Lessons Learned from the Design and Development of Technology-enhanced Outdoor Learning Experiences

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Abstract

Outdoor learning expeditions supported by emerging technologies and occurring in remote locations are often engaging and motivating. Such expeditions however, are demanding, physically challenging, and logistically complex. In this paper, we describe how we used a framework for the design of technology-enhanced learning expeditions to develop small and local expeditions, and what we learned through the process. Our contributions to the literature include (a) descriptions of projects that took place in local environments in contrast to projects in the existing literature that focus on remote locations, (b) descriptions of projects in which students and teachers acted as expedition members and leaders, in contrast to the existing literature which describes expeditions undertaken by explorers while teachers and students follow along, and (c) design processes and decisions we took to create these projects in contrast to the existing literature which describes cognitive and affective outcomes associated with such projects.

***Keywords*:** digital learning environments, adventure learning, technology-enhanced outdoor learning experiences, field experiences, design and development, instructional design

In recent years, a number of approaches have been developed to foster the development of technology-enhanced learning environments that are student-centered and inquiry-driven. Examples range from Peer Instruction (Mazur, 1997), to project-based learning (Krajcik & Blumenfeld, 2006), to open online learning (McAuley, Stewart, Siemens, & Cormier, 2010). One approach that our team has used to design and develop technology-enhanced learning environments, is called Adventure Learning (AL) (Doering, 2006, 2007; Veletsianos & Kleanthous, 2009). Although the existing literature examines Adventure Learning in the context of remote and exotic expeditions, we found the framework useful in our efforts to design initiatives for local outdoor environments. Concomitant to our work, we came to the realization that the current literature on Adventure Learning and technology-enhanced outdoor learning experiences lacks descriptions of (a) learning environments that focus on local settings, and (b) projects in which learners take active roles in the expedition process. In this paper we bridge this identified gap in the literature by describing how we used this approach to design and develop five small-scale interventions that used technology to enhance outdoor learning experiences. We also describe how we came to use the Adventure

Learning guidelines to inform rather than dictate our designs; how we operationalized adventure in locales that were neither exotic nor remote; and what we understood to be the most salient design elements for engaging participants and delivering Adventure Learning expeditions. By describing these projects, we hope to demonstrate how a diverse range of projects have used the Adventure Learning approach and how we have refined the approach to enable individuals (e.g., designers, teachers, and faculty members) to enact technology-enhanced interventions and meaningful inquiry in their own outdoor communities.

Review of Relevant Literature

Adventure Learning environments seek to engage learners in compelling investigations and explorations (Veletsianos & Kleanthous, 2009). For example, in the *Go 4 The Summit* projects, explorers climbed mountains around the world (e.g., Mt. Kilimanjaro) as they connected with their classroom back in the United States to teach social studies content (Moos & Honkomp, 2011). In the *GoNorth!* Projects a team of explorers traveled through Arctic regions of the world on dog-sledding expeditions collecting and sharing data that students in remote schools used in conjunction with inquiry-driven curricula (Doering, 2006). In both cases, the curricula and learning materials were enhanced through an online learning environment that hosted data and media sent from the trail (e.g., video, audio, imagery) and through interactions between expedition members, students, teachers, and content experts.

The AL framework was originally based on seven principles (Doering, 2006, 2007). It was revised in 2010 to include two additional principles (The Learning Technologies Collaborative, 2010). The framework notes that AL experiences should:

1. Be adventure-based;
2. Be research-based;
3. Be supported through collaborative and interactive online environment tools;
4. Use the Internet to connect varied audiences;
5. Use media and text within the online environment to educate, engage, and inspire;
6. Have pedagogical guidelines that support teachers in implementation and engagement;
7. Include synchronous and asynchronous learning opportunities that engage students, teachers, and content experts in the content being explored;
8. Identify a location and issue to explore (including investigation of the contextual factors surrounding the location and issue); and
9. Consist of an authentic narrative that unifies the expedition, curriculum, student activities, media, and learning experience under a common purpose and theme.

Adventure Learning expeditions, though engaging and successful (e.g., Doering, Scharber, Riedel, & Miller, 2010; Henrickson & Doering, 2013), are oftentimes logistically complex, resource-intensive, and demanding in terms of time. These issues have prevented individual teachers or small teams of collaborators from implementing AL projects (Veletsianos & Kleanthous, 2009; Veletsianos, 2012), though such work is slowly appearing in the literature (e.g., Moos & Honkomp, 2011) and new learning environments (e.g., Connected Classrooms, 2014; WeExplore, 2014) are making it easier for individuals to develop their own projects that incorporate local contexts.

