Adventure, Inquiry, and Technology as Driving Forces in Sustainability Education

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Finally, thank you to my parents, Lindor and Johanne Henrickson, for forever imbuing me with a love for learning, caring, embracing challenge, and valuing the natural world**.**

Dedication

"Whenever you think or you believe or you know, you're a lot of other people: but the moment you feel, you're nobody-but-yourself."
— E. E. Cummings

"The human spirit needs places where nature has not been rearranged by the hand of man."
— Author Unknown

This thesis is dedicated to my two awesome children, Liam and Riley Cashin. May you be lifelong explorers and learners seeking understanding, sharing humor, pursuing your passions, and helping create a better world for all along the way.

Abstract

Education for Sustainable Development (ESD) has increasingly taken on importance around the world, in part due to the growing awareness of environmental concerns such as climate change, and in part due to a challenge set forth by the United Nations Decade of Education for Sustainable Development (2005-2014) to integrate the principles, values, and practices of sustainable development into all aspects of education and learning. There is, as a result, a growing body of ESD literature (e.g., see Blum, Nazir, Breiting, Goh, & Pedretti, 2013; Chalkey, 2006; De Hann, Bormann, & Leicht, 2010; Eilam & Trop, 2011; Green & Somerville, 2014; Karatzoglou, 2013; Kemmis & Mutton, 2012; Reunamo & Pipere, 2011; Rieckmann, 2013; Walshe, 2008; Weaver, 2015), and many places in the developed world have begun to establish policies addressing ESD.

Adventure has been incorporated into sustainability education in a variety of ways throughout history: through literature, outdoor and physical education, field-based exploration and research, and most recently, technology, which has, for example, allowed learners to journey virtually along with explorers and scientists on expeditions to the far-reaches of the world. Technology has also enhanced and expanded the types of adventures we can engage in today, such as through advances in equipment and tools that allow us to explore regions of the planet that were previously inaccessible, and to participate in events previously unimagined, via the personal computer, the Internet, and mobile devices.

The three related studies that comprise this dissertation focus on the use of adventure learning as a driving force in inquiry-based sustainability education. These studies examine three different online adventure learning projects. Paper 1 shares research conducted on the role of adventure in the *GoNorth!* adventure learning series, and advances suggestions for how adventure might be employed in distance, online, and mobile learning in ways that promote experiential learning and sustainability education. Paper 2 examines to what extent an informal online learning environment such as *WeExplore* might provide a technology-fueled classroom tool for teachers that fosters inquiry and creativity while allowing learners to design authentic transdisciplinary experiences grounded in contemporary issues. Paper 3 shares data and narratives from six *Earthducation* field expeditions and examines how education might influence sustainability in differing contexts and geographical locations.

Findings from the studies indicate adventure learning is a promising model that educators and designers can draw from in both formal and informal learning settings as a means to fuse inquiry, sustainability education, and technology in a pedagogically meaningful way that engages learners and teachers alike. The studies advance our understanding of how we might better design technology-enhanced learning environments that foster engagement and creativity while encouraging learner curiosity and wonder and cultivating inquiry and collaboration.

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CHAPTER 1

Introduction to the Three Studies

Education for Sustainable Development (ESD) has increasingly taken on importance around the world, in part due to the growing awareness of environmental concerns such as climate change, and in part due to a challenge set forth by the United Nations Decade of Education for Sustainable Development (2005-2014) to integrate the principles, values, and practices of sustainable development into all aspects of education and learning. There is, as a result, a growing body of ESD literature (e.g., see Blum, Nazir, Breiting, Goh, & Pedretti, 2013; Chalkey, 2006; De Hann, Bormann, & Leicht, 2010; Eilam & Trop, 2011; Green & Somerville, 2014; Karatzoglou, 2013; Kemmis & Mutton, 2012; Reunamo & Pipere, 2011; Rieckmann, 2013; Walshe, 2008; Weaver, 2015), and many places in the developed world have begun to establish policies addressing ESD. The less-developed world is a different matter, however, and case studies on ESD have rarely been drawn from developing regions (Manteaw, 2012; Nomura, 2009).

At its core, sustainable development, or sustainability, is about living responsibly and within limits, allowing us to meet present needs without compromising the needs of future generations (World Commission on Environment and Development, 1987). Environmental, social, and economic demands all impact sustainability, which encourages harvesting from the earth using methods and tools that do not deplete or permanently damage a resource, species, or ecosystem; recognizes the need to ensure the continuation of a plurality of life and a healthy environment for people worldwide and for

generations to come; and takes into consideration the importance of equitable distribution of resources and opportunities for all (see International Institute for Sustainable Development, http://www.iisd.org/sd).

As global citizens of different natural environments and different cultures, we collectively and individually have different relationships with the natural environment. These complex relationships are embedded, and can be nurtured, within education. ESD must encompass affordances that facilitate a shared respect for the natural environment while recognizing the unique factors within individual cultures that affect the formation of environmental attitudes and behavior.

Previous studies have found that education can positively influence environmental attitudes and behaviors (Franzen & Vogl, 2013; Hamilton, Colocousis, & Duncan, 2010; Marquart-Pyatt, 2012; Mayer, 2013; Tikka, Kuitunen, & Tynys, 2000). Those studies have typically focused on developed nations with high standards for, and broad accessibility to, formal education, and do not assess impact from additional factors such as informal learning experiences or familial and cultural attitudes and behaviors. Some recent studies, however, emphasize the importance of community engagement and local culture in ESD in formal education settings. For example, Green and Somerville (2014) do so in a compelling examination of teacher integration of sustainability education in primary school classrooms in Australia.

Other research has provided case studies examining impacts of informal education programs on environmental attitudes and behaviors, with varying outcomes depending on the program being examined. Many of these studies have looked at experiential-focused

programs targeting teachers and/or youth, and indicate a positive relationship between firsthand exposure to and engagement with the natural environment, and pro-environmental attitudes and behaviors (Bogo, 2003; Dresner & Moldenke, 2002; Irvin, 2007; Lieberman & Hoody, 1998; Riordan & Klein, 2010; Ruebush et al., 2009; Silverstein, Dubner, Miller, Glied, & Loike, 2009; Windschitl, 2003).

The past decade has also shown an increasing number of studies exploring the role and impact of Indigenous or traditional knowledge in environmental sustainability. Indigenous peoples throughout the world have historically depended heavily on traditional knowledge to educate and to sustain life, language, and culture (McGregor, 2010; Nakashima, Galloway McLean, Thulstrup, Ramos Castillo, & Rubis, 2012; Nunavut Tunngavik Incorporated, 2012; Roland & Semali, 2010). As defined by Nakashima et al. (2012), traditional knowledge "encompasses not only empirical understandings and deductive thought, but also community know-how, practices and technology; social organization and institutions; and spirituality, rituals, rites and worldview" (p. 30). There are an increasing number of initiatives that have begun to integrate traditional knowledge into both formal and informal education programs (for some examples from the Arctic, see Annahatak, 1994; Berger, 2009; McGregor, 2012; Pember, 2008). Traditional knowledge is also increasingly being integrated with western science in assessing and creating adaptive strategies for environmental issues such as climate change (Alexander et al., 2011; Dikison, 2009; Nakashima et al., 2012; Robson et al., 2009).

The question of the role or place of technology in sustainability education has been

a controversial one (Louv, 2005; Louv, 2012; Markaki, 2014; Willis & Weiser, 2005; Willis, Weiser, & Kirkwood, 2014; Zaradic & Pergams, 2007). The papers included here do not explicitly examine the question of the role of technology in sustainability education. They do, however, examine several ways technology is being integrated promisingly into sustainability education using the adventure learning model, while pursuing answers to such questions as: How do we design technology-enhanced learning environments that foster engagement, inquiry, and creativity among teachers and learners alike? What tools can we provide teachers that encourage learner curiosity and wonder, cultivate inquiry and collaboration, and are scalable?

Adventure has been incorporated into sustainability education in a variety of ways throughout history, including through outdoor education and, more recently, through technology-enhanced learning. Technology has, for example, expanded opportunities for experiential learning through adventure as well as allowing learners to journey virtually along with explorers and scientists to the far-reaches of the world. The three related studies that comprise this dissertation focus on the use of adventure learning as a driving force in inquiry-driven sustainability education. These studies examine three different online adventure learning projects:

- *GoNorth!*: a five-year series of dogsledding expeditions around the circumpolar Arctic tied to an inquiry-based online curriculum focused on climate change, culture, science, and sustainability
- *WeExplore*: an online user-driven adventure learning environment that scaffolds learners through the process of generating an inquiry-based adventure learning

project centered on a specific mission and guiding question of their choosing, and to then explore solutions to that question while sharing artifacts such as field notes, photos, videos, and maps in an online storyline.

- *Earthducation*: a five-year adventure learning project with an online learning environment tied to field expeditions to each continent that explored connections between education and sustainability in climate hotspots worldwide.

Adventure learning (AL) provides a framework for the design of learning experiences that allow learners to explore real-world issues through authentic, field-based narratives within an interactive online learning environment (Doering, 2006, 2007). AL blends experiential (Dewey, 1938; Kolb, 1984), inquiry-based (Bransford, Brown, & Cocking, 1999; Hudspith & Jenkins, 2001), and authentic (Jonassen, 1991) learning. Grounded in a strong curriculum and pedagogy, an adventure-based narrative, and place-based concepts of learning (Sobol, 2004), AL emphasizes real-world, authentic problem solving, and merges an online learning environment with teacher-led classroom activities. It has been shown to have a positive influence on student engagement, motivation, and learning outcomes, and to be a successful model for teaching and learning across the curriculum (Doering, 2007; Doering & Miller, 2009; Henrickson & Doering, 2013a; Koseoglu & Doering, 2011; Moos & Honkomp, 2011; Veletsianos & Doering, 2010; Veletsianos, Doering, & Henrickson, 2012; Veletsianos & Kleanthous, 2009). AL is grounded in nine core principles: (1) a defined issue and place; (2) authentic narratives; (3) an element of adventure; (4) a sound curriculum grounded in inquiry; (5) collaboration and interaction opportunities between learners, experts, teachers, and

content; (6) synched learning opportunities that tie together content with curriculum; (7) an online venue to deliver content; (8) multiple media that enhance the curriculum; and (9) scaffolding for teachers as well as learners (Doering, 2006; Doering & Miller, 2009; see Fig. 2.1).

To illustrate, within an AL program, a team engages in an adventure-based expedition or exploration centered on a specific location and social or environmental issue; for example, climate change in the Arctic. The team travels out into the field to capture authentic data and narratives that are synched with a predesigned inquiry-based curriculum tied to that expedition, issue, and location. The field experiences, data, media assets, and observations of the team are shared online in an environment in which learners are able to actively participate and collaborate with the explorers, their peers around the world, their teacher(s), and a variety of field experts. These online collaboration and interaction opportunities allow learners to form connections between what is happening in the real world and their studies. Learners complete activities related to the real-world events, engage in online and face-to-face discussions around them, and present potential solutions to issues that are raised.

With its grounding in experiential and inquiry-based pedagogies, adventure learning is a framework that aligns well with environmental education (EE) standards, including the North American Association for Environmental Education (NAEE; www.naaee.org) guidelines for quality EE, and the EE awareness to action model. Adventure learning environments scaffold learners through a similar learning progression as the awareness to action model, guiding the learner from awareness about and

sensitivity toward the natural environment, through knowledge-, attitude-, and skill-acquisition, with the ultimate goal of the learner actively participating in environmental stewardship, whether on an individual or larger group level.

Adventure learning also has close ties to place-based education (Sobol, 2004), with each AL project grounded in a specific location and issue. The power of using place-based learning and the natural environment as an integrating context to teach across the curriculum and as a means to help close achievement gaps in education has been well documented (Bogo, 2003; Dresner & Moldenke, 2002; Irvin, 2007; Lieberman & Hoody, 1998; Meichtry and Smith, 2007; Riordan & Klein, 2010; Silverstein, Dubner, Miller, Glied, & Loike, 2009).

Paper 1 in this dissertation defines adventure and provides overviews of, and discusses the differences between, adventure education and adventure learning. It shares research conducted on the role of adventure in the *GoNorth!* adventure learning series, and advance suggestions for how adventure might be employed in distance, online, and mobile learning in ways that promote experiential learning and sustainability education. User-driven adventure learning is proposed as one model that educators and designers can draw from in both formal and informal learning settings as a means to fuse adventure, sustainability education, and technology in a pedagogically meaningful way.

Paper 2 looks at *WeExplore* and examines to what extent an online user-driven adventure learning environment might provide a technology-fueled classroom tool for teachers that fosters creativity and inquiry while allowing learners to design authentic transdisciplinary experiences grounded in pressing contemporary issues. It also explores

what role teacher pedagogy and practice might play in influencing learner creativity and engagement within an online learning environment. Paper 2 concludes with a model that reflects key criteria in learning environment design and teacher pedagogy relative to creative development.

Paper 3 shares data and narratives from *Earthducation* field expeditions conducted in Burkina Faso; northern Norway; Australia; Peru and Chile; Arctic Alaska and Canada; and Nepal. Based on these narratives, assertions are proposed related to how education might influence sustainability in differing contexts, as well as what types of education appear to be influential in the three realms of sustainable development (sociocultural, economic, environmental). Data gathered to date illustrate both how education can influence sustainability in different regions of the world, and the complexities that geographical location and culture bring to this topic.

Theoretical Frameworks and Data

All three studies use an interpretive lens and the adventure learning framework (as described above) to examine case studies in differing contexts. These case studies are drawn from formal and informal learning settings in multiple regions.

The research for Paper 1 is informed by six teachers and 185 students in three public elementary schools in a large Midwestern city in the United States. Participating individuals used the *GoNorth!* AL programs in their 3rd, 4th, and 5th grade classrooms during the 2005-2009 academic years. The data informing this study are comprised of 12 classroom observations, 11 focus groups with participating students, and 6 personal interviews with participating teachers.

The research for Paper 2 is informed by one teacher and 95 ninth-grade students in a public high school in a large Midwestern suburb in the United States. Participating individuals used the *WeExplore* online learning environment for 4 months, from February through May 2014. The data informing this study are comprised of 5 classroom observations, 6 focus groups with participating students, and 3 personal interviews with the participating teacher.

The research for Paper 3 is informed by 243 interviews from individuals in 76 communities on 6 continents: in Alaska, USA, and Nunavut, Canada, in North America; in Burkina Faso, Africa; in Northern Norway in Europe; in New South Wales, the Northern Territory, and Queensland in Australia; in Peru and Chile in South America; and in multiple locations in Nepal, Asia. Formal interviews were conducted with individuals from diverse backgrounds, ranging from farmers, factory workers, students, and teachers, to government officials, grassroots organizers, indigenous leaders, and much more. Approximately two-thirds of the formal interviews are with men, and one-third with women. Ages of the participants range from 16 through 83. The full interviews span, on average, 30 minutes to an hour.

Research Designs and Analysis

All three papers use the constant comparative method (Glaser & Strauss, 1967) to analyze data, and take a case study approach to the research design. The constant comparative method involved engaging in open coding of the data where the researcher(s) independently read and analyzed the data to (a) note emerging patterns and (b) gain an understanding of participant experiences. Any patterns discovered were

compiled and reanalyzed in order to confirm and disconfirm themes across and between participants. Analysis continued until no more patterns could be identified and the researcher(s) felt that the data had been saturated (i.e., when researchers felt the data had been completely represented by current codes/themes). Once these patterns were identified, they were grouped into the themes.

Triangulation methods were used to examine the accuracy of the collected data and reduce the possibility of researcher bias in drawing conclusions from the data:

1. Data were collected from multiple sources, and data sources informed each other.
2. Findings were shared with participants for member checking and input, when possible.
3. Themes from interviews and focus groups were cross-checked against publicly available artifacts shared in the online learning environments.

Research Questions

Together, the three studies in this dissertation (see table 1.1), and the questions and data that inform them, investigate how educators and designers might use adventure learning to fuse inquiry, sustainability education, and technology in a pedagogically meaningful way that engages learners and teachers alike. The specific guiding research questions that set the stage for the studies that follow are:

1. How do students perceive *adventure* when participating in an adventure learning program?
2. What role do teachers believe *adventure* plays in teaching and learning?

3. To what extent does an informal, technology-fueled adventure learning environment facilitate in-service teachers' ability to stimulate students' creativity and motivation?
4. In what ways might education, in its myriad forms (formal, informal, traditional), support sustainable environmental practices?
5. In what ways might education, in its myriad forms (formal, informal, traditional), support sustainable cultural practices?

The pursuit of these questions led to studies that address the following areas:

1. How adventure learning might be employed in distance, online, and mobile learning in ways that promote experiential learning and sustainability education.
2. To what extent adventure learning might provide a technology-fueled tool for teachers to help foster creativity, inquiry, and authentic transdisciplinary experiences in the classroom.
3. How different types of education (formal, informal, traditional) might influence sustainability in varying contexts and geographic locations.
4. How different types of education (formal, informal, traditional) appear to influence the three realms of sustainable development (sociocultural, economic, environmental).

Table 1.1. Outline of the three studies.

Title	Teaching sustainability through adventure	Fostering creativity through inquiry and adventure in informal learning environment design	Earthducation: Capturing global narratives on education and sustainability
Research Question(s)	1. How do students perceive adventure when participating in an adventure learning program? 2. What role do teachers believe adventure plays in teaching and learning?	To what extent does an informal, technology-fueled adventure learning environment facilitate in-service teachers' ability to stimulate students' creativity and motivation?	1. In what ways might education, in its myriad forms (formal, informal, traditional), support sustainable environmental practices? 2. In what ways might education, in its myriad forms (formal, informal, traditional), support sustainable cultural practices?
Research Design	Case study	Case study	Case study

CHAPTER 2: STUDY 1

Teaching Sustainability through Adventure

This study appears in the online, peer-reviewed Journal of Sustainability Education under the citation below. The study was a joint research effort between myself and my advisor, Dr. Aaron Doering. I took the lead on this study and served as first author, drawing on data previously collected for Doering's GoNorth! adventure learning series.

Citation: Henrickson, J., & Doering, A. (2013). Teaching sustainability through adventure. *Journal of Sustainability Education, 5*. Retrieved from http://www.jsedimensions.org/wordpress/content/teaching-sustainability-through-adventure_2013_06/.

Introduction

It's the adventure that captivates the students. The students are enthralled with feeling as if they are part of the experience.

Sheryl Johannsen, 4th Grade Teacher

In literature and real life, adventure captivates our imagination and draws us into its path. We become caught up in wonderment of the risk being undertaken, the uncertain outcomes in the balance, and the courage, strength, and daring displayed by those involved. It can be a transformational experience for participants and observers alike. Adventure is typically defined as an event involving risk, challenge, and excitement, as an out-of-the-ordinary experience whose outcome at the start is unknown (Merriam-Webster, 2012; Miles & Priest, 1990; Weir, 2004). It does not need to involve a physical

challenge; the challenge may instead be purely of the mind (e.g., via an immersive online game). It is, however, inherently experiential, and particularly so if reflection and sharing are built into the experience, along with opportunities to practice solving real-world issues. It has the potential to help build deep connections to the natural world, and both reflection on and action toward issues of sustainable development.

Adventure has been incorporated into sustainability education in a variety of ways throughout history: through literature, outdoor and physical education, field-based exploration and research, and most recently, technology, which has, for example, allowed learners to journey virtually along with explorers and scientists on expeditions to the far-reaches of the world. Technology has in fact enhanced and expanded the types of adventures we can engage in today, such as through advances in equipment and tools that allow us to explore regions of the planet that were previously inaccessible, or to participate in events previously unimagined via the personal computer, the Internet, and mobile devices.

