Research In Geographic Education

EDITOR
Richard G. Boehm

MANAGING EDITOR
Joann Zadrozny

The Gilbert M. Grosvenor
GCGE
Center for Geographic Education

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Editor
Richard G. Boehm
Texas State University

Associate Editor
Denise Blanchard
Texas State University

Managing Editor
Joann Zadrozny
Grosvenor Center for Geographic Education

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OPEN INVITATION FOR COMMENTARY

The Grosvenor Center for Geographic Education is interested in continuing and expanding the conversation that began with the Roundtable Discussion of the Future of Geography Education.

Although the report presents concerns and strategies that reflect a diversity of viewpoints, it was never intended to be a one-off activity for the invited participants. Instead, we want to open up the discussion so that other stakeholders can offer commentary.

Do you agree or disagree with the perceived threats and opportunities facing geography education? Are there other issues affecting the health and status of geography education that are missing in the report, and if so, what should be done about them? Has there been any discernible progress in relation to the report's recommendations since the Roundtable event?

We encourage a fruitful, professional, and positive discussion about the future of geography education. A conversation in which we can discuss how we can all do our part to further geography education in a healthy manner across various mediums, platforms, and organizations.

Readers are invited to contribute a reply to the following report by sending their responses to the Managing Editor, Dr. Joann Zadrozny at j_z37@txstate.edu

SPECIAL REPORT

A Report on a Roundtable Discussion of the
Future of Geography Education

Prepared by
The Gilbert M. Grosvenor Center for Geographic Education
Texas State University

February 2020

Note: This Report was finalized in February 2020. It does not reflect
any progress that has been made in any of these areas since February.

I.
Background

The geography education community in the U.S. is small and acutely aware of the challenges it faces. Moving forward, its members must work collaboratively and build capacity to provide high quality geography instruction in schools. Judicious decision-making matters now more than ever. Alarms were sounded by a series of events taking place across the last three years (2017-2019). Initially, these threats to the field's well-being and status might not have been perceived as ominous; but when compounded over time, their potential negative influence cannot be ignored. Numerous developments endanger the security and sustainability of geography in the future of K–12 education:

- In December 2018, the National Geographic Society (NGS) terminated the Network of Alliances for Geographic Education that had supported geography education initiatives in every state since 1985. It was replaced with a regional network and emphasis on online courses, communities and Advisory Councils, led by Regional Directors and other National Geographic staff. Heavy emphasis was placed on media outreach and a challenge for teachers and students to become explorers.

- In the Fall 2019, NGS terminated the State Geography Stewards and Advisory Councils, which facilitated communication with geography educators in each state. Following this news, the Society announced the vision and goals of its new Education Strategy, highlighted by three pillars: 1) Movement Building for Solution Finding, 2) Game Changing Tools, Supports, and Resources, and 3) Field Building and Influencing the Space. It is unclear how these pillars will be applied to improve the formal geography curriculum, especially regarding teacher training, curriculum development, and assessment.

- Institutional challenges exist for the National Council for Geographic Education, including, 1) declining registrations at annual meetings, 2) maintaining an understaffed office headquartered in a high-cost Washington, DC, 3) significant financial losses in the past decade, and 4) diminished membership.

- The National Assessment Governing Board announced in July 2019 that geography would no longer be assessed in the National Assessment of Educational Progress (NAEP), which has issued data and reports since 1994 to provide national-level assessments of student achievement and proficiency in geography.

- Recent AAG Council Meetings (2015-2018) have witnessed a sharp reduction in time allotted to discussing geography education issues (especially K–12-related matters).

- Among universities, faculty positions have declined for scholars specializing in geography education. Geography-related positions, predominantly focusing on GIS, have been added or merged with environmental science, digital scholarship labs and other non-traditional roles.
- The Geography Education National Implementation Project (GENIP) has sponsored no national-scale geography education initiatives since 2017. Meanwhile, the 35-year old GENIP organizational model (AAG, NCGE, AGS, NCGE) does not reflect or account for emerging capacities and existing initiatives in geography education (*e.g.*, university-based research centers, the research coordination network funded by National Science Foundation, Esri Education, and others). Changing priorities among GENIP members also warrant concern. For example, GENIP's recent letter in response to NAEP was not signed by NGS, which raises questions about the committee's ability to "Present a unified voice on issues of policy, research, and developments in geography education" (quoted from GENIP's guidelines).

II.
Initial Discussion

Because of these warning signs, the Grosvenor Center for Geographic Education prepared a Roundtable regarding the future of geography education at the 2019 National Council for Geographic Education annual meeting in Austin, TX. A small, preliminary meeting occurred in San Marcos, TX on 26 September 2019. In attendance:

- *Dr. Alexander Murphy*: Professor, Rippey Chair in Liberal Arts and Sciences, University of Oregon; pioneer of the College Board's Advanced Placement Human Geography course.
- *Dr. Ellen Foster*: Associate Professor, University of Mississippi; President of National Council for Geographic Education (2016).
- *Dr. Robert Morrill*: Professor Emeritus, Virginia Tech; Virginia Geographic Alliance Treasurer; Writing Committee for *The Guidelines for Geographic Education* (1984), *Geography for Life: National Geography Standards* (1994); President of National Council for Geographic Education (1989); George J Miller award winner.
- *Dr. Michael Solem*: Professor, Texas State University; Director of Educational Affairs for American Association of Geographers (AAG) (2006-2019); Co-Director of the National Center for Research in Geography Education; Representative to Geography Education National Implementation Project (GENIP) for AAG; AAG Grosvenor Honors.

- *Dr. Richard Boehm*: Professor, Jesse H. Jones Distinguished Chair in Geographic Education, Texas State University; Director of Grosvenor Center for Geographic Education; President of National Council for Geographic Education (1983); Writing Committee for *The Guidelines for Geographic Education* (1984), *Geography for Life: National Geography Standards* (1994); George J. Miller award winner; AAG Grosvenor Honors (2002).

From this meeting, an agenda was developed for the Roundtable discussion in Austin on "The Future of Geography Education." This meeting was held on Friday morning, 22 November 2019, 9:00AM to 12:00PM, at the joint conference of the National Council for the Social Studies, NCGE, and the Texas Council for the Social Studies.

III.
Agenda for the Discussion (Abridged)

1. Support for K–12 geography education at the American Association of Geographers (AAG).
2. Prospects for reinventing the Network of Alliances for Geographic Education, formerly supported by the National Geographic Society, with new goals and new leadership.
3. Repurposing GENIP and its membership guidelines.
4. K–12 education support and approaches based on new curriculum theory (e.g., student career and life aspirations) and state-based models of standards, teacher preparation, and assessment.
5. Revitalizing NCGE (e.g., expanded membership, financial growth, more traditional annual meetings, and a revamped Central Office).

What follows is a summary of the Roundtable's response to the five agenda items, accompanied by recommendations. The synopsis captures the range of views and ideas expressed by participations about possible paths forward.

IV.
AAG and Geography Education

AAG would benefit from regular reporting of K–12 geography education issues at the Council Meetings of the American Association of Geographers (AAG) and communication with the broader membership. Geography education lies at the core of AAG's aim to address geography's persistent underrepresentation of women and minorities, as well as the stagnant numbers of undergraduate and graduate geography degrees earned over the last few decades. Improvements are

unlikely without broad structural reforms in K–16 that encourage diverse populations of students to pursue degrees and careers in geography.

AAG should consider the following:
-   Plan for annual meetings between the Executive Committees of the AAG and the National Council for Geographic Education. This strategy was used in the early 1980s with the "National Reform Movement in Geography Education," which included publication of the Five Themes in *The Guidelines for Geographic Education, Elementary and Secondary Schools*, and National Geographic Network of Alliances for Geographic Education.
-   Reserve a section of the AAG journal, T*he Professional Geographer*, for articles reporting on advances in teaching and learning in U.S. higher education. This section's subject matter would represent the American counterpart to the British publication, *Journal of Geography in Higher Education.*
-   Assess the ongoing effects of renaming geography departments in order to emphasize science and technology.
-   Encourage research, education, and outreach that bridges geography in K–12 and higher education.

V.
Network of Alliances for Geographic Education

The final chapter of the Alliance Network does not end with the NGS withdrawal of direct financial and institutional support. More than 20 states are secured by educational endowments contractually oriented toward state-based K–12 activities in geography education. Advocacy, a central tenet for the Alliances throughout history, remains a priority for active states to advance K–12 geography education. While not tethered to National Geographic, remnants of the original 50-state network have the opportunity to mobilize NGS's new programs.

To continue the service function of the state-based Alliance program, the following is recommended:
-   Assign NCGE as the new home for the Network of Alliances.
-   Require Active Alliances to pay annual dues to NCGE for organizational services.
-   Develop and maintain an accurate roster of Alliance Coordinators and other leaders in geography education. Accompany this roster with a statement of educational purpose that unifies the Alliance Network's message, regardless of varying responsibilities from state to state.

- Through Alliance Coordinators, identify state education award winners for the annual NCGE conference.
- Foster dialogue and idea-sharing through a business meeting of Alliances Coordinators during the annual NCGE conference.
- Elect a leadership group to determine the Alliance Network's common trajectory.
- Alert Alliance Coordinators to the proprietary value of the state-based network as gatekeepers for private industry to K–12 schools, teachers, and students. Negotiate the extent of access and coordination between Alliances and the commercial outlet in question.

VI.
GENIP

The Geography Education National Implementation Project (GENIP) was formed in 1985 and includes four major geography associations: AAG, NCGE, NGS and the American Geographical Society (AGS). The founding purpose of GENIP was to advocate for and support the 1984 *Guidelines for Geographic Education*, the "five themes," and *Guidelines*-related publications. Later, GENIP undertook a planning and clearinghouse role to fashion large-scale geography education projects, such as the Geography Framework for the 1994 National Assessment of Education, National Assessment Governing Board, and the national standards project (1994) *Geography for Life*, including the revision and update (2012). Through these projects, GENIP has enjoyed successes in advancing geography education. As institutions have changed, however, institutional membership has not. GENIP risks stagnation in a period of rapid growth and broadened thinking within the geography education community.

To modernize the role of GENIP or an alternative national coordinating committee into the future, the following actions are recommended:
- Broaden membership to include new voices and points of view, especially as levels of involvement change among the four original institutions.
- Clarify the relationship of GENIP to the NGS Educator Network. Ascertain how the work traditionally performed by the former Alliance Network (31 December 2018) can be maintained or enhanced, particularly in light of NGS's termination of State Stewards and Advisory Council members and organization's decision to no longer participate in organizational statements and sign-on letters (*e.g.*, the recent GENIP response to NAEP).

- In the case of considering GENIP membership by commercial companies, carefully negotiate the conditions of membership to avoid financial "conflicts of interest."
- Extend the review of GENIP guidelines (revised as of 2018) beyond the internal advisory board to a broader audience from dues-paying organizations.
- Revise leadership positions in GENIP to be short-term, revolving, and inclusive of diverse perspectives and expertise in geography education.

VII.
K–12 Curriculum

As of 2020, geography education's most visible contribution to the K–12 curriculum has been the national standards in 1994 and 2012, published in the volume *Geography for Life*. This thoughtful document emanated from the national standards movement of the early 1990s and represents a high point in thinking and advocacy among geography educators and school officials. Despite these efforts, results from NAEP have repeatedly documented no significant gains in geographic learning over the last quarter-century, indicating especially low-levels of achievement among African Americans and Hispanic students. Discussions are afloat concerning yet another revision of *Geography for Life*. Future curriculum documents and approaches should draw on empirical research that reflects educational contexts, students' life and career aspirations, and state and national workforce needs.

