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Bridging Natural and Digital Domains: Attitudes, Confidence, and Interest in Using Technology to Learn Outdoors

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Abstract

Background: The current study, Project EARPOD (Engaging At-Risk Populations Outdoors, Digitally), addressed two questions: First, does the use of technology in environmental education detract from students' experiences outdoors? Second, can these technological interventions be expanded to provide access to students and schools across the socioeconomic spectrum? **Purpose:** EARPOD used an integrated technology program, Digital Observation Technology Skills (DOTS), to engage underserved students in experiential education meant to increase environmental literacy and provide evaluative data for pedagogical development in environmental education. **Methodology/Approach:** Researchers collected data on the impact of technology-integrated environmental programming on students' knowledge and attitudes toward using technology in outdoor education. Lessons were conducted in small groups, encouraging peer mentoring with regard to tool use and observation that promoted teamwork within groups at an informal science learning (ISL) center. **Findings/Conclusion:** Preliminary results showed that students reported an increase in three main characteristics with regard to technology: confidence in using technologies outdoors, knowledge of available technologies, and knowledge of using different technologies. **Implications:** The results of the Project EARPOD study will help future educators and administrators make decisions regarding best practices and resource allocation for the use of technology within the field of environmental education.

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Introduction

Project EARPOD (Engaging At-Risk Populations Outdoors, Digitally) was a pilot study that implemented and assessed an experiential pedagogical approach called Digital Observation Technology Skills (DOTS), which integrates mobile, digital technology into outdoor environmental education programming. The DOTS approach uses portable kits of handheld digital tools in experiential lessons in which students collect data and observations about their surroundings outdoors. The pilot study was enacted as a collaboration between an informal science learning (ISL) center—Upham Woods Outdoor Learning Center (Upham Woods) in Wisconsin Dells, WI—and several Wisconsin public school classes. DOTS was designed to integrate technology into outdoor, experiential learning in such a way that it did not detract from the learning experiences of the participating students. Ultimately, the goal of DOTS is to allow students to use technology to form deeper connections to experiential, environmental curricula that emphasize student inquiry and observation.

Project EARPOD was designed to address two research questions. The first was concerned with whether the incorporation of technology into environmental education would detract from students' experiences outdoors. Researchers administered a questionnaire to students before and after their technology-enhanced learning experiences to assess the DOTS pilot. The results of Project EARPOD indicate initial success in the adoption of DOTS; however, the project's assessment methodology also highlights difficulties in assessing pedagogical developments in an ISL setting. These considerations are discussed in the "Limitations" and "Results" sections of the present article. The second research question addressed by Project EARPOD had to do with the potential for DOTS to be administered to students on a widespread, accessible scale. The present article details the success with which DOTS was made scalable and accessible to larger, diverse populations of students.

Background

ISL supports hands-on and experiential opportunities for learners to connect to the environment in immersive and contextualized ways (Noel-Storr, 2004). For this reason, environmental education is associated with ISL, a field that requires engagement with both one's immediate surroundings and the natural processes that produce such immediate conditions. For the purposes of Project EARPOD, the term *environment*—as it pertains to the pedagogical content of environmental education programs—refers to interdependent physical and ecological systems and their interaction with the social, cultural, and political systems that affect them. Project EARPOD's pedagogical goals for environmental education draw from the definition of environmental literacy established by the National Association for Environmental Education, in particular, its components that emphasize knowledge of "physical and ecological" and "social, cultural and political systems" and "the appropriate behavioral strategies to apply such knowledge and understanding in order to make sound and effective decisions" (Hollweg et al., 2011, p. 3).