The purposeful use of adventure in education perhaps began with the formation of an expeditionary society for boys in Great Britain in 1932. The Public Schools Exploring Society allowed boys the opportunity to participate in adventure experiences abroad. It was founded with an educative mission grounded in experiential learning, with the goal of teaching that exploration had a scientific end and was not just a pleasure trip or adventure for adventure's sake (Allison, Stott, Felter, & Beames, 2011). It may be argued, however, that adventure has in fact been part of education since ancient times, as some indigenous cultures have sent youth into the wilderness on quests of personal

discovery and challenge as part of cultural, wilderness, and survival learning processes for many hundreds of years (Berry, 2011; Miles & Priest, 1990).

Adventure today is infused into numerous aspects of our lives and society: adventure travel, adventure sports, and adventure games to name a few; along with movies, books, and scientific explorations. Some forms of adventure exist purely for the thrill-seeker, for the fun of it; they are not necessarily intended as learning or growth experiences. There are, however, ways that adventure is being incorporated into both formal and informal education, including education for sustainability, that combine the risk-taking, adrenaline-producing, imagination-inspiring elements of adventure with a sound pedagogy to produce rich learning experiences with multiple benefits. The best known of these learning models are adventure education and adventure learning.

This paper provides overviews of, and discusses the differences between, adventure education and adventure learning. It also shares research conducted on the role of adventure in the GoNorth! Adventure Learning Series, and advance suggestions for how adventure might be employed in distance, online, and mobile learning in ways that promote experiential learning and sustainability education. User-driven adventure learning is proposed as one model that educators and designers can draw from in both formal and informal learning settings as a means to fuse adventure, sustainability education, and technology in a pedagogically meaningful way.

Adventure Education

Seminal thinkers who have influenced the adventure education approach to learning

include John Dewey and Kurt Hahn. Dewey focused on the importance of spurring a continuum of learning where students are learning not just from teachers but also from their peers and their environment as they draw on and extend preexisting knowledge. He wrote, "Every experience both takes up something from those which have gone before and modifies in some way the quality of those which come after" (1938, p. 35). Dewey also emphasized the role of collaborative learning and creative problem solving in education.

Hahn was a German educator who founded schools in Germany and Great Britain that were grounded in experiential and service-based learning with a focus on character development (Berry, 2011). Adventure education might in fact be considered an outgrowth of organizations such as the aforementioned Public Schools Exploring Society, along with the growing interest in experiential education beginning in the first half of the twentieth century, and the creation of schools and organizations such as the Salem School (www.salem-net.de/en/home.html), Gordonstoun School (www.gordonstoun.org.uk), and Outward Bound (www.outwardbound.org), all of which were founded by Hahn. Adventure education has taken the form of team/trust building, cooperative games, physical education, and outdoor risk challenges (e.g., high ropes courses, nature and wilderness activities, expeditionary pursuits). It typically occurs within small-group settings, with the learning and experience limited to the individual and the small group. While adventure education is not restricted to outdoor pursuits, it is often associated with the outdoors and environmental and sustainability education, and is typically employed in informal or nonformal settings.

In adventure education programs, participants are physically or psychologically challenged, with a focus on risk-taking, problem solving, and individual psychological growth and development (Berry & Hodgson, 2011; Miles & Priest, 1990). Typical desired learning outcomes of adventure education include enhanced self-concept and interpersonal skill building (Hattie, Marsh, Neill & Richards, 1997). Hattie et al. (1997) identified six specific outcome areas for adventure education: leadership, self-concept, academic, personality, interpersonal, and adventuresomeness. Formal processing or reflection activities are incorporated into some, but not all, adventure education programs, with other programs taking instead the nonfacilitiated, or "mountains speak for themselves," approach (Bunyan, 2011; James, 1980).

Examples of adventure education programs include Project Adventure (www.pa.org), Outward Bound (www.outwardbound.org), and the National Outdoor Leadership School (NOLS; www.nols.edu). There are, however, many smaller organizations, including environmental learning centers and community nature centers, that incorporate adventure education into their programming (for example, see the Eagle Bluff Environmental Learning Center in southeastern Minnesota at www.eagle-bluff.org).

Adventure Learning

In the early 1990s, explorers such as Will Steger, Dan Buettner, Robert Ballard, Lonnie Dupre, and Paul Pregont began experimenting with ways to use technology to connect classrooms with their adventures on the trail in the hopes of educating students

about environmental and social issues worldwide. These experiments led in 2004 to the development of Arctic Transect 2004—a 3,000-mile dogsled journey across Arctic Canada that was tied to a comprehensive curriculum and online learning environment centered on sustainability education—and the establishment of a new pedagogical framework known as adventure learning (Doering, 2006, 2007; Doering & Miller, 2009).

Adventure learning (AL) provides a framework for the design of learning experiences that allow learners to explore real-world issues through authentic, field-based narratives within an interactive online learning environment (Doering, 2006, 2007). AL blends experiential (Dewey, 1938; Kolb, 1984), inquiry-based (Bransford, Brown, & Cocking, 1999), and authentic (Jonassen, 1991) learning, and synchs an online learning environment with teacher-led classroom activities. It is grounded in nine core principles: (1) a defined issue and place; (2) authentic narratives; (3) an element of adventure; (4) a sound curriculum grounded in inquiry; (5) collaboration and interaction opportunities between learners, experts, teachers, and content; (6) synched learning opportunities that tie together content with curriculum; (7) an online venue to deliver content; (8) multiple media that enhance the curriculum; and (9) scaffolding for teachers as well as learners (Doering, 2006; Doering & Miller, 2009; see Fig. 2.1).

To illustrate, within an AL program, a team engages in an adventure-based expedition or exploration centered on a specific location and social or environmental issue; for example, climate change in the Arctic. The team travels out into the field to capture authentic data and narratives that are synched with a predesigned inquiry-based curriculum tied to that expedition, issue, and location. The field experiences, data, media

assets, and observations of the team are shared online in an environment in which learners are able to actively participate and collaborate with the explorers, their peers around the world, their teacher(s), and a variety of field experts. These online collaboration and interaction opportunities allow learners to form connections between what is happening in the real world and their studies. Learners complete activities related to the real-world events, engage in online and face-to-face discussions around them, and present potential solutions to issues that are raised.

Figure 2.1. The principles, practice, and community models for adventure learning (Doering & Miller, 2009).

Adventure learning moves adventure beyond the realm of individual and small-group participation to online learning in classrooms throughout the world. Unlike adventure education, AL is not an isolated learning experience with a small group of

participants (see Table 2.1 for a comparison of adventure education and adventure learning.). Reflecting on the experience, sharing it with others, and synching it with a curriculum and interactive online educational activities are central to AL. AL also targets not only building awareness and understanding of an issue, but becoming actively involved in problem solving real-world issues and crafting innovative solutions to them. These are key components in sustainability education, for, as Kemmis and Mutton (2012) point out, it is critical that ESD guides learners in developing skills that lead to action, rather than simply generating an understanding of an issue.

A prime example of an AL program is the GoNorth! series of circumpolar dogsledding expeditions (Fig. 2.2; also see chasingseals.com/gonorth), "a program whose central goal was to deliver an online multidisciplinary K–12 program focused on climate change, sustainability, and Arctic culture" (Veletsianos, Doering, & Henrickson, 2012, p. 48). Other examples of projects that have employed the AL framework to greater or lesser degrees include Earthducation (earthducation.com), North of Sixty° (n60.co), the Quest series of bicycle treks (e.g., see www.teachervision.fen.com/tv/classroomconnect/maya/index.html), the Jason Project (www.jason.org), Eat Bike Grow (eatbikegrow.ning.com), World by Cycle (worldbycycle.info), and AL@UI (alatui.wordpress.com).

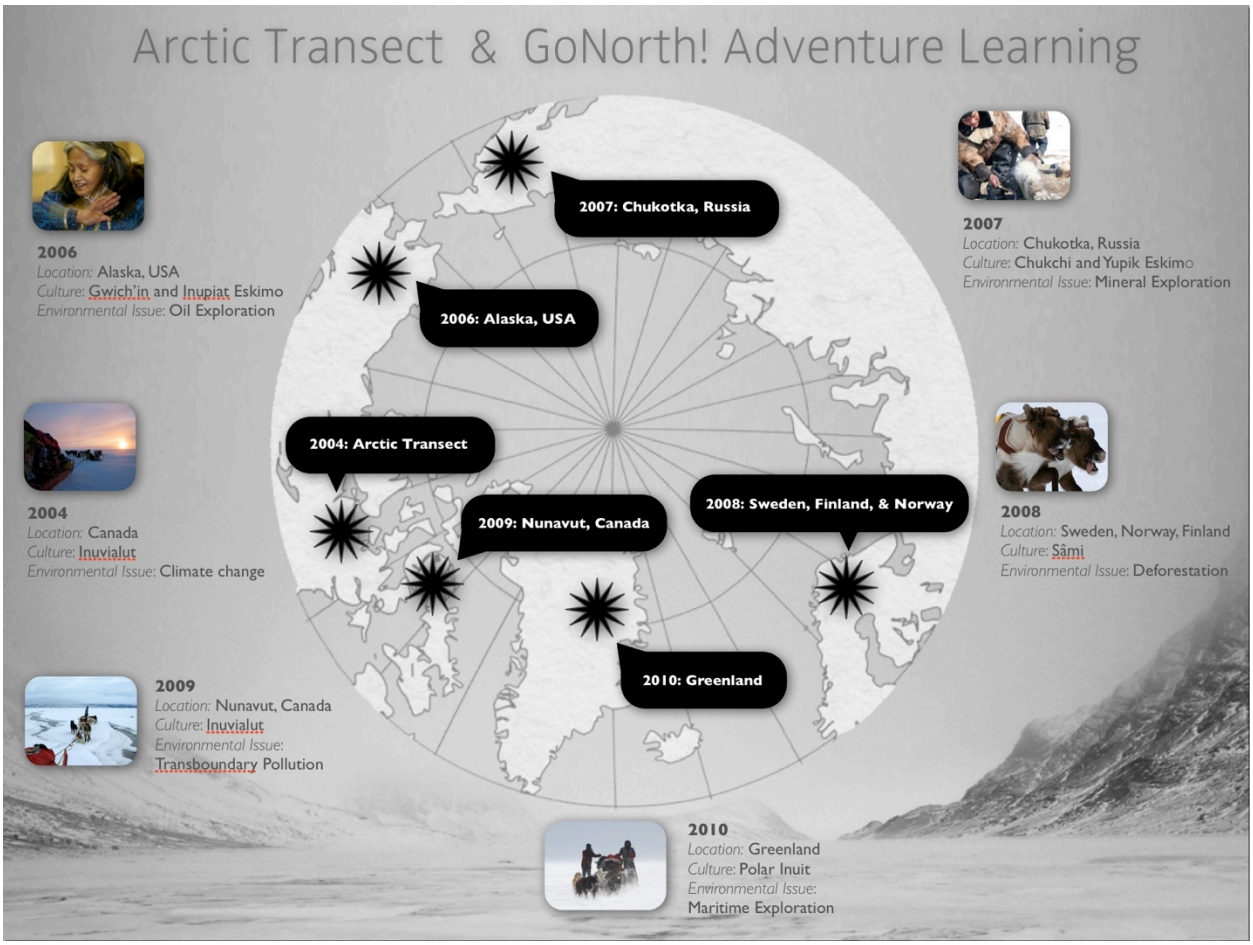

Figure 2.2. Arctic Transect 2004 and the GoNorth! Adventure Learning Series delivered an online multidisciplinary K–12 program tied to a live dogsledding expedition and focused on climate change, sustainability, and Arctic culture.

In AL, field expeditions and authentic narrative play a key role. The field expeditions form the heart of the program. They bring excitement, engagement, and challenge to the learning and serve as journeys of discovery that are synched with the AL curriculum. These field expeditions also offer a means to gather authentic narrative, data, and media assets to be shared with learners. The narratives and media involve much more

than simply capturing the voices of the explorers as they embark on the field expedition. The focus of the expedition is on capturing the narratives of people who live and/or work in the place where the expedition is taking place and/or who are connected to the real-world issue being explored.

Technology also plays an important role in adventure learning, from the collection of assets to the delivery of the AL program online. Expedition teams typically make use of laptops, GPS units, cameras, audio recorders, and satellite technologies, among other items, to collect and share data, media, and narratives from the field within the online learning environment. Participating classrooms have traditionally used desktop and laptop systems to access AL learning environments, along with multiple tools and software to, for example, engage in online chats with the project team and outside field experts; complete authentic activities to share online; and collaborate with other learners online.

AL programs have been consistently shown to serve as an effective means to engage students in learning, involving students in active and innovative problem solving, and as a successful model for interdisciplinary teaching and learning that integrates real-world issues and inquiry-based learning across the curriculum (Doering, 2007; Doering & Miller, 2009; Doering & Veletsianos, 2008; Doering, Scharber, Riedel, & Miller, 2010; Koseoglu & Doering, 2011; Moos & Honkomp, 2011; Veletsianos & Doering, 2010). Further, AL programs have been shown to offer potential for providing impactful teacher professional development and to influence teacher motivation and learning (Veletsianos, Doering, & Henrickson, 2012).

Many online learning environments use generic or stock media and text to feed content to the learner, are focused largely on cognitive elements, and offer no venue for learners to interact with each other or share their questions, stories, and discoveries. Thus, they are missing the opportunity to generate a more meaningful, personalized, and engaging experience (Parrish & Botturi, 2009; Wilson, Parrish, & Veletsianos, 2008). One of the goals of an AL environment is to move beyond stagnant and generic transmittal of information to a passive audience. AL seeks instead to immerse and engage the learner in the issue and location, generate critical and creative thinking and active reflection on the issue, and inspire learners to become involved in finding innovative local and global solutions to social and sustainability issues (Doering & Veletsianos, 2008). In sum, one of the major goals of AL is to help generate transformative learning. With its grounding in experiential, authentic, and inquiry-based pedagogies, adventure learning is a framework that aligns well with environmental education (EE) standards, including both the North American Association for Environmental Education (NAEE; www.naaee.org) guidelines for quality EE, and the EE awareness to action model. The awareness to action model, established as part of the Tbilisi Declaration during the world's first intergovernmental conference on environmental education in 1977, provides a framework for EE that moves learners from awareness about and sensitivity toward the natural environment, through knowledge-, attitude-, and skill-acquisition, with the ultimate goal of the learner actively participating in environmental stewardship, whether on an individual or larger group level. AL has been shown to move learners and teachers through a similar process, with similar transformative results (Doering & Veletsianos,

2008; Veletsianos, Doering, & Henrickson, 2012; Veletsianos & Kleanthous, 2009; Wilson & Parrish, 2011).

Transformative learning disrupts a learner's perception of an issue and challenges them to reflect critically upon previously held assumptions and beliefs about that issue or about other people (Mezirow, 1991, 1997). It also leaves an enduring imprint on learners and enhances their ability to creatively and collaboratively solve problems and to transfer their learning across domains (Wilson, Parrish, & Veletsianos, 2008). AL has been recognized as an example of a framework that has the power to generate transformative learning (Doering & Veletsianos, 2008; Veletsianos & Kleanthous, 2009; Wilson & Parrish, 2011). In discussing transformative learning experiences and the role that emerging technologies play within them, Veletsianos (2011) advocates for "a move towards technology use to provide the opportunities for personally relevant and meaningful transformation" (p. 42), noting, "At the core of recent theoretical and technological advances in online learning is the notion of utilizing technology as an impetus for designing novel learner experiences and opportunities for engagement with online communities" (p. 42). He cites adventure learning as one example of a type of learning environment that has potential to fulfill such objectives.

Transformative learning typically involves some form of authentic learning (Herrington, Oliver, & Reeves, 2003; Mezirow, 1991; Wilson, Parrish, & Veletsianos, 2008). Authentic learning is multidisciplinary, immerses learners in real-world scenarios, and engages them in complex, inquiry-based problem solving, helping make things meaningful by presenting them with people, stories, and issues they might encounter or

could envision encountering in everyday life (Lombardi, 2007).

Table 2.1. Comparison of Adventure Education with Adventure Learning

	Adventure Education	**Adventure Learning**
Target learner	Direct participants.	Direct participants, online followers, educators, and field experts.
Pedagogical focus	Experiential and place-based.	Experiential and inquiry-based.
Pedagogical approach	Varies widely depending on the program. Sometimes includes a structured curriculum and embedded reflection time; sometimes takes a "mountains speak for themselves" approach. Typically includes elements of risk-taking, problem solving of issues directly tied to the adventure experience, and individual psychological growth	Multidisciplinary and synched with a predesigned curriculum that aligns with the field experiences. Learner interaction, reflection, and sharing play a key role. Learners interact not only among themselves and with a classroom teacher, but also with the adventurers and with experts in the field. Typically includes elements of risk-taking,

	and development.	problem solving of both issues tied to the adventure experience as well as larger real-world issues, and intellectual/creative/social growth and development.
Technology use	Generally restricted to field tools such as GPS devices and tools needed to engage in outdoor adventures.	Broad. Encompasses not only field tools but also tools that allow for online sharing, reflection, and interaction.
Group size	Small (usually less than 10).	Direct participant group is generally small (less than 10), but online followers have numbered in the millions with the most popular programs.
Role of adventure	Adventure serves as a key engagement factor in the learning experience.	Adventure serves as a key engagement factor in the learning experience.
Typical desired learning	Enhanced leadership skills, self-	Enhanced awareness,

outcomes	concept, intellectual understanding, personality, interpersonal skills, and adventuresomeness.	understanding, empathy, critical and creative thinking skills, collaboration skills, technology skills, and active involvement in problem solving real-world issues.

The Role of Adventure in Adventure Learning

While multiple studies exist exploring the impact of adventure education and adventure learning in student and teacher engagement, motivation, and learning, for this study we were interested in specifically investigating (1) how students perceive *adventure* when participating in an adventure learning program and (2) what role teachers believe *adventure* plays in teaching and learning. To answer these questions, we drew on data gathered from classrooms participating in the GoNorth! Adventure Learning Series, a series of five dogsledding expeditions conducted over five years throughout the circumpolar Arctic that was tied to a multidisciplinary K-12 curriculum centered on climate change, sustainability, and Arctic culture.

Each year, a team of GoNorth! explorers, scientists, and educators traveled out by dogsled into a different region of the Arctic, visiting remote communities and schools, interviewing local residents and participating in cultural events, and collecting both scientific and cultural data, as they covered thousands of miles through landscapes previously unknown to the millions of schoolchildren who were following the team's

journey online. The expedition team posted weekly updates online that included photos, videos, text, maps, and interactive graphics, all of which was synched with a previously designed, comprehensive curriculum that had been provided to teachers prior to the expedition start. The GoNorth! online learning environment also included multiple opportunities for classrooms to interact with the team, a variety of field experts worldwide, and each other. In addition, classrooms could share their own projects and data related to the expedition within this online environment.

Participants and Data

This study is informed by six teachers and 185 students in three public elementary schools in a large Midwestern city. These individuals used the GoNorth! AL programs in their 3rd, 4th, and 5th grade classrooms during the 2005-2009 academic years. The data corpus informing this study consist of 12 classroom observations, 11 focus groups with participating students, and 6 personal interviews with participating teachers.

Data Analysis

This study used the constant comparative method (Glaser & Strauss, 1967) to analyze participants' interview responses. Researchers engaged in open coding of the data where they independently read and analyzed the data to (a) note emerging patterns and (b) gain an understanding of participant experiences. The researchers then met five times to discuss results, compare notes, and collaboratively analyze data in search of common meanings. The patterns discovered were compiled and reanalyzed in order to

confirm and disconfirm themes across and between participants. Analysis continued until no more patterns could be identified and researchers felt that the data had been saturated (i.e., when researchers felt the data had been completely represented by current codes/themes). Once these patterns were identified, they were grouped into the themes.