Attempts to connect outdoor learning experiences to local contexts in order to engage students are not new. According to Sobel (2008) for instance, children are often closer to nature

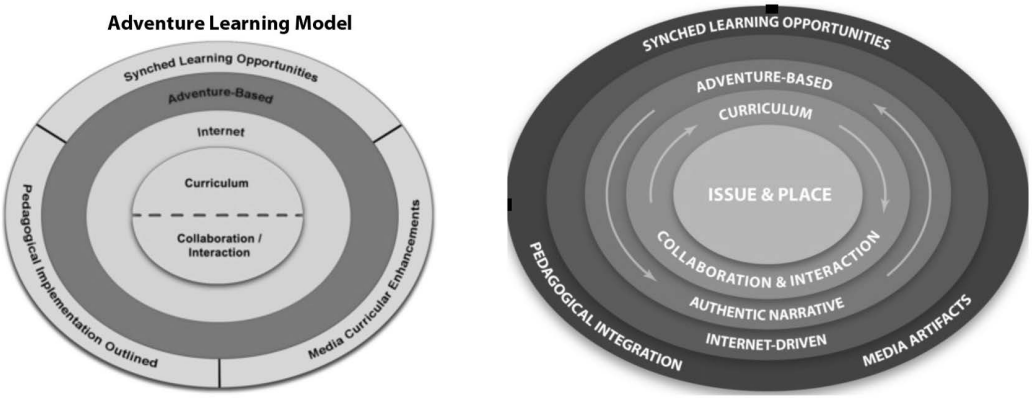

Figure 1. The first and second iterations of the Adventure Learning model

than adults and educational materials that are related to nature can take on a more profound meaning for students. Connecting students with nature and their surroundings is an important component of Adventure Learning environments (Miller, Hougham, & Eitel, 2013), and the use of the Internet in the design of such experiences introduces new opportunities for learning, teaching, and participation.

In order to understand how the design suggestions presented above can work on a local level and on a smaller scale, our team of researchers and designers has been involved in the design, development, and dissemination of small-scale projects in localized contexts. The small-scale expeditions have allowed us to explore questions tied to specific locales and to learn how such projects may be enacted at a local level. In this paper, we describe these projects and explain how our development efforts inform future design endeavors. An important aspect of this work is that the projects discussed occurred in local environments (e.g., inner cities, national forests, wilderness areas, neighborhood parks, etc.) and have enabled students and teachers to act as expedition members and leaders, with the goal of creating meaningful inquiry tied to the students' own communities. One of the reasons that we were attracted to the projects we describe below is the opportunity to inspire people through place, in the tradition of place-based education (Sobel, 2004; Smith, 2002; Gruenewald & Smith, 2014). Remote areas with breathtaking landscape and unique wildlife are appealing, but the questions that we keep asking ourselves are: How remote and unique do these destinations need to be in order to inspire students? Can we find beauty, adventure, and inspiration in local environments? How can we use local communities to design exciting learning environments? Local venues might not always be exotic, but they provide ways to conduct field expeditions without incurring the high financial burden that goes along with travel to remote places and the support of an expedition team.

This paper makes three contributions to the literature. First, we describe projects that took place in local environments in contrast to projects in the existing literature that focus on exotic and remote locations (e.g., the circumpolar Arctic, the world's highest mountains). Second, we discuss projects that have empowered students and teachers to act as expedition members and leaders, while, with very few exceptions, the projects discussed in the literature describe expeditions supported by professional teams while teachers and students follow along. Third, we present design decisions undertaken in the context of Adventure Learning projects, which is an area that is unexplored in the current literature.

Technology-Enhanced Outdoor Learning Experiences

In this section we describe the five projects we designed and developed, and explain the lessons that we learned from these implementations. An array of mobile and digital technologies was incorporated into the projects described below. For example, mobile devices were used to support geocaching activities and to enable learners to capture images and written reflections from the field; hand-held computers with sensors were used to enable learners to quickly analyze data (e.g., water quality data); social media such as video-sharing and audio-sharing websites were used to display and crowdsource content; geospatial technologies (e.g., Google Maps) were used to display and map points of interest such as expedition routes and locations for data collection.