In addition to providing experiential learning opportunities for environmental topics, ISL centers like Upham Woods expand the network of educators and facilitators engaged in environmental education and provide students with "direct access to compelling . . . phenomena in the natural world" (National Science Foundation [NSF], 2011, "Program Description," para. 5). While ISL centers like camps and nature centers have historic programming legacies in the natural sciences, these sites can be in tension with elements of contemporary STEM education that feature the adoption of modern technology (Cuthbertson, Socha, & Potter, 2004). Using technology in outdoor education settings holds great promise in deepening scientific connections to place through data collection. Data collection within a context of location, community, and inquiry is one example of place-based education in practice that contributes to active and engaged citizens (Hougham & Kerlin, 2016; Sobel, 2004). In modern science classrooms and careers, most scientific tools are digital. For this reason, adopting digital tools requires ISL centers to strike a careful balance between retaining the connection to place that outdoor, experiential learning promotes and providing formal education audiences with modern STEM curricula.

The ubiquity of mobile technology in students' lives is a common consideration for educators across academic disciplines. According to a 2015 Pew Research Center survey, 91% of American teens access the Internet from mobile devices, at least occasionally, and 94% of these mobile teens go online daily or more (Lenhart, 2015). The term *digital natives* (Prensky, 2001a) has been widely adopted to refer to this generation, raised with access to ubiquitous mobile technology and surrounded by digital stimuli. Prensky (2006) suggests that these digital natives have unique attitudes and preferences that have been shaped by the technologically saturated milieu in which they have grown up. These qualities shape the way digital natives interact with content in educational environments. For this reason, educators across subject areas have been encouraged to adapt to students' proclivity toward changing, technologically inclined, learning (Prensky, 2001b).

The call for educators to adapt to students' orientation to technology as a feature of learning environments has been supported by related research on student's information processing. The authors of *Learners in a Changing Learning Landscape* suggest that educators are most effective in engaging learners when they are able to recognize and navigate the learner's own landscape (Visser & Visser-Valfrey, 2008). These educators are often part of a generation distinct from that of their students; Prensky (2001b) uses the term *digital immigrant* to refer to these older generations that were not "natively" immersed in technology from a young age. In most classrooms today, educators are digital immigrants who may be significantly less comfortable navigating digital technology than their (digital native) students. For this reason and others, not all efforts to adopt digital technology for classroom use have been considered successful.

The call to adopt digital methodologies in all subject areas has not been met with unanimous support. In particular, practitioners of experiential, outdoor education have expressed doubt about the intersection of the digital and the experiential. Cuthbertson et al. (2004) warn of the consequences of adopting digital tools that serve as "short-cuts" that mediate students' exposure to learning processes. Specifically, when modern technology serves only the purpose of increasing efficiency and ease for its users, its incorporation in curricula can eliminate an important learning process that occurs when students work through the "analog" version of a task. Cuthbertson et al. argue that many traditional tools require deeper knowledge of scientific principles than their digital counterparts. For example, using a magnetic compass and sextant requires a navigator to understand spatial and mathematical concepts that a global positioning system (GPS) does not require. The skills gained through a more direct relationship with the task of navigation can foster a more thorough understanding of the scientific concepts at play. When a digital tool only serves as a shortcut to information that is already accessible without it, Cuthbertson argues, its use can obstruct the learning process rather than facilitate it.

O'Connell and Dyment (2016) highlight a different but equally salient concern about adopting digital technology for use in lesson plans. They found that digital natives, despite their technologically immersed backgrounds, will not always opt to use this technology when given the option to complete a task with or without it. When students in O'Connell and Dyment's study were given four formatting options for an assigned reflection essay—handwriting, word processing, creating a PowerPoint, and blogging—students reported that they chose the option they considered to be most expedient. For a majority (75%) of the students, this option was word processing, despite the fact that more advanced digital options were present. Based on their responses to a survey conducted after the experiment, it can be concluded that most students chose not to adopt the more advanced technology when it (a) was not essential to the completion of the task and (b) required them to adopt a new skill set that the analog equivalent did not require. These results indicate that students who have grown up surrounded by digital technology may not automatically lean toward its use when it does not make sense for the purposes of the task at hand.