Triangulation and Rigor

Triangulation methods were used to examine the accuracy of the collected data and reduce the possibility of researcher bias in drawing conclusions from the data:

(1) Data were collected from multiple sources (observations, focus groups, and interviews), and data sources informed each other.

(2) Researchers analyzed data independently and then met to compare and discuss their findings.

(3) One researcher examined the themes and the extent to which they were congruent with participants' experiences as revealed through publicly available artifacts shared by participants in the online learning environment.

Findings

Data revealed that adventure provided motivation and engagement both for the students and the teachers in ways neither had experienced before in the learning process. These themes are described next, using both teacher and student quotes to illustrate and clarify the findings.

Adventure affords a desire for learners to be part of the entire adventure learning experience

Over 70 percent of the students noted that once they learned about the GoNorth! adventure (the dogsledding expedition in the Arctic) they wanted to follow along until the adventure was completed. Students commented that normally they would engage in a learning experience for the minimal amount of time to complete the activity and quickly move on to the next task. When adventure was part of the learning experience, they returned to the learning environment not only during class, but also during study halls, at home, and on mobile devices. Brad said, "I really wanted to see what was going to happen next. I followed the expedition from Week 1, when the team was getting ready, and I wanted to follow them until they reached the destination." Sara said, "I normally just want to get my assignments done and move on. With GoNorth! I continually returned to see what was happening next. I loved to see all the different people and cultures." Over 50 percent of the students also noted that the learning experience was as if they were reading a book. Chelsea said, "I love reading books and to be able to be part of this adventure was like reading a book. A book that you couldn't put down." She continued to explain that she would return to the learning environment as often as she could to read the new updates and to see what the next adventure was. Donny noted, "Whether it was the dogs or the Inuit or the team's crazy experiences, I wanted to be part of the entire adventure. I think my parents were wondering why I was always on the computer."

Adventure provides motivation for learners

Ninety percent of the students interviewed noted that adventure motivated them to learn. With this extremely high percentage came numerous explanations of what motivation meant to them. Sue said, "I hate school. I didn't hate this. I wanted to be part of the adventure and I wanted to see what was happening at all times." Charlie explained that the adventure motivated him outside the classroom walls. He said, "As I watch all the explorers and I see all the different people throughout the world, I want to be like them. I want to be an explorer. I want to find new things." Ty commented that he really didn't feel like class was work, as in the past. He said, "At times I realized that I was spending so much time with [GoNorth!] and that I loved it. I didn't hate it. I really liked the entire experience."

Adventure brings an understanding of the real world to learners

The third most common theme is that the students gained an understanding of the world beyond their local community. Students commented that they felt they had a better understanding for remote locations and cultures. Katrina noted, "I really couldn't believe that people lived in the Arctic. That they lived like they did. I couldn't believe how the babies were carried in their mom's hoods and how everyone drove a snowmobile." George said, "It was crazy to see reindeer and that people were racing with them. I really didn't think reindeer existed." Beth said, "I love that I could follow along and every day I learned a new thing about the world."

Adventure motivates teachers to become part of the learning community

All six of the teachers interviewed commented that they were motivated to be part of the learning community because they, too, wanted to follow along and be part of the adventure. From comments about the daily updates to the how the adventure connected to the curriculum, the teachers noted the idea of adventure was what was needed in the classroom and beyond. Amy said, "I've been teaching for six years and I was so excited to be part of this learning experience. I, like my students, wanted to follow along and learn the real-world experiences. I also wanted to get other teachers involved within my school while also connecting with other teachers literally throughout the world." Luke noted, "Every learning experience needs to have some adventure. Students and teachers, too, are motivated to be part of something that is real, ongoing, and has a beginning and an end."

Adventure motivates the teachers through their perception of their learners' excitement

Five of the six teachers commented that they were motivated because their students were motivated. Kara said, "I don't think it is said enough, but if you see your students motivated, you get motivated. That's what happens when I bring adventure into the classroom." Jessie said, "My students loved to go on to the website and see what new was happening. They were learning and they didn't know it. I was so motivated and excited to bring a project in the classroom where an adventure was at the heart of it." Every teacher interviewed had some additional items throughout the classroom as a result of the adventure they were following. This ranged from an actual miniature dogsled that a class had built to photos of the explorers and dogs on the classroom walls.

In summary, we found that the adventure within the *GoNorth!* Adventure Learning Series provided heightened motivation, excitement, community-building, real-world understanding, and learner participation. Teachers and students alike became engaged in learning in a new and impactful way as they followed along with the adventures of the expedition team. They found themselves drawn into the expedition in a visceral way through the affordances of the technology; the powerful stories, data, and media assets shared by the team; and the online interaction opportunities, all of which allowed them to feel as though they were part of the adventure itself. They also found themselves engaged with the issues that were raised, and collaborating to craft new ways to contribute to solve issues, both on a local and a global scale.

The Future of Adventure in Education

Throughout the world, individuals have traveled and participated in expeditions and adventures in search of new experiences and new understandings. The rise of Web 2.0 technologies and user-generated content offer the opportunity to share these experiences and understandings with the world. But the online sharing of most adventures tends to take the shape of a blog that focuses on the adventure and the adventurer and that consists primarily of an online diary and some photos. It is difficult for outside observers to truly engage in learning around the experience when it is presented in this manner, and impractical for teachers to try to use such environments in formalized learning.

This brings us to future developments in adventure in sustainability education, and the

concept of user-driven adventure learning environments (UDALE) in which learners create and share self-initiated AL projects online (Doering & Miller, 2009; see Fig. 2.1). Though the best-known and -researched AL programs to date, such as the *GoNorth!* Adventure Learning Series, have involved large-scale expeditions and remote locales, it's important to emphasize that AL programs can just as effectively focus on ordinary, everyday adventures with people familiar to us (Henrickson & Doering, 2013; Veletsianos, Miller, Bradley Eitel, Eitel, & Hougham, 2012). User-driven AL environments have the potential to allow learners to act not only as explorers and expedition leaders within their own communities seeking out answers to their own questions, but also to serve as teachers and facilitators, strengthening their knowledge of a subject and a geographical area as they communicate to others about it. Learners engaged with UDALE also have the opportunity to practice their social networking skills as they interact with others online around a topic that is important to them. One of the keys to UDALE as regards sustainability education is that learners, in developing and implementing their own adventure tied to a real-world issue and location, become active problem solvers and innovators, engaged with an issue on a level not possible in the classroom alone.

One of the challenges to date with implementing UDALE has been that there are no existing online environments or tools that provide the optimal structure and scaffolding needed for teachers and learners to be able to easily create and share an AL project. That is about to change with the introduction of two new AL tools that will be free for educational use: the *WeExplore* online learning environment and the *Nature Detective*

mobile app. In combination, these tools will allow learners to: (1) identify an AL expedition or exploration they would like to undertake and provide some background about the location and issue they are choosing to focus on; (2) go out into the field and collect, geolocate, and organize photos, videos, audio files, maps, and field notes associated with that expedition; and (3) incorporate those assets into their AL project within a shared and socially networked online learning environment.

WeExplore (Fig. 2.3) is a new project by the Learning Technologies Media Lab at the University of Minnesota. It provides the opportunity for learners to become explorers in their respective geographic locations and share their explorations with the world through a socially networked AL environment. Teams of students, guided by a teacher or other adult sponsor, can work together to generate an adventure learning project centered on a specific location and environmental or social issue. They can then share their project online through a unique, custom-designed environment that scaffolds them through the process of creating an adventure learning project. Learners are also able to follow along with teams whose projects interest them.

Figure 2.3. WeExplore: a user-driven adventure learning environment.

Mobile technologies are also being explored as a means to engage learners in AL and help them form a closer connection with both the natural world and their local community. The *Nature Detective* app (Fig. 2.4) is a mobile AL tool in development that will allow learners to go out in the field and explore and gather media artifacts that can then be shared with classmates, families, and teachers through a synched online environment. It is designed to facilitate the collection of media artifacts, field notes, and geographical data in an organized manner tied to the specific issue and location being explored, and to then be able to easily share those assets among team members and within an online learning environment.

Figure 2.4. Nature Detective app: an adventure learning tool.

Conclusion

Adventure has played a role in sustainability education for more than a century. Adventure education and adventure learning are two frameworks that offer teachers a means to introduce adventure in formal and informal learning in a pedagogically meaningful way, drawing on experiential and inquiry-based approaches and, in the case of adventure learning, incorporating the multitude of affordances that technology has to offer as well as the opportunity to practice active problem solving of real-world issues. In both adventure education and adventure learning, *adventure* is key. It serves not only as a "hook" to draw the learner or participant into the learning pursuit, but also introduces a

challenge to the learner along with an element of risk and uncertainty via the opportunity to embark on an exploration of a specific physical or psychological challenge or a specific location and issue.

The introduction of user-driven adventure learning environments (UDALE) and new online and mobile tools and technologies are making it easier than ever for teachers and learners to create and share with the world their own adventures, and to extend learning well beyond the walls of the classroom. In many respects, UDALE merges components of adventure education and adventure learning, allowing learners the opportunity to engage in their own physical adventure while concurrently teaching others about a real-world issue, sharing authentic data and narratives, and employing technology for data collection, disbursement, and collaborative involvement with other learners and field experts.

As illustrated in published studies around adventure education and adventure learning, adventure works in education because it lends excitement, risk, and motivation to a learning environment, even as it advances real-world understanding, enhances critical and creative thinking skills, and builds community. We encourage designers and educators to explore the use of adventure in their learning spaces, and to create their own adventure learning environments in collaboration with their learners. More study around such environments and around the use of adventure in sustainability education will lead to refinement of these adventure-in-education models and perhaps initiate a new age of exploration and discovery and a new approach to sustainability education.

CHAPTER 3

Fostering Creativity through Inquiry and Adventure in Informal Learning Environment Design

This study appears in the print, peer-reviewed Journal of Technology and Teacher Education under the citation below. The study was a joint research effort between myself and my advisor, Dr. Aaron Doering. Though I am listed as second author, our work on this study was equally weighted. I conducted the interviews and focus groups and completed the literature review for the study. We worked together on the data analysis and theme generation. It may be helpful for the reader here to understand that we view inquiry as "a self-directed, question-driven search for understanding" (Hudspith & Jenkins, 2001, p. 9) in which the learner formulates a question, designs and conducts an investigation to research that question, and ultimately shares findings and reflects on their outcomes.

Doering, A., & Henrickson, J. (2015). Fostering creativity through inquiry and adventure in informal learning environment design. *Journal of Technology and Teacher Education, 23*(3), 387-410.

Introduction

"The formulation of a problem is often more important than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle, requires imagination and marks real advance in science." Einstein and Infeld, 1938

How do we design informal learning environments (ILEs) that foster creativity among teachers and learners alike? What tools can we provide teachers that encourage learner curiosity and wonder, cultivate collaboration, and are scalable? These are common questions posed by teachers who engaged with global adventure learning (AL) programs (Doering, 2006) in their classrooms over the past decade. These AL programs successfully employed technology-fueled ILEs that rallied millions of teachers and learners online around transdisciplinary issues, leading teachers to ask how they might design and develop their own ILEs that foster innovative thinking on par with that generated within these large-scale AL environments.

In response, over the past two years the Learning Technologies Media Lab at the University of Minnesota designed and deployed a user-driven AL environment called *WeExplore* (http://we-explore.com). *WeExplore* provides an online and mobile environment that scaffolds teachers and learners through integrated, authentic learning experiences with real-world application, spurring them to take a collaborative, experiential approach to creatively solving driving questions they identify.

This study examines to what extent an ILE such as *WeExplore* might provide a technology-fueled classroom tool for teachers that fosters creativity while allowing learners to design authentic transdisciplinary experiences grounded in pressing contemporary issues. We also explore what role teacher pedagogy and practice might play in influencing learner creativity and engagement within an ILE. Findings show that teacher and student creative prowess was influenced by the unique design of the learning environment, the opportunity to define self-identified driving questions, the process of

collaborative group work, and the opportunity to combine more traditional research approaches with more creative arts-influenced ones. We conclude with a model that reflects key criteria in learning environment design and teacher pedagogy relative to creative development.

Creativity, Exploration, and Wonder

"Educators should give students opportunities to be creative and reflective within a real-world context and to use digital tools and resources in both face-to-face and virtual environments" ISTE, Standards for Teachers, 2014

Creativity is a hot topic not only in education but also in business today, as we face global challenges – such as climate change, aging infrastructures, social inequalities, and medical pandemics – that require novel thinking and technological innovation. Self-directed, inquiry-based learning opportunities focused on transdisciplinary real-world problem solving have been shown to foster creativity in learners (Esquivel, 1995; LaBanca & Ritchie, 2011; Liu & Lin, 2014; Mishra, Fahnoe, Henriksen, & the Deep-Play Research Group, 2013; Schmidt, 2010). Consensus on how to best define and assess creativity, however, has yet to be reached within the broader academic community (Parkhurst, 1999; Runco & Jaeger, 2012; Schmidt, 2010; Simonton, 2012). Most definitions include the criteria of *novelty* and *usefulness* or *effectiveness* or a variation of these terms, stressing that to be considered creative a product or solution must be unique but also serve a function or provide some value. Some scholars add a third criterion. For example, Simonton (2012) draws from the U.S. Patent Office criteria and includes

surprise (nonobviousness) as a third criterion. Mishra and Koehler (2008) draw from Besemer and O'Quin (1999) and add *wholeness* (aesthetic sensibility). We believe these trifold perspectives provide a more contemporary and complete perspective of creativity than has been offered previously; they consider not only the practical nature of creative endeavors (novelty and effectiveness) but also the intangible elements: surprise, aesthetics, wonder.

Creativity may furthermore be examined from a personal standpoint versus a professional one (Parkhurst, 1999; Runco, 2003). Examining creativity from a personal standpoint involves looking at an individual's work or thought process and considering whether it reflects a divergent or novel approach relative to that individual's previous work, age, and developmental stage. Runco (2003) ties this type of creative insight to Piaget's (1973) concept of *invention*. In comparison, a professional standpoint reflects on the creativity of an individual's work or thought process relative to similar artifacts created by other individuals in a given field. Does, for example, an individual physicist's work represent a novel, unique, and nonobvious approach relative to other physicists? We believe examining creativity from the personal standpoint makes the most sense in K-12 education, with an emphasis on fostering creative development in learners and cultivating learner belief that creativity is not limited to artists and musicians, for example, or to certain gifted individuals, but is rather a way of uniquely perceiving the world and approaching problem solving that is possible by any individual in any field. Thus, how might we best spur learners to feel comfortable to approach problem solving and solution crafting from unique (creative) angles? How might we scaffold them to

consider novelty, usefulness, and wonder in their thought processes, solution crafting, and learning artifacts?

In addition to considering a personal versus professional approach to creativity, creativity may be looked at as a process rather than assessed by a finished product (Runco, 2003), which is the approach we take in this study. That is, we are examining how the *WeExplore* ILE and the participating teacher's pedagogy facilitate creative thinking and development among learners, as well as how the learners themselves perceive creativity and its role in their classroom activities.

The influence of a teacher's pedagogy and personality on learner creativity has been well studied in the past (Anderson, 2002; Esquivel, 1995; de Souza Fleith, 2000; Horng, Hong, ChanLin, Chang, & Chu, 2005; Lee & Kemple, 2014; Liu & Lin, 2014; McGreevy, 1990; Reilly, Lilly, Bramwell, & Kronish, 2011; Rinkevich, 2011; Woods & Jeffrey, 1996). Teacher traits that have been shown to influence creative development in learners include flexibility, openness, and acceptance, and the ability to develop strong interpersonal relationships with students (Dacey, 1989; Esquivel, 1995; McGreevy, 1990; Reilly, Lilly, Bramwell, & Kronish, 2011). A survey of students about creative teachers by McGreevy (1990) found that teacher personality traits such as a sense of humor, spontaneity, understanding, and being able to share personal experiences with students tended to define creative teachers in students' eyes. Creative teaching has been associated with improved learner achievement and engagement (Rinkevich, 2011; Schacter, Thum, & Zifkin, 2006).

Considering a teacher's pedagogy in conjunction with the design of learning

environments is an important component in investigating how we might engage learners in creative problem solving within the classroom setting. The teacher-participant in this study thus factors into our findings and recommendations regarding the design of informal learning environments that foster creative development.

WeExplore and Adventure Learning

Adventure learning (AL) is a form of hybrid distance education that blends experiential (Dewey, 1938; Kolb, 1984) and inquiry-based (Bransford, Brown, & Cocking, 1999) approaches. Grounded in a strong curriculum and pedagogy, an adventure-based narrative, and place-based concepts of learning (Sobol, 2004), AL emphasizes real-world, authentic problem solving, and merges an online learning environment with teacher-led classroom activities. It has been shown to have a positive influence on student engagement, motivation, and learning outcomes, and to be a successful model for teaching and learning across the curriculum (Doering, 2006; Doering, 2007; Doering & Miller, 2009; Doering, Scharber, Riedel, & Miller, 2010; Doering & Veletsianos, 2008; Henrickson & Doering, 2013a; Henrickson & Doering, 2013b; Koseoglu & Doering, 2011; Miller, Doering, Roehrig, & Shimek, 2012; Moos & Honkomp, 2011; Veletsianos & Doering, 2010; Veletsianos, Doering, & Henrickson, 2012; Veletsianos & Kleanthous, 2009).

Within an AL program, a team undertakes an expedition centered on a specific location and issue; for example, climate change in the Arctic. The team develops an inquiry-based curriculum tied to that issue and location, and then travels into the field to

capture authentic data and narratives synched with that curriculum. The team's field experiences, data, and media assets are shared online in an environment where learners are able to interact and collaborate with field experts, the explorers, and their peers and teachers. Learners complete activities related to real-world events, engage in discussions around them, and present potential solutions to issues that are raised, all while following along with the field adventures of the explorers. These experiences allow learners to form connections between what is happening in the real world and their studies.

Though the best-known AL programs have involved large-scale expeditions and remote locales, it is important to emphasize that AL programs can just as effectively focus on ordinary, everyday adventures with people familiar to us (Henrickson & Doering, 2013a; Veletsianos et al., 2012). A new advancement in AL, in fact, is the creation of user-driven adventure learning environments (UDALE), in which learners create and share self-initiated AL projects online (Doering & Miller, 2009). Such environments allow learners to act as teachers and facilitators, strengthening their knowledge of a subject and a geographical area as they communicate to others about it, while practicing their social networking skills as they interact with others online around a topic that is important to them. A prime example of a user-driven adventure learning environment is *WeExplore*, the design of which is grounded in the adventure learning framework and inquiry-based learning practices.

WeExplore (http://we-explore.com; see fig. 3.1) provides students with the opportunity to become explorers pursuing answers to their own questions, and to then share their discoveries online. Working in teams, students choose a real-world location

and a geographical, environmental, or social issue that interest them and create an expedition focused on that topic. They then craft a mission statement and a guiding question to investigate, and begin collecting media and field notes that speak to the question at hand. Using a desktop, laptop, or mobile device, students upload and share their media and findings within the *WeExplore* online environment. *WeExplore* teams can follow along with each other's adventures and learning as they contribute to world knowledge about contemporary issues through a personal lens.