The following is suggested:
- Tailor new curriculum guides for K–12 geography to address the diverse life and career aspirations of the modern student. Consider existing initiatives like Powerful Geography, which applies empirical research to generate a bottom-up curriculum (see www.powerfulgeography.org for more information).
- Align new subject matter in geography with curricular work in other disciplines such as the National Council for the Social Studies C3 (College, Career, and Civic Life) Framework, the Next Generation Science Standards, and Career and Technical Education.
- Recognize the varying educational priorities of local educational institutions, such as the attitude of "Enroll, Employ, or Enlist" among some high schools.
- Prepare any new framework guide to reflect state-based curriculum and assessment alignment, along with state-based teacher certification programs.

VIII.
NCGE

Opportunities abound for NCGE to reenergize its institutional makeup and leverage resources like the newly incorporated Alliance Network. One-on-one discussions have taken place between the Grosvenor Center and the new NCGE Executive Director. Through these conversations, it becomes clear that NCGE has an important function to lead geography educators through the twenty-first century. Roundtable participants agree that reinvigorating NCGE is necessary for securing the future of geography education. A strong and productive NCGE is critical to all of the other recommendations in this report.

Our suggestions include:
- Coordinate a membership drive for both K–12 educators and administrators, and for university professors.
- Hold a broad fundraiser consisting of the 35 Past Presidents and their close associates.
- Establish an independent annual conference, publish a fall conference program, and elevate the visibility of the NCGE awards program for teachers, professors, and researchers.
- Arrange an annual meeting between the NCGE and AAG Executive Committees to discuss cooperation.
- Consider relocating the NCGE Central Office to a university campus.
- Maintain the network of past Alliance Coordinators.
- Carefully review financial relations with commercial companies.
- Prepare educational and financial reports for the business meeting at the national conference.

IX.
Participants for the Roundtable Discussion

Moderator:
- *Dr. James Kracht*, Professor Emeritus, Texas A&M University; Past-President NCGE 1987

Participants:
- *Dr. Richard Boehm*, Professor, Texas State University; Past-President of NCGE 1983; Texas Geographic Alliance
- *Mr. Kurt Butefish*, Instructor, University of Tennessee Knoxville; Tennessee Geographic Alliance
- *Dr. Dawna Cerney*, Professor, Youngstown State University
- *Ms. Annie Evans*, Director, New American History, University of Richmond; Virginia Geographic Alliance Coordinator

- *Dr. Thomas Herman*, Professor, San Diego State University; California Geographic Alliance
- *Dr. Georgeanne Hribar*, Professor, Old Dominion University; Virginia Geographic Alliance
- *Mrs. Erin Kracht*, Alabama Geographic Alliance (retired); Alabama Geographic Alliance
- *Dr. Edward Kinman*, Professor, Longwood University; Virginia Geographic Alliance Coordinator
- *Dr. Robert Morrill*, Professor Emeritus, Virginia Tech; Past-President NCGE 1989; Virginia Geographic Alliance Treasurer
- *Dr. Michael Solem*, Professor, Texas State University; GENIP representative for AAG
- *Dr. Joseph Stoltman*, Professor, Western Michigan State University; Past-President NCGE 2009; Michigan Geographic Alliance Coordinator

Recorders:
- Dr. Thomas Larsen
- Dr. Joann Zadrozny

Note

This report was prepared by the Research Faculty of the Grosvenor Center for Geographic Education: Dr. Richard G. Boehm, Dr. Michael Solem, Dr. Joann Zadrozny, and Dr. Thomas Larsen. The Final Report was sent to all the participants of the Roundtable for their input and review before this final published version. We thank everyone for their input.

Becoming global-minded scientists:
The short- and long-term impacts of international exchange

Niem Tu Huynh*
Concordia University
*corresponding author: niem.huynh@concordia.ca

Patricia Solís
Arizona State University

Philippe Huot
McGill University

Nwasinachi Menkiti
Texas Tech University

Aishah-Nyeta Brown
George Mason University

Dara Carney-Nedelman
YouthMappers

Alan Coronado
Universidad Tecnológica de Panamá

Kayla Soren
International Student Environmental Coalition

Abstract
Research on international exchange demonstrates multiple positive outcomes for participating students. Using data collected from the participants of a Youth TechCamps program, the research questions are squarely focused on how international experience impacts learners' understanding of the world and their new cultural awareness. The working hypothesis is that the experiences of working with international peers will influence students' perceptions and understanding about global matters. This article adds to the literature by showing that some changes have an influence in the short-term while others persist and

have a long-term impact. Specifically, the difference between short- and long-term impacts relates to how students integrate those changes. The former is passive (*i.e.,* I understand differences exist among people) while the latter mark intentional change (*i.e.,* I incorporate attractive components of another culture to ways of doing things). The findings are couched in research that brings together students in the U.S.A., Bolivia, Panama, and South Africa.

Keywords: international exchange, cultural awareness, cultural sensitivity, high school students

Introduction

How do our perceptions of people and different cultures impact the way we behave and treat others? This is an important question as cultural capital influences the way we think about, speak to, and engage with people of a different background. Geography education offers a strong contribution to the way we understand the world, from formal classes about the world to informal knowledge acquisition through travels or National Geographic media. At the root of geographic literacy, we consider how to understand people and places, and the differences across boundaries that separate cities, states, and countries. The future promises a society that will face complex issues as a result of continued globalization, increasing movements of a growing population, interconnections between people and places, as well as potential new cultural conflict arising from global change or decreasing resources. How prepared are students, whether in the U.S.A or abroad, to understand this landscape, let alone be at the helm to lead globally?

One measure to approach answering this question is through standardized testing of students' geography knowledge, although if this is any suggestion of students' ability to make informed decisions, it is not promising. Students in the U.S.A. perform poorly on national geography tests (National Center for Education Statistics, 2011), in international assessments (Trivedi, 2002), and young adults are equally baffled by geography in public surveys (Growth For Knowledge, 2006).

The question of student preparedness to lead was an impetus to the project *Global Connections and Exchange Program Youth TechCamps* (from heron referred to as 'Youth TechCamps'), funded by the State Department Youth Programs Division. The authors' curiosity ranges from how problem-based contexts could fulfill learning standards in geography (Solís et al., 2017) with one focus on geospatial technology and global climate change (Solís et al., 2019). Youth TechCamps was designed around an immersive 2-week international

exchange for high school learners to focus on climate change and geospatial technologies. Another critical focus of the program was to examine how cultural exchanges influence learners' perceptions of people and places in different learning situations.

The Youth TechCamps stands out because unlike many of the international exchange studies, which are between member countries of the OECD, specifically between wealthy countries, this research involved developing countries. Through this program, high school youth from the U.S.A., Bolivia, Panama, and South Africa developed deep knowledge about geospatial technologies and how to apply them in service to their communities. Participants were emerging science students applying a science and geography lens to their practice while gaining a deeper understanding about different cultures of the world.

The Youth TechCamps experience was created by following an 'overdetermined design', (Solís et al., 2019) where redundant steps in the research method increase the likelihood of having the desired results of improving students' confidence in STEM, geospatial technologies, and cultural knowledge Two instruments were used to collect in-depth answers about participants' exchange and reflections. The first instrument consisted of a 21-question survey with Likert scale options about participant perception of cultural perspectives, impact of science to society, and climate change knowledge. The second instrument, given to all participants, U.S.A. and foreign participants, at the end of their experience, was a set of open-ended questions. The research outlined here is squarely focused on how this international experience impacts students' understanding of the world and their newfound cultural awareness. The authors hypothesize that the experiences of working with international peers will influence students' perceptions and understanding about the world's people and cultures. The desired outcome is for the students to see a problem from multiple perspectives, be open to learn from those with a different approach than their own, and to be able to ask research questions that encompass diverse viewpoints. The program offered the opportunity as a qualitative experiment to observe how global-minded scientists are nurtured and what their learning process looks like when it unfolds in an international exchange context.

This paper begins by situating the research in the literature on international exchanges and their impact on learners. This is followed by a description of the data collection methods and of the participants in the program. Next, the results section provides a comparison between pre-, post-, and final-test surveys and descriptions alongside the changes (or lack thereof) in student learning as a result of this international experience. Finally, a discussion of findings is followed by a conclusion of lessons learned and a call for future research.

Literature review

The experience of taking part in an international exchange has resulted in multiple positive outcomes for students involved. Through immersion in another culture, students adapt to and learn to appreciate differences across cultures. This impact translates into adolescent development which results in overall wellbeing and psychological health (Lawford et al., 2012), the workplace (Crossman and Clarke, 2010; Rapoport, 2008; Duffy et al., 2005; Neander and Markle, 2005; Inkson and Myers, 2003). Its impact is long-lasting, as shown by studies that examine children or teenagers who have participated in such experiences (Peiser, 2015; Zhu et al., 2011; Zsiray et al., 2001). Bachner and Zeutschel (2009) followed a group of 14-18-year olds after their US-German exchange. The positive impacts, which include improved self-confidence and autonomy, were maintained years after the experience. Students generally found that the exchange created opportunities to build friendship and improved communication skills (Yang et al., 2013; Bishop, 2009). Generally, the literature suggests that international exchanges have positive long-term effects on student confidence, ability to accept cultural and language differences and the learners were passionate about global citizenship.

The literature also suggests that students in exchanges benefit both in the short- and long-term. Whereas such gains as developing friendships and building cultural capital are immediate measures of a successful experience, follow-up studies posit that participants gain both explicitly and implicitly weeks to a few years after the experience. Over a thirty-year period, Bachner and Zeutschel (1994) conducted follow-up studies on high school students, in Germany and U.S.A., who had travelled to the partner country. The researchers found that this experience helped students develop personal traits (*e.g.,* self-confidence, acquire resources for problem solving, self-reliance), abilities and skills (*e.g.,* research techniques, foreign language proficiency, leadership abilities, knowledge of German culture) as well as education and career choice (*e.g.,* influence their career choice, enrolment and completion of undergraduate degree, choice of specialization in graduate studies). In another longitudinal study, Paige et al. (2009) found short- (one to five years after experience) and long-term outcomes (six years and more after experience) from undergraduate students' study abroad participation. The results, derived from quantitative and qualitative data, support the notion that the international exposure played an important role in their societal engagement. The authors classified these types of engagements into five classes (civic engagement, voluntary simplicity, knowledge production, philanthropy, and social entrepreneurship) as well as educational and career choices.

The positive impact of exposure and interaction with different cultures is not limited to those found in a structured format. Travel, even if not part of an exchange program, also has similar positive improvements in being open-minded

and feeling comfortable with people of diverse backgrounds (Scarinci and Pearce, 2012; Abarbanel, 2009).

Access to cultural capital is increasingly essential in public and private sectors, to better serve 'clients' and collaborate with international and national partners. For example, cultural awareness and the ability to work with diverse stakeholders are valued in the field of research. Where national and international collaborations occur, with the latter seeing higher citation impacts (Adams, 2013) that enrich research quality and production (Martinez et al., 2015). Adams' (2013) research on international collaboration found that research with partners outside of one's home country has increased in the last 30 years. The benefit to researchers is that international co-authored papers are cited more often than purely domestic publications. In the U.S.A., papers published with at least one author from another country was cited 22% and 36% more than domestic papers in 2001 and 2011, respectively (Adams, 2013). What motivates researchers to work with colleagues across borders? Some studies point to similarities in researchers' culture and language to be a driving force for collaboration (Adams et al., 2014; Boshoff, 2010), giving value to international experiences, which are known to foster cultural awareness and language acquisition (Jokisch, 2009).