Cuthbertson et al. (2004) and O'Connell and Dyment (2016) highlight the pitfalls of adopting digital technology in education without careful consideration of the role that technology will play in achieving learning goals. For this reason, the DOTS project team developed the DOTS approach by selecting only the technological components necessary to encourage engagement with the scientific concept in focus.

Given the perception of outdoor and experiential education practices as at odds with mobile, digital technology, what are the best pedagogic practices to bring these two together? It is clear that educators would benefit from a better understanding of the gap between unplugged, experiential curricula and youth who are increasingly "plugged in" to digital technology. Project EARPOD was designed to investigate the role of digital technology in experiential education by piloting the DOTS approach in collaborative use between ISL centers and formal classrooms and collecting data on students' attitudes toward and engagement with technology in an outdoor, experiential setting. The lessons, approach, and evaluation in the pilot study examined here are a subset of the DOTS program.

The DOTS program is a STEM curricular enhancement that has been active since 2014. It is based at Upham Woods. This program engages students and teachers in STEM education through adaptable curricula based on scientific literacy and communication. The program uses mobile technology tools and student-generated data to encourage students to be active participants in the scientific process outdoors. The program is based on the use of DOTS kits, portable sets of scientific tools that consist of a portable microscope, thermal imager, GPS unit, mobile weather station, infrared thermometer, digital camera, and a tablet. The kits are adaptable to teacher needs and are available through loan programs or on-site lessons at Upham Woods.

The model for DOTS was first developed through a NSF grant to engage high school students in atmospheric research in the Arctic and in their local environments, enhancing climate science literacy. Students conducted scientific inquiry associated with their location that aligned with scientific principles and communicated their findings to their peers and communities. To facilitate this process, a pilot DOTS kit was developed as a suite of proxy tools to make arctic atmospheric science replicable for high school students and classroom educators. However, a common critique emerged: Although this approach works for well-funded grants and well-funded schools, how does it generalize to populations without these resources? Does this approach work across the spectrum of educational settings, particularly in schools where resources are often stretched thin?

In part to address this challenge of generalizability, the research team developed the EARPOD pilot study to focus on an approach that would reach underserved audiences in outdoor learning settings. Best practices in education suggest instructors should "identify underserved student populations related to environmental literacy and sustainability" (Wisconsin Department of Public Instruction, 2011, p. 13). Environmental education professionals suggest that educators pursue projects that increase access to environmental education in communities that are lacking such programs or resources (National Environmental Education Advisory Council, 2015). Although underserved student populations may be lacking effective environmental education programs, the ubiquity of technology may provide promise in bridging this gap.

Project EARPOD was a pilot research study funded through 2015 by the Wisconsin Environmental Education Board that used the DOTS program to examine two issues. First, does the use of technology in environmental education detract from students' experiences in the natural world? Second, can these technological interventions be expanded to provide access to students and schools across the socioeconomic spectrum? Project EARPOD gave students the opportunity to engage with nature using new mobile technologies and place-based education. This research focused on the influence of technology on student attitudes. The project produced lesson plans that not only featured digital technology—specifically, a Microsoft Surface Pro 3® tablet and applications—but also included traditional education tools such as field guides and hand lenses. All of the Project EARPOD-enhanced lessons included in this study were based on plant observation and identification: students used hand lenses, dichotomous keys, digital microscopes, and tablets to observe and investigate the plants and trees around them. To evaluate this digitally enhanced curriculum, Project EARPOD surveyed students' confidence and interest in learning outdoors using technology. The data collected about students' attitudes and perceptions can be of use to experiential educators who aim to incorporate digital technology in their curricula. It can also be used to inform further development of evaluation approaches on this topic.

Method

A subset of the Common Measures instrument (National 4-H Council, 2017) focusing on science and technology was adapted for use in the evaluation component of the project. Implementation of this evaluation was facilitated through the distribution of pre- and post-lesson questionnaires. The survey questions provided students with various statements relating to the use of technology and the outdoors. Students self-assessed their level of agreement with each statement on a 5-point Likert-type scale. Questions were worded on a fifth-grade reading comprehension level. The survey questions were approved by the institutional review boards of University of Wisconsin–Extension (#2015-61) and each participating school. A dependent sample *t* test was run to measure changes in students' pre- and post-lesson responses.