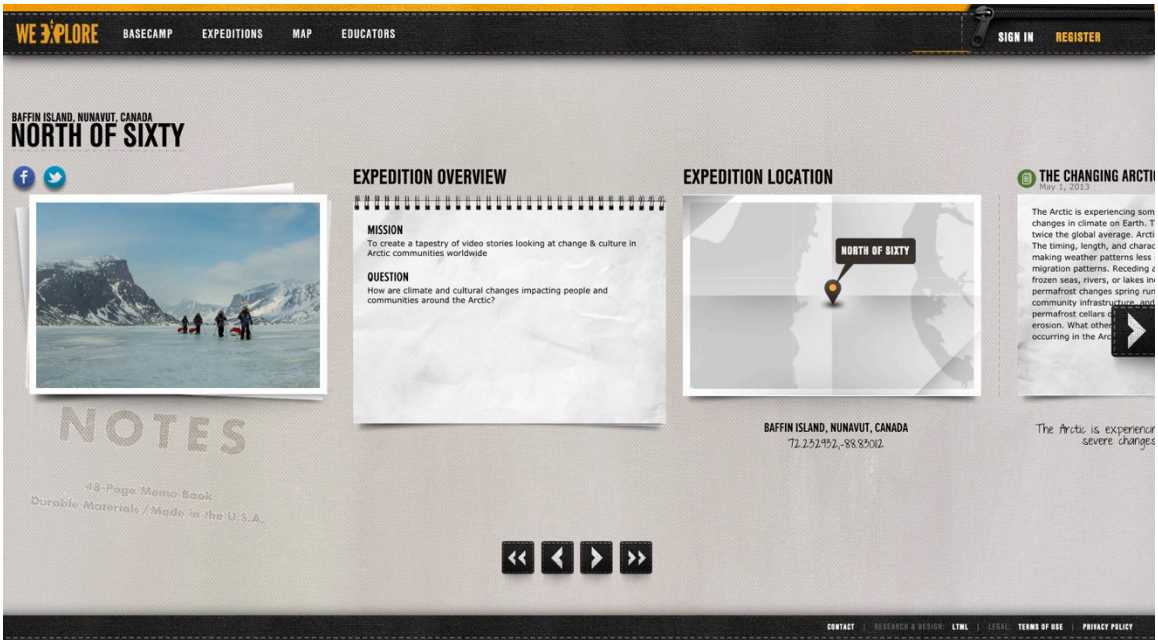

Figure 3.1. The WeExplore online learning environment.

Educators can provide as much or as little guidance as desired in setting guidelines and rubrics for learners within the *WeExplore* environment. *WeExplore* can be incorporated within existing curriculums tied to geography, STEM learning, digital storytelling, place-based learning, and project-based and design learning, to name just a few examples.

The students and teacher participating in this study used the *WeExplore* environment to generate projects focused on geographic inquiry. Geographic knowledge and inquiry skills are particularly key in today's globally interdependent world (Edelson, 2009; Heffron & Downs, 2012; Kuhn, 2012; Schell, Roth, & Mohan, 2013). We are facing a plethora of challenges that demand an understanding of geographic concepts such as location, place, movement, human and environment interaction, and region. These challenges include issues with worldwide impact such as climate change, migration, political unrest, and food security, along with more localized challenges such as freshwater access, deforestation, and land use.

Geography is identified as a core academic subject in K-12 schools under both the Elementary and Secondary Education Act of 1965 as well as in the 2002 No Child Left Behind Act. However, it has yet to receive the federal funding and attention that the other identified core subjects have. And although geography decidedly fits within the much-in-demand STEM (science, technology, engineering, and mathematics) learning arena, it is often overlooked as such (Baker, 2012; Hayes-Bohanan, 2011).

Professional development opportunities for geography teachers are thus limited, and new tools and models are needed to guide teachers and learners alike through the process of geographic inquiry. As geographic inquiry rapidly embraces new technologies, such as geographic informational systems (GIS), opportunities for teachers and students to engage with these technologies is also critical. The geospatial industry is a burgeoning field, feeding an average $73 billion per year into our national economy (Boston Consulting Group, 2012). According to the U.S. Department of Labor (2013), the

geospatial industry is one of the fastest growing technology fields, with geospatial jobs increasing at an annual rate of 30 percent globally and impacting multiple career paths (Oxera, 2013).

Geographic learning offers a broad swath of transdisciplinary skills, spatial understanding, and technology training. It presents, too, an understanding of culture and the changing nature and relationship of human and environmental systems around the globe. *Spatial thinking* is a key skill that can be gained through geographic inquiry (Heffron & Downs, 2012; Jo & Bednarz, 2014; Kuhn, 2012; National Research Council, 2006). In their 2006 landmark study, *Learning to Think Spatially,* the National Research Council defines spatial thinking as "a collection of cognitive skills comprised of knowing concepts of space, using tools of representation, and reasoning processes" (p. 12). Spatial thinking has been shown to be an important force and influence on creative aptitude and technical innovation, particularly within STEM fields, but models and systems for teaching and assessing spatial thinking are few (Gardner, 2011; Jo & Bednarz, 2014; Kell, Lubinski, Benbow, & Steiger, 2013; Lubinski, 2010).

Storytelling is a related—and often overlooked—skill that drives the *WeExplore* learning environment. The criticality of communicating scientific findings and data to the public in an engaging, relevant, and readily understandable way has taken on prominence and heated discussion across STEM fields today (Eagleman, 2013; Hart & Nisbet, 2012; Horst, 2013; Leshner, 2012; Lupia, 2013; Wilcox, 2012). Cameron (2012) explicitly discusses the changing nature and role of storytelling within geography, whether as an object of knowledge, a form of practice, or a mode of academic expression.

Related, STEM skills and knowledge are overall essential to our worldwide ability to contribute innovative solutions to pressing global issues. K-12 schools have typically separated STEM learning into individual content areas (Berland, 2013; Sanders, 2009). However, recent articles emphasize the need to infuse creativity and interdisciplinary approaches in STEM education (Mativo & Park, 2012; Mishra, Henriksen, & the Deep-Play Research Group, 2012; Root-Bernstein & Root-Bernstein, 2013). There has been a push, for example, toward introducing authentic, integrated STEM learning experiences in K-12 classrooms (Basham & Marino, 2013; Becker & Kyungsuk, 2011; Nathan et al., 2013). Such experiences have been limited to date, in part due to teachers lacking the proper training, knowledge, and tools to generate authentic, integrated STEM activities for their students (Nathan et al., 2013). *WeExplore* was designed with these concerns in mind, and with a focus on providing teachers and learners with a technology-driven platform within which to generate authentic geographic and STEM-focused inquiry within a real-world context.

Research Question

To what extent does an informal, technology-fueled adventure learning environment facilitate in-service teachers' ability to stimulate students' creativity and motivation to learn geography content?

Methods

Participants and Data

This study involved one teacher and 95 ninth-grade students in a public high school in a large Midwestern suburb. The teacher was chosen from a group of teachers who had participated in a summer professional development workshop that was focused on technology integration in the geography classroom. All forty-five teachers in the workshop were offered the opportunity to participate; the final teacher chosen was selected based on his and his school's interest in the study and ability to integrate the study within their existing curriculum during the timeframe desired by the researchers. IRB protocols were followed for all study participants, including the collection of signed consent/assent forms from the participating teacher, his school principal, and the participating students and their parents or guardians.

During the study, students worked in small, self-selected groups to collaboratively design, develop, and present geography research using the *WeExplore* adventure learning environment. The participating teacher determined the focus of the student research and designed the rubric for assessing it. In the participating teacher's own words during our final interview:

> I used *WeExplore* as what I refer to as an authentic assessment. At the conclusion of each geography unit that we covered, the students would have to pick a question based on that unit's content and then research that question and present their research using *WeExplore*.

The study spanned 4 months, from February through May 2014, with student groups each taking about three weeks to complete their *WeExplore* projects at differing times within the course of the four-month span. Students presented their *WeExplore*

projects to their classmates and teacher upon completion of them.

Participating students were part of three different required introductory high-school geography classes taught by the participating teacher. Approximately 86% of the students in the three classes chose to participate. Non-participating students completed a traditional research paper in lieu of the *WeExplore* project.

The geography classes were designed for average students (i.e., they were not advanced placement classes). Within the classroom, students had access to iPads and iPod Touch players. The school also had a BYOD (bring your own device) policy. Approximately half of the participating students used their own devices, and half used classroom-supplied devices. Students also did periodic class work in the school computer lab, which housed desktop PCs with Windows operating systems. The participating students noted during focus groups that although they make use of technology frequently in their geography class with Mr. Anderson (the participating teacher), their other teachers rarely make use of technology for class assignments.

The participating teacher, Mr. Anderson (name has been changed to protect the teacher's privacy), has more than a decade of experience as a teacher and is an enthusiastic classroom innovator. He is a district-wide leader in integrating technology in the classroom and has been recognized statewide as an exceptional teacher for his innovative work with technology integration. He has also been recognized as a teacher of the year within his school district.

The data informing this study consist of 5 classroom observations, 6 focus groups with participating students, and 3 personal interviews with the participating teacher.

Data Analysis

We used the constant comparative method (Glaser & Strauss, 1967) to analyze participants' interview responses, and took a case study approach to the research design (Yin, 1994). The constant comparative method involved researchers engaging in open coding of the data where they independently read and analyzed the data to (a) note emerging patterns and (b) gain an understanding of participant experiences. The researchers then met seven times to discuss results, compare notes, and collaboratively analyze data in search of common meanings. The patterns discovered were compiled and reanalyzed in order to confirm and disconfirm themes across and between participants. Analysis continued until no more patterns could be identified and researchers felt that the data had been saturated (i.e., when researchers felt the data had been completely represented by current codes/themes). Once these patterns were identified, they were grouped into the themes.

Triangulation methods were used to examine the accuracy of the collected data and reduce the possibility of researcher bias in drawing conclusions from the data:

1. Data were collected from multiple sources (classroom observations, student *WeExplore* project analysis, Learning.com pre/post-tests, focus groups, and interviews), and data sources informed each other.
2. Researchers analyzed data independently and then met to compare and discuss their findings.
3. Researchers shared their findings with the participating teacher for member

checking and input.

4. One of the two participating researchers examined the themes and the extent to which they were congruent with participants' experiences as revealed through focus groups, interviews, and publicly available artifacts shared in the online learning environment.

Findings

Our original questions was, to what extent does an informal, technology-fueled adventure learning environment facilitate in-service teachers' ability to stimulate students' creativity and motivation to learn geography content? Data from the focus groups, teacher interviews, and classroom observations revealed the following themes that fueled or impacted student creativity as a result of both the design of the *WeExplore* informal learning environment (ILE) and the context of the classroom created by the teacher while utilizing this ILE. These themes are broken into two facets: student-driven and teacher-driven creativity. Student-focused themes include *curiosity, self-pace*, *perceptions of creativity*, *constructivist learning*, *teamwork*, and *mobile learning*. Teacher-focused themes include *supportive pedagogy* and the role of *trust and inspiration*.

Student-Driven Creativity

Students described their perception of creativity and the importance of having both face-to-face (F2F) and virtual environments (VE) that allow them to creatively express

their learning. Being able to set their own pace on projects and to work collaboratively on teams of their own choosing were factors that students cited as strongly influencing their ability to be creative. These and other themes tied to student creativity are discussed below.

Curiosity. The importance of curiosity permeated all focus groups. Curiosity was influenced by the design of the ILE and the teacher's enthusiasm about the ILE. During the focus groups, seventy-five percent of all students noted that they can be "curious" and interested in a subject, but if the ILE they are using does not enhance and support that curiosity, they become "bored" and their curiosity turns to a lack of self-direction. However, if an ILE supports their curiosity, it can lead a student to dynamic and impressive results. During one focus group, Todd noted:

> I believe my creativity is impacted by the technology I am using. When I used *WeExplore*, I could show my thoughts in a variety of ways, like through photos or videos or maps. I liked it because I could share my findings quickly, it was a fun environment to work with, and it had a cool look too.

When asked how it was different from other technologies he had used, Todd responded, "It was really visual and it was easy to use. It made me think before I started creating, made me think about what it was I was trying to explain to others, to share with others." Jessica described that she liked working with *WeExplore* as it allowed her to do what she thought was best without guiding her down a predefined path. During one focus group, she noted:

> We decided what our mission and question were and we were quickly sharing our

story. I could do what I wanted when I wanted to do it and use my phone to do it too. This was motivating for me.

Students noted during focus groups that their teacher's enthusiasm about a project or learning environment influenced their own enthusiasm and curiosity.

When asked what features they thought were needed in an ILE to support creativity, students described the importance of ease of use and navigation, engaging aesthetics, and reliable functionality. Noah stated, "I like the way *WeExplore* looks and how easy it is to create an expedition. We could do some research and quickly share it with anyone, like Twitter or Snapchat. It just worked." Sarah shared, "I wanted to show my friends and my parents what we had created. *WeExplore* made it feel like we were actually explorers and I wanted to tell others."

Mr. Anderson also felt the *WeExplore* ILE spurred his students curiosity and encouraged deeper investigation of geography issues. During our final interview with him, he noted:

The students were really, really excited about using *WeExplore*. They liked using this technology to investigate a question and present their research. They could make the research more their own, more personal, be more creative. For my purposes, it was a perfect tool too, a good means to assess their learning and understanding.

Self-Pace. Students unequivocally stated that they appreciated the ability to work at their own pace on their *WeExplore* projects, and that they could work from anywhere as well. Two students shared that they worked on their projects collaboratively with their

teammates online from out of state while they were on vacation.

Students noted that having time to explore the ILE and to think and discuss their project with their teammates prior to beginning to work in the ILE was critical to being able to express themselves creatively. When rushed on projects, they stated they were more likely to just "cut and paste" data. Jenna noted, "Mr. Anderson lets you take your time and be myself and that leads to creativity." Shane commented during one focus group:

> It's much easier to take my time and do my thing. Mr. Anderson is there for me if I have a question, and he checks in with our team to see how things are going, but he doesn't hover over us. He trusts we're going to get the project done and do it well.

In one interview, Mr. Anderson noted:

> Students will come in to class and they'll want to know if it's a work day, which means they're going to have the opportunity to work on their *WeExplore* projects independently. They ask that right away, and to me that's a good indicator that they feel that that time is really valuable, that they want to be able to work where they're at, don't always want a teacher saying, 'Alright, class, let's talk about this together….' They appreciate the time working independently with their groups on their projects.

Perceptions of Creativity. The idea of what is creative varied among students and appeared difficult for some to define. In describing creativity, students used words and phrases such as "different," "using my imagination," "coloring outside the lines," "thinking in ways others don't think," or "being good at art or music." Eighty-four

percent of students participating in focus groups said they felt creativity was important, and more than 70 percent expressed that opportunities to be creative were minimal in most of their classes. They therefore believed most teachers did not place much importance on creativity. Beth shared, "I never think much about being creative. I think mostly about getting the right answer." Danny noted, "Creativity isn't encouraged in most of our classes. We are just always looking for the right answers." Students felt Mr. Anderson's class was different, however. Sherene noted:

> Mr. Anderson supports us working with lots of different technology and working on projects that let us share our ideas in different ways than most teachers. He gives us choices too, so we can, like, have a choice of doing a research paper or sharing our research through something like *WeExplore*.

Mr. Anderson expressed in interviews how much he valued creativity, and that he felt it was a critical skill for students today. "I think we live in a very unique time," he noted:

It's not that we are necessarily more creative than other generations of people, I just feel like we have so many opportunities. To me creativity is not necessarily coming up with something that's never been heard of, but really more of the hybrid of bringing existing things together in new and more meaningful ways. Platforms like *WeExplore* allow for this, guide students to experiment with this.

Constructivist Learning. Students felt that even if they were creative, the majority of school assignments were simply a checklist that needed to be completed by a due date rather than meaningful work that fostered creativity and exploration. The importance to

them of working in an environment that supported meaningful learning was critical. They appreciated being able to formulate their own questions to answer rather than answering questions designed by the teacher. Danny shared during one focus group:

I want to be able to create and develop things that are reflective of me. Most of the time I create something I don't feel like I can share what I truly know. I'm just responding to move to the next question.

During the same focus group, Parker commented:

> *WeExplore* allowed us to develop and showcase our thoughts. It's things like *WeExplore* that help me be creative because there is not a right or wrong answer. We form our own questions, create what we think is best.

Teamwork. Students shared that being able to work in teams and to choose their own teammates on a project enhanced their ability to be creative. "I like being able to choose my own teammates because I'm more likely to share my real thoughts with them, to trust them," Jasmine noted. "It's great to be able to talk through ideas with a group. I feel like our ideas are stronger when we work together in groups," Mack said.

Mobile Learning. The importance of mobile, ubiquitous learning dominated the focus group conversations. Students described the importance of being able to collaborate with peers anywhere and anytime. Students noted how collaborating with peers online on the same project allowed them to be creative and still keep on schedule to complete the project as assigned. Two students described how they worked on the project while out of state on vacation, one working on an iPad and the other an iPod. Jim shared, "I was able to work on our project on the plane, in the car, or wherever. I was able to login and share

my research with my teammates. That's how all technology should be now."

Teacher-Driven Creativity

Mr. Anderson exhibits many of the teacher traits shown in previous studies to influence creative development in learners, including flexibility, openness, and the ability to develop strong interpersonal relationships with students. Students in our study described that a critical aspect to being able to be creative in the classroom is having a teacher who reinforces creativity by developing a supportive learning environment. Following are themes related to the role of the teacher developing an environment that supports creativity.

Supportive Pedagogy. The theme that received the most unified comments was the role of the teacher supporting creativity through the design of classroom lessons, the context of the classroom, and supportive pedagogy. The students' teacher, Mr. Anderson, was viewed as a "rock star" by the majority of his students because of his approach to supporting students' self-directed investigation. Mr. Anderson had developed a climate in his classroom of students self-pacing their own learning through predefined themes within which students made choices about content and delivery method. Angie shared:

> Mr. Anderson allows us to chose our own topics but guides us through the activity. He is there to support us, not tell us what to do. I feel like I can be more creative in Mr. Anderson's class than I can be in even a classes like art or music where I would think I would be allowed to be creative.

Along a similar vein, Jeremiah said:

> We can be ourselves and explore topics that motivate us. He doesn't spend a lot of time lecturing, but if there's something he thinks most kids in class don't understand, he'll talk through it with the whole class. He has a good feel for what we need and what we understand and he's always there for us, moving through the class and checking in with us even when we're working on our own or in small groups.

Trust and Inspiration. Trust and inspiration have been noted to be critical in both face-to-face and online learning environments. In Mr. Anderson's classroom, almost 80 percent of students participating in the focus groups commented on Mr. Anderson's ability to build trust within his classroom and how he provides inspiration for students to pursue investigation of topics in ways they had never thought about or attempted before. This trust begins with allowing each team to self-select not only their team members, but, for example, within the *WeExplore* ILE, also the topic, mission, and question to be investigated. Furthermore, Mr. Anderson gives students adequate work time to generate ideas and be creative. He also encourages students to think beyond their typical assignments, activities, and issues. Jonah said, "Mr. Anderson allows us to be ourselves. He trusts us that we will do the right thing and is not overlooking every step we do." Sara shared, "Mr. Anderson inspires us to do our best work. We want to come to class. We want to do our best. *WeExplore* was perfect for Mr. Anderson's class because it reflected the way he teaches."

Implications and Recommendations

We began this study by asking to what extent an informal, technology-fueled adventure learning environment facilitates students' creativity and motivation to learn geography content. We specifically examined how the *WeExplore* ILE and the participating teacher's pedagogy facilitated creative thinking and development among participating students, as well as how the students themselves perceived creativity and its role in their classroom activities. We learned that (a) students' creativity and self-direction are influenced by the technology tools (learning environment) that the students use within the classroom, (b) students' creativity is limited by their own idea of what creativity is and the support they receive within the classroom to support such endeavors, (c) a constructivist learning environment is needed to support creativity, (d) mobile learning opportunities inspires students to be creative, (e) creativity is impacted by the extent there is supportive pedagogy, and (f) without trust and inspiration from the instructor, the extent to which students feel they can be creative will be limited. These lessons allow us to draw the following implications for the design, development, implementation, and integration of technology tools to support creativity within the classroom.