The literature provides strong evidence that international exchanges positively impact learners' sensitivity towards diversity, regardless of the age of the learner. The literature supports the notion that short study abroad experiences foster cultural awareness and the ability to reason differences (Zhu et al., 2011; Ellenwood and Snyders, 2010; Jackson, 2009). However, few research studies examine this longitudinally with exception (*e.g.,* Bachner and Zeutschel, 2009; Paige et al., 2009; Duffy et al., 2005) where much of the literature, although supporting positive impact of international exchange, is focused on immediate or short-term gains. Unfortunately, this reflects the current reality of conducting research with school-aged learners, given the increasing difficulty to access this population and to acquire ethics approval.

Overall, research on international exchange suggests that learners' post-experience has a positive shift in their personal as well as professional spheres. What is less often discussed in these studies is how these gains might influence their engagement with geographic understanding of people and places over time. Within the geography education literature, few studies delineate which are the short- and long-term gains from exposure to cultural differences. This article addresses these paucities directly, especially in a geographic context, while calling for more research and better methods to answer questions about the potential gains from international exchange experiences.

Methodology

This study used a mixed-methods approach. The first instrument consisted of a 21-question survey with Likert scale options about participant perception of cultural perspectives, impact of science to society, and climate change knowledge. Two statistical operations, Wilcoxon signed-rank test and Friedman test, were used to determine significance in the results. Only results of the cultural perspectives survey will be discussed here.

The second instrument, given to all participants, U.S.A. and foreign participants, at the end of their experience, was a set of open-ended questions. These were used to collect in-depth answers about their exchange and reflections.

This section begins with a description of how quantitative data were collected and analyzed. This includes an overview of the surveys and its dissemination timeline, followed by the hypotheses tested in the research. Next, a discussion details how the qualitative data were collected and analyzed. Finally, a profile of the participants is summarized.

Quantitative data collection

The 21-question survey borrows questions from a cultural sensitivity questionnaire developed by Olson and Kroeger (2001). The selected questions were specifically about responders' perceptions of culture. In total, surveys from three different time points were collected from U.S.A. participants, with response rates ranging from 100% (pre-test) to 50% (post-test) to 80% (final-test). Due to the extreme lack of time during orientation for international students and the challenges connecting to some students via digital communication, they did not complete a pre-survey. However, they participated in a post-survey that was released at the same time as that for U.S.A. students. For this reason, the quantitative analyses are focused on the U.S.A. students who provided pre-, post-test data for comparison.

A pre-test and two post-evaluations were conducted to measure participants' experiences abroad. All U.S.A. students responded to the online pre-survey (100% response rate) during an allotted period at the orientation, prior to departure. Of the sample, 69% of the respondents were female (n=22) while 31% were males (n=9). These students were generally well travelled outside of their home state, with a median of three trips per year. Reported international travel ranged from 1 to 5 per year but just over half had never left the country prior to this trip (55%) while 69% of respondents had a passport prior to the Youth TechCamps.

Approximately 6 weeks after returning from the program, U.S.A. students were surveyed again (referred to as 'post-test' from hereon). Fifteen survey responses were collected from five male and 10 female participants (50% response rate).

Nine months after their return, the same post-survey was sent out (referred to as 'final- test' from hereon). Twenty-four complete surveys were collected from 7 male and 17 female participants (80% response rate).

The authors sought to measure whether the Youth TechCamps participation had any impact on a shift in U.S.A. students' perception, understanding, and action towards international matters. The dataset includes all responses from complete surveys collected at three time periods: before departure, six weeks after return, and nine months upon return. The hypotheses and statistical tests are elaborated below.

Test 1: To identify whether the intervention (*i.e.,* Youth TechCamps) had any immediate impact on student perception and interaction with peers of different culture(s). The tests examined whether statistical differences exist between responses provided in the pre-test and post-test questions. The non-parametric Wilcoxon signed-rank test was used to compare paired responses, between 12 students who answered both the pre-test and post-test, as it enabled us to conduct paired comparisons in a context in which the sample size was small and data could not be assumed to follow a normal distribution (Howell, 2008; Siegel and Castellan, 1988).

The hypothesis is that the intervention would produce an increase in overall respondent confidence in their understanding of differences and similarities across cultures. A one-tailed method was used. Twelve students completed both pre-test and post-test. Gender differences on this particular topic were not considered, as a separate test showed no statistical difference between female and male responses. Furthermore, the number of female respondents (n=8) was much higher than that of males (n=4).

Test 2: To identify whether the intervention (*i.e.,* Youth TechCamps) had any long-term impact on students in general, whether it be personal worldview or way of being. The tests examined whether statistical differences exist between responses provided in the pre-test and final-test questions, the latter that was conducted 9 months, labelled as 'final- test', after students returned from the trip. The non-parametric Friedman test was used to compare paired responses, between 11 students who answered the pre-test and post-test and final-test. The Friedman test was selected because it enables conducting repeated measure analysis when normality of data cannot be assumed or when sample size is small (Howell, 2008; Siegel and Castellan, 1988).

The hypothesis is that the intervention would influence some element of their personal view or interaction with different cultures. A one-tailed method was used. Data from eleven students who completed all three surveys were used. Gender differences were not considered on this particular topic as a separate test showed no statistical difference between female-male responses. Furthermore, the number of female respondents (n=8) was much higher than that of males (n=3).

There are two limitations in this study, both related to the data collection process. First, not all participants completed the three surveys. Second, post-test participation was lower compared to the pre-test, although the final-test response rates returned to a high level. Thus, not all views were represented over the mid-term comparison. Nevertheless, sufficient responses were generated across the groups to permit descriptive quantitative assessment and qualitative interpretation of results.

Qualitative data collection

The post-survey for all participants included nine open-ended questions, which were developed for the Youth TechCamps program. Specifically, the questions were designed to solicit feedback on student's experience working with peers of different cultures, immediate gains from the program, and any impact to future plans. The questions were sent 6 weeks after the conclusion of the Youth TechCamps, yielding a 50% response rate from U.S.A. students (15 received from 30 participants). Twenty-nine responses were received from international students (33% response rate), almost half from Panama (n=15 out of 29), followed by Bolivia (n=7 out of 30), and South Africa (n=6 out of 27).

Responses from all participants were compiled, by question, resulting in a rich set of qualitative data. The analysis was performed by a single researcher who combed through the data using the grounded theory approach (Charmaz, 2006). The process was iterative and refined by the emergence of words and ideas that repeatedly popped up in the data. The researcher looked at overall common themes from all participants and also took note of differences, if any, between USA and international participants. The selection of qualitative themes was informed by author participation in national level geographic research agendas to discover a road map for establishing disciplinary learning progressions (Huynh et al., 2015).

The themes were brought to two colleagues for discussion: Principal Investigator (PI) of the project and lead project evaluator. Due to their intimate knowledge of the program and close communication with the participants, the PI was able to validate the interpretations with respect to conformity to the implementation framework and vet that the surfaced themes were comparable to those observed and heard from participants during the Youth TechCamps. Finally, the lead evaluator, who is removed from the operation of the project, provided a neutral space to discuss ambiguous responses and how to group findings, particularly in ways that inform the current literature gap.

Participants

Participants from the U.S.A were outstanding high school students who were selected to team up with counterparts in Bolivia, Panama or South Africa. They collaborated online and in person at one of the three rounds of training

events to address the theme of *Geotechnologies for Climate Change & Environment.*

A total of 116 students participated, with 30 from the U.S.A, 30 from Bolivia, 29 from Panama and 27 from South Africa. While the international students participated in their own country, 10 U.S.A. students went to one of the three host countries (Table 1). Of the U.S.A. group, 63% (n= 19) were female, while this number was 55% (n=47) for the International students. Their ages range between 15-18 years old. Participants were competitively selected for this program from across the country, attendees primarily coming from the east and central U.S.A. compared to the south and west. Residence of students from Bolivia, Panama, and South Africa was clustered around the large cities.

Table 1. Number of student participation, by country

Participants	Host Country		
	Bolivia	*Panama*	*South Africa*
U.S.A.	10	10	10
Bolivia	30	-	-
Panama	-	29	-
South Africa	-	-	27
Total participants	**40**	**39**	**37**

Results

Comparison of pre-, post-, and final-tests of U.S.A. participants

Table 2 compares the responses between two timeframes: 1) pre-and post-tests and 2) pre- and final-tests. The second column ['Immediate impact of intervention (Pre-test to Post-test)'] shows statistically significant differences that were found in 3 survey questions, with scores increasing from the pre-test to post-test, namely questions 3, 5, and 10. The third column ['Long-term impact of intervention (Pre-test to Final-test)'] shows statistically significant differences in 3 survey questions, detected by the Friedman test. This means that differences were found across the pre-test, post-test and final-test in survey questions 4, 6, and 8. It is important to note that none of these 3 survey questions, from the post-test and final-test scores, dropped to the pre-test level.

Within the first six weeks of returning from the trip, the quantitative data suggests that the most immediate impactful influence was on their perception of people from different cultures. The essence is that people are the same, regardless of the outward appearance or lived culture, and that friendships are forged (Questions 3, 5, and 10). The second set of data collected 9 months after the return suggest that students practice personal reflection about one's views which have

the power to bring upon action such as questioning personal prejudices or incorporating aspects of a culture into one's life (Questions 4 and 6). Question 8 is statistically significant and suggests that students recognize the value or cultural importance to be fluent in a language other than their mother tongue.

Table 2. Comparison of responses between pre-, post-, and final-tests

Survey questions	Immediate impact of intervention (Pre- to Post-tests)[1] (n=12)	Long-term impact of intervention (Pre-Post-Final-tests)[2] (n=11)
1. I am aware of ways that I could raise awareness about my involvement in this program in my home city or		
2. I am able to temporarily give up my own worldview to participate in another worldview		
3. I understand that differences exist but believe that we should focus on similarities. We are all human	*($p = 0.0078$; $W = 28$)	
4. I question my own prejudices as well as all national and cultural stereotypes		*($p = 0.0283$; FS = 7.103)
5. I have long-term friendships with several people from other cultures	*($p = 0.0313$; $W = 19$)	
6. I incorporate the attractive aspects of other cultures into my own way of doing things		*($p = 0.0213$; FS = 7.517)
7. I have substantive knowledge about at least one other culture outside of the United States		

8. I am linguistically competent in a language other than my native language	*(p =0.0237; FS = 7.583)
9. I want to continue to learn about the world's peoples, cultures, and issues	
10. People are the same despite outward differences in appearance	*(p = 0.0098; W = 45)

[1]Wilcoxon signed-rank test, One-tailed <0.05
[2]Friedman test, Two-tailed <0.05

Open-ended questions collected from all participants

Qualitative data are complementary to the quantitative data in Table 2 to enhance the understanding of the immediate and long-term impacts. Qualitative analyses, using grounded theory, were applied to the open-ended responses in the post-tests. Table 3 summarizes the survey questions posed followed by an expanded understanding of each theme based on aggregated student responses. The emerging themes include cultural awareness, outreach to peers and community, research and collaboration. Direct quotes are taken from surveys to illustrate students' thinking; no attempt has been made to correct grammar so as to preserve the participant's original writing.

Table 3. Themes from participant feedback

Theme	Open-ended question(s)
Cultural awareness	1. Having now worked with students from another country, how have your reactions or views to different cultures changed, if at all? 2. Describe your experience working within a team of diverse peers in the Youth TechCamps.
Peer education and community outreach	3. Please describe any specific action or activity you plan to do or have done as a result of your experience with the program? Are there any actions you have taken up or planned to do now that you are home? 4. What experiences or tools or skills that you developed during the Youth TechCamps do you plan to share or have you shared with friends or classmates?
Research and collaboration	5. Describe your experience working within a team of diverse peers in the Youth TechCamps.

Theme 1: Cultural awareness

The majority of participants described the Youth TechCamps experience as pivotal to their cultural sensitivity, expanded perspectives of other cultures, and more confidence engaging with different cultures. The international participants mentioned a number of interesting discoveries and enjoyed learning about such topics as U.S.A. dance, music, meals, fashion, school system, and climate.