Site Description

Upham Woods is a traditional ISL center that is a part of the University of Wisconsin–Extension. The center serves more than 11,000 youth and adults annually. Upham Woods programming ranges from on-site group visits to outreach learning experiences. The center has served participants from 50 Wisconsin counties. On-site Upham Woods experiences include traditional curriculum offerings similar to most ISL centers: for example, guided nature hikes, low ropes challenge course elements, macroinvertebrate study, archery, paddle sport experiential education, swimming, and camping skills. The average youth who is served on site is in the sixth grade. Curriculum is taught to school, scout, 4-H, and adult visiting groups by degree-holding seasonal naturalists.

Program

Project EARPOD featured a 90-min lesson that communicated the importance of making scientific observations outdoors. This lesson contained a 30-min "classic observation" portion, using analog tools such as hand lenses and field guides, followed by 30 min of a "technology-enabled observation" portion that utilized digital microscopes and Microsoft Surface Pro 3® tablets with associated apps (Celestron MicroCapture Pro and Corinth Micro Plant).

To address the impact of variability in instructor experience to the extent possible, facilitators of this study participated in a 2-hr training prior to conducting research. Training topics included experiential education learning principles and field

Table 1. Overview of Youth Participants.

Date	School/group	Age range	Youth, *n*
9/28/2015	Lyndon Station Elementary	7-9	28
11/11/2015	La Escuela Fratney	7-9	32
11/20/2015	Rusch Elementary	8-9	34
12/11/2015	Black Hawk Elementary	8-11	77
12/12/2015	4-H Group in Oshkosh	9-14	12
		Total	183

instruction techniques. This training also included technology training to ensure that facilitators were able to guide participants through the proper use of the technology. The lessons were designed based on the experiential education framework suggested by Carver (1996), characterized by the practice of inviting students to develop their own inquiries while exploring the environment. Lessons incorporated an authentic, active learning style. Students used the resources they were provided in each portion of the lesson to make scientific observations in new and authentic ways.

Both the classic and technology-enabled portions of each lesson ended with a scientific sketching activity: Students produced scientific sketches on paper that included labeled drawings and notes of their observations. The scientific sketching activity was used as a way to invite students to reflect on their observational experiences when using traditional and technology-enabled approaches. The products of this activity could be used as a data set for future analyses of artifact-based evaluation.

Participants

Table 1 lists the total number of students who participated in the Project EARPOD study. Schools involved in Project EARPOD were selected based on the percentage of their student populations eligible for free or reduced lunches through the National School Lunch Program (NSLP), reported by the Wisconsin Department of Public Instruction's (2014) public statement. Researchers used NSLP eligibility as a proxy for socioeconomic status and its associated qualification of "at risk" for low school performance. School districts that served student populations at or above the state average of 43.3% NSLP eligibility for the 2013-2014 school year were given participation preference. Table 1 lists the participating organizations and total number of participating students from each organization.

Measures

A total of 183 students, ages seven through 14, participated in the study. Not all students elected to complete both the pre- and post-lesson assessments. Unmatched surveys were removed from the paired *t*-test analysis (n = 136). The survey consisted of 12 questions relating to students' feelings about technology, environmental observation,

Table 2. Pre–Post Items Following EARPOD.

