Adventure Learning @ the Learning Sciences

Brant G. Miller, University of Idaho, bgmiller@uidaho.edu
R. Justin Hougham, University of Wisconsin–Madison, rjustinhougham@gmail.com
Christopher Cox, University of Colorado Boulder, Christopher.Cox-2@Colorado.EDU
Von Walden, Washington State University, vonw@uidaho.edu
Karla Bradley Eitel, University of Idaho, kbradley@uidaho.edu

Abstract: Teaching the general public and K-12 communities about scientific research has taken on greater importance as climate change increasingly impacts the world we live in. The Adventure Learning approach to designing learning environments was used to engage high school students in authentic climate science inquiries in Greenland. The learning sciences represent an important next step in the evolution of Adventure Learning.

Teaching the general public and K-12 communities about scientific research has taken on greater importance as climate change increasingly impacts the world we live in. Science researchers and the educational community have a widening responsibility to produce and deliver curriculum and content that is timely, scientifically sound and engaging. To address this challenge, in the summer of 2012 the *Adventure Learning @ Greenland* (AL@GL) project, a United States' National Science Foundation (NSF) funded initiative, used hands-on and web-based climate science experiences for high school students to promote climate and science literacy. This poster reports on an innovative approach to education and outreach for environmental science research known as Adventure Learning (AL) and seeks to engage the learning science community in a dialog around research on Adventure Learning.

AL is a curricular approach that combines face-to-face and online learning experiences. The AL framework was originally tested through a series of circumpolar Arctic expeditions where a team of adventurers traveled via dogsled between remote villages (see the GoNorth! project at http://www.polarhusky.com). The AL framework as enacted by the GoNorth! project proved to be extremely successful, effectively reaching millions of students from around the world (The Learning Technologies Collaborative 2010).

AL was originally defined by Doering (2006) as "a hybrid distance education approach that provides students with opportunities to explore real-world issues through authentic learning experiences within collaborative learning environments" (p. 198). Building upon this definition, Veletsianos and Kleanthous (2009) define AL as "an approach for designing teaching and learning environments, whether those are online or hybrid, or used in face-to-face or distance education contexts" (p. 91). The framework associated with AL for the purposes of design, development, and implementation has nine principles that operationalize the approach (The Learning Technologies Collaborative 2010).

The purpose of AL@GL was to engage high school students in the US, and in Greenland, in atmospheric research that is being conducted in the Arctic to enhance climate and science literacy. Climate and science literacy was explored via three fundamental concepts: radiation, the greenhouse effect, and climate vs. weather. Over the course of the project, students in each location engaged in activities and conducted experiments through the use of scientific instrumentation. Students were taught science research principles associated with an atmospheric observatory at Summit Station, Greenland with the objective of connecting climate science in the Arctic to student's local environments.

Summit Station is located on the Greenland Ice Sheet [72°N, 38°W, 3200 m] and was the primary location of interest. Approximately 35 students at multiple locations in Idaho, USA, and Greenland participated in the hybrid learning environments as part of this project. The AL@GL project engaged students in an inquiry-based curriculum with content that highlighted a cutting-edge geophysical research initiative at Summit: the Integrated Characterization of Energy, Clouds, Atmospheric state, and Precipitation at Summit (ICECAPS) project (http://www.esrl.noaa.gov/psd/arctic/observatories/summit/). ICECAPS is an atmospheric observatory focused on obtaining high temporal resolution measurements of clouds from ground-based remote sensors including radar, lidar, infrared spectra and others. ICECAPS also launches radiosondes twice daily. This large suite of complementary observations are providing an important baseline understanding of cloud and atmospheric conditions over the central Greenland ice sheet and are supporting Arctic climate research on cloud processes and climate model validation. ICECAPS measures parameters that are associated with those identified in student misconceptions, for example, different types of atmospheric radiation, the effect of greenhouse gases, and climate versus weather (see also Haller et al., 2011). Thus, ICECAPS research and the AL@GL project combined to create a learning environment and educational activities that sought to increase climate literacy in high school students as well as communicate important atmospheric research to a broader audience.

Students participating in AL@GL activities were given a pre/post survey that measured content knowledge, understanding of science inquiry and the nature of science, and perceptions of human ecological impact. The survey instrument was developed specifically for the AL@GL project and included questions modified from the Student Understanding of Science and Scientific Inquiry (SUSSI) instrument (Liang et al., 2008), and the New Ecological Paradigm instrument (Dunlap et al., 2000), along with content specific questions (e.g. What is a cloud?). Pre surveys were administered to students in Greenland and the US prior to AL@GL activities. Post surveys were administered immediately following AL@GL activities and prior to students departing for home.

The pre/post assessment of student content knowledge produced mixed results. Total scores across the multiple-choice items relating to understanding of science inquiry, the nature of science, and perceptions of human ecological impact remained essentially unchanged for students in Greenland and the US after participating in the program. However, short-answer responses indicated that students' understanding of key climate topics, including clouds, radiation, greenhouse effect, and weather and climate, all increased. An increase in understanding is evident for students in Greenland and the US across all four topics. Overall, percentages were higher for students in Greenland than for students in the US. These results represent a limited view of student experience. Therefore, more focused research avenues need to be explored to understand the impact of the AL approach on student learning.

The learning sciences represent an important next step in the evolution of Adventure Learning. The seminal work of Bransford, Brown, and Cocking (2000) shifted the focus from instructional design for memorization of information to learning for understanding and the application of knowledge. There is much we can gain from the learning sciences as it relates to Adventure Learning that will greatly inform the next iteration. Three learning sciences paradigms will serve as the starting point for research on Adventure Learning. The paradigms of constructionism (Kafai, 2006), case-based reasoning (Kolodner, 2006, Kolodner et al., 2003), and project-based learning (Krajcik & Blumenfeld, 2006) each stand to inform rich avenues of inquiry for future Adventure Learning projects. The Design Based Implementation Research (DBIR) (Penuel, Fishman, Cheng, & Sabelli, 2011) approach is the perfect methodology for exploring the iterative back and forth between research and education. Thus, future Adventure Learning research, including the NSF EPSCoR *Managing Idaho's Landscapes for Ecosystem Services* (MILES) project, will implement a DBIR methodology.

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