The increased sensitivity to culture stems directly from interaction. International students admitted their biases and stereotypes about students in the U.S.A., but these were soon dispelled, and they quickly learned that there were many similarities. An international participant recalls their change in perception: "*At first I thought that Americans were all self-centered as they portray them in movies but opposite is the case the TechCamp helped me to see that we are all people with common goals in life*".

A second form of cultural sensitivity comes from the participants' reflection of past interaction with peers from different cultures and making a connection between geography, culture and behavior. A participant explained in their middle school, "*African students that were ostracized pretty badly because of how boisterous and playful they were. None of us Americans understood it, but after actually being in South Africa and seeing the difference in culture, I see it.*"

Regardless of the participants' home country, many explained that they saw their peers as people, with similar dreams, hopes, and fears, despite the physical distance. It was also clear to them that despite economic differences among countries, peers are very similar. A representative quote is "*Everyone around me had similar plans for the future and ideas in general and it opened my eyes to the fact that there are people all around the world who want the same things for this planet that I do. I feel that there is a lot of potential power in that.*"

Similar to developing sensitivity to cultural differences, participants have overwhelmingly noted that they have "*a new perspective on the lives of others around the world.*" Since interacting with diverse peers and realizing that one's perspectives developed from media or other sources may not be correct, participants feel more comfortable visiting other countries as they will be able to relate to different ideas and perspectives. A consensus is that "*I've seen that at the end of the day transcontinental cultures have far more similarities than differences.*" For some, the Youth TechCamps inspired students to appreciate and be curious about other cultures. As a result, generally, participants have become more open to immersing into different cultures than before.

Some students have taken the initiative to actively participate in their local culture. These ranged from being friendly and open to everyone to engaging and learning from cultures in the host country. One student from the U.S.A., an enthusiast of Hispanic music and Latino culture, described "*During another day, I had the pleasure of talking to a student about the various styles of dance in,*

including típico, and how these styles both came about and evolved-again this was in Spanish."

Theme 2: Peer education and community outreach

The Youth TechCamps have resonated with participants tremendously. As a result, the scale of action plans ranges from doing something for the self, for/with peers, and for the larger community. A list of these plans for the near future or items in action is summarized below:

Action for/with self
- Join the New Global Citizens club and Model U.N. club at school to continuously be involved with international issues.
- Study environmental issues, major in International Relations, with a goal to work for developing countries on social justice issues. This student mentioned that *"The experience completely changed the course of my life."*
- Independently study effects of climate change and Spanish language.
- Plan to map the impact of mountaintop removal in Appalachia, Kentucky.
- Study abroad in college for the experience. This participant explains *'Now I want to do this so much more than I did before. It is now an official requirement of my college experience.*

Action for peers
- Initiate Earth club at school to plan a garden and teach students about food sustainability.
- Contribute ideas to class projects on climate change (GIS Analysis class), explained climate change to Geography class.
- Educate peers on the importance of individual action. For example, the idea of carbon footprint and ways to minimize this.
- Educate peers and community about reforestation and its value to the environment.
- Describe the experience of interacting with a new culture with family and friends.
- Continue interacting with friends from host nation and U.S.A. via Skype.
- Educate peers on technology (e.g., ERDAS, GIS, GPS etc).
- Involve with Green team at school.
- Start a GIS club at school and have contacted a local university for support.

Action for community
- Model after a Youth TechCamp project on sink holes at Centurion mall, will visit malls around the community to document evidence of sink holes (as a result of glacial retreat).
- Organize a clean-up day/trash pick-up day.
- Assemble a support group to reduce pollution in the community.
- Use GIS skills in local GIS group, part of 4-H program (leading one in the US).
- Interview organizations for school paper/blogs about climate change/GIS.
- Encourage school to participate in National Service Weather Program (Storm ready) that engages community readiness.
- Organize a book drive to raise money for children in low income areas. This idea is motivated by the participant's experience interacting with children on Mandela Day.

An example of a project a student initiated after participating in the Youth TechCamps:

> As a result of the program I have currently finished the first stage of an investigation project about the quality of water resources in the area we visited near the Zongo Glacier and Milluni Valley. The Project consists of the analysis of anions through out the current that flows from the Glacier to Lakes near by. I am testing the water in the Environmental Chemistry Lab UMSA (Universidad Mayor de San Andres). This project is to prove how great the contamination of mining is. In our second stage I will analyze cations and bacteria, and how soiled water with contaminants affects the glacier.

There were overlaps in ideas between International and U.S.A. peers, however, one difference was apparent: the location of their action. International students' outreach was generally in their community, such as picking up trash, organize groups of people for various activities. The U.S.A. participants also participated in some large group activities such as teaching about geospatial technology to peers, starting an Earth Club at school, but these are within a formal setting rather within the community.

Theme 3: Research and collaboration
The value of working in a team is apparent in participant answers. Overall, participants enjoyed working with peers from the host nation, building

"*lifelong friendships with people completely different*" from themselves. Similar sentiments provide evidence that the Youth TechCamps were "*incredible and life changing*".

Participants experienced an authentic situation where they worked with peers different from themselves, bringing forth perspectives, language proficiency, and life experiences. The majority of participants saw these differences as positive learning opportunities. A majority of participants saw value in different viewpoints and opinions because "*each of us came from completely different backgrounds and so we were able to bring unique suggestions to the table.*" A concrete example given is of a team whose members, familiar with the state of local ongoing drought, supported the project with "*their knowledge of leading news-sites (such as La Prensa) which became invaluable during our data collection period.*"

The language barrier was cited as an obstacle, but only a temporary one. Each team found ways to communicate their idea, such as through translation of a bilingual teammate. This was not left to chance; the program design was set up for teams to mediate this expected obstacle and facilitators actively placed team members where needed to facilitate this kind of communication. An exemplary quote is "*75% of the members did not speak English, it resulted in the best experience of my life by overcoming a challenge and creating lifelong friendships with people completely different from me.*" Some participants understood "*That language barriers can't stop you from becoming friends.*"

Perhaps related to culture and language, were lessons on learning to compromise in a group with strong and differing opinions. The teams recognized this obstacle and either "*powered through it*" or worked it out. Again, this approach was reinforced by the program design, where facilitators were explicitly trained and decided to forgo intervening too soon to permit the learning experience to unfold, rather than prematurely solving problems of group dynamics at play. In all groups, the participants enjoyed working with their team and found it rewarding to find solutions to address issues. Many participants reported developing friendship and "*deep respect for each other grew*" from working long hours together.

Discussion

Supported by the quantitative (responses from U.S.A. participants) and qualitative datasets (responses from all participants), both U.S.A. and international participants demonstrated increased confidence and ability to work collaboratively, their keen interest to learn about culture, and reflection on cultural sensitivity. The changes measured included different results for short- and long-term impacts.

The grounded theory approach brought out a concept worthy of note, which may foreshadow gains from international exchanges. The authors propose the idea that short- or long-term changes are preceded by an internal awareness, an element of maturity. Unlike the Likert scale that can be quantified or the responses that can be analyzed qualitatively, the element of personal growth is a subjective observation by reading between the lines. A number of answers across the survey questions, demonstrated students' deep reflection and mindfulness such as taking on responsibility to improve the community. These responses shed light on the profound influence of the Youth TechCamps on participants' attitudes, thinking, perspectives, engaging with people and the world, and how they want to conduct themselves to make meaningful contributions in their communities. Such favorable shifts in engagement with a new culture seems to be a consistent outcome of international experiences observed in adolescents, regardless of exchange duration (Zhu et al., 2011; Zsiray et al., 2001). A powerful example from this project is that of Kayla Soren, a co-author of this article and a student from the U.S.A. who took part in the Panama camp.

Kayla is a co-founder of the International Student Environmental Coalition (ISEC) (https://www.isecoalition.org/about), a global youth climate change movement. Soren elaborates, "I know the program was absolutely life-changing and completely opened the door to international youth activism for me. I would not have founded the International Student Environmental Coalition if it weren't for the YouthTech Camp program!"

Personal growth comes in different forms, but always when the participant has an insight about themselves or a shift in their plans for the future or even attitudes about people outside of their home country. Time may be the filter that clarifies what learning is ephemeral and what persists and is incorporated into their thinking. For example, between the pre- and post-tests, U.S.A. students believed that they should focus on similarities rather than differences between people (Question 3) ('I understand that differences exist but believe that we should focus on similarities. We are all human'). This was statistically significant within 6 weeks of their return to the U.S.A but it did not persist longer than this. The same is true for Question 5 ('I have long-term friendships with several people from other cultures') and Question 10 ('People are the same despite outward differences in appearance'). Perhaps the short-term impact of these changes may be attributed to environmental factors. Travelling overseas, being part of a structured learning environment, and living in a new culture may have all been push-factors to interact with international peers, clearly a mandate of the Youth TechCamps. However, once the students returned home and perhaps faced with decreased opportunities to connect with diverse communities and peers in their home city or school, the impact of the international experience subsided. Even more so if students return to a hometown that is

culturally homogenous, there may simply be few opportunities to integrate their earlier perceptions or lack models of what cultural sensitivity looks like.

Alan Coronado, co-author on this article who was a U.S.A. student who participated in the Panama camp, now lives in the country. Half a decade later, he is still adamant on the personal impact of this project. He says *"This type of investigative paper gives the real-life data of what intercultural collaboration can actually achieve, and to not be wary about learning and living in other cultures. Having this type of knowledge can be helpful for the youth of now that want to make the world a much more understanding place. In particular we are surrounded by issues that exist as a result of cultural differences. In my opinion, cultural awareness can only lead to advantageous circumstances for the future."*

Long-term changes in perception were equally interesting, as demonstrated in Question 4 ('I question my own prejudices as well as national and cultural stereotypes'), Question 6 ('I incorporate the attractive aspects of other cultures into my own way of doing things'). These changes persisted nine months after participation in the Youth TechCamps. This finding suggests that once a change in perspective, behaviour, or new understanding has been integrated into one's learning, **this change perseveres past the actual experience.** The authors surmise that once the change becomes part of the person's character or mindset, it is no longer dependent on the environment, unlike the short-term changes above. Dara Carney-Nedelman, co-author of this paper and a participant from the U.S.A. to the Bolivia camp, reminds us how long-term changes may also be reignited by world events.

> *"Due to everything that has been happening in Bolivia, I've reignited some of my relationships with the Bolivian students. The Youth TechCamp you (Dr. Solís) worked so hard on is still having lasting impacts. I've been in touch with four of the Bolivian students just this week. I've also reached out to my local news agency to try to get more publicity about the demonstrations and election fraud in Bolivia. Personally, on my recent Fulbright English Teaching Assistant application, I was able to reflect back on several experiences I had in Bolivia."*

Finally, the third long-term impact is one's perception of their language ability, as seen in Question 8 ('I am linguistically competent in a language other than my native language'). This may be interpreted in a couple of ways. Some of the students from the U.S.A. were already able to speak Spanish before the trip. For those who travelled to Bolivia or Panama, they benefited from being immersed in a Spanish-speaking country where they could interact with peers and locals. Furthermore these students, being bilingual, served as interpreters between peers during the Youth TechCamps. These two experiences may have provided confirmation and self-confidence of their ability in the language. However, since

participants' language abilities was not inquired in the surveys, it is not possible to separate out the differential impact of being conversant or fluent on the end results here.