Assessment questions (n = 136)	*M*			Mode			*t* test
	Pre	Post	Difference	Pre	Post	Difference	*p* value
I know about different types of technologies*	3.81	4.15	0.34	4	5	1	<.001
I like to be outside	4.39	4.48	0.09	5	5	0	.236
I like to use technology*	4.25	4.46	0.21	5	5	0	.017
I know how to use different technologies*	3.76	4.11	0.35	4	5	1	<.001
I like to use technology outside*	3.40	3.99	0.59	3	5	2	<.001
I can use technology to learn	4.33	4.44	0.11	5	5	0	.12
I care about nature	4.57	4.52	0.04	5	5	0	.53
I use technology at home	4.38	4.51	0.13	5	5	0	.098
I can use technology to have fun*	4.35	4.54	0.20	5	5	0	.024
I like to look at birds*	3.53	3.87	0.34	3	5	2	<.001
I like to look at plants*	3.57	3.97	0.40	5	5	0	<.001
I want to learn more about technology	4.15	4.29	0.15	5	5	0	.123

Note. Mean and modal response were calculated with the total paired student responses. Scale: 1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, and 5 = *strongly agree*; EARPOD = Engaging At-Risk Populations Outdoors, Digitally.
*p = .05.

and the role of technology in the outdoors. All 12 questions are listed in Table 2. Researchers tracked individual responses by school-issued student identification number. The time between the pre- and post-assessment administration was at-most 1 week. In many cases, the pre- and post-assessment were completed by the students on the day of lesson delivery.

After the programming was complete, central tendencies of student responses before and after the lesson were calculated as well as a paired t test. Differences in mean, median, and mode for each question provided insight with respect to the level of student interest in technology and the environment before and after Project EARPOD.

Case Study

The following case study describes the procedures of Project EARPOD as they were conducted with one of the schools participating in the study, Lyndon Station Elementary School. Lyndon Station Elementary and Upham Woods are both located in south central Wisconsin. This narrative is an example of Project EARPOD procedures conducted on site at Upham Woods; however, procedures that took place at participating schools were conducted in a similar manner.

Project EARPOD researchers met with the students and teachers from Lyndon Station Elementary near the flagpole at Upham Woods on September 28, 2015. The Lyndon Station Elementary students visited Upham Woods for the day to participate in this research project as well as other outdoor educational experiences such as a guided ecology hikes, live animal programming, and ground-based initiatives with Upham staff. To begin the portion of their visit in which they engaged in EARPOD activities, the group gathered in a large circle and instructors facilitated the "Five-Second Survey" game, which consisted of asking the youth to look around them for 5 s and observe everything they could. After the students spent 5 s observing, researchers asked the students to close their eyes and then quizzed them on the attributes of their surroundings. Example prompts included "point to an object that is red" and "point to an object that has a straight line." The goal of the 5-s Survey was to prompt students to think about the importance of making scientific observations of the world around them.

Then, the group split in half, with approximately 15 students per group. These two groups were assigned to travel to opposite ends of the Riverbend Trail with their respective instructors. While walking, the students talked in pairs about what they already knew about trees and what they wondered about trees. They also made sensory observations along their walk. Each group stopped a couple of times on the way to their destinations to discuss their observations as a group; the instructor facilitated these discussions by asking additional questions. Once they had arrived at their respective destinations on the Riverbend Trail, the groups began to discuss trees, and more specifically leaves. Both groups began with the "I Notice, I Wonder, It Reminds Me of . . ." (INWR) scientific observation activity, as described by Better Environmental Education Teaching, Learning, and Expertise Sharing (BEETLES; 2015). The students were asked to look around to individually locate an oak leaf to make observations about and share their thoughts in small groups.

After this activity, the EARPOD lesson differed for the two larger groups that were at different locations along the trail. The first group studied the leaves with the use of technology, specifically a Celestron Digital Microscope, Microsoft Surface Pro 3, and the application *Corinth Micro Plant*. This allowed them to get a closer look at the "bumps" or "lines" that they observed and to see features that they could not have otherwise seen with the naked eye (e.g., cellular structure). The second group used hand lenses to make closer observations about their leaves, using an INWR activity to facilitate this observation. Both groups ended the activity by using dichotomous keys to identify the types of leaves they found.

Then, both groups engaged in a journaling session: Students recorded their observations by writing and drawing on blank paper with crayons and colored pencils. Students sketched features they thought were interesting and described what they learned during the first portion of their lesson.