Adventure Learning at Taylor Wilderness Research Station

We launched the first project in August 2011. The destination was Taylor Wilderness Research Station (TWRS), located in the heart of the *Frank Church River of No Return Wilderness*, which encompasses much of central Idaho (ID) and is part of the largest expanse of designated wilderness in the lower 48 states. The expedition involved University of Idaho graduate students and faculty and was part of the annual McCall Outdoor Science School (MOSS) training in which graduate students received professional development in how to engage K-12 students in environmental science content. The expedition to TWRS included a 70-mile truck and van journey via gravel road from McCall, ID to Big Creek, ID. From Big Creek, expedition members used a Cessna aircraft for a 30-mile shuttle down the canyon to TWRS.

Once at TWRS, the expedition team engaged in activities that developed their ability to teach environmental science through content and pedagogical instruction with a specific focus on place-based and inquiry based models of instruction (Bybee, 2000). Ample time was provided to explore the surrounding area, including a day hike to a pictograph site. The final leg of the TWRS expedition was a 30-mile backpacking expedition along Big Creek to the trucks and vans located at the airstrip.

For AL@TWRS we wanted to communicate the expedition experience to preservice

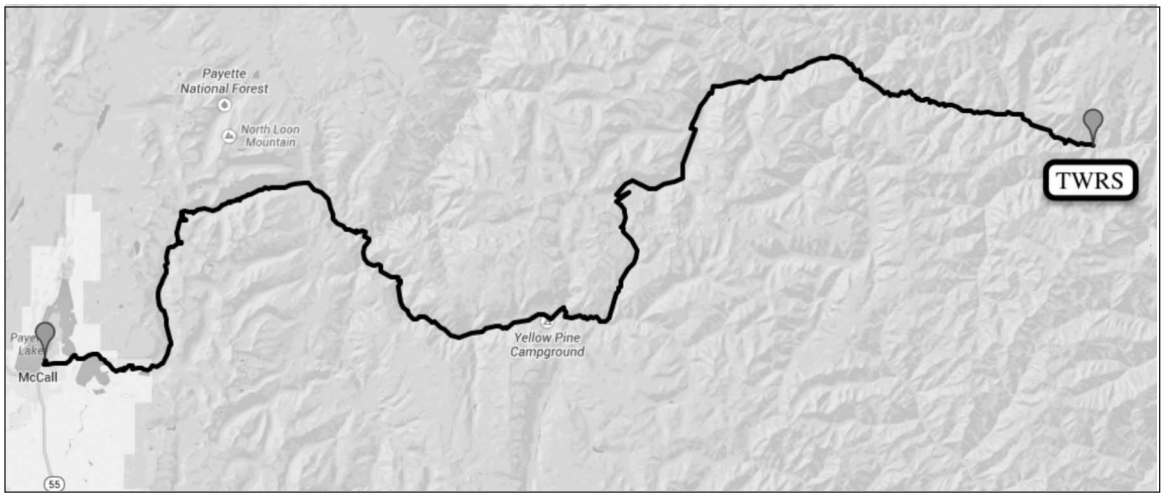

Figure 2. The route for AL@TWRS

elementary teachers following along at a distance via the online environment. We did this through daily multimedia posts from the field and a live audio conference via satellite phone once during the expedition. The purpose of AL@TWRS was to gain an understanding of the intricacies of delivering an education program from locations without Wi-Fi or 4G connectivity and to further explore mechanisms for connecting audiences at a distance using the AL approach.

This expedition was an important first step in (a) troubleshooting the technology, (b) understanding how to deliver content from the field, and (c) developing and maintaining an online environment to support technology-enhanced outdoor learning experiences. In addition, participants were able to experience the use of satellite technology to support communication between expedition team members in the field and the support staff at the University of Idaho who were tasked with updating the online learning environment.

A number of lessons were learned during the pilot project: First, we used the free and off-the-shelf blogging platform provided by Wordpress.com as a learning environment and it satisfied all the needs that we had. The platform encompassed numerous features, allowed us to efficiently and effectively provide updates from the field, and required limited technical know-how. Thereafter, Wordpress became the platform of choice for future projects, and Wordpress.com hosted all of the projects described in this paper. Second, we encountered many difficulties with the technology needed to upload media from a remote location. Managing and conserving electric power was arduous because the solar charging equipment functioned sporadically as a result of the mountainous terrain. Since the rest of our technology depended on power generated from solar energy, in future projects we sought other options for power storage and generation. Third, opportunities for interaction and collaboration were limited and we realized that these needed to be more explicitly provided in the curriculum. Finally, the technology obstacles we faced prompted us to question whether such expeditions were feasible for individuals to create. Even though the project was local and conducted on a small scale, it still required expensive equipment and transportation options, as well as specialized satellite technology for data transfer.