There are a couple of surprises in the results. It is curious that neither Questions 7 nor 9, in the survey, showed any statistical difference in the short- or long-term gain. A closer look at Question 7 suggests that the U.S.A. students scored high in this question prior to the trip, so with the international experience, this does not move the needle much farther. It may also reflect the "self-selection" bias that participants chose to apply for an international exchange experience in the first place. For Question 9, the expectation is that the U.S.A. students would have a heightened desire to learn about the people, cultures and issues around the world. Another look at the data show that the respondents were generally as enthusiastic prior as they were after their trip to explore this learning opportunity. Thus, the positive affection was strong even at the start of the Youth TechCamps.

This research brings to light the impact of intentional opportunities that support student learning and sensitivity to different cultures. Here, the authors recount the key results of the Youth TechCamps but are cautious to generalize beyond the sample cohort. Mirroring the findings from the literature, the authors found impactful changes in students' perception of a new culture, depth in relationships, and increased expectation of self to contribute to the world. The data suggests that those changes that directly challenge the way one thinks or feels about differences, have the most long-term impact. For example, survey questions 4 and 6 tackle the notion of questioning one's own prejudice(s) and incorporating new ways of doing things, respectively. These reactions require more than rote doing but likely a sense of maturity and reflection prior to deciding to take action. Perhaps taking the time to ponder and deliberately choosing what makes sense to include in one's way of doing makes these actions persist over time. On the contrary, the impact on one's understanding of differences (Question 3) or making friends with diverse peers (Question 5) seems to taper out over time and thus have a short-term impact. The authors venture that these actions, once completed, may not require continual action and thus the effect may ultimately stagnate without repeat access to cultural learning to reinforce it. In other words, the most profound learning opportunity over the long run may be those cultural exchanges which present an internal struggle or challenge associated with taking action, such as an intentionally-designed experience to pursue a team science problem, rather than those which simply offer moments of friendship and understanding. Further research is needed to determine the parameters of such a possible interpretation.

Similar to some findings in the literature, this study found discernible short- and long-term impacts. For example, the international experience in this study influenced the reported education and future career choices (*e.g.,* Bachner and Zeutschel, 2009; Paige et al., 2009; Bachner and Zeutschel, 1994),

particularly drawing students' interest in environment and international study and to work in developing countries on climate change.

> "It (Youth TechCamps) definitely did influence my view of climate change. I knew (obviously) that environmental problems affect every country, but seeing this in person had a huge impact on me. I am even more committed to my current plan of majoring in Environmental science in college."

The global engagement variables reported by Paige et al. (2009) were not found in this study perhaps due to the differences in the age of participants between this study and the work of Paige et al (2009) (*i.e.*, high school versus university students), longitudinal time frame (*i.e.*, months versus years after international experience) and length away in an international setting (*i.e.*, weeks versus months).

The authors believe that the changes illustrated in students could have a strong influence in their future in any career that necessitates working with someone from a different geographic region, whether that is a different state in the U.S.A. or another country in the global context. These experiences are found in powerful quotes that attempt to capture the subtle and explicit messages of change powered by this program.

> "The impact that the Youth TechCamp has had on me and everyone that participated has been immense. I was really energized and had that special 'goosebump' feeling again." (local coordinator, in an unsolicited email).

> "I'm a worthy human being. I have talents that I'm good at and I should be proud of them. This camp increased my confidence, seven-fold."

Conclusion

Participants' reaction to the Youth TechCamps has been overwhelmingly positive. This opportunity has provided them with technological and soft skills, as well as precious exchanges to broaden their views and understanding of different cultures. For many following the exchange, the motivation to act, whether alone or in an organized group, to improve the world's environmental issues is clear. The learning did not stop at the conclusion of the Youth TechCamps. Years later, alumni still actively engage their peers, classmates, extracurricular groups, and the community to share their knowledge and skills. At the time of this publication, alumni connect with peers on social media platforms as well as give regular updates of their successes with Dr. Patricia Solís.

The current research findings, similar to those from previous studies on the impact of international exchanges, have found that some changes are short-term while others have a longer effect on the understanding and perspectives of different cultures. Here is a fitting time to summarize the Youth TechCamps experience from Aishah-Nyeta Brown, one of the authors of this paper and a participant of the South Africa camp, reflecting 5 years later.

While in South Africa, I connected with the South African peers on such a deep level that we still keep in contact regularly, for birthdays, holidays, and no occasion at all. This is not my only valuable take away, in fact, it shaped the way I approached my future. Before South Africa, I had little confidence in my academic outlook, but always had a positive feeling for the future. My confidence soared from the interaction and learning in a classroom setting in South Africa. I was asked by counterparts what I wanted to do with what I was learning there. At that time, I had a vague understanding of wanting to synthesize my creative passions with making a global impact, but it sounded silly.

Five years later, I am a Global Sustainability Scholar and an undergraduate student with some incredible global career hopes. I study climate change in hopes to creatively bring awareness to environmental injustices to the world with the knowledge of sustainability.

A gap in this research that invites further investigation is to examine what factor(s) determine short- versus long-term impact and if changes effected can be extended. Essentially, how do we help students make those impacts persist after the experience, like Aishah-Nyeta Brown. Another area in this line of research could look at whether the learning setting, such as exposure to cultural differences in one's own community or online would generate similar changes as an in-person international exchange. Participation in an international exchange is an obvious experience to measure, however, the financial element limits its access by the mass. Given the diversity generally found in major cities around the world, students may experience stimulating cultural exchanges within their own geography (*e.g.,* celebrate festivals of ethnic communities or learn through discussion with people of varied experiences) (*e.g.,* Chamberlin-Quinlisk, 2005), online (*e.g.,* Peiser, 2015) or in curriculum in the classroom (*e.g.,* Seifert, 2009). Unlike structured and formal learning opportunities, informal experiences are certainly harder to track and to measure because they happen on a personal level, but the interest here is to look at everyday exchanges across cultures that are happening organically and how these might induce short- and long-term changes.

These lines of research would contribute to experiential learning that fits neatly into 'doing geography' called for in the national geography standards *Geography for Life: National Geography Standards, Second Edition* (Heffron and Downs, 2012) and add to the recommended research on how geography knowledge is learned across individuals, settings and time as put forth in *A Road Map for 21st Century Geography Education: Geography Education Research* (Bednarz et al., 2013).

What is the importance of providing learning opportunities with potential to shape students into culturally sensitive people? The answer lies in what they can contribute to society in general and more specifically using geography to this effect. We are living in rapid changes steeped in such big influences as technology, human migration, and climate fluctuations. Given these large-scale and interdisciplinary concerns, geographical concepts and information are used by scientists and policy makers alike (National Research Council, 2010). It is clear that sound geography knowledge, which lends to informed perceptions of people and cultures, has an important role in national and international decisions, whether for government, business, or environmental challenges. In the U.S.A. how knowledgeable are our students in their geography understanding to exercise global influence for this kind of future?

Declaration of interest
No potential conflict of interest was reported by the authors.

Notes

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Niem Tu Huynh, PhD, PPCC, is a geographer, inquirer and calculated risk taker. Her interest in supporting graduate students in searching for meaningful careers was ignited by her own journey. Professional work took her to Texas, for an Assistant Professor position, and this was followed by a research role in a non-profit organization in Washington, DC. Feeling like the Canada goose, she traced her roots back to Canada where she has since enjoyed being a career advisor at McGill University, working primarily with graduate students. Today, Niem uses her suite of transferable skills as a Professional and Personal Life Coach as well as an Internship Coordinator to support graduate students' placement exploration at Concordia University. Niem's research interests include graduate student success as well as careers exploration. She has published chapters about navigating employment prospects for new graduates in the geospatial sciences and geography education and career readiness.

Patricia Solís, PhD, is Executive Director of the Knowledge Exchange for Resilience at Arizona State University, where she also works on the faculty of the School of Geographical Sciences and Urban Planning. She is Co-Founder and Director of YouthMappers, a global network of student-led groups working to create open spatial data for humanitarian and development projects reaching 120+ university campuses in 38 countries. Solis has been awarded federal, state and foundation funding for over fifty competitively funded projects promoting innovation in integrating research and education, including fostering interdisciplinary academic networks among emerging scholars in developing countries. Her expertise focuses on leveraging geospatial technologies to address socially relevant challenges through community-collaborative research methodologies and research-centered authentic learning.

Philippe Huot, MD, PhD, is Assistant Professor at McGill University. His research uses experimental models of Parkinson's disease (PD) to develop novel pharmacological therapeutics to treat motor and non-motor complications in Parkinson's patients.

Nwasinachi Menkiti is a PhD student at Texas Tech University. She has keen interest in the application of geospatial technologies for environmental sustainability. Her passion for reduction of disaster and risk among vulnerable communities has ignited her desire to volunteer in numerous humanitarian projects worldwide using Open source Geo-spatial technologies.

Aishah-Nyeta Brown is an undergraduate student at George Mason University and second-year Global Sustainability Scholar. Aishah studies environmental sustainability with a concentration in climate change and society. She will be using what she learns at school in Germany for the next two summers with Creating Interfaces to work on the Food-Energy-Water nexus and climate change mitigation. Brown has an associate's degree in fine arts and a background in performing arts and hopes to use this transdisciplinary thinking to combine ideas around climate and creativity.

Dara Carney-Nedelman graduated from the University of Tennessee, Knoxville in May 2019 with a bachelor's degree in communication studies. Dara applied her mapping skills in college by taking geography courses and being involved with the "Geo Club"; she further developed her global awareness by living and studying in Spain and Indonesia. Currently she is balancing her role as Communications Specialist for YouthMappers, and as an intern with the Partnership for Public Service.

Alan Coronado is an undergraduate student at the Universidad Tecnológica de Panamá. Alan studies logistics engineering and supply chain, mainly focusing on supply chain management and how to minimize continuous pollution on the planet while protecting companies' bottom line.

Kayla Soren is the Executive Director and Co-Founder of the International Student Environmental Coalition, an organization of young people fighting climate justice in over 30 countries. She will be completing her undergraduate studies in International Relations and Environmental Studies at the University of Southern California in May 2020.

Enhancing Powerful Geography with Human-Environment Geography

Thomas B. Larsen
University of Northern Iowa

John Harrington, Jr.
Kansas State University

Abstract

GeoCapabilities and Powerful Geography are advancing the conversation related to improving the relevance and status of geography within K-12 education during the so-called Third Enlightenment. Credibility and success of geography's contribution to K-12 education will be increased with the addition of capabilities provided by the human-environment identity, such as adapting to emerging circumstances, thinking in systems, and adopting a sense of timefulness. Traditionally, human-environment geography has encompassed three substantive areas: human impacts on the environment, the environment as hazard, and environmental perception. Each of these areas has implications for Powerful Geography's fundamental premise: to help teachers generate bottom-up curricula that better align diverse student aspirations with the knowledge, skills, and perspectives employed by professional geographers. Contemporary K-12 teachers are members of teams who attempt to integrate curricular activities across their subject areas, which include science, technology, engineering, and mathematics. Human-environment subjects, such as climatic change, environmental pollution, sense of place, drought, or flooding, provide useful interdisciplinary subjects for integrative teaching. Using an understanding of how K-12 geography education has addressed human-environment issues since the introduction of the five themes in the 1980s, this paper discusses how a marginalized aspect of geography can greatly assist Powerful Geography.

Geography Education in the Third Enlightenment

> Think of humanity in this century, if you will, as passing through a bottleneck of overpopulation and environmental destruction. At the other end, if we pass through safely and bring most of the rest of life with us, human existence could be a paradise compared to today. And a long geologic lifespan, essentially immortality, for our species would be possible (Wilson, 2017a, p. 162).