After journaling was complete, the groups traded places: The first group engaged in the classic observation activity and the second group engaged in technology-enabled observation. All students ultimately participated in both the technology-enabled and classic observation sections. For pedagogical consistency, the Upham Woods instructors who taught the technology-enabled sessions did so for both groups; the instructors who taught the classic sessions did the same. At the end of the second half of the lessons, both groups returned to the flagpole. On the walk back, students paired up and discussed with their partner what they learned and observed that day. Once all were gathered around the flagpole, the entire group shared personal discoveries as a concluding activity.

Limitations

The research conducted during Project EARPOD was limited in design by two factors. The first was the need to ensure that all students who participated in programming at Upham Woods had access to equitable education experiences. The second limiting factor was the short duration of contact between researchers and the students who participated in the study.

To provide consistent programming experiences for students and educators familiar with existing programming at Upham Woods, Project EARPOD did not drop the classic observation lesson from the curriculum. Instead, the new, technology-enabled lesson was added to the classic observation lesson, resulting in the two-group structure described in the Lyndon Elementary case study. This structure was also chosen to assuage concerns brought forward by participating school system internal review boards that separating students into a test group and control group would result in unequal access to the benefits of the lesson enhancements. The programmatic structure implemented in Project EARPOD ensured equal student access to programming at Upham Woods; however, it resulted in a significant limitation to research design: All of the students experienced both the classic and technology-enabled observation lessons. This design limitation exemplifies a common difficulty for education researchers based in ISL centers who need to experiment with new instructional approaches while also ensuring equal student access to educational opportunities.

The second limitation inherent to education research at ISL centers like Upham Woods is the short duration of contact with the students and teachers participating in the study. The research conducted through Project EARPOD was limited by the 1- to 4-day time frame within which the school groups visited Upham Woods. This time frame resulted in a short time between lesson delivery and pre- and post-assessment administration. This short time frame is characteristic of ISL programming: ISL centers commonly have just one programming event attended by students of a given school and limited access to follow-up contact with students after programming is completed. As a result, the window of time between pre- and post-test administration is short.

Results

Researchers observed positive changes in students' self-reported attitudes toward and confidence in using technology between the pre- and post-assessments. Overall, there was an increase in the total number of students who chose *strongly agree* for many statements that framed learning with technology in a positive way. The most common (modal) response of all the questions in the postassessment was *strongly agree*. Table 2 summarizes the pre- and post-assessment results for all 12 questions in the survey, including the average student response, the modal response for each question, and the differences between pre- and post-assessment means and modes.

For the following questions, there were significant differences between the pre- and post-survey responses when a paired t test was run on the population (n = 136): I know about different types of technologies ($p < .001$), I like to use technology ($p = .017$), I know how to use different technologies ($p < .001$), I like to use technology outside ($p < .001$), I can use technology to have fun ($p = .024$), I like to look at birds ($p < .001$), and I like to look at plants ($p < .001$). These results suggest that by using technology tools in an outdoor setting, students' perspectives on using technology outdoors shifted. Similarly, students' interest in observing nature increased after this lesson from a most common response of *neutral* to a most common response of *strongly agree* in the case of "I like to look at birds." Researchers acknowledge the limitations of this experiment design; however, no data from this study suggest that the use of technology in an outdoor education setting had a negative impact on students' attitudes toward the learning they engaged in during the programming.