Adventure Learning at Main Salmon River

AL at Main Salmon River (MSR) built upon the aforementioned expedition. The project was a partnership between MOSS and a K-8 school that uses an expeditionary learning model. A new online environment was created using the Wordpress platform that included a curriculum supported by content from the expedition. Unlike the first project, the expedition at MSR included more explicit guidance for collaboration and interaction between students, teachers, and content experts. The expedition involved traveling by raft through the largest un-dammed watershed in the contiguous United States. The expedition team was comprised of parents, educators, students and scientists. The team explored the excitement of traveling in the wilderness, collected data pertaining to salmon fisheries, and was immersed in the river culture of remote Idaho. A student-centered model of inquiry drove this process, meaning that students were provided with scientific inquiry apparatus, technological tools, and the freedom to ask questions of interest to them within the constraints of the larger curriculum

focus on salmon habitat (e.g. habitat suitability, changes in water characteristics throughout the watershed, etc.). Concurrently, students at MOSS examined some of the same water resource issues, as well as interacted with the website synchronously and asynchronously. One of the major innovations of this expedition was the inclusion of students aged 6-11 as expedition team members. Students participating in the expedition conducted authentic science inquiries, while remote students followed the expedition through the online environment. On a daily basis, trail reports were provided on the website to encourage participation and provide guiding questions for the expedition. One such report appears below:

> How do things change over time? How has Moscow/the Salmon River/ Lake Payette changed over time? From the perspective of the expedition team, the Salmon River is in a state of constant change. The incredible hydraulic force of the river shapes the canyon through which it flows. Fire is another change agent that is evident on this expedition. There are many places along the river where fire has left its mark and has provided the opportunity for new growth and succession to occur. What does change look like where you live? Share with us how you see things change over time or how your local places are changing, just like the Salmon River corridor is changing.

The site was visited thousands of times during the expedition, and teachers, students, family, and outdoor enthusiasts left comments. Science educators visited and commented on the project, some offering feedback with respect to the application of this approach to their own work.

The concepts of adventure and authentic narrative featured prominently in this expedition, supported by unexpected events such as concurrent snow flurries and lightning. The canyon topography made it challenging to connect to the geosynchronous satellite and required periodic ascending of south facing slopes to enable satellite communication. Photos and video from each day were selected and compressed for upload and a narrative trail report of approximately 500 words accompanied the media each day. Collaboration and interaction opportunities for the Main Salmon River expedition consisted of a synchronous audio expert chat with an expedition team member via satellite phone to students at MOSS; and asynchronous text-based communication facilitated by support staff between individuals, the classroom following along, and the expedition team. Pedagogical guidelines consisted of a "For Teachers" tab within the online environment that included a lesson related to the content of the expedition along with guiding questions and suggestions on how the expedition could be used within existing curricular structures.

The first two projects built upon the classic expeditionary model of a team of explorers traveling to remote, and potentially inhospitable, locations with the intent to engage learners. While designing and participating in these small-scale, localized expeditions, we realized that our design approach required significant changes in order to allow students and teachers to design and enact technology-supported field experiences.

CreekPlace Summer Camp

The CreekPlace Summer Camp was a research and development effort to understand the experiences, practices, successes, and tribulations of students and teachers in small-scale AL projects. This design followed Veronica (a pseudonym) who developed a weeklong AL project for nine children entering the 1st, 2nd, and 3rd grades. The camp focused on the ecology of the ocean and other water environments, the biological and social effects of the 2010 Gulf Coast Oil Spill, and the creation of a business plan to raise awareness and resources for local coastal cleanup efforts.

Veronica developed an AL learning environment which included face-to-face instructor-led sessions, student-led exploration of digital resources, technology-enhanced outdoors activities (e.g., geocaching), and a small fraction of resources and curriculum from the 2010 GoNorth! AL program (http://www.polarhusky.com/support/get-curriculum/). Additional online resources were integrated to provide content specific to the local aquatic environments and the Gulf Coast Oil Spill crisis.