We are entering a Third Enlightenment, one in which the sciences and humanities will combine to "serve as leaders of a new philosophy, one that blends the best and most relevant from these two great branches of learning" (Wilson, 2017b, p. 198). That Enlightenment is not only desirable, it is necessary for human survival amid global change. The bottleneck seems like a five-lane interstate reduced to a single lane highway with no frontage roads for an escape. Unifying knowledge represents a form of creativity essential to moving society and the environment through this constriction (Wilson, 2017a). Combining creativity and consilience has yet to be fully achieved; scholars and educators are deprived of capabilities to unify knowledge in response to 21st century problems (Wilson, 2017b, p. 190-191):

> Although humanistic arts and analyses superbly capture details of history, they remain largely unaware and uncaring about the evolutionary events of prehistory that created the human mind, which after all created the history on which the humanities focus. […] In their own way, scientists are equally unprepared for collaboration with creative artists and scholars of the humanities.

No topic depends on knowledge unification more than human-environment relations. Powerful Geography and GeoCapabilities are 21st century ideas to improve K-12 geographic education in response to major challenges accumulating due to misguided human-environment interactions.

Curriculum approaches designed by geography teachers for geography teachers have the real-world wisdom and intellectual merit necessary to produce powerful and capable geographic knowledge. Strengths lie in their international perspectives, as well as their applied and theoretical foundations. A capabilities approach to education addresses how a student gains agency to lead a life that s/he values (Unterhalter and Walker, 2007; Campbell and McKendrick, 2017). GeoCapabilities represents the European argument that students will develop greater potential to lead a valuable, fulfilling life if they acquire knowledge that enables them to think geographically (Solem *et al.*, 2013; Lambert *et al.*, 2015). Powerful Geography embodies the American effort to train geography teachers on how to tailor course content to student aspirations and workforce applications. According to Solem and Boehm (2018, 195), Powerful Geography involves "applying the capabilities approach pioneered in GeoCapabilities to research the design and development of new geography curriculum standards and programs." These efforts link to the idea of powerful disciplinary knowledge (PDK).

Powerful disciplinary knowledge needs to help a student think, analyze, determine, and explain, or to 'think the not yet thought' (Young and Muller, 2013). Building off the ideas of Michael Young (2008), Alaric Maude (2016, p. 75) wrote that the concept of powerful geographic knowledge "does not lead to a list of content that must be taught, but only to ways of thinking that should be developed through whatever content is selected." New emphasis in K-12 education shifts attention away from "the acquisition of literacy skills: simple reading, writing, and calculating" (NAS, 2000, p. 5), and transitions toward helping students find and use information rather than repeating something that has been remembered (Simon, 1996). Teachers now are tasked to help students "to think and read critically, to express themselves clearly and persuasively, to solve complex problems" (NRC, 2000, p. 4). According to Maude (2016), powerful geographic knowledge includes: (1) new ways to conceptualize about the world, (2) strategic ways to analyze, understand, and share knowledge about the world, (3) student recognition of the knowledge they have gained, (4) the information and confidence for students to engage in debates at scales ranging from the local to the global, and (5) improved global system understanding.

Despite accelerating human-induced impact on the global system (Steffen *et al.*, 2004), much of the emphasis to-date in K-12 geography education derives from the five themes introduced in 1984 by the Joint Committee on Geography Education. Themes included the importance of (1) place and (2) location as a grounding for activities, changes, or differences; the idea that similar places are logically integrated into (3) regions; recognition of the importance of (4) movements of goods, services, and ideas from place-to-place or region-to-region; and the concept of (5) relationships within places. Relationships within places, as a way to discuss nature-society relationships at the local scale, may have made sense in the 1980s. But the cumulative human imprint on the planet has

changed dramatically since 1984. Part of Harper's (1990, p. 28) critique of the five themes suggested that "the five themes are spatial in nature," spatial to a fault. Geography educators doubled down on the spatial-chorological pathway in a human-environment world filled with more-than-spatial meanings, changes through time, ethical implications, and ways of knowing (Turner, 2002). Given the implications of global climate change, ocean acidification, and the sixth extinction (Orr, 2016; Kolbert, 2014), no longer can the human-environment tradition be interpreted as the marginalized 'other' sitting in the backseat, while space and place drive the discipline.

In the following sections, we look at how the theme of integration in place (human-environment geography) has morphed over the last 30 years. Examining this backstory, we discover writers using different terms to label this marginalized aspect of K-12 geography. We then summarize major ideas in human-environment or nature-society geography, followed by addressing the value of human-environment geography within the context of Powerful Geography, powerful disciplinary knowledge, and GeoCapabilities. Bringing a greater emphasis of human-environment geography to the Powerful Geography effort, we produce two figures that help summarize integrative aspects of geography and powerful thinking. We also introduce and describe three capabilities that can lead to the bottom-up development of powerful geographic knowledge: adapting from the inside-out, thinking in systems, and adopting a sense of timefulness.

From Relationship within Places to Human-Environment Geography

During the 1990s, the theme first identified as 'relationships within places' was discussed in a number of ways. Gersmehl (1992) labeled this theme 'Interaction' as he discussed points and counterpoints relating to the five themes. Interaction included how humans modify the environment and how environmental conditions impact human behavior. His counterpoint addressed how place influences environmental perception, recognizing that relationships within places encompass more than humans modifying and adjusting to local settings.

While discussing ideas that influenced the five themes, Natoli (1994, p. 3) mentioned Pattison's (1964) four traditions of geography, suggesting that the "Pattison's 'man-land' tradition provided transition from the subjectivity of place to the theme of relationships within places." These words illustrate the spatial thinking emphasis within the five themes. They conveyed that the theme which is now labeled the human-environment geography was initially local in scale and dealt with "relationships within places" and "the intricate interactions between people and their physical and cultural environments" (Natoli, 1994, p. 3). 'Environmental' represented another label used in the 1990s for human-

environment thinking (McKeown-Ice, 1994). In documenting the geographic aspects of environmental education, McKeown-Ice (p. 40) listed: human impacts on the environment, environmental influences on human behavior, differing cultural perceptions of the environment, and studies of the natural environment or physical geography. 'Relationships within places' appeared insufficient to characterize a fragmented assortment of human-environment descriptions. Employing other terms in lieu of 'relationships within places' exhibited an ongoing struggle to operationalize the theme.

Meanwhile, Boehm and Petersen (1994) discussed the five themes listing 'human-environment relations' as parenthetically equivalent to 'relationships within places.' According to Boehm and Petersen (1994, p. 212), the geography consensus group of the National Assessment of Educational Progress (NAEP) moved away from the five themes and "chose to organize the content of geography into: (1) space and place; (2) environment and society; and (3) spatial dynamics and connections." Although the human-environment identity became more explicit, using the connector 'and' to link 'environment' and 'society' presents a dichotomous view, separating society from nature. Use of a hyphen to link humans with their environment (*e.g.*, human-environment geography) can subtly reinforce student comprehension of the complexity and linkages involved in the coupled global system.

In *Geography for* Life, six essential elements link together 18 standards, and the 'environment and society' label was used for the essential element that groups standards pertaining to human-environment relationships (Geography Education Standards Project, 1994; see also Heffron and Downs, 1992). Both the spatial-chorological and human-environment identities ascribed to geography (Turner, 2002) appear in the 1994 volume documenting the then new national geography standards, *Geography for life* (Geography Education Standards Project, 1994). In the K-12 geography education realm, appropriate knowledge and skills involve a spatial perspective paired with "the ecological perspective" (p. 32). In discussing the thought processes associated with geography's ecological perspective, the authors of *Geography for life* indicated (p. 58):

> Understanding Earth as a complex set of interacting living and nonliving elements is fundamental to knowing that human societies depend on diverse small and large ecosystems for food, water, and all other resources. People who regularly inquire about connections and relationships among life forms, ecosystems, and human societies possess an ecological perspective.

Note that the ecological perspective in geography education involves complexity, (eco)systems, connection and/or interaction between the biotic and abiotic, and resources. Unfortunately, the word choices for labeling the ecological perspective differ from other available options to characterize this major aspect of geographic thought.

As geographers struggled with how to label the content that is included within human-environment thinking, the decade of the 1990s saw a rapid expansion of students enrolled in geography classes in universities (NAS, 1997) and the growing popularity of geographic information systems (GIS) (Goodchild *et al.*, 2000). GIS education has attracted numerous new students to geography and has expanded the spatial geographic perspective outside the classroom with an emphasis on applied spatial thinking. It can be argued that the spatial-chorological hegemony of the second half of the 20th century (Turner, 2002) is exemplified by the NAS publication, *Learning to Think Spatially* (2006). Perhaps we have lost sight of the human-environment baby, with an overemphasis on the spatial thinking bathwater in K-12 geography education.

It is interesting that geography education scholars have a history of linking human-environment thinking with geography (see Murphy, 2018). For example, Gregg and Leinhardt (1994, p. 313) indicate that a late 20th century rationale for separating geography out from integrated social studies and putting geography back into the K-12 curriculum was "acquiring competence in geographic reasoning, a competence that is built by learning and applying the tools of spatial analysis to problems associated with human interaction with the environment." Turner (2002) reinforces the case for the importance of geography for addressing human-environment content using spatial analytic methods.

In his discussion of the two major geographic identities, Turner (2002) identified human-environment interactions as the 'other' and marginalized major geographic identity. Writing about the same topic in the *Annals of the American Association of Geographers*, Zimmerer (2010) referred to the subject matter as nature-society geography. It likely does not help with K-12 teacher understanding of the value of the human-environment identity in geography, when those who write about the topic use a plethora of names to label the subject.

Human-Environment Geography

Geography has been regarded as the human-environment discipline and signifies a core tradition in geographic thought (Pattison, 1964; Turner, 2002; Yarnal and Neff, 2004; Murphy, 2014). Generally defined, human-environment geography encompasses geographic ways of understanding, approaching, and synthesizing ideas and questions about the complex relationship between people and the places they inhabit (Zimmerer, 2010, 2017). It addresses a broader task that extends beyond geography, the process of "seeking lessons about society and

nature taken from the study of the relationships between the two" (Turner 2002, p. 60).

Geographers possess a direct bloodline to studying the human-environment relationship. Alexander von Humboldt has been identified as the forefather of human-environment geography, and the writings of George Perkins Marsh in the 1800s helped triangulate the ways that humans were modifying their environment (Turner, 2002). Geographers played a fundamental role in the two major stocktakings related to human-induced planetary change (Thomas, 1956) and modifications to Earth systems (Turner *et al.*, 1990). From modifying to changing to transforming, human-environment thinking includes more than just anthropogenic impacts on the system. Glacken (1967) synthesized the character of human-environment geography up to the end of the 19th century. His analysis outlined three major ideas in the history of human-environmental thought: the idea of a divinely designed earth (environmental perception), the idea of environmental influence on people (hazards), and the idea of human influence on the environment (human impacts).

Human-environment geography's influence has increased through time. In an analysis of geography presidential addresses covering the period 1940-1999 using Pattison's (1964) four traditions, a greater percentage of the addresses covered aspects of the human-environment tradition (Datel, 2000). Zimmerer (2010) examined the frequency of articles on human-environment topics appearing in the *Annals of the American Association of Geographers* and found a generally upward trend over ten decades. Writing about nature-society geography in *Geography: Why it matters*, Murphy (2018, p. 90) observed that "geographical work on the subject has blossomed in recent decades" and "of the traditional disciplines, geography today is the one that arguably is most centrally concerned with looking at the interrelations between natural and human processes on the Earth's surface." Murphy (p. 8) asserted that geography is a "critically important window" into "the environments and patterns that exist on the ground or that humans create in their minds," as well as "the interconnections that exist between the physical and human environment."