Trust Students and Create Opportunities

The ability for students to share their own voice is the foundation of supporting and encouraging creativity. This voice cannot be achieved unless the pedagogy of the classroom is one that is built upon trusting students to contribute not only their own

answers, but also their own questions. With trust, students are willing to take risks that they normally would not take in other classrooms. In addition to developing this trust, creating opportunities for students to showcase their knowledge in guided approaches that do not overwhelm the students is crucial. As noted earlier in this paper, self-directed, inquiry-based learning opportunities have been shown to foster creativity in learners (Esquivel, 1995; LaBanca & Ritchie, 2011; Liu & Lin, 2014; Mishra, Fahnoe, Henriksen, & the Deep-Play Research Group, 2013; Schmidt, 2010). Our study findings support this past research.

Allow Students to Self-Pace

With a standards-driven environment in a majority of classrooms today, the idea of self-pacing is normally not a pedagogical option. However, as was showcased in this study, when students can work individually and collaboratively at their own pace, they feel supported and encouraged to do their best and with less pressure and stress, are able to express themselves more creatively. Students commented that in other classrooms they were simply ticking off checklists, rather than being given the opportunity to be creative and innovative. Allowing students to self-pace can thus support creative development in students as they have time to navigate problem solving and solution crafting from unique angles. This concept ties to the *personal* and *process* approach to creativity discussed by, for example, Runco (2003) and others.

Offer Technology Tools That Provide Choice and Structure

At the heart of the comments from both the students and the teacher, certain components are needed in an ILE to support creativity. The tool or environment needs to provide aesthetic inspiration and scaffolding while also offering freedom and flexibility for learners to contribute their own content on their own terms. The *WeExplore* environment provided aesthetic inspiration through the unique design of the environment, while also providing scaffolding by walking learners through the process of setting up an inquiry-based expedition in real-time, and also through tutorials provided within the environment, available to learners as needed. Students felt as if they were true explorers, as they were able to share findings through photos, videos, maps, and text. They could showcase their work easily, and explore the expeditions of their peers worldwide. Students and teachers could also access support at any time if needed, and access and contribute to the environment from anywhere at any time.

Combine Science and the Arts

Students need to be given the opportunity to conduct scientific inquiry while using technology and a variety of media to showcase their work. Science can be learned through inspiring experiential work that fuels creativity (e.g., see studies now emerging on the STEAM movement, which inserts *Art* into *Science, Technology, Engineering, and Mathematics*). Allow students to use technology tools and media that inspires and motivates them to create and share in ways they have not in the past. Teaching and learning activities must be diverse, fun, and meaningful, and with the access many classrooms and students have to a wide range of devices, software, and apps, now is the

time to create inspirational learning spaces in both face-to-face and online settings.

Use Participatory Design

Jonassen, Myers, and McKillop (1996) note in looking at how people learn with multimedia that "people who learn the most from instructional materials are the designers" (p. 95). Positioning teachers and learners as co-designers has been shown to enhance understanding and engagement (Cviko, McKenney, & Voogt, 2014; Könings, van Zundert, Brand-Gruwel, & van Merriënboer, 2007; Noriega, Heppell, Bonet, & Heppell, 2013; Penuel, Roschelle, & Shechtman, 2007; Pieters, 2004; Stears & Malcolm, 2005). Bringing learners into the design process is also crucial to fuel creativity. Technology tools and online learning environments today offer students the opportunity to give personalized input into the end result. Although not every student may view his/herself as a designer, participatory design is possible through a wide range of tools today and offers students a great deal of opportunity to explore and create. ILEs such as *WeExplore* offer toolkits that scaffold students through inquiry and design and allow them to identify, visualize, and ultimately showcase their learning and work.

Conclusion

Looking back to our original question as to what extent a technology-fueled ILE such as *WeExplore* can facilitate in-service teachers' ability to stimulate students' creativity and motivation to learn geography content, we would like to offer the following visual summary (see fig. 3.2). This model helps illustrate some of the ILE design

affordances and teacher pedagogical approaches that influence creativity in the classroom, based on our own study, along with past studies. ILEs that provide affordances such as authentic content, scaffolds, graphic tools, transdisciplinary challenges, and collaboration opportunities, and that are aesthetically engaging, incorporate multiple media, and prompt participatory design, facilitate creativity in learners. When employed in the classroom by a teacher committed to learner choice, project-based assessment, and self-directed inquiry, and who her/himself exhibits curiosity, enthusiasm, and wonder, you create an ideal learning environment that stimulates creativity and innovation.

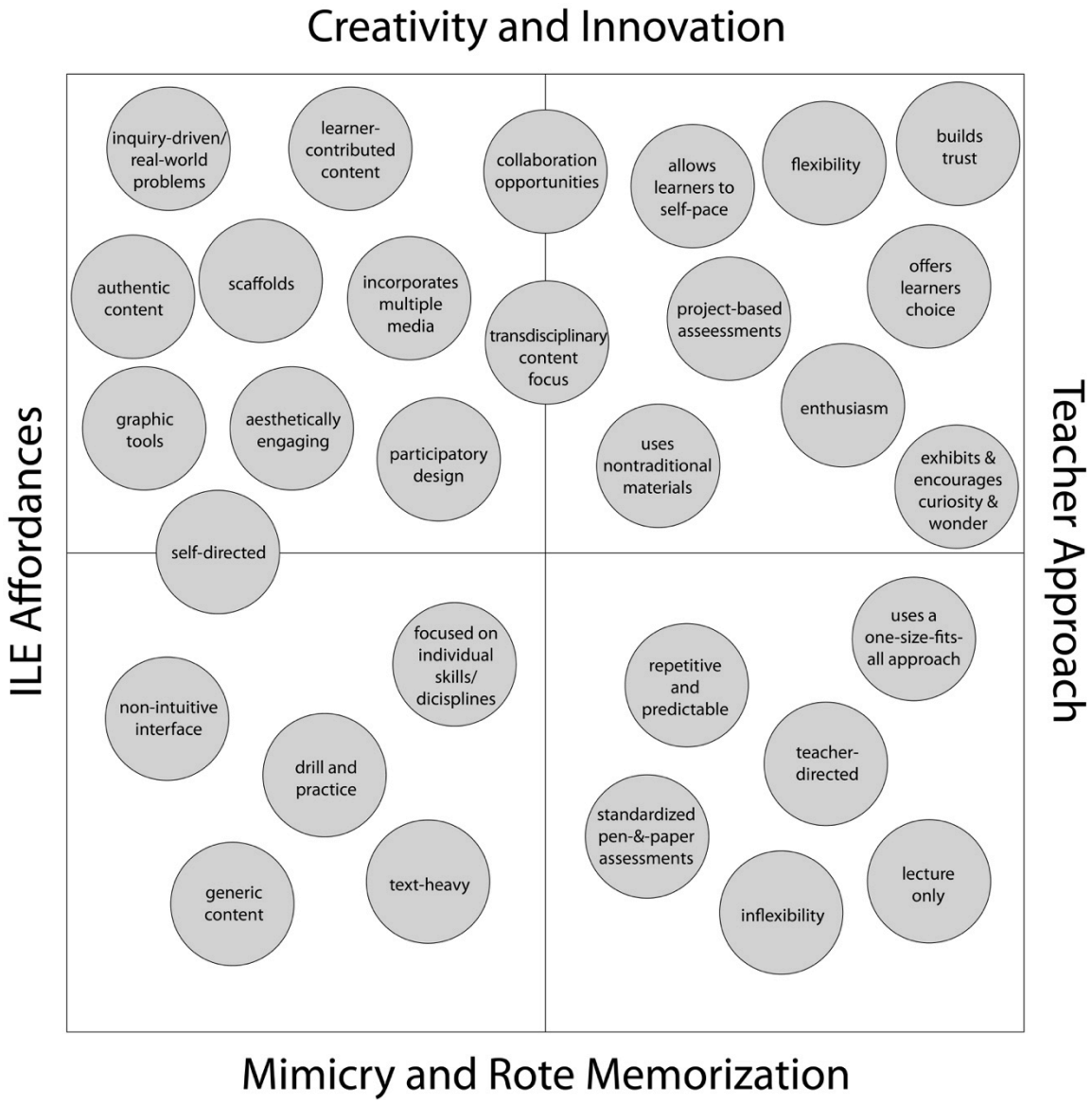

Figure 3.2. Model summary of ILE design affordances and teacher approaches that influence creativity in the classroom.

CHAPTER 4

Earthducation: Capturing Global Narratives on Education and Sustainability

This study has been submitted for publication with a peer-reviewed journal and is being reviewed after requested revisions. It was authored jointly with my advisor, Dr. Aaron Doering, with myself as first author and taking the lead on the study. Though this study deviates from the previous two studies in that it does not examine the learners or teachers engaging with Earthducation (the adventure learning program in question), it does examine the data being collected through an adventure learning program and how that data sheds light on sustainability education practices around the world. It illustrates intersections between education and sustainability along with the complexities that geographic location and culture bring to this topic. Collected data also lend themselves to the formation of broader assertions about how different types of learning might influence sustainability in varying contexts.

Introduction

Education for Sustainable Development (ESD) has increasingly taken on importance around the world, in part due to the growing awareness of environmental concerns such as climate change, and in part due to a challenge set forth by the United Nations Decade of Education for Sustainable Development (2005-2014) to integrate the principles, values, and practices of sustainable development into all aspects of education and learning. There is, as a result, a growing body of ESD literature (e.g., see Blum, Nazir, Breiting, Goh, & Pedretti, 2013; Chalkey, 2006; De Hann, Bormann, & Leicht,

2010; Eilam & Trop, 2011; Green & Somerville, 2014; Karatzoglou, 2013; Kemmis & Mutton, 2012; Reunamo & Pipere, 2011; Rieckmann, 2013; Walshe, 2008; Weaver, 2015), and many places in the developed world have begun to establish policies addressing ESD. The less-developed world is a different matter, however, and case studies on ESD have rarely been drawn from developing regions (Manteaw, 2012; Nomura, 2009).

At its core, sustainable development, or sustainability, is about living responsibly and within limits, allowing us to meet present needs without compromising the needs of future generations (World Commission on Environment and Development, 1987). Environmental, social, and economic demands all impact sustainability, which encourages harvesting from the earth using methods and tools that do not deplete or permanently damage a resource, species, or ecosystem; recognizes the need to ensure the continuation of a plurality of life and a healthy environment for people worldwide and for generations to come; and takes into consideration the importance of equitable distribution of resources and opportunities for all (see International Institute for Sustainable Development, http://www.iisd.org/sd).

As global citizens of different natural environments and different cultures, we collectively and individually have different relationships with the natural environment. These complex relationships are embedded, and can be nurtured, within education. ESD must encompass affordances that facilitate a shared respect for the natural environment while recognizing the unique factors within individual cultures that affect the formation of environmental attitudes and behavior.

Earthducation (www.earthducation.com; Fig. 4.1) is an adventure learning project that is examining intersections between education and sustainability around the world. This project considers how education in its multiple interconnected forms might influence a healthier future for our planet, from the formal classroom with a designated teacher leading a group of students in learning activities, to the informal social networks and activities that make up our lives, and the passing along of traditional knowledge from elder to younger members of a community. The configuration and role of these varying sources of education look different for different communities around the world. What we know, how we acquire knowledge, and how we define knowledge is tied to place, to landscape, to culture (Roland, Margaret, & Semali, Ladi, 2010). It is influenced by accessibility and infrastructure, and it changes over time.

The Earthducation team has thus been traveling to climate hotspots on each continent, gathering data on local culture, education, and environmental issues, and collecting video narratives from individuals discussing beliefs about how these myriad forms of education impact sustainability in their personal lives and region of the world. Some of these data are being shared online while the team is in the field. They are housed in a website that includes background information about communities and issues being explored, along with associated educational resources and activities for teachers. At the same time, the general public is discussing these issues via self-posted videos in an online EnviroNetwork (Fig. 4.2). Data gathered to date illustrate both how education can influence sustainability in different regions of the world, and the complexities that geographical location and culture bring to this topic.

Previous studies have found that education can positively influence environmental attitudes and behaviors (Franzen & Vogl, 2013; Hamilton, Colocousis, & Duncan, 2010; Marquart-Pyatt, 2012; Mayer, 2013; Tikka, Kuitunen, & Tynys, 2000). Those studies have typically focused on developed nations with high standards for, and broad accessibility to, formal education, and do not assess impact from additional factors such as informal learning experiences or familial and cultural attitudes and behaviors. Some recent studies, however, emphasize the importance of community engagement and local culture in ESD in formal education settings. For example, Green and Somerville (2014) do so in a compelling examination of teacher integration of sustainability education in primary school classrooms in Australia.

Other research has provided case studies examining impacts of informal education programs on environmental attitudes and behaviors, with varying outcomes depending on the program being examined. Many of these studies have looked at experiential-focused programs targeting teachers and/or youth, and indicate a positive relationship between firsthand exposure to and engagement with the natural environment, and pro-environmental attitudes and behaviors (Bogo, 2003; Dresner & Moldenke, 2002; Irvin, 2007; Lieberman & Hoody, 1998; Riordan & Klein, 2010; Ruebush et al., 2009; Silverstein, Dubner, Miller, Glied, & Loike, 2009; Windschitl, 2003).

The past decade has also shown an increasing number of studies exploring the role and impact of Indigenous or traditional knowledge in environmental sustainability. Indigenous peoples throughout the world have historically depended heavily on traditional knowledge to educate and to sustain life, language, and culture (McGregor,

2010; Nakashima, Galloway McLean, Thulstrup, Ramos Castillo, & Rubis, 2012; Nunavut Tunngavik Incorporated, 2012; Roland & Semali, 2010). As defined by Nakashima et al. (2012), traditional knowledge "encompasses not only empirical understandings and deductive thought, but also community know-how, practices and technology; social organization and institutions; and spirituality, rituals, rites and worldview" (p. 30). There are an increasing number of initiatives that have begun to integrate traditional knowledge into both formal and informal education programs (for some examples from the Arctic, see Annahatak, 1994; Berger, 2009; McGregor, 2012; Pember, 2008). Traditional knowledge is also increasingly being integrated with western science in assessing and creating adaptive strategies for environmental issues such as climate change (Alexander et al., 2011; Dikison, 2009; Nakashima et al., 2012; Robson et al., 2009).

In this paper, we share data and narratives from field expeditions conducted in Burkina Faso; northern Norway; Australia; Peru and Chile; Arctic Alaska and Canada; and Nepal. Based on these narratives, we propose assertions related to how education might influence sustainability, as well as what types of education appear to be influential in the different realms of sustainable development (sociocultural, economic, environmental). We conclude with suggestions for future study.

Figure 4.1. The Earthducation main online hub.

Figure 4.2. The Earthducation EnviroNetwork.

Earthducation and Adventure Learning

The Earthducation project evolved from almost a decade of delivering adventure learning (AL) (Doering, 2006) projects to students and teachers around the globe. AL is a form of hybrid distance education that blends experiential (Dewey, 1938; Kolb, 1984) and inquiry-based (Bransford, Brown, & Cocking, 1999) approaches. Grounded in a strong curriculum and pedagogy, an adventure-based narrative, and place-based concepts of learning (Sobol, 2004), AL emphasizes real-world, authentic problem solving, and merges an online learning environment with teacher-led classroom activities. It has been shown to have a positive influence on student engagement, motivation, and learning outcomes, and to be a successful model for teaching and learning across the curriculum (Doering, 2007; Doering & Miller, 2009; Henrickson & Doering, 2013a; Koseoglu & Doering, 2011; Moos & Honkomp, 2011; Veletsianos & Doering, 2010; Veletsianos, Doering, & Henrickson, 2012; Veletsianos & Kleanthous, 2009).

Within an AL program, a team undertakes an expedition centered on a specific location and issue; for example, climate change in the Arctic. The team develops an inquiry-based curriculum tied to that issue and location, and then travels into the field to capture authentic data and narratives synched with that curriculum. The team's field experiences, data, and media assets are shared online in an environment where learners are able to interact and collaborate with field experts, the explorers, and their peers and teachers. Learners complete activities related to real-world events, engage in discussions around them, and present potential solutions to issues that are raised, all while following along with the field adventures of the explorers. These experiences allow learners to form

connections between what is happening in the real world and their studies.

With its grounding in experiential and inquiry-based pedagogies, adventure learning is a framework that aligns well with environmental education (EE) standards, including the North American Association for Environmental Education (NAEE; www.naaee.org) guidelines for quality EE, and the EE awareness to action model. Adventure learning environments scaffold learners through a similar learning progression as the awareness to action model, guiding the learner from awareness about and sensitivity toward the natural environment, through knowledge-, attitude-, and skill-acquisition, with the ultimate goal of the learner actively participating in environmental stewardship, whether on an individual or larger group level.

Adventure learning also has close ties to place-based education (Sobol, 2004), with each AL project grounded in a specific location and issue. The power of using place-based learning and the natural environment as an integrating context to teach across the curriculum and as a means to help close achievement gaps in education has been well documented (Bogo, 2003; Dresner & Moldenke, 2002; Irvin, 2007; Lieberman & Hoody, 1998; Meichtry and Smith, 2007; Riordan & Klein, 2010; Silverstein, Dubner, Miller, Glied, & Loike, 2009).

As we embarked upon AL expeditions through such projects as Arctic Transect 2004 and the GoNorth! Adventure Learning Series, we collaborated with diverse cultures in locations ranging from the Arctic to South Africa. It became evident there were exhilarating narratives, large and small, that might benefit a worldwide audience and could serve as jumping-off points for critical discussions around ESD. To develop ESD

requires insight into regional education in its myriad forms and an understanding of how differing educational traditions relate to the natural environment with respect to structure, content, pedagogy, and process – these are insights and understandings that Earthducation seeks to foster.

Context and Disclosure

The paper's authors are post-secondary educators and practitioners in the field of Learning Technologies, with extensive experience in both K-12 and postsecondary education. Author 1 has more than five year's experience working collaboratively with remote communities, is a research assistant on the Earthducation project, has been in charge of logistics and arranging interviews for the project, and has participated in two field expeditions. Author 2 has more than a decade of experience working collaboratively with remote communities, with an emphasis on technology-enhanced education, sustainability education, and adventure learning. Author 2 is a principal investigator on the Earthducation project and has participated in all field expeditions to date.

The Earthducation project is funded by the University of Minnesota (UMN) Institute on the Environment and the UMN Learning Technologies Media Lab. Limited gear was provided to the project at a free or reduced rate by commercial sponsors, but no commercial funding has been directly supplied to the project. National Geographic Education is a communications partner for the project, but has supplied no funding, serving rather as a partner to help promote the project to educators worldwide. The nature of the project is exclusively educational. The online learning environments and

educational resources are offered free to educators worldwide, with no registration required.

Research Questions

The overarching guiding questions for the project are below.

- In what ways might education, in its myriad forms (formal, informal, traditional), support sustainable environmental practices?
- In what ways might education, in its myriad forms (formal, informal, traditional), support sustainable cultural practices?

Participants and Data

To date the Earthducation team has visited communities on six continents: in Alaska, USA, and Nunavut, Canada, in North America; in Burkina Faso, Africa; in Northern Norway in Europe; in New South Wales, the Northern Territory, and Queensland in Australia; in Peru and Chile in South America; and in multiple locations in Nepal, Asia. We have collected 243 formal interviews from individuals in 76 communities on 6 continents, with an additional 438 self-posts in the EnviroNetwork. Interview questions are translated into the native language of participants prior to travel, and an on-site translator (native speaker) has been used when interviewing participants not fluent in English. Some participants were identified prior to the beginning of each field expedition, and some were identified while the field expedition was underway. Identification of participants results from research conducted by the project team online;

discussions with other researchers familiar with the communities to be visited; discussions with local and international leaders in the fields of education, environmental issues, and/or Indigenous studies; and referrals by other participants in the project. Potential participants have been contacted by email, by phone, or in person.