The second issue examined in this study was the feasibility of application of these technological components on a wider scale to a larger population of students. Project EARPOD served as a pilot implementation of the DOTS approach to integrating technology and outdoor education. This project, by using the resources available at the ISL center, Upham Woods, was filled to the capacity of grant funding. Implementation in the ISL venue mapped easily onto existing training, curriculum, and outdoor classroom spaces. Although the addition of digital tools added to the inventory of equipment that instructors had to manage, this fell within the bounds of feasibility. The grant funded up to 200 participants for this research, and the researchers were able to fill that capacity in half of the time (one semester) projected for the study to run that year. Although grant funded to participate at the ISL venue, the tools themselves remained portable enough that they later became available for use by teachers back in their school through a lending program at the conclusion of the study. One partnering educator reflected,

> The EARPOD project will be a great resource for youth, especially in middle school and high school classes, after they have had some natural resource background. Students will begin to connect the sciences of cellular structure to organisms found in their own backyard. In the long run, students will begin to connect how we treat our environment to what is able to live there—and become aware of environmental education on a deeper level.

The details reflected here pertaining to feasibility and expanded access suggest that the curricular approach piloted through EARPOD can be further developed.

Discussion

After engaging in Project EARPOD's digital technology-infused outdoor learning, students, on average, reported increased interest in using technology outdoors and observing plants. Results also indicated that, on average, students' confidence in their knowledge of mobile technology and its uses also increased. These results suggest that Project EARPOD's incorporation of digital technology in an experiential, outdoor lesson plan did not detract from students' learning experiences; in fact, it may have contributed to their reported increase in confidence and interest in digital tool use. To determine steps for future research and program implementation, an in-depth reflection on the role of digital technology in Project EARPOD is necessary.

Arguably, the most important consideration to make when adapting digital tools for outdoor education is to ensure that students are given the minimum tool necessary to facilitate engagement with concepts that are inaccessible without the tool. Project EARPOD aimed to adopt digital technology in such a way that it achieved task-technology fit, that is, so that the features of the technology are appropriate for the requirements of the task it has been adopted for. Only when this condition is met can the technology in question adequately support the individual performance of its user (Goodhue & Thompson, 1995). The digital tools used in Project EARPOD were adopted only for purposes that necessitated them, that is, purposes for which a more basic method would be inadequate. For example, the Corinth Micro Plant application illustrated plant cell biology that students cannot see with the naked eye or with a hand lens. As shown by previous investigations into student attitudes toward technology in educational environments (Naismith, Lee, & Pilkington, 2011; O'Connell & Dyment, 2016), students who consider technology to be either inadequate or unnecessary for a task will not perform that task successfully or will forego the technological intervention when completing the task. In the Project EARPOD evaluation instrument, the increase in positive responses to questions such as "I like to use technology outside" and "I know how to use different technologies" suggests that the technology incorporated was appropriate for the tasks and as a result enhanced the learning experiences of its users.

The nontechnological components of Project EARPOD's lesson plans may have also played a part in students' positive experiences using the digital components of these lessons. The incorporation of both digital tools and traditional scientific practices in Project EARPOD's lesson plans allowed students to interact with the subject matter in both capacities. In this way, the traditional STEM learning strategies helped to contextualize the use of digital technology in the learning environment. All lessons began with a prompt to students to observe their surroundings without the aid of any tools. Students conducted observations of color, shape, and texture engaging in basic observation and scientific inquiry on which they were later invited to build on with more focused observations. On a macrolevel, students used hand lenses and dichotomous keys to identify differences between plant species around them. On a microlevel, students used microscopes and tablets to learn about these species at a level of detail inaccessible without the use of high-tech equipment. Project EARPOD scaffolded the use of digital tools by connecting a practice that is intuitive to most students (observing the world around them) to a more formalized scientific observation methodology. For this reason, students were primed to use digital devices specifically for scientific investigation.

The contextualization of digital tools in the scientific inquiry process is important to establish because students have grown up surrounded by digital technology used heavily for social networking and entertainment (Lenhart, 2015). In their study on building conceptual knowledge through use of digital tools, Land and Zimmerman (2015) point out that digitized STEM education still benefits from “connecting talk,” a concept introduced by Allen (2002) to refer to the practice of making explicit connections between what is being learned and some other knowledge or experience beyond it. Many students arrive in classrooms with more experience using technology to play than to learn. By scaffolding the scientific inquiry process before introducing digital tools into it, Project EARPOD was able to establish this familiar technology for students as another way to engage with the natural world around them rather than a source for social networking or games. Prensky (2006) argues that digital natives more readily adopt digital methodologies for learning than their digital immigrant educators, but the usefulness of such technologies in these learning environments is wholly dependent on careful curricular planning. When adapting digital tools to a learning environment, it is important that educators ensure the tools connect learners to the material without acting as a negative mediator of the learning experience.