Global-scale planetary conditions at the end of the second decade of the 21st century present new K-12 education challenges, such as climate change, ocean acidification, and species extinctions. Classroom teachers are challenged to connect human actions which students can see at the local scale with their global footprints. Since the introduction of the five themes in 1984, there have been a number of new ideas developed to address changing human-environment conditions, with many concentrating on conditions at the global scale. In his book, *The end of nature*, McKibben (1989) attempted to alarm readers to the fact that one could find evidence of humanity at every spot on the Earth's surface. By 1997, it became clear to Vitousek *et al.* (1997, p. 494) that we live on a "human dominated planet." One decade later, Kareiva *et al.* (2007, p. 1866) indicated that

"we have domesticated landscapes and ecosystems in ways that enhance our food supplies, reduce exposure to predators and natural dangers, and promote commerce." Two years later, Rockström et al. (2009) introduced the idea of planetary boundaries, suggesting that humanity should have greater concern about the cumulative effect of activities that were pushing the planet beyond the safe operating space for biodiversity loss, global freshwater use, change in land use, ocean acidification, climate change, chemical pollution, atmospheric aerosol loading, biogeochemical processes, and stratospheric ozone depletion. Kolbert (2014) presented evidence that humanity was the primary agent of change producing a sixth major planetary extinction.

The Great Acceleration is a label that has been applied to the rapid changes in physical and social conditions following World War II (Steffen et al., 2004). The rate, magnitude, and scales of human-induced changes have been profound. Proposing a new time period for the geologic timeline began as an utterance at a scientific conference (Crutzen and Stoermer, 2000; Crutzen, 2002) and morphed into a proposal to add the Anthropocene as a new epoch documenting an Age of Humans (Zalasiewicz et al., 2015). By the second decade of the 21st century, geographers were transforming the Anthropocene idea to address physical science, social science, and humanistic perspectives related to the human imprint on the planet (Ziegler and Kaplan, 2019).

Human-environment geography has a lengthy tradition among prominent geographic writers and a growing societal relevance. Zimmerer (2010) identified six major aspects to the area of study: (1) environmental governance and political ecology, (2) environmental hazards, risk, and vulnerability science, (3) land use and cover change science, (4) human-environment interactions, (5) environmental landscape history and ideas, and (6) scientific concepts and environmental management. Clearly, human-environment geography encompasses geographic ways of understanding, approaching, and synthesizing ideas and questions about the complex relationship between people and the places they inhabit (see Zimmerer, 2017).

Human-Environment Geography is a Critical Component of Powerful Geography

The contemporary relevance of human-environment geography for K-12 teachers suggests that this geographic identity should have a prominent place in any framework of geography made available to teachers. Boehm et al. (2018, p. 132) suggest that such a "simplified content framework" should limit the number of "overarching synergistic content areas" and present a figure that identifies: Places and Regions, Environment and Society, Physical Geography, and Human Geography as four meta concepts (see Figure 6 in Boehm et al., 2018).

We agree with the thought of limiting the number of meta-constructs that are the building blocks of a solid geographic understanding and provide a figure

with three major geography topics or identities: Cartography and GIScience; Place and Region; and Human-Environment (Figure 1). The three major meta concepts build from the two identities, spatial-chorological and human-environment, advocated by Turner (2002). Our use of three meta constructs echoes Turner's (2002) ideas that Human-Environment is a content area (addressing an object of study or dealing with a 'what' question – what is the character of the human-environment interaction?). What is new in our figure is the suggestion that Turner's spatial-chorological identity (an approach) can be separated into a Cartography and GIScience approach (which we think of as similar to the spatial chorological identity) and a Place and Region object of study, wherein the 'what' question pertains to the characteristics of a place or region.
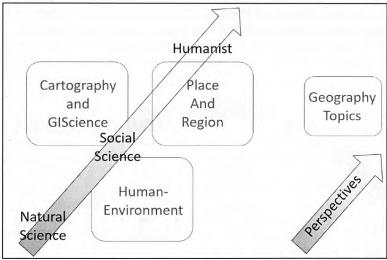

Figure 1. An alternative powerful geography framework diagram for teacher education. A legend is provided in the lower-right hand corner indicating perspectives (arrow) crosscutting major geography topics (boxes). Three meta-constructs for geography are presented in the boxes and three dominant scholarly perspectives are presented along the arrow that cuts across the diagram from lower left to upper right.

In designing Figure 1, three dominant branches of the Academy (the Physical Sciences, the Social Sciences, and the Humanities) are included to signal perspectives of which teachers will have an awareness. A real-world grounding of a meta-construct and a perspective can be illustrated with the issue of anthropogenic climate change (using the Human-Environment construct). Within the Physical Sciences, an outcome of increasing greenhouse gas emissions will be the impacts on temperature and extreme rainfall. In the Social Sciences, students might critique institutional responses and examine attitudes toward taking

environmental precautions in the midst of ongoing environmental transformations. From a Humanities perspective, students can share their ideas about global climate change with music, paintings, and verse.

Recognizing the need for students to gain agency, we add Figure 2 that connects with ideas from the arc of GeoInquiries developed at ESRI (2003)— concepts incorporated into the National Council for Social Studies Inquiry Arc (NCSS, 2014), and advocated more recently by the National Geographic Society as the Geo-Inquiry Process (Oberle, 2020). Figure 2 is designed to articulate some of what we think is intended in the gray area (geographic knowledge, skills, and perspectives) of Figure 6 in Boehm *et al.* (2018). The process depicted in Figure 2 aligns with ideas put forward by Maude (2016) related to powerful geographic knowledge. Inquiry will enable students to better understand the systems under consideration as they analyze and better understand their world, find new ways to conceptualize and visualize their knowledge, gain an appreciation for what they are learning, and contribute to conversations about making things better at local to global scales.
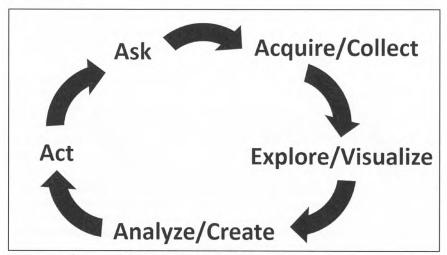
Figure 2. A five-step process for students to use as they inquire about a subject. The process begins with **asking** a geographic question and proceeds through geographic data **collection** and **exploration**, to geographic data **analysis** and creative suggestions that can be **act**ed upon. In many cases, the process can lead back to asking an additional geographic question, so that the process advances in a constructive manner. Modified from ESRI (2003).

What Constitutes Capabilities and Powerful Knowledge in Human-Environment Geography?

> Great knowledge sees all in one.
> Small knowledge breaks down into the
> many.
> – Chuang Tzu (Merton, 1965, p. 40)

Waking up in the Third Enlightenment, geographers have a chance to leverage the human-environment identity to advance powerful geographic knowledge that enhances student capabilities. Geographers are already considering geography education's role in seeking solutions to problems relating to the Anthropocene (Pawson, 2015). Interlinking Powerful Geography with human-environment relations will look differently across educational contexts. Yet, powerful disciplinary knowledge can be produced by cultivating three human-environment capabilities: adapting from the inside-out, thinking in systems, and adopting a sense of timefulness.

Adapt from the Inside-Out

A capabilities approach to human-environment thinking builds 'from the inside-out,' in terms of an ability to "examine the individual and collective values, beliefs, and worldviews that support the behaviors, institutions, and systems that create and perpetuate the problems to which we have to adapt," such as climate change (O'Brien, 2013, p. 307). Since the introduction of the five themes in 1984, our need to appreciate environmental problems has expanded from the local to the global. Thus, there is a need to help students understand environmental phenomena and their interdependencies among multiple scales. According to *Rediscovering geography* (NAS 1997, p. 31), this way of looking at the world "enables geographers to examine the impacts of global changes on local events and the impacts of local events on global changes."

Spatial-chorological approaches, like spatial thinking, are useful in working with and identifying patterns in data that challenge our preconceptions about the world (Gersmehl and Gersmehl, 2007). Factfulness has been heralded as a way to crunch numbers to challenge conventional wisdoms about the world, such as humans' instinct to cast blame, expect negative results, make generalizations, and approach problems with a single perspective; when quizzed about basic facts about global population demography, a sample of global leaders did worse than a sample of chimpanzees (Rosling *et al.*, 2018)! Adapting from the inside-out involves the capability to exorcise our tendencies to make judgements not based on the evidence. Relying on instincts or gut feelings rather

than facts can produce powerfully harmful knowledge, in the sense that the ignorance can lead to potentially dangerous decisions.

From the perspective of human-environment geography, enhancing the capabilities of students does not mean training students to be cogs in the existing wheel, nor is it limited to merely meeting the individual needs of diverse students. It involves preparing students to meet the challenges and uncertainties of a rapidly accelerating society (Epstein, 2019). American communities and the students they cultivate are already becoming displaced because of global changes; Kivalina, an island off the coast of Alaska, represents one such place facing major transformations in native ways of life because of sea level rise (Shearer, 2011). Adapting from the inside-out helps student cultivate foresight about the consequences of environmental decisions and how they are communicated.

Students must have the ability to discern grave impacts mistaken for progress, such as when physicists J. Robert Oppenheimer offered up his retrospective thoughts on building the atomic bomb, "When you see something that is technologically sweet, you go ahead and do it, and you argue about what to do about it only after you have had your technical success" (qtd. in McKibben, 2019, p. 199). According to McKibben, technological dependence poses an environmental gamble, a high-stakes game in which bets are rising and humanity is doubling down, at risk of losing everything if it doesn't cash in its chips in time. Powerful geographic knowledge, in the words of poet Wendell Berry, calls on teachers and learners to "do something/that won't compute" (qtd. in McKibben, 2019, p. 229).

Spatial-chorological approaches can only take us so far. Under the human-environment identity, powerful geographic knowledge can prevent students from becoming ensnared in alluring, yet unwise beliefs about how the world works (Frankfurt, 1986; Pawson, 2015). Misinformation about human-environment relations abounds among digital media outlets and can deceive even the smartest citizens (Pawson, 2015). Having intelligence, according to David Robson (2019), is similar to having a high-end Maserati or Ducati. More intelligent people can get from point A to point B quickly, but results are disastrous if the wrong move is made. Intelligence traps are varied, some of which include:

- *Bias blind spot*: the ability to point out the flaws of other people, while being inept at reflecting upon one's own intellectual limitations
- *Contaminated mindware*: having a foundational knowledge that leads to counterproductive behavior, such as preferring pseudo-scientific remedies over medical treatments based on scientific evidence
- *Earned dogmatism*: the idea that we have acquired enough expertise that we have the right to close our minds off to other viewpoints

- *Functional stupidity*: the tendency to avoid self-reflection, questioning preconceptions, and having the foresight of the ramifications of our actions
- *Motivated reasoning*: the habit of applying one's intellectual energy toward conclusions that only support a preconceived objective
- *Pseudo-profound bullshit*: seemingly credible statements that appear true but are hollow when critically examined

Humans too often default to trusting the word of strangers and the credibility of media they consume; even the Central Intelligence Agency (CIA) struggles with identifying counterspies within its own organization (Gladwell, 2019). When things go awry, rather than blame strangers, people ought to "accept the limits of our ability to decipher strangers" and inform ourselves as much as possible (p. 343). Adaptation requires the ability to separate truth from nonsense and avoid mistaking one for the other. Adapting from the inside out enables citizens to better understand a rapidly changing world.

Think in Systems

Another human-environment capability is thinking in systems—not just social systems, but how humans interact with the surrounding world at various scales (Pawson, 2015). Systems thinking helps students recognize that the planet is more than the sum of its parts, and that it functions in complex ways through stocks and flows; feedback loops; shifting dominance, delays, and oscillations; constraints; resilience, self-organization, and hierarchy; and nonlinear surprises (Meadows, 2008). Mastering systems knowledge means students will "have to be able to learn from—while not being limited by—economists and chemists and psychologists and theologians" (Meadows, 2008, p. 183). Geographers have confirmed that powerful thinking depends on teachers and students practicing "the art of moving between and combining types of knowledge continuously in their dialogue" (Béneker and van der Vaart, 2020, p. 4). While adapting from the inside-out involves distinguishing between evidence and opinion, systems thinking entails piecing relevant disciplinary knowledge together to form a larger and complex picture, like seeing Gaia through the forest (Lovelock, 2019).