Prior to the team's departure, we work to identify regions strongly impacted by or vulnerable to a changing climate. The Earthducation team works for months contacting locals within these target regions, discussing issues that are most relevant to their lives and setting up the interviews, homestays, and site visits. Also before departure, the team designs and develops a new online learning environment and EnviroNetwork specific to the continent, communities, and issues of that field expedition.

Formal interviews have been conducted with individuals from diverse backgrounds, ranging from farmers, factory workers, students, and teachers, to government officials, grassroots organizers, indigenous leaders, and much more. We strive to include a balanced perspective from individuals from different socioeconomic and cultural backgrounds in each location. While we also strive to include a balanced representation from both genders, we have found that in some cultures, women are more hesitant to speak on camera or to speak with male interviewers or translators if a female is not available to assist with the interview. Approximately two-thirds of the formal interviews are with men, and one-third with women. Ages of the participants range from 16 through 83. The full interviews span, on average, 30 minutes to an hour.

Data Analysis

Data analysis is ongoing and will continue through the end of the interview collection period in 2016. We used the constant comparative method (Glaser & Strauss, 1967) to analyze participants' interview responses, and took a case study approach to the research design (Yin, 1994). Researchers engaged in open coding of the data where they independently read and analyzed the data to (a) note emerging patterns and (b) gain an understanding of participant experiences. The researchers then met five times to discuss results, compare notes, and collaboratively analyze data in search of common meanings. The patterns discovered were compiled and reanalyzed in order to confirm and disconfirm themes across and between participants. Analysis continued until no more patterns could be identified and researchers felt that the data had been saturated (i.e., when researchers felt the data had been completely represented by current codes/themes). Once these patterns were identified, they were grouped into the themes. The patterns discovered are continually being reanalyzed as new data is acquired, in order to confirm and disconfirm themes across and between participants.

Triangulation and rigor

Triangulation methods were used to examine the accuracy of the collected data and reduce the possibility of researcher bias in drawing conclusions from the data:

(1) Data were collected from multiple sources (field observations, historical documents, and interviews), and data sources informed each other.

(2) Researchers analyzed data independently and then met to compare and discuss their findings.

(3) One researcher examined the themes and the extent to which they were congruent with participants' experiences as revealed through publicly available artifacts shared in the online learning environment.

For the purpose of this study, we are sharing narratives that best illustrate some of the issues faced by, and views expressed by, participants in the communities the team has visited to date. Some emerging assertions follow these narrative illustrations.

Expedition Narratives

Expedition 1: Burkina Faso, Africa

In this small, landlocked nation where 80 percent of the population relies on subsistence agriculture, the community is facing tremendous impacts from climate change. Unpredictable rainfall and increasingly high temperatures have led to soil degradation, water shortages, and reduced crop yields. These factors combined with a fast-growing population, a weak communications and technology infrastructure, environmentally harmful practices such as deforestation and overgrazing, and an adult literacy rate of less than 30 percent present great challenges to the nation of Burkina Faso.

While Africa overall is facing many environmental, social, and economic challenges, Burkina Faso presents a particularly compelling opportunity to explore the relationship between education and sustainability. In this small, landlocked, and impoverished nation where 80 percent of the population relies on subsistence agriculture, the community is facing tremendous impacts from climate change. Unpredictable rainfall

and increasingly high temperatures have led to soil degradation, water shortages, and reduced crop yields, among other impacts (Sawadogo, 2007). Such changes not only disrupt the lives and livelihoods of Burkinabe, but also have the potential to instigate political instability and regional conflict over such issues as water availability, food security, disease prevalence, and population distribution (Brown & Crawford, 2008). In northern Burkina Faso, one recent study has shown that the cultural values of several ethnic groups may be impeding their adaptation to the effects of climate change (Nielsen, D'haen, & Reenberg, 2012).

These factors combined with a fast-growing population, a weak communications and technology infrastructure, environmentally harmful practices such as deforestation and overgrazing, and an adult literacy rate of less than 30 percent present great challenges to the nation of Burkina Faso. Though formal schooling is mandatory through age 16, only about 80 percent of children attend primary school, and less than 42 percent of those who begin are able to complete it. That percentage drops in half yet again in terms of the number of children who continue on to secondary school.

During Earthducation Expedition 1, the team traveled over 1,000 miles within Burkina Faso, visiting 17 villages and towns throughout all regions of the country. The team captured over 35 interviews with individuals ranging from the minister of basic education and literacy, to kings, farmers, teachers, and schoolchildren. The online learning environment showcased both our journey and the interviews we captured, which revealed that some of the key education and sustainability challenges throughout Burkina Faso are access to freshwater, quality education, and food production (agriculture) in a

resource-poor and rapidly changing environment. Schools are overcrowded (70-80 students per classroom with one teacher, often not well trained or adequately supported) and ill-supplied with basic tools and books. Students often lack access to freshwater, sufficient food, and sanitary facilities.

Reflections from interview participant Benao, an elder from Zao (Fig. 4.3), captured challenges that many residents in Burkina Faso are facing. He shared that farming and access to freshwater have changed dramatically over the past decades. Many farmers used to plow with hoes, but because the ground is now so dry, they cannot plow by hand. They are instead in need of oxen, but there is not enough water both to grow food for the oxen as well as provide water for both the animals and the people. Also, although in his community there are boreholes for the water, many of those holes are running dry and are not potable. Benao shared, "Living on the land is becoming more and more challenging. We had good rain in the past, which made the ground fertile, allowing us to have a good harvest to support our family. Nowadays, rains are rare. As a result, the young plants die before maturing because of the drought. Freshwater is a challenge for us."

Figure 4.3. Benao, an elder from Zao, Burkina Faso.

Expedition 2: Northern Norway, Europe

Though Norway is a wealthy country with a high standard of living, a sparse population, abundant natural resources, and a public commitment to living sustainably, the country is facing some tough decisions. Does it continue to expand its oil drilling and mining operations that supply much of its wealth, and risk harming the natural environment, the wildlife and marine populations, and the culture and livelihood of some of its citizens in the north? And what stand should it take on such issues as land and water rights for the indigenous Sami population, aquaculture (fish farming), whaling, and the future of small, rural schools?(Carrington, 2011)

Earthducation: Expedition 2 took the team to Northern Norway, where the water-saturated landscape and abundant natural resources starkly opposed what the team had

found in Burkina Faso. This sparsely populated, mountainous region of Norway comprises three counties (Nordland, Troms, and Finnmark) and sits almost entirely north of the Arctic Circle. Within this region, the Earthducation team found a mix of remote villages and small cities; several distinct cultures and languages; and a number of diverse ecosystems. These factors have led to some unique educational and environmental challenges, along with some creative commitments to sustainability.

Norway has been a global leader in the green movement, with aggressive goals for cutting carbon emissions, a commitment to renewable energy development, and a fishing industry that has been said to be a model for sustainability. It also has a 100 percent literacy rate among its citizens, and a detailed plan for incorporating education for sustainable development into its national curriculum.

Within Norway, the team traveled almost 1,000 miles to 10 communities, capturing more than 30 interviews. Ranging from the tiny community of Digermulen with a school that serves only 12 students, to the isolated island community of Røst and the bustling city of Tromsø, each community faced unique challenges. For example, the island of Røst (population circa 600) is a major producer of Norway's stockfish (dried cod), the longest sustained export in the region. The fishing industry serves as the primary source of economic revenue in Røst. Were the cod to disappear from its waters, the community would be hard-pressed to find an alternate source of income and would likely simply become a ghost town. As interview participant Olaf Jr. from Røst succinctly stated, "If we don't have sustainable catches of cod . . . it means the end of the community, because we are 100% dependent on the cod."

On the mainland in northern Norway, in the Sami community of Drag, the team met with Lars (Fig. 4.4), a Lule Sami leader, who talked about how language and culture influence environmental sustainability. Lars described a recent struggle that occurred in his region, where the Norwegian government was attempting to establish a national park inside a fjord that is a traditional homeland to the local Sami. Lars shared one of the reasons the Sami are opposed to the establishment of a park there.

"A lot of culture [is] embedded in the landscape. When we go into the fjord, we are going home. . . . If the state makes a national park, in itself it could be a good idea. The problem is then we are going into a national park, not home anymore. Those subtle nuances like what a name is is extremely important because it's all about identity, it's all about feeling rooted, connected with the landscape. If you lose the rights to make a definition of the landscape, you also lose yourself somehow through that process. For us, that's a kind of environmentalism, not to lose the connection to the land."

Lars also talks about how the spoken Sami language first began to disappear when the Sami moved from their traditional homeland in the fjord to nearby towns, where they tried to assimilate into the dominant Norwegian culture. He feels language is crucial to sustaining a strong cultural identity. He and others have established a Lule Sami cultural center that offers language and culture classes, both in-house and via distance education technologies, to help young people in particular learn their native tongue and re-instill a sense of their cultural identity. Lars also works with the local school, which offers a unique curriculum that blends Sami and Norwegian language and culture in all its teaching and learning. About half the school's students are from Sami homes, and half

from Norwegian homes.

Figure 4.4. Lars, outside the Árran Lule Sami Center in Drag.

Expedition 3: Australia

Australia's biodiversity is at risk from even moderate climate change and already under stress, for example from habitat degradation, changed fire regimes and invasive species. (Steffen et al., 2009)

Australia is one of the most biologically diverse countries on Earth. It is home to a rich array of plants and animals, including about one million different native species, as well as the world's largest coral reef system. Unfortunately, Australia also has one of the largest documented declines in biodiversity of any continent over the past 200 years. In addition, it is typically cited as being one of the countries most at risk from climate change.

Earthducation: Expedition 3 was a vast 4,000+ mile expedition across the continent of Australia. Traveling from Sydney to the small Northwest Territory island community of Galiwin'ku to the ranches of Queensland and the Great Barrier Reef, the team observed many close connections between education and sustainability. These observations included how Aboriginal Australians' lives are changing and how their educational system is trying to adapt to bridge two cultures and changing environment. The team also observed how "bringing farmers … on board for conservation is a key step in halting biodiversity decline and an important way to link fragmented habitats" (Pickrell, 2011, np). Sustainable ranching is not about how many acres you own, as we learned from interview participant Roger, a third-generation rancher in Queensland, it's about how you manage your grasslands and grazing.

In addition to pressing environmental issues, Australia, like many countries, is facing concerns about the loss of its traditional cultures and languages. Aboriginal Australians have a long history of and connection to caring for the land, and are the keepers of a wealth of invaluable traditional knowledge related not only to the environment, but also to the arts, culture, and history here.

The indigenous people of Australia have the oldest living cultural history in the world, going back at least 50,000 to 65,000 years, with some of the longest surviving artistic, musical, and spiritual traditions known on Earth. Prior to 1788, when the first Europeans began populating the continent, there were approximately 700 languages and 750,000 indigenous people living in Australia. Today, there are approximately 410,000 Aboriginal people and Torres Strait Islanders, comprising about 2% of the overall

Australian population. Fewer than 200 of the original languages remain in use, and all but 20 are considered endangered. As language embodies cultural, traditional, and ecological knowledge unique to its speakers, the loss of language also embodies the loss of unique place-based knowledge in communities throughout Australia. This connection of language to place, to ecology, is a sentiment echoed above in our interview with Lars, a Sami leader in Northern Norway.

On the island of Galiwin'ku in the Northwest Territory, the Aboriginal population is striving to put their lost culture back into the education system. This has taken the form of introducing more experiential learning opportunities to students outside the school walls, as well as establishing community cultural liaisons and Elders who work with the school and the students, and serve as a community voice within the schools.
Maratja, a respected elder on the island, described how the culture and environment has changed on the island. When asked about how education is impacting environmental sustainability, Maratja replied, "I think we need to do much more work and look at the issue from a holistic view of connecting with the land and knowing where you are coming from in order to make ends meet. In order for us to survive, this issue is really important."

Expedition 4: Peru and Chile, South America

Unprecedented demand for the world's remaining resources, combined with new technologies to extract previously inaccessible resources in the remotest regions, are putting even the most isolated minorities and indigenous peoples under increasing threat

from governments and private companies wanting to profit from the resources found on or under their lands. (Walker, 2012)

South America is a continent rich in natural resources, including timber, freshwater, fish, rubber, agricultural products such as fruits, nuts, and quinoa, and minerals and metals such as gold, copper, lithium, and silver. As a result, the countries that inhabit this continent are highly reliant on natural resources to drive their economies and provide a livelihood to their citizens.

Overdependence on these natural resources, however, is neither good for the economy nor the environment. Deforestation, mercury contamination, soil degradation, desertification, and air pollution are only a few of the environmental ills that are resulting from such activities as mining and other natural resource extraction, including the clearing of land for agriculture and the harvesting of trees for commercial purposes. Deforestation in the Amazon basin is a serious concern, in particular, though several countries are beginning to work to slow the rate of clear cutting. Brazil, specifically, has had much recent success in beginning to slow deforestation in the Amazon basin. Throughout South America there is a growing tension between "global demands for resources and local demands for respect and the safety of their citizens" (Sabatini, 2012), particularly impacting indigenous populations in remote regions of the Amazon and elsewhere. Recent clashes (some deadly) between natural resource extraction firms, such as mining and petroleum companies, and local communities have highlighted this tension and brought this issue to the forefront of discussion in countries such as Peru and Chile. Earthducation: Expedition 4 visited some of these impacted communities within the

Amazon, as well as traveling to two other major environmental hotspots: the Atacama Desert and Chilean Patagonia. Traveling to 16 villages and cities and recording over 50 interviews, we attempted to capture a small glimpse of some of the intersections between education and sustainability found on this continent of extremes.

We first traveled through Villa El Salvador to Villa Maria Del Triunfo, an impoverished community that sits atop a large hill south of Lima. As we made the drive from Lima, we passed many small homes built into the sides of the hills. About 20 years ago, large numbers of people moved to this area from regions across Peru, seeking refuge from terrorism that was occurring throughout the country at that time. The effects of this massive migration continue to be felt, as Lima struggles to provide employment, electricity, freshwater, and sewer services to both the city and the surrounding regions. At Villa Maria Del Triunfo, we met with Artemio (Fig. 4.5), vice president of the local agriculture association, along with several members of the association who work on a fog harvesting project. The Villa Maria Del Triunfo fog harvesting project was sponsored by USAID, a non-governmental organization (NGO). With an annual precipitation of less than half an inch, rain rarely falls within these regions on the outskirts of Lima, but dense fog is a common occurrence here during the winter months, from June through about November. Tall fish-net-looking screens are thus placed on top of the hills to literally "catch" the fog. The dew of the fog drips down the net into a half-pipe that flows into a canister.

Although fog harvesting cannot be relied on for water year-round, we witnessed firsthand the benefits it provides to communities such as Villa Maria Del Triunfo. Only

five years ago the region was nothing more than dry desert. Now, the area is lush green with aloe vera plants growing from irrigation provided by the water collected from the fog. Although there is a filter on each collector, the water is not yet fit for drinking. It is hoped that in the future, the community will be able to derive drinking water from the fog as well.

Artemio shared that education is needed for sustainability in this region where job opportunities are scarce. He stated, "Education is the most important part of our future. Education is needed as it allows us to accomplish projects such as [the fog harvesting]. Without education, we will not move forward in a direction of [sustainability]."

Figure 4.5. Artemio showcasing the fog harvesting nets during an interview in Villa Maria Del Triunfo, outside Lima, Peru.

Great strides have been made in education in South America over the past decade.

Some of the primary issues still facing many countries there, however, are inequity, affordability, and access, particularly in rural, remote, and indigenous communities. These issues were highlighted worldwide by the 2010–2012 Chilean student protests, in which demonstrators demanded a new framework for education in the country, including more direct state participation in secondary education and an end to the existence of profit in higher education. Currently, only 45% of Chilean high school students study in traditional public schools, and most universities are also private. No new public universities have been built since the end of the Pinochet era (1990), even though the number of university students has swelled. Protests included massive nonviolent marches, but there has also been some violence on the part of select protestors as well as riot police.

Expedition 5: North America

For thousands of years, education was centered on traditional Indigenous knowledge which included not only spirituality, culture, and language, but also focused on local environmental conditions, physics, geology, geography, math, astronomy and other sciences, as well as medicines and medical knowledge. Knowledge about family, community, national and political relations were intertwined with knowledge about our relations with the earth, water, sun, moon, sky, birds, animals, fish and plants. (Chiefs of Ontario, 2012)

Throughout the world, remote communities face similar educational challenges related to formal schooling. These challenges include recruiting and retaining qualified

teachers and administrators (Sharplin, O'Neill, & Chapman, 2011), conflicting interests between local culture and national curriculums and educational directives (McClean, 1995; Nunavut Tunngavik Incorporated, 2012; Redwing Saunders & Hill, 2007), and limited access to the infrastructure, technologies, and resources found in many urban and suburban communities (Irvin, Hannum, de la Varre, Farmer, & Keane, 2012). Due to climate and terrain, remote communities may be extremely isolated from the outside world, accessible only by plane or boat, for example. They also may be home to indigenous populations on whom mandated, government-sponsored schooling has been forced, with little to no input from the local community.

The circumpolar Arctic is home to many such remote, indigenous communities. It is also a region that is receiving increasing global attention due to climate change debates and the opening of new possibilities for natural resource extraction and global transportation routes. This increased attention brings its own set of unique challenges, including new threats to local culture, language, and traditional knowledge bases.
For Expedition 5: North America, the Earthducation team visited communities in Alaska and Canada, including Kotzebue, Noatak, and Kodiak Island in Alaska, and Qikiqtarjuaq and Pangnirtung on Baffin Island in Nunavut, Canada. There were similar themes expressed within these remote, largely indigenous communities, with relation to education and sustainability, and some similar struggles, particularly related to education. Absenteeism in the schools, particularly in the spring months, is a serious concern, as students become engaged in land-based activities with their families. The changing climate is also having an impact in many Arctic communities, on everything from the

possibility of the need to relocate entire communities (such as for the community of Kivalina, in the Northwest Arctic Borough) to changing animal migration patterns and its effect on a family's ability to feed itself through subsistence hunting and fishing.

Other challenges expressed by interview participants include basic infrastructure (including everything from water and sewage to internet connection speeds) and housing in these communities; recruiting and retaining skilled teachers and administrators; sustaining and revitalizing cultures and languages fragmented by decades of oppression; creating new job opportunities; adapting bureaucracies to align with local traditions, seasons, and rhythms; and better engaging youth in learning opportunities.

Billy, an Elder in Qikiqtarjuaq, Canada, shared that he was born in a camp outside Pangnirtung before he was forced to move into the community to go to school. He said, "It was a time that the government was just setting up a federal residential school system. At the same time the federal government slaughtered all the dogs across the Arctic so our people, our parents, had no form of transportation for survival. That's why they were forced as well to move to the same location." Billy also spoke about the changing climate, noting, "There's a big change in the climate, it's much warmer in the summer and the season is getting earlier and earlier and here. It was normal that the ice was gone late August, and now last year we were [word unclear] June 22."

Raymond, who works with the schools in the Northwest Arctic Borough in Alaska, emphasized the importance of better engaging students in learning in order to improve attendance. He talked about the value of experiential learning programs and how critical it is to make learning more culturally relevant to specific communities. Willie, an Elder in

Kotzebue, Alaska, talked about how the forced location of the Inupiaq people into communities and into a cash-based economy and a Western school calendar had devastating effects on their traditional culture and language as well as subsistence hunting activities and even the ability of youth to learn basic survival skills critical to understand when one lives in a remote community with such an extreme climate as is found in this area of Alaska. And Sven, the executive director of the Alutiiq Museum on Kodiak Island, detailed the challenges the island is facing in reviving a near-lost language and cultural practices, trying to help reinstate traditional knowledge in a living context.