Two important findings from this implementation informed our future work. First, although Veronica found the AL model valuable, she faced difficulties in developing a traditional adventure learning design. Her final product shared numerous features with AL environments found in the literature (e.g., connection to a local place) but it also lacked a number of elements as well (e.g., an encompassing online learning environment through which students collaborate with others). This finding reinforced our belief in using off-the-shelf solutions such

as Wordpress to enable individuals to develop purposeful learning environments and led us to question the degree to which teacher-designers should strictly adhere to the model. We realized that if the model was going to scale to individual teacher-designers, the model should be flexible enough to allow adaptation to local needs, while at the same time avoiding losing its essence.

Second, this project problematized the notion of the AL "hook." In the GoNorth! projects, it was shown that the polar husky dogs that pulled the sleds served as "hooks" to draw students into the learning experience. As a result, researchers have encouraged "educators, designers, and researchers to seek out those potential 'hooks' within their respective domains that may encourage student motivation and pull students further into the environment and inherent educational activities" (Doering et al., 2010, p. 503). In this investigation, we observed that students were attracted to the experience through two venues: the animals and the narrative. The "animal as a hook" is a finding that makes sense developmentally, as Sobel (1995), in his place-based work argues that "[e] mpathy between the child and the natural world should be a main objective for children ages four through seven" (p. 3). Our observations and interviews with the teacher also suggest that the students were pulled into the project as a result of the narrative of environmental degradation and the opportunity to make a difference through personal action (Veletsianos, 2010). The opportunity to make a difference was empowering for students. Students felt empathy towards the animals, engaged with the project, and continued asking about the animals for a long time after the end of the project. Thus, going forward, the examination of multiple hooks within a project and the consideration of how an expedition's narrative contributes to engagement will be a valuable component to our work.

Adventure Learning at MOSS (AL@MOSS)

AL@MOSS was an effort to use the AL framework to inform the MOSS curriculum in order to allow students to become expedition members. We sought to achieve this by asking students attending weeklong residential learning experiences at MOSS to create and post daily Trail Reports on a Wordpress environment. The Trail Report approach provided a structure for students to reflect on their learning experiences and connected schools, communities, and parents to the work students were doing at MOSS. The site was also a space where visitors could comment. The connection to students' home communities was an important extension of the MOSS curriculum that was previously difficult to achieve.

AL@MOSS highlighted the location of exploration by focusing on Ponderosa State Park and the surrounding Payette River watershed and lake. A researched curriculum was integrated into the expedition through the activities at MOSS, but collaboration and interaction were not specifically designed to occur through the environment, though the opportunities provided by the platform enabled parents and grandparents to make contributions to the learning environment. Providing students with the opportunity to be expedition leaders and create/share daily updates was significant as it allowed the students to shape the narrative of the expedition. The MOSS field-based curriculum draws from place-based and outdoor education pedagogies (Sobel, 2004; Smith, 2002; Woodhouse & Knapp, 2000), while also working from an inquiry approach to instruction (Bybee, 2000). This iteration of the technology-enhanced field-based expedition provided two insights for future projects. First, we discovered that familial involvement in the expedition was valued and in future projects we sought to provide opportunities for families to contribute to the online learning environment and interact with remote students. Second, we found that trail reports created by students changed the narrative of the expedition and collapsed the top-down structure that seemed to be present when trail updates were delivered by remote expedition teams. As a result, trail reports created by students who were part of the expedition team became staple activities in future designs.

YoTeach!: Adventure Learning in a Higher Education Setting

The YoTeach! project was a two-semester initiative implemented in two undergraduate sociology courses at the University of Texas at Austin. In this project, a team of urban explorers collected video narratives of teachers' classroom roles that were then presented within an online learning environment. Using this environment, students collaborated with each other in making meaning of the social forces that influence teacher roles, and created and discussed their own digital projects of real-world sociological issues (e.g., videos, digital slideshows, and hypertext). The intention of the learning environment was to (a) support a sociology professor in integrating an innovative technology intervention into a predominantly

Figure 3. An example of a time-released blog entry

lecture-based course, (b) enhance learners' understanding of sociological concepts, and (c) create opportunities for meaningful engagement with sociological topics. The activities that students were asked to enact occurred outside of the classroom in order to bring to life the real-world nature of Sociology and introduce students to authentic data gathering and analysis.

At first the design team traveled to various micro-communities within the local city and asked participants to respond to the following prompts:

- What is the role of a teacher?
- Tell us a story about a memorable teacher.

Responses were filmed and compiled into three 5-minute long "documentaries," with each documentary focusing on a central theme relevant to the content area and shared on three *time-released* blog entries discussing the themes (figure 3). Additionally, contributions in the form of YouTube videos were requested and received from colleagues across the United States and those videos, along with noteworthy responses from the field, were shared on a video page on the online learning environment. Videos were posted on a single page in order to encourage student exploration. Thereafter students were assigned to groups and asked to (a) follow the team's 3-week journey, (b) interact with the team and other experts contributing to the project, (c) develop multimedia or blog entries to examine a sociological issue, (d) share their projects, and (e) post comments on other students' projects.

This implementation allowed us to integrate the AL model in a higher education setting. We observed that the release of pre-recorded content on timed intervals did not appear to distract from the experience and learners reported "feeling like a sociologist", while creating their own projects. These reports suggest that the model can support engagement *with* a discipline rather than learning *about* a discipline. For instance, one student noted that "It was interesting to kind of feel like a sociologist for a few seconds and ask people questions and take all the information you get from them and [analyze it]," while another described that she also felt this way because, like sociologists, students sought to ensure ethical treatment of the subjects they interviewed: "I felt a little bit that way, because we made sure of the ethics of it, we changed the people we interviewed, we changed their pictures, we changed their names,

we made that for ethical reasons." We consider students' reports of *feeling like sociologists* to be significant, and since then we have sought to be more intentional in supporting learners in learning disciplinary practices rather than just learning *about* them.

Discussion

In this paper, we described five small and local Adventure Learning projects and their associated environments. The designs described were grounded on the idea that local expeditions hold value for learners, and make sense developmentally for younger audiences (Sobel, 1995). Through iterative design, we have gained invaluable knowledge about how to effectively design and develop technology-enhanced field-based learning experiences.

While designing the learning environments described above, we often felt that we needed to implement all components of the Adventure Learning framework. Over time, we realized that we were using the framework as a checklist, feeling that we were required to implement all aspects of the model for our projects to be successful. This realization was powerful because it helped us recognize that even though the model provided insightful guidelines, our designs would be more effective *if they were informed, rather than be dictated,* by Adventure Learning guidelines. This realization freed us to think creatively about the learning environments that we were building and allowed us to think about AL as a helpful roadmap rather than a principle. Instructional designers should exercise caution when using similar frameworks and principles. Designs should address local realities, and even though designs might be shaped by a specific approach such as Adventure Learning, exhibiting orthodoxy towards a particular model might preclude learning designers from developing better designs.

Over the course of implementing these projects, we realized that the location and the issue to be examined during an expedition are of major significance. By highlighting location and issue, students are able to connect to a known place instead of relying exclusively upon mediated connection to a remote location. Furthermore, by connecting to familiar contexts, students may become more invested, and by having the opportunity to engage with community issues, learners are provided with an important civic perspective. In designing technology-enhanced outdoor learning environments, learning designers need to think creatively about using local places in inspiring and effective ways. The projects described here provide a number of ideas for creating such experiences (e.g., trail updates, students as explorers, enacting local change).

In a number of the designs described, what constitutes "adventure" is easily understood because of the remote nature of the location and the travel involved to reach point B from point A. In other designs however, the location and/or activities may not elicit the same kind of understanding of "adventure." In those cases, we understand adventure to mean a progression through a set of tasks, or the work toward a final product or event. We considered the key design elements for adventure to be a project that (a) was bound by time, (b) encompassed a storyline, and (c) involved participants in addressing an issue in need of action. This understanding provided our team with a diverse range of options for integrating "adventure" into our designs.

Text, photos, videos, audio, and geospatial technologies are critical ingredients for engaging learners in technology-mediated place-based learning experiences. Capturing, editing, managing, and publishing audiovisual materials however can be a daunting task. While enacting the projects described above, we found it helpful to outline clear and concise protocols for capturing and publishing information within the curriculum. By integrating collection protocols and audiovisual material collection in the curriculum, management became easier and students/teachers were supported and guided in their collection of material to be posted on the online learning environment.

Conclusion

Adventure Learning provides a number of suggestions for the design of place-based and technology-rich learning environments. The work presented here showcases how iterative development of small-scale projects by our research and development team has informed future design efforts. We hope that our experiences and lessons are worthwhile to researchers and practitioners contemplating similar efforts.

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