Responding to the critique offered to the initial explorations of technology in outdoor learning settings that were levied against early phases of the DOTS program, the EARPOD program shows promise. In this approach, the amount of technology and depth of use are scaled down in implementation, affordability and provided access for instructors utilize the approach in conjunction with their existing curricula. Many factors influence technology adoption, including instructor and student perceptions of accessibility. Instructors at the ISL venue elected to continue using elements of the program after the study concluded and, similarly, educators from the K-12 environment whose students participated in the study requested follow-up use of the tools. The implementation of the EARPOD program did demonstrate feasibility in that underserved populations elected into the project, completed the study, and positively reviewed the experience. To more fully respond to concerns of accessibility, additional development could include coauthoring curriculum with participating schools as well as facilitation of related experiences pre- and post-visit to the ISL venue.

Suggestions for Future Program Research

Outdoor educators who aim to engage the next generation of students in scientific observation would be well served to incorporate digital technology in their curricula. By encouraging youth to take and use technology outside, educators can harness learners’ existing modes of interaction with the world to teach them scientific research skills and enrich their experiences in the natural world. This pilot study provides data on student attitudes toward technology in outdoor education that could be useful to educators hoping to bring their experiential, outdoor curriculum into the digital age. These exercises scaffold a student's experience so they better understand the art and science of observing before they are handed a digital tool to supplement, document, and share their inquiry with others.

Project EARPOD's technological components are adaptable to various curricula and easy to use in the field. Facilitators do not necessarily need to have a strong background in environmental education to effectively deliver a Project EARPOD-based curriculum. Because of this, many user groups could successfully implement a technology-based environmental education program including scouts, 4-H, Young Men's Christian Association (YMCA), Boys and Girls Clubs, youth camps, schools, and so on. The EARPOD technology can fit into agriculture education curriculums, science curriculums, environment science curriculums, and social studies curriculums (as an added resource or stand-alone concept). There are applications of the technology that range from simple, such as basic exploration of a nature space, to more complex, such as conducting an energy audit of a building or a climate change study. The tools also enable a teacher-as-facilitator role and put the student at the center of their experience and learning. Students presented with the seemingly simple task of leaf observation and plant identification discovered that their focused, careful observations led them to dive deeper and begin to pose questions about organisms they noticed or ecological phenomena they may not have seen before, as well as big topic questions that scientific communities are currently grappling with.

Regarding future use, Project EARPOD could be explored further through use inside and outside of school settings, at camps, and in one-time offered activities. The opportunity for young people to get outside, use technological resources, and work together in small groups provides this tech-savvy generation of students with a new way to engage with the natural world.

Project EARPOD offers an initial data set from a pilot exploration of the DOTS method of introducing technological components to outdoor ISL programming. There are several ways in which this project can be expanded upon to better assess learning outcomes and student experience in comparison with similar curricula that do not adopt the DOTS method. This project has potential to be enhanced by the addition of more robust evaluation criteria and longitudinal explorations of the DOTS methodology. In particular, a longitudinal exploration of technology adoption in experiential education settings would measure the effectiveness of such technology against the novelty effect often seen in single-study analyses of curricular innovations (Bracht & Glass, 1968).

Technology-enhanced experiences for youth outdoors can support students while also expanding access to STEM learning. The initial findings from Project EARPOD contribute to a body of literature that supports the development of such programs. In future, robust evaluation of the technological components piloted in Project EARPOD would contribute to the goal of identifying best practices to serve both students and educators in technologically enhanced environmental education programming.

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