Expedition 6: Nepal, Asia

Nepal is currently one of the least developed countries on Earth, with the lowest per capita energy consumption. However, with a largely rural population that relies heavily on natural resources and a press toward modernization, Nepal is facing numerous environmental challenges, including air pollution in its urban centers, deforestation, erosion, watershed disruption, pesticide use, and indoor air pollution related to the burning of wood for fuel. Global warming, meanwhile, is instigating rapid melting of critical glacial ice, increasing extreme climate-related events, and threatening the livelihoods of millions of already impoverished communities. Inadequate infrastructure, lack of institutional capacity, and a high dependence on natural resources constrain climate change resilience and are a major challenge for the people of Nepal.

The Earthducation team visited urban and rural communities within Nepal, and found some especially compelling implementations of education for sustainability in the

remote mountain village of Nangi. At 7,380 feet, Nangi is nestled in the southern flank of the Annapurna and Dhaulagiri ranges of the Himalayas, surrounded by terraced farming and flanked by the high Himalayas in the north, including Dhaulagiri and Annapurna, the seventh and tenth highest peaks in the world. There are fewer than 500 people that live in Nangi, and the trek to reach this small village from the nearest city of Pokhara takes nearly nine hours by jeep, including a harrowing ride up a steep, unpaved road along a route that only opened to motorized vehicles in 2010.

Due largely to the work of local resident Dr. Mahabir Pun and his Himanchal Education Foundation and Nepal Wireless Networking Project, Nangi offers a stunning example of a community that has worked to retain their cultural values and traditions while bringing running water, electricity, and cutting-edge technology into its village and school. From solar panels to water pumps, Internet and computers in the local school, sustainable farming practices, and electricity, the local community and volunteers from around the world have made this village a model of sustainability. Projects the community has undertaken to advance both environmental and economic sustainability include jam making, yak breeding, paper making, and an impressive reforestation project, through which villagers are planting multiple varieties of trees to be transplanted to the forest when the trees are mature enough.

Dr. Mahabir Pun has to date built a network connecting 175 villages to free wireless Internet services through his Nepal Wireless Networking Project. For this pioneering work bringing Internet to rural schools and communities, promoting digital literacy, and helping improve the quality of education, he was inducted into the Internet

Hall of Fame in Hong Kong in 2014, and received the Ramon Magsaysay Award, Asia's equivalent of the Nobel Prize, in 2007. In our interview with Dr. Pun, he shared his story and his vision for the future with us. His vision includes: (1) a focus on establishing a community-based eco-tourism program to keep tourism income in the villages, and (2) a focus on establishing an innovation center for the economic development of Nepal using its human resources. Mahabir also described his desire to advance hydropower in Nepal to assist in supporting villages and villagers. With Nepal being second only to Brazil in hydropower, he outlined a vision that would allow plants to sell electricity back to the electric company, providing funds to support people throughout rural Nepal.

Our team observed sustainability innovations in urban settings within Nepal, as well as in rural villages like Nangi. In Pokhara, we interviewed a young farmer, Govinda, who has started an organic farm as an education and training center for locals. On his small farm he is growing more than 30 species of diverse plants, with a commitment to sustainability and pesticide-free food production. His commitment to a sustainable lifestyle extends to his home life as well, where a biogas system fed by cow dung generates cooking gas for the stove. Most homes in Nepal use wood fuel for cooking, which, in addition to contributing to health issues from the smoke generated, is not a sustainable source of fuel without proactive measures to replenish the trees being consumed in the process.

Even in the urban heart of Kathmandu, we find farmers committed to sustainable practices. Our team interviewed members of a local cooperative that has as its mission to help farmers buy land, fertilizer, and seeds, and provide training on new farming

technologies and techniques, encouraging reduced pesticide use and more organic farming methods. We were given a tour of plots of land on the city's outskirts where many cooperative members farm, growing vegetables and other crops that are sold within the city of Kathmandu. However, with the rapid growth of Kathmandu, there is worry that these plots will soon disappear, giving way to new buildings and city infrastructure that today literally stretches right to the border of the fields.

One of the least developed countries in the world with one of the highest poverty rates, Nepal is transforming itself from the ground up. The most impressive transformations we observed are springing from small, community-based initiatives, which we found everywhere we went, from the cities of Kathmandu and Pokhara to remote villages like Nangi. We witnessed a host of innovative, inspirational sustainability projects, and found even in areas of great poverty there was an optimistic outlook for the future of Nepal.

Several common themes that appear in the Nepal interviews we conducted include:

- A desire to provide enhanced education and employment opportunities for rural communities especially, so villagers do not need to leave their homes to earn a decent living.
- The introduction of new techniques and technologies for sustainable and organic farming in rural and urban areas alike.
- A concern for the environment and the impact that climate change is having on freshwater access, mountain glaciers, farming, and tourism.

Emerging Themes and Assertions

Some of the themes that have emerged from the 243 formal interviews conducted to date are noted below.

Cultural identity is closely tied to language and the natural environment, and can influence sustainability within that environment.

When culture and language are disrupted through such means as forced removal of a people from their traditional lands, forced relocation of people into permanent settlements and schools where they are required to speak a language different from their native tongue, and/or implementing a school calendar that goes against traditional seasons and cultural activities, it can adversely influence sustainable development in a region. We've seen this evidenced powerfully in communities in the Arctic as well as in Aboriginal communities in Australia.

As noted earlier, Lars, a Sami leader in Norway, expressed how the Sami identity in his community is tied to the fjord where they live, to the landscape. "For us, that's a kind of environmentalism," he said, "not to the lose the connection to the land." He also discussed how crucial language is to maintaining a strong cultural identity, a sentiment that was echoed by interview participants in Alaska, Canada, and Australia.

Willie and Raymond, two Inupiaq Elders in Kotzebue, Alaska, noted that their community was facing degraded social networks, a loss of connection to and understanding of the land, alienation between generations, and loss of culture and language. Factors they felt contributed to these issues included the forced location of the

Inupiaq people into: settled communities, a cash-based economy, and a Western school calendar at odds with local traditions. All these factors, they said, had devastating effects on traditional culture and language as well as subsistence hunting and fishing activities and opportunities for youth to learn about the land, including basic survival skills critical to understand in an extreme climate as is found in Arctic Alaska. Willie noted, "In order for the next generation to survive, they need an education and jobs… But it's also very important that [this change in lifestyle from a subsistence focus] doesn't destroy our culture, and that's why we're making such efforts to revitalize our language because every culture's dependent on its language. The language dies, our culture dies."

In Arctic Canada, Billy, an Elder in Qikiqtarjuaq, shared a similar story of the shift from a subsistence lifestyle to a lifestyle dependent on a cash-based economy. He discussed the widespread slaughter of sled dogs by the Canadian government in his community and elsewhere in Arctic Canada in the 1950s through the 1970s. Having lost their means of transportation and subsistence travel on the land to be able to hunt and fish, this event forced Inuit people into settled communities and dependence on cash-based economies and store-bought food. In Qikiqtarjuaq and throughout Nunavut in Canada, however, knowledge of the Inuktitut language has remained strong and is still spoken in many homes, unlike many of the Native languages in Alaska.

On the island of Galiwin'ku in the Northwest Territory, native languages are also still spoken in many homes. The school, however, has only in recent years converted to a bilingual approach, and the Aboriginal population is striving to put lost culture back into the education system there. This has taken the form of introducing more experiential

learning opportunities to students outside the school walls, as well as establishing community cultural liaisons and Elders who work with the school and the students, and serve as a community voice within the schools.

Maratja, a respected elder on the island of Galiwin'ku in the Northwest Territory of Australia, described how culture and environment has changed on the island. When asked about how education is impacting environmental sustainability, Maratja replied, "I think we need to do much more work and look at the issue from a holistic view of connecting with the land and knowing where you are coming from in order to make ends meet. In order for us to survive, this issue is really important."

Providing experiential learning opportunities to youth and establishing relationships between community Elders and knowledge keepers and schools is an important component in helping youth engage with the environment and local issues of sustainability.

On the island of Galiwin'ku in Australia, we observed programs that were successfully pairing knowledge keepers and Elders from the local communities with the schools, to help the students learn traditional skills, knowledge, and language, all of which are rooted in a deep connection to the land and to principles of sustainability. "I believe mainstream education as we know it doesn't fit remote communities," said Bryan, principal of the local K-12 school on the island. "We're very proud to be a bilingual school…. The first thing our young children have to learn is about themselves, who they are, where they come from, and what their culture is."

Programs designed to connect Elders with students in order to build language skills, cultural identity, and pride, and re-instill traditional knowledge and understanding of the environment are also being put into play in the Northwest Arctic Borough and on Kodiak Island in Alaska. On Kodiak, Sven is the director of the Alutiiq Museum and himself a Native Alaskan. The museum is unique in its push as a museum to not only share traditional knowledge through exhibits and education programs but also in its push to help reinstate traditional knowledge, skills, and language in a living context. The museum is accomplishing this through partnerships with Elders, Native villages, and schools on the island. Sven noted, however, that "most of our fluent speakers in Alutiiq and most of the people who grew up in these traditional ways are 70 and up. Their timeline is shrinking." He explained the importance of moving quickly to capture existing knowledge before this generation disappears.

Raymond, an Inupiaq Elder who works with schools in the Northwest Arctic Borough in Alaska, shared some powerful examples of engaging youth in experiential, land-based activities outside the classroom walls. He uses such opportunities as an incentive for students to improve their school attendance (students must meet specified attendance requirements in order to participate), while concurrently teaching traditional skills, language, and ecological knowledge through such activities.

Raymond said: "Our place, our lifestyle here in this region above the Arctic Circle, is about survival. You're talking about cold weather, you're talking about gathering food… You've got to have experience on it, you've got to know how to do it. When I teach our language, I include our culture. And we do a lot of hands-on training with our

kids using our language and telling stories. Telling stories is important and they learn about [their cultural identity] through our stories."

Raymond emphasized the importance of making learning meaningful and culturally relevant to the communities with which he works. We had the opportunity to participate in a school program with William while visiting Kotzebue in February 2013, traveling out by snow machine with a small group of students, teachers, and elders from Kotzebue High School. The temperature that day was -20F, and we traveled over 70 miles across the ice, collecting ice and snow and water depth samples to be used both in science class as well as by the local authorities in town to help them communicate the safest routes across the ice. All told, the students spent 7.5 hours outdoors, learning not only important science concepts, but also critical winter survival skills, while also contributing important civic knowledge that would aid the safety of the community as a whole as residents traveled out across the traditional routes about which the students had just gathered important ice data.

Schools need to do a better job of adapting to local culture, seasons, and rhythms, to improve school attendance and community engagement.

It was evident in the locations we visited, particularly those in extremely remote areas or where there was a large indigenous population, that there is a need to start adapting school calendars and hours to local needs, to help improve student attendance and community engagement. This concept is perhaps illustrated most powerfully through experiences in North America in the Arctic. In Alaska, Willie perhaps spoke most

strongly to this point when he noted:

The white people figured out a way to lock us in, they built the schools, kept us from learning what we needed to learn about survival…. When I was a kid we couldn't wait to move to camp. Then we were free to live with the elements, to welcome the animals that were coming back in the springtime…. I miss that, I miss that because now, unless my grandkids have a certain number of days in school, they will not graduate, they will not move up in the next grade… So we've got to adapt to that and we've done that.

Basic needs must be met, and teachers well educated and trained, before being able to successfully speak to sustainability education in a meaningful way.

In Burkina Faso, Africa, it is difficult to speak about education for sustainability in formal education when the classrooms are overcrowded and so many basic needs of the students and teachers are not being met, including access to freshwater, food, and medical care. Approximately 80 percent of Burkinabe live in one of the thousands of rural villages scattered around the country. There is great disparity between its urban and rural areas concerning revenue, health, education, and general infrastructure. The communications and technology infrastructure nationwide is weak. Radio is the country's most popular medium. As of 2008, less than 20 percent of Burkinabe had telephone access, and less than 1 percent had Internet access.

Luc, who is employed with the Ministry of Secondary/Higher Education and Scientific Research in Burkina Faso, shared that, though there are restrictions on classroom sizes in Burkina, they are difficult to enforce. Class sizes in some schools

reach up to 130 students with one teacher. He also noted that teachers are sometimes very young, barely older than the oldest students, and that classroom management is challenging for them. Romaric, a Burkinabe who is working with his community to reforest a large plot of land and establish better soil health there, stated that many teachers receive inadequate training and are unprepared to handle the day to day demands of teaching. In addition to poor training and overcrowded classrooms, teachers face lack of access to basic school supplies and resources such as books, paper, and pencils.

Some small villages in Burkina do not even have access to schools. Outside Cassou, the team met with a village Elder and a small group of community members. When the conversation moved into a discussion of education, one community member shared, "We have no school, but sitting here [the Elder] teaches us what he knows. For example, speaking of medicinal plants, when he goes to the bush to look for ingredients such as roots, he has the kids come along. He explains the types of diseases that are cured with these roots. Often he is tired and asks the children to dig for him."

Many people we spoke with in Burkina explained the critical importance of freshwater to communities, and how water impacted every aspect of life there, including education. Lassane, who is heading up a community farm in Sabou, commented, "It is because we have a reliable water source that we can provide an educational forum in which students can learn."

The community farm that Lassane oversees is employing reforestation and water conservation efforts to help improve soil health and grow food sustainably for the local community. It was one of several community-based programs we encountered in Burkina

using informal education to advance sustainability. Another example was a shea butter factory that we visited that employed widowed women to help the women pay for their children's education.

Traditional education and knowledge are necessary components to establishing environmental sustainability.

Traditional knowledge is rooted in many years of collaborative, communal knowledge. Modern science and technology certainly can help with some environmental and educational practices, but newer is not always better. There are numerous studies that have emerged over the past decade in particular that speak to the benefits of traditional ecological knowledge and practices.

In many remote communities we have visited throughout the world, a strong connection to the land and to principles of sustainability have been part of the culture for many thousands of years. Ironically, interruptions to those connections and to sustainability seem to begin to occur when cash-based economies and formal education are forced upon communities and when communities are pushed to adapt to non-native languages and lifestyles.

As an Elder in Cassou, Burkina Faso, so eloquently shared, "Being born in this community, our main knowledge is traditional. That is, we know the land, the plants, the animals, and how to live here. We had our traditions before the arrival of westerners."

Willie, an Elder in the Northwest Arctic Borough of Alaska, noted:

Right now, I'm very concerned about my grandkids and I see the change in my life

> is not going to be the same as theirs, so I'm preparing them to be prepared in any kind of an emergency. I teach them how to hunt, I teach them how to fish, I teach them the land, I teach them the elements, but at the same time I encourage them to go to school. That's the way it is now. Take advantage of what there is today with the jobs and the educational opportunities but still remember your culture. You're an Inupiaq. I teach them that. And these are the things that we eat. Things are the things that we hunt. These are the things that make us Inupiaq. That survived the elements for thousands of years.

Traditional education is not just found in or just important to indigenous communities, however. In northern Norway, on the remote island of Røst, which is almost 100 percent reliant on fishing to sustain its economy. We interviewed an Elder on Røst, Olaf Sr., who voiced community concerns regarding oil exploration in the seas surrounding the island. Locals are worried that such exploration might alter the annual cod migration, and could destroy the livelihood of island residents. Olaf doesn't believe the Norwegian government understands much about fish or the fishing industry, or that they trust that locals have unique knowledge that is valuable to the debates about sustainable seas. Fishing has been a sustainable endeavor for more than 1,000 years here, and Olaf believes locals should be given more voice in determining how to sustainably manage the industry.

He notes that though it's critical for fishermen today to learn how to use sophisticated computers and navigation equipment, traditional learning plays equal importance in learning this craft. He says: "Fishermen have to know quite a lot about how

the sea behaves. You need to know because the machine doesn't tell you it's too bad weather to go in that direction today. I think most fishermen they combine computer and brain, they're good at it."

When asked about sustainability of the sea and the role locals play in that, Olaf notes, "We have to also to take care of stability in the sea and follow all the rules. In years with less fish, we have to be very exact, measuring and having the right numbers, the right figures, everything." The interviewer responds: "Do you think that helps with the sustainability of the fish compared to back when there were no rules like that?" Olaf replies: "We don't know. There is everything in nature goes in cycles. We've had some years of poor little fish . . . and suddenly this year it's exploding, there's fish everywhere. So, we don't know. I think the cycle is more than the strict rules and regulations because I think nature regulates itself to a certain degree. Of course we have to help sometimes, but I think there is more to it than a lot of people think."

Formal education has increased in perceived importance in many rural/remote communities today due in part to the role technology and bureaucracy have come to play in many working environments today.

Formal education has increased in perceived importance in many rural/remote communities today due in part to the role technology and bureaucracy (legal rules and regulations) have come to play in many working environments today, including land-based endeavors such as fishing and farming, which used to be much less regulated and to rely heavily on informal or traditional education via the passing along of knowledge

from elder to younger, or master to apprentice. We saw this evidenced in northern Norway in particular, where fishing figures heavily into the economy of many communities. In communities around the world we've visited, however, interviewees have spoken to the importance of formal education in securing a well-paying job.

A cotton farmer in Burkina Faso, Bouliou, shared: "Education is very important to me. With the land degradation it is difficult to be a farmer so I am forced to learn other jobs to be able to get by. I cannot cultivate during the dry season due to lack of water so I am forced to take other small jobs to get by. … I see the value of education today. I'm not happy for not being able to pursue my schooling. I would like to go back to school." Benao, an Elder from Zao in Burkina Faso, noted: "Education is important to us because without it we are blind…. [but] we need help in order to educate our children. Living on the land is becoming more and more challenging. We had good rain in the past, which made the ground fertile, allowing us to have a good harvest to support our family. Nowadays, rains are rare. As a result, the young plants die before maturing because of drought. Fresh water is a challenge for us."

Willie and Raymond, Elders in the Northwest Arctic Borough in Alaska, both spoke about the importance of formal education today in securing a job. Raymond commented: "We had a great big change like urban lifestyles now… We've got better machines… better technology, better houses, but it costs money. In order to live that new urban lifestyle you have to have a good job to pay for that urban lifestyle. Fifty years ago it wasn't like that. Fifty years ago there was no running water here, there was hardly any electricity, people were packing their own water, they were hauling there own wood to

heat the houses, and go out and hunt off the land to bring food on the table."

Olaf Sr., an Elder on the remote island of Røst in northern Norway, also noted how crucial formal education is for young people today: "It's extremely important because we see that the companies that are growing, they have people with good education, very good education, for economy, for hand treating fish, and all that. Some years ago, you could do anything, but now you have a million rules to follow and if you're not good with computers, you've got no chance." Olaf explains that the computers are used not just on the business side of fishing, but on the boats as well, which have become highly sophisticated equipment-wise.

He says, "I see in companies now the young people who go away five, six, seven, eight years, they come back and get to work in their family companies and they have a lot to give back to their companies because of their education. I think education for running fish industry is absolutely necessary, but that's necessary for almost any industry you want to join.

"The young men who want to go into fishery, before they just started on the boat and worked and got on and buy a new boat for their own, and bigger boat and bigger boat. But now the people who want to be fishermen, they go to the school to learn navigation, economics, everything . . . because the fishing boat is like a computer, everything is done with that, you just look at the map and you plot in the route and the boat almost goes by itself (laughing)."

Broader Implications

When taken as a whole, these assertions and others from the interviews to date lend themselves to the formation of broader assertions about how different types of learning might influence sustainability. We caution, however, that though there are similarities facing some of the communities we have visited, there are also unique sociocultural, geographic, and economic factors influencing each community that must be taken into account and that mediate making too broad of comparisons. For example, a country like Burkina Faso in Africa faces so many stark environmental, political, and economic hurdles compared to a country like Norway that addressing what form education for sustainability might take in each region must be examined completely independently of the other. On the other hand, the Aboriginal communities in Arctic North America and those in Australia face some similar historical and political struggles (e.g., forced settlement in government-designated communities and forced residential schooling, to name a few) as well as similar cultural connections to the land, such that ESD in these communities might share certain characteristics (e.g., experiential learning opportunities and partnerships between schools and community Elders). Such are some of the complexities that geographical location and culture bring to the topic of ESD.

