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Sameer Honwad
SUNY Buffalo

Andrew D. Coppens
University of New Hampshire, andrew.coppens@unh.edu

Greg DeFrancis
MIT Museum

Marcos Stafne Montshire
Montshire Museum of Science

Shivaraj Bhattarai
Royal Thimphu College

Comments
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Weaving strands of knowledge

Learning about environmental change in the Bhutan Himalayas

Sameer Honwad, Andrew D. Coppens, Greg DeFrancis,
Marcos Stafne & Shivaraj Bhattarai

Abstract: *Climate change is a complex phenomenon, so much so that even those with expert knowledge on the scientific data struggle to understand the impacts of climate change on their everyday lives. Contradictions across systems of knowledge make clear that climate change is not just a problem of scientific understanding but is also simultaneously a problem of global coordination as well as a sociopolitical problem of connecting domains of knowledge that are seldom valued equitably. The project described in this paper is a prototype effort to put knowledge from community members in two culturally distinct rural areas of the world at equal footing with scientific knowledge. The overarching project aim was to design partnership-based inquiry into environmental and climate change that coordinated the aforementioned three facets of climate change (a) scientific understanding, (b) cross-cultural coordination among globally dispersed communities, and (c) sociopolitical equity in bringing nondominant perspectives to the table.*

Keywords: Community based science, science podcasts, cross cultural learning, learning technologies, Bhutan

Climate change is a complex phenomenon, so much so that even those with expert knowledge on the scientific data struggle to understand the impacts of climate change on their everyday lives and may continue everyday behaviors that contribute to it (Leiserowitz, Maibach, Roser-Renouf, Feinberg & Howe 2012; IPCC 2013). Contradictions across systems of knowledge make clear that climate change is not just a problem of scientific understanding but is also simultaneously a problem of global coordination as well as a sociopolitical problem of connecting domains of knowledge (e.g., policy-level expertise with "on the ground" cultural ecosystemic insights) that are seldom valued equitably. A climate change education program that is likely to change behavior, beyond merely disseminating scientific knowledge, likely requires a form of collaboration among experts and community members that brings together scientific knowledge, cultural understanding,

pedagogical expertise, and community engagement (Bang & Vossoughi 2016).

The project described in this paper is a prototype effort to put knowledge from community members in two culturally distinct rural areas of the world at equal footing with scientific knowledge. We aimed to bring together narratives and stories of environmental change that communities have observed in rural areas of Bhutan. The overarching project aim was to design partnership-based inquiry into environmental and climate change that coordinated the aforementioned three facets of climate change as a complex socioscientific issue – climate change as a problem of: (a) *scientific understanding,* (b) *cross-cultural coordination* among globally dispersed communities, and (c) *sociopolitical equity* in bringing nondominant perspectives to the table.

Briefly, the project involved a multi-layered partnership among two universities (one in Bhutan and one in the United States), two museums (one in Bhutan and one in the United States), and a non-governmental organization that conducts work in rural Bhutan on issues related to climate change and environmental change as observed by local people. Five undergraduate students from the United States and five undergraduate students from Bhutan travelled to parts of rural Bhutan and rural New England to elicit and record stories from local community members about the environmental change that they have observed within their community over the last several years or generations. The students collected the stories, developed them into podcast episodes, and then worked with museum personnel to curate the stories and turn them into museum exhibits. The exhibits were then publicly displayed at the US and Bhutan museums.

The most important aspect of the project prototype was the "unit of coordination" that would facilitate scientific, cross-cultural, and sociopolitical perspectives on environmental and climate change to come together in a unified and publicly legible medium. Those involved in the project's early design decisions (co-authors, among others) strongly committed to the epistemological power of story and narrative, finding promise in podcasting for its ability to link long-standing ways of knowing embodied in stories and cultural narrative with more recent new media innovations such as audio editing and internet-based distribution. The project used high-quality podcasts for sharing and broadcasting the stories for public consumption for two additional reasons. The first is accessibility-radio and podcasts are inexpensive and an almost universal medium. Once podcasts are uploaded to the internet then they can be heard in virtually every household in the community (rural Bhutan has 3G accessibility; much of rural New England has this level or greater connectivity). The podcasts were made available on the project website and were shared over the internet. The second reason is that audio storytelling connects deeply with communities with oral traditions. Communities in rural Bhutan have oral storytelling traditions that have served as a way of knowledge creation for centuries. Of the modern media, podcasts come closest to an original form of human storytelling: stories told "in the dark" with the pictures formed in the listener's imagination.

The stories were a powerful medium of communication as they gave a voice to the emotional and personal impacts that climate change is having on the lives of the community members in rural Bhutan. Often, the issues related to climate change and environmental change are discussed from a perspective of science, which is impersonal and unattached to the emotional and personal disturbances that

are faced by individual community members. As more people today are feeling the impact of climate change at a personal, emotional, and community level it is important for them to tell their own stories and connect with people undergoing similar experiences. The project described in this paper allows people to share their stories and to engage with climate change in an emotional and personal way. The paper also discussed how the project design allowed the learners to learn from the community members about how environmental change was occurring in rural parts of Bhutan.

Theoretical framework for partnership-based climate education

The project was grounded in literature that connects community-based issues to student learning (community-based science) and informal science education (learning in informal spaces such as museums). We define informal science learning as learning about science, technology, engineering, and math (STEM) that takes place across a variety of designed learning environments outside of school (Rogoff *et al.* 2016).

Educating children and young people about climate change is not just a responsibility borne by formal and informal learning institutions, but families, neighbors, and other community members are also vital educational resources (Bouillion & Gomez 2001; Atran, Medin & Ross 2005). Effective climate change education programs need take into consideration community-based knowledge as well as knowledge generated by climate scientists and other formal institutional sources (Hoadley, Honwad & Tamminga 2010). However, in order to consider community-based knowledge designers of learning environments need to build partnerships with community members, so as to connect community-based knowledge to knowledge generated by formal scientific sources (Wilson 2008). Partnerships between designed learning environments (formal and informal) and communities, when built correctly, increase student motivation and attainment (Moll *et al.* 1992; Zeichner *et al.* 2016) as well as well-being within families (e.g., Bauch 2001; Crowson & Boyd 1993; Sanders 2001, 2003; Sanders & Harvey 2002).

The project design and development grounds itself in informal education scholarship and learning sciences theories that focus on different design processes that involve building community-educator partnerships since the last several decades. Funds of knowledge (González, Moll & Amanti 2006); design-based research (Bell 2004; Sandoval & Bell 2004), design-based implementation research (Penuel, Fishman, Cheng & Sabelli 2011; Penuel, Coburn & Gallagher 2013) and participatory design-based research (Bang & Vossoughi 2016) provide closely related theoretical frameworks for how the design process for education programing can involve community members and how to position community-based knowledge to optimize learning. Although evidence-based