Models for moving forward like the Oberlin Project offer bottom-up opportunities to develop powerful geographic knowledge in higher education. Founded by David Orr (2016), the Oberlin Project represents a joint university-community collaboration to advance a more sustainable local future. Among its many purposes, the Oberlin Project acts as "an educational experiment that engages students in the design and development of a model of integrated sustainability that pertains to virtually every department and discipline" (Orr,

2016, p. 229). This model has been developed in response to the costly problems of "bureaucratic fragmentation" by incorporating "systems-based knowledge and extending the time horizon by which we judge our successes and failures" (p. 224). Clearly, aspects of an effort to develop local resilience can be part of the curriculum at K-12 levels. Systems thinking has implications for both powerful disciplinary knowledge and the production of that knowledge where geography teachers contribute to integrated curriculum efforts.

Adopt a Sense of Timefulness

Going beyond space and place, powerful geographic knowledge necessitates an intimate understanding of change through time (Pawson, 2015). More than that, students must expand their "time horizons" to consider how systems are altered in the long- and short-terms (Meadows, 2008, p. 182). One capability is timefulness, which represents "an acute consciousness of how the world is made by—indeed, made of—time" (Bjornerud, 2018, p. 5). Speaking from the perspective of a geologist, Bjornerud (p. 178) argued:

> an attitude of timefulness could transform our relationships with nature, our fellow humans, and ourselves. Recognizing that our personal and cultural stories have always been embedded in larger, longer—and still elapsing—Earth stories might save us from environmental hubris.

Timefulness encapsulates human potential to stimulate the act of *remembering*, which philosopher Merleau-Ponty ([1945] 2012, p. 23) described as "to plunge into the horizon of the past and gradually to unfold tightly packed perspectives until the experiences that it summarizes are as if lived anew in their own temporal place." If the present day is an ark, then the past is a deep, unruly, anarchic ocean of human-environment ideas and events that drive us in different directions (Cohen, 2017). Comprehending global environmental change "is indispensable as part of the basis for guiding future environmental management" (Dickinson, 2000, p. 483). Timefulness can contribute toward the act of *upstream thinking*, solving problems before they occur (Heath, 2020).

One bottom-up way of cultivating timefulness is to encourage students to develop an environmental history of their town and use that knowledge to propose resilient and upstream solutions for local governments. Knowledge produced can be conveyed through a variety of ways, such as museum exhibits developed by students (Stine, 2002). Historian Michael Lewis (2004) challenged university students to participate in writing a book on the history of human-environment relations along Maryland's Wicomico River. Lewis (p. 607)

explained how the river's site and situation—a short walk from campus—were ideal for stimulating students' agency and curiosity within the community:

> It is intimately tied to the local economy, and the Salisbury port is the second largest in Maryland in terms of tons of materials received and shipped (following Baltimore, but ahead of cities such as Annapolis). The river has a long history of human use, from the Wicomicos who gave the river its name, to the English settlers who established Salisbury in the 1740s, to the farmers and timber barons who used the river to ship goods to Baltimore and beyond in the nineteenth and twentieth centuries. It has seen resource overuse, as its once vibrant fishery has been decimated in recent decades.

Pursuing timefulness and powerful human-environment knowledge calls on teachers to take a critical look at community decision-making through time and encourage students to follow suit. Geography students can further enhance this localized approach by integrating changes happening at the global level (Wilbanks and Kates, 1999).

Powerful Knowledge in the Age of Humans

Powerful geographic knowledge benefits from an emphasis on the human-environment identity. Not only does geography serve to integrate academic disciplines, it also equips students with the capabilities to adapt from the inside-out, think in systems, and adopt a sense of timefulness. Like professional geographers, students are producers of planetary knowledge, and that capability enables equal proportions of power and responsibility (see Lehman, 2020). Further inquisition may yield new ideas—such as an Age of Reckless Humans, the Age of Irresponsible Humans, an Age of Feckless Humans, or the Age of GeoEngineering—suggesting that an Anthropocene, or Age of Humans, is perhaps too neutral to characterize the enduring environmental emergency faced by society (Alley, 2011; Orr, 2016).

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Thomas B. Larsen is an Instructor of Geography in the Department of Geography at University of Northern Iowa. He studies issues at the interface between humans and the environment. He has research interests in the Anthropocene, consilience, human-environment geography, geographic thought, and geography education.

John Harrington, Jr. is an Independent Scholar and Professor Emeritus at Kansas State University. Awards include the Lifetime Achievement Award from the AAG Climate Specialty Group, the NCGE Miller Award, and being named an AAG Fellow. John is a former geography department head and was the Alliance Coordinator for Kansas for over a decade. His research interests include climatology, human dimensions of global change, GIScience, applied geography, geographic thought, and geography education.

Global Narratives on Education and Sustainability

Aaron Zadrozny
Independent Scholar

Joann Zadrozny
Texas State University

Abstract

Education for Sustainable Development has increasingly taken on importance around the world. The Earthducation project has been examining intersections between education and sustainability in climate hotspots worldwide, with six field expeditions completed to six different continents to date. While in the field, the team is documenting culture, environmental issues, and educational practices, and collecting video narratives from individuals discussing the role of, and intersections between, education and sustainability. In addition, the general public has been contributing perspectives on these issues via self-posted videos within an online EnviroNetwork. The data gathered to date illustrate both how education can influence sustainability in different regions of the world, and the complexities that geographic location and culture bring to this topic.

Introduction

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. Education for sustainable development (ESD) can help 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.

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).

Earthducation (Figure 1) is an adventure learning project that has been 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 (Figure 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; Doering, 2006; Doering & Veletsianos, 2008; Doering et al., 2008; Doering & Henrickson, 2015; Henrickson & Doering, 2013; Marquart-Pyatt, 2012; Mayer, 2013; Miller et al., 2008; 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 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 do so in their compelling examination of teacher integration of sustainability education in primary school classrooms in Australia (Green & Sommerville, 2014).

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 first-hand 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).

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" (Nakasima, et al., 2012, p. 30). The past decade has shown an increasing number of initiatives and studies exploring the role and impact of traditional knowledge on environmental sustainability (Alexander et al., 2011; Annahatak, 1994; Berger, 2009; McGregor, 2012; Pember, 2008). Traditional knowledge has long served as a means to educate and sustain life, language, and culture among Indigenous peoples worldwide (McGregor, 2010; Nakashima, Galloway McLean, Thulstrup, Ramos Castillo, & Rubis, 2012; Nunavut Tunngavik Incorporated, 2012; Roland & Semali, 2010).

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.
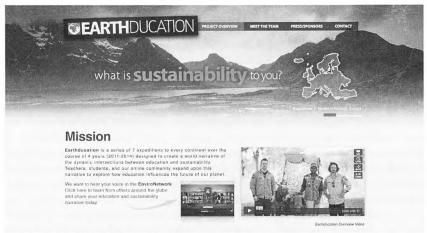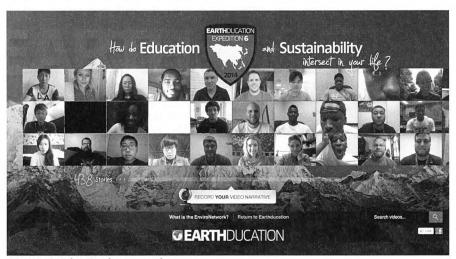
Figure 1. Earthducation main website.

Figure 2. The 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, 2009; Doering, 2015; Doering, 2013a; Doering, 2010; Moos & Honkomp, 2011; Doering, 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.

Methodology

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 six continents: Alaska, USA, and Nunavut, Canada, in North America; Burkina Faso, Africa; Northern Norway in Europe; New South Wales, the Northern Territory, and Queensland in Australia; Peru and Chile in South America; and multiple locations in Nepal, Asia. We have collected just over 235 formal interviews, 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 2017. We used the constant comparative method (Glaser & Strauss, 1967) to analyze participants' interview responses, and took a case study approach to the research design (Merriam, 1998). 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, 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."

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, 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.

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, 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]."

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. As shared in the Canadian Arctic example earlier in this paper, 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 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 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 incredibly inspirational 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 just this year inducted into the Internet Hall of Fame in Hong Kong. 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 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.
- A focus on sustainable farming and providing opportunities for people to grow their own food.
- 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 more than 235 formal interviews conducted on six continents 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 have 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.

As noted above, 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.

As noted earlier, we 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 their 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 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 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.

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. A key outcome of this project upon its conclusion will therefore 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. At that time, 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 base of data and experience grows with each subsequent expedition, this project could have additional impacts on both a local and global scale, and we encourage other researchers to engage in their own examinations of the questions above.

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Author, A. A., Author, B. B., & Author, C. C. (Year). Title of article. *Title of Periodical, volume number*(issue number), pages. http://dx.doi.org/xx.xxx/yyyyy

Single Author. Last name first, followed by author initials.

Berndt, T. J. (2002). Friendship quality and social development. *Current Directions in Psychological Science, 11*, 7-10.

Two Authors. List by their last names and initials. Use the ampersand instead of "and."

Wegener, D. T., & Petty, R. E. (1994). Mood management across affective states: The hedonic contingency hypothesis. *Journal of Personality and Social Psychology, 66*, 1034-1048.

Three to Seven Authors. List by last names and initials; commas separate author names, while the last author name is preceded again by ampersand.

Kernis, M. H., Cornell, D. P., Sun, C. R., Berry, A., Harlow, T., & Bach, J. S. (1993). There's more to self-esteem than whether it is high or low: The importance of stability of self-esteem. *Journal of Personality and Social Psychology, 65*, 1190-1204.

More Than Seven Authors. List by last names and initials; commas separate author names. After the sixth author's name, use an ellipses in place of the author names. Then provide the final author name. There should be no more than seven names.

Miller, F. H., Choi, M. J., Angeli, L. L., Harland, A. A., Stamos, J. A., Thomas, S. T., . . . Rubin, L. H. (2009). Web site usability for the blind and low-vision user. *Technical Communication, 57*, 323-335.

Organization as Author.

American Psychological Association. (2003).

Two or More Works by the Same Author. Use the author's name for all entries and list the entries by the year (earliest comes first).

Berndt, T. J. (1981).

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When an author appears both as a sole author and, in another citation, as the first author of a group, list the one-author entries first.

Berndt, T. J. (1999). Friends' influence on students' adjustment to school. *Educational Psychologist, 34,* 15-28.

Berndt, T. J., & Keefe, K. (1995). Friends' influence on adolescents' adjustment to school. *Child Development, 66,* 1312-1329.

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Berndt, T. J. (1981a). Age changes and changes over time in prosocial intentions and behavior between friends. *Developmental Psychology, 17,* 408-416.

Berndt, T. J. (1981b). Effects of friendship on prosocial intentions and behavior. *Child Development, 52,* 636-643.

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Calfee, R. C., & Valencia, R. R. (1991). *APA guide to preparing manuscripts for journal publication.* Washington, DC: American Psychological Association.

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Dissertation, Unpublished

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Government Document

National Institute of Mental Health. (1990). *Clinical training in serious mental illness* (DHHS Publication No. ADM 90-1679). Washington, DC: U.S. Government Printing Office.

Conference Proceedings

Schnase, J. L., & Cunnius, E. L. (Eds.). (1995). Proceedings from CSCL '95: *The First International Conference on Computer Support for Collaborative Learning.* Mahwah, NJ: Erlbaum.

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