Educational initiatives that appear to be producing the most engagement and pro-environmental influence from a community level toward achieving sustainability in countries including Norway, Nepal, Australia, the United States, and Canada, are ones that actively invite community members to participate in formal schooling, and that integrate traditional knowledge and experiential learning activities into the curriculum. For example, in a community such as Pangnirtung on Baffin Island in the Canadian

Arctic, students are brought out on the land for a three-week spring camp to learn by working with Elders and family members – the traditional Inuit way (e.g., see Davies, 2009). This finding aligns with previous studies focused on both community engagement and experiential education noted earlier in this paper's introduction.

The Earthducation narratives as a whole illustrate the type of challenges formal education faces when inherited human relationships to the natural environment are not paralleled within educational settings. For example, in regions where subsistence-based hunting and fishing activities are critical to sustain life and culture, schools would be advised to adapt their calendars to accommodate those activities – or to offer alternative opportunities to students to complete schoolwork during those times. School attendance typically falls dramatically during late spring in the Arctic, for example, as families travel out of the community to camp on the land for extended periods.

Bonds between culture and climate continue to change across the planet as events such as climate change, technological globalization, and resource extraction reach the remotest regions of the Earth. These changes need to be addressed in education in all its guises.

Online and mobile technologies offer great opportunities to rural and remote communities, in particular, to extend learning opportunities in all realms, and to capture and preserve traditional knowledge that is being lost as Elders pass away and native languages are eroded by encroaching social changes. Unreliable and unaffordable Internet service and slow broadband speeds are issues plaguing many remote communities currently, however. Broadband access in Burkina Faso, for example, is

among the most expensive in the world, with fees reported at about $1,300 per month (Smith, 2009). Internet use in Africa as a whole lags significantly behind the rest of the world. In 2010, Internet user penetration in Africa was estimated at 9.6%, compared with a world average of 30%, and a developing country average of 21% (International Telecommunications Union, 2010). Radio is Burkina Faso's most popular medium. As of 2008, less than 20 percent of Burkinabe had telephone access, and less than 1 percent had Internet access. Mobile phones, however, outnumber landlines by a 15 to 1 margin, with approximately 2.6 million mobile phone subscribers as of 2008. Mobile phone use predominating over landline use is a trend found throughout Africa, which has seen mobile phone use increase by 550% over a five-year period. Mobile technologies thus offer some exciting educational possibilities there.

Teacher education and training is also an important ongoing factor that is impacting the integration of sustainability education, not just in developing countries but worldwide. We observed some of the strongest teacher education around sustainability issues in Norway and Australia, and encourage other nations to work toward
A summary of perceived benefits of different types of learning and their areas of influence, as expressed by Earthducation interviewees, is below. This is a general overview that is being developed into a more nuanced illustration as the data analysis of the project continues.

Formal Schooling

Perceived benefit: Upward social mobility

Definition: Serves as a means to learn about tools and resources (technological, legal, and environmental) one can use to promote sustainability. Can lead to more sustainable business practices and legal decisions.

Most influences: Socioeconomic sustainability (e.g., business-oriented knowledge geared toward technology, scientific, and legal learning)

Informal Learning

Perceived benefit: Personal fulfillment and effective land stewardship

Definition: Serves as a means to learn how to put theory into action and what has worked for other individuals and communities. Can lead to sustainable land practices, collaborative and grassroots efforts, and more sustained commitment to practices.

Most influences: Environmental sustainability (e.g., experiential knowledge geared toward practice and toward inspiring passion and action)

Traditional Learning

Perceived benefit: Communal and land health; continuity of language and cultural beliefs

Definition: Serves as a means to learn about traditional practices used to manage the land and natural resources, as well as cultural beliefs and language. Can lead to sustainable land practices specific to one's home environment, as well sustainment of cultural practices and language.

Most influences: Sociocultural sustainability (e.g., communal knowledge geared toward retaining a cohesive social unit and protecting one's land, history, and language)

Conclusion

Education in all its forms has the power not only to influence the methods and tools we use to conduct our lives and the decisions we make, it also broadens accessibility to additional sources of knowledge, empowers individuals and communities, and can shift attitudes and behaviors in ways that benefit not only those directly involved but the world at large. At its heart, education is about forming individual as well as collective wisdom in order to develop understanding, better lives, and protect the diversity and spirit of human communities and natural environments worldwide.

The Earthducation team has traveled to six continents to date, learning about and documenting local culture, environmental issues, and educational practices, and collecting video narratives from a broad array of individuals discussing their beliefs about the role of and intersections between education and sustainability. The formal interviews gathered and shared during each expedition are beginning to form a picture of how education can influence sustainability, as well as illustrating the complexities that geographical location and culture bring to this topic.

Understanding the connection between education and the natural environment on local scales may enable and empower change in education on a global scale, as it provides structure for modeling new approaches to education for sustainable development. It is hoped that one outcome of this project will be the creation of a global dialogue of collective beliefs on education and the environment that can serve as a foundation for embedding sustainability in learning at all levels in all cultures. We hope

to be able to posit answers to such questions as:

- How do views of education and sustainable development differ and converge from community to community, and culture to culture, around the world?
- In what ways do our educational experiences and local landscapes influence the creation of our individual and collective ecological identities?
- Can knowledge of different regional approaches to education aid us in developing a global approach to education that facilitates the emergence of a universal ideology of nature or a common cultural model about the environment?
- How does education culturally inherent to a region's natural environment serve the process of learning for sustainable development?

These are just a few of the societal and scientific impacts we foresee could result from this research. We expect, however, that as the collected data is analyzed and written up in greater detail than is possible in this one article, this project will have additional impacts on both a local and global scale. We also encourage other researchers to engage in their own examinations of the above questions.

CHAPTER 5

Conclusion and Implications

To reiterate, the three studies that comprise this dissertation focused on the use of adventure learning as a driving force in inquiry-driven sustainability education. These studies examined three different online adventure learning projects:

- *GoNorth!*: a five-year series of dogsledding expeditions around the circumpolar Arctic tied to an inquiry-based online curriculum focused on climate change, culture, science, and sustainability
- *WeExplore*: an online user-driven adventure learning environment that scaffolds learners through the process of generating an inquiry-based adventure learning project centered on a specific mission and guiding question of their choosing, and to then explore solutions to that question while sharing artifacts such as field notes, photos, videos, and maps in an online storyline.
- *Earthducation*: a five-year adventure learning project with an online learning environment tied to field expeditions to each continent that explored connections between education and sustainability in climate hotspots worldwide.

The studies were guided by the following questions:

1. How do students perceive *adventure* when participating in an adventure learning program?
2. What role do teachers believe *adventure* plays in teaching and learning?
3. To what extent does an informal, technology-fueled adventure learning

environment facilitate in-service teachers' ability to stimulate students' creativity and motivation?

4. In what ways might education, in its myriad forms (formal, informal, traditional), support sustainable environmental practices?
5. In what ways might education, in its myriad forms (formal, informal, traditional), support sustainable cultural practices?

The pursuit of these questions led to research projects that addressed:

1. How adventure learning might be employed in distance, online, and mobile learning in ways that promote experiential learning and sustainability education.
2. To what extent adventure learning might provide a technology-fueled tool for teachers to help foster creativity, inquiry, and authentic transdisciplinary experiences in the classroom.
3. How different types of education (formal, informal, traditional) might influence sustainability in varying contexts and geographic locations.
4. How different types of education (formal, informal, traditional) appear to influence the three realms of sustainable development (sociocultural, economic, environmental).

In this chapter, the three studies are summarized and the findings are synthesized and discussed, with consideration for the limitations of the work. The chapter concludes with implications for future research.

Summary of the Studies

Paper 1 in this dissertation defined adventure and provided overviews of, and discussed the differences between, adventure education and adventure learning. It shared research conducted on the role of adventure in the *GoNorth!* adventure learning series, and advanced suggestions for how adventure might be employed in distance, online, and mobile learning in ways that promote experiential learning and sustainability education. User-driven adventure learning was proposed as one model that educators and designers could draw from in both formal and informal learning settings as a means to fuse adventure, sustainability education, and technology in a pedagogically meaningful way.

Paper 2 looked at *WeExplore* and examined to what extent an online user-driven adventure learning environment might provide a technology-fueled classroom tool for teachers that fosters creativity and inquiry while allowing learners to design authentic transdisciplinary experiences grounded in pressing contemporary issues. The paper also explored what role teacher pedagogy and practice might play in influencing learner creativity and engagement within an online learning environment. Paper 2 concluded with a model that reflects key criteria in learning environment design and teacher pedagogy relative to creative development.

Paper 3 shared data and narratives from *Earthducation* field expeditions conducted in Burkina Faso; northern Norway; Australia; Peru and Chile; Arctic Alaska and Canada; and Nepal. Based on these narratives, assertions were proposed related to how education might influence sustainability in differing contexts, as well as what types of education appear to be influential in the three realms of sustainable development (sociocultural,

economic, environmental). Data gathered to date illustrated both how education can influence sustainability in different regions of the world, and the complexities that geographical location and culture bring to this topic.

Summary of the Findings

Data from Paper 1 revealed that the adventure in the *GoNorth!* adventure learning series provided motivation and engagement both for students and teachers in ways neither had experienced before in the learning process. The themes unveiled in this study included:

- Adventure affords a desire for learners to be part of the entire adventure learning experience
- Adventure provides motivation for learners
- Adventure brings an understanding of the real world to learners
- Adventure motivates teachers to become part of the learning community
- Adventure motivates the teachers through their perception of their learners' excitement

In summary, this first study found that the adventure within the *GoNorth!* adventure learning series provided heightened motivation, excitement, community-building, real-world understanding, and learner participation. Teachers and students alike became engaged in learning in a new and impactful way as they followed along with the adventures of the expedition team. They found themselves drawn into the expedition in a visceral way through the affordances of the technology; the powerful stories, data, and

media assets shared by the team; and the online interaction opportunities, all of which allowed them to feel as though they were part of the adventure itself. They also found themselves engaged with the issues that were raised, and collaborating to craft new ways to contribute to solve issues, both on a local and a global scale.

Paper 2 examined how the inquiry-based *WeExplore* adventure learning environment and the participating teacher's pedagogy facilitated creative thinking and development among participating students, as well as how the students themselves perceived creativity and its role in their classroom activities. The data revealed that (a) students' creativity and self-direction are influenced by the technology tools (learning environment) that the students use within the classroom, (b) students' creativity is limited by their own idea of what creativity is and the support they receive within the classroom to support such endeavors, (c) a constructivist learning environment is needed to support creativity, (d) mobile learning opportunities inspires students to be creative, (e) creativity is impacted by the extent there is supportive pedagogy, and (f) without trust and inspiration from the instructor, the extent to which students feel they can be creative will be limited. These lessons allowed us to draw the following implications for the design, development, implementation, and integration of technology tools to support creativity within the classroom:

- *Trust students and create opportunities for students to contribute not only their own answers, but also their own questions.* As noted in Paper 2, self-directed, inquiry-based learning opportunities have been shown to foster creativity in learners (Esquivel, 1995; LaBanca & Ritchie, 2011; Liu & Lin, 2014; Mishra,

Fahnoe, Henriksen, & the Deep-Play Research Group, 2013; Schmidt, 2010). Our study findings support this past research.

- *Allow students to self-pace.* With a standards-driven environment in a majority of classrooms today, the idea of self-pacing is normally not a pedagogical option. However, as was showcased in this study, when students can work individually and collaboratively at their own pace, they feel supported and encouraged to do their best and with less pressure and stress, are able to express themselves more creatively.
- *Offer technology tools that provide choice with structure.* The tool or environment ideally needs to provide aesthetic inspiration and scaffolding while also offering freedom and flexibility for learners to contribute their own content on their own terms.
- *Combine science and the arts.* Science can be learned through inspiring experiential work that fuels creativity (e.g., see studies now emerging on the STEAM movement, which inserts *Art* into *Science, Technology, Engineering, and Mathematics*).
- *Use participatory design.* Jonassen, Myers, and McKillop (1996) note in looking at how people learn with multimedia that "people who learn the most from instructional materials are the designers" (p. 95). Positioning teachers and learners as co-designers has been shown to enhance understanding and engagement (Cviko, McKenney, & Voogt, 2014; Könings, van Zundert, Brand-Gruwel, & van Merriënboer, 2007; Noriega, Heppell, Bonet, & Heppell, 2013;

Penuel, Roschelle, & Shechtman, 2007; Pieters, 2004; Stears & Malcolm, 2005). Online learning environments such as *WeExplore* offer toolkits that scaffold students through inquiry and design and allow them to identify, visualize, and ultimately showcase their learning and work.

Paper 3 examined the *Earthducation* adventure learning project and looked at how different types of education (formal, informal, traditional) influence sustainability in varying contexts and geographic locations. Emerging themes and assertions from this study included:

- Cultural identity is closely tied to language and the natural environment, and can influence sustainability within that environment.
- Providing experiential learning opportunities to youth and establishing relationships between community Elders and knowledge keepers and schools is an important component in helping youth engage with the environment and local issues of sustainability.
- Schools need to do a better job of adapting to local culture, seasons, and rhythms, to improve school attendance and community engagement.
- Basic needs must be met, and teachers well educated and trained, before being able to successfully speak to sustainability education in a meaningful way.
- Traditional education and knowledge are necessary components to establishing environmental sustainability.
- Formal education has increased in perceived importance in many rural/remote communities today due in part to the role technology and bureaucracy have

come to play in many working environments today.

When taken as a whole, these assertions and others from the interviews to date lend themselves to the formation of broader assertions about how different types of learning might influence sustainability. Educational initiatives that appear to be producing the most engagement and pro-environmental influence from a community level toward achieving sustainability in countries including Norway, Nepal, Australia, the United States, and Canada, are ones that actively invite community members to participate in formal schooling, and that integrate traditional knowledge and experiential learning activities into the curriculum. For example, in a community such as Pangnirtung on Baffin Island in the Canadian Arctic, students are brought out on the land for a three-week spring camp to learn by working with Elders and family members – the traditional Inuit way (e.g., see Davies, 2009). This finding aligns with previous studies focused on both community engagement and experiential education noted earlier in this paper's introduction.

The Earthducation narratives as a whole illustrate the type of challenges formal education faces when inherited human relationships to the natural environment are not paralleled within educational settings. Bonds between culture and climate continue to change across the planet as events such as climate change, technological globalization, and resource extraction reach the remotest regions of the Earth. These changes need to be addressed in education in all its guises.

Online and mobile technologies offer great opportunities to rural and remote communities, in particular, to extend learning opportunities in all realms, and to capture

and preserve traditional knowledge that is being lost as Elders pass away and native languages are eroded by encroaching social changes. Unreliable and unaffordable Internet service and slow broadband speeds are issues plaguing many remote communities currently, however. Mobile phones, however, outnumber landlines in many developing countries, and mobile technologies thus offer some exciting educational possibilities there.

Teacher education and training is also an important ongoing factor that is impacting the integration of sustainability education, not just in developing countries but worldwide. We observed some of the strongest teacher education around sustainability issues in Norway and Australia.

Conclusion

Looking at the three studies as a whole and reflecting on the use of adventure learning as a driving force in sustainability education, we can see a progression of the learner from a more passive participant in the learning process in Paper 1 (the *GoNorth!* study), where the learner follows along with an external adventure and experiences heightened engagement and motivation with the learning content, to that of a designer and leader in the learning process in Paper 2 (the *WeExplore* study), in which the learner experiences enhanced creativity as they generate their own inquiry- and adventure-based output through the user-driven adventure learning environment *WeExplore*. Paper 3 helps us then put into context how sustainability education is influenced by geographic location and socioeconomic considerations. Viewed in another light, we can see through the three

papers the use of adventure as a means to (1) generate excitement and awareness, (2) scaffold learners as designers and leaders, and (3) share real-world narratives in context.

The introduction of user-driven adventure learning environments (UDALE) like *WeExplore,* along with new online and mobile tools and technologies, are making it easier than ever for teachers and learners to create and share with the world their own inquiry-driven adventures, and to extend learning well beyond the walls of the classroom. UDALE merges components of adventure education and adventure learning, allowing learners the opportunity to engage in their own physical adventure while concurrently teaching others about a real-world issue, sharing authentic data and narratives, and employing technology for data collection, disbursement, and collaborative involvement with other learners and field experts. As noted earlier, previous studies have indicated a positive relationship between firsthand exposure to and engagement with the natural environment, and pro-environmental attitudes and behaviors (Bogo, 2003; Dresner & Moldenke, 2002; Irvin, 2007; Lieberman & Hoody, 1998; Riordan & Klein, 2010; Ruebush et al., 2009; Silverstein, Dubner, Miller, Glied, & Loike, 2009; Windschitl, 2003). One of the keys to UDALE as regards sustainability education is that learners, in developing and implementing their own adventure tied to a real-world issue and location, become active problem solvers and innovators.

With its grounding in experiential and inquiry-based pedagogies, adventure learning is a framework that aligns well with environmental education (EE) standards, including the North American Association for Environmental Education (NAAEE; www.naaee.org) guidelines for quality EE, and the EE awareness to action model.

Adventure learning environments scaffold learners through a similar learning progression as the awareness to action model, guiding the learner from awareness about and sensitivity toward the natural environment, through knowledge-, attitude-, and skill-acquisition, with the ultimate goal of the learner actively participating in environmental stewardship, whether on an individual or larger group level.

Findings from the studies included in this dissertation indicate adventure learning is a promising model that educators and designers can draw from in both formal and informal learning settings as a means to fuse inquiry, sustainability education, and technology in a pedagogically meaningful way that engages learners and teachers alike. The studies advance our understanding of how we might better design technology-enhanced learning environments that foster engagement and creativity while encouraging learner curiosity and wonder and cultivating inquiry and collaboration.

Implications for online and mobile learning environment design drawn from the three studies support the importance of:

- Scaffolding teachers along with learners
- Offering learners opportunities to self-pace and collaborate
- Keeping learning authentic and grounded in real-world issues
- Employing participatory design and giving learners a voice
- Affording social presence
- Bringing sustainability issues to life through local, relatable examples

Limitations

The studies included here are focused within limited settings and on specific online learning environments. In addition, user-driven adventure learning (UDALE) is a newer concept and has been studied in a formal research context only minimally to date. It is therefore important to note that additional research on UDALE environments is needed before forming too broad a conclusion as to their contribution to learning and engagement. However, the research to date on such environments has been promising.

Finally, I want to disclose that I was involved not only in the research of the adventure learning environments included in this study, but also in the design and development of two of the environments (*WeExplore* and *Earthducation*). While each study took every precaution to ensure triangulation, rigor, and non-bias, and I have no financial stake in any of the online learning environments' successes or failures, there is still the potential for bias. This effect has been mitigated by the inclusion of co-authors in the research study, in member-checking findings as possible, and in the fact that this researcher is motivated to genuinely improve student engagement and learning and to make adjustments to the online learning environments accordingly.

Future Directions

The studies presented here offer a glimpse into the potential of using the adventure learning model to develop engaging technology-enhanced learning that advances sustainability education and practice, fosters engagement and creativity, encourages learner curiosity and wonder, and cultivates inquiry and collaboration. Additional research is needed, however, to substantiate best design practices around adventure

learning environments (particularly user-driven adventure learning environments), and to investigate content learning and retention related to adventure learning environments. To date, only a handful of studies have looked specifically at content-specific learning and retention in such environments (see, for example, Moos & Honkomp, 2011). Studies that implicitly examine long-term sustainability practices of learners that engage with adventure learning programs focused on environmental education would also be of immense value to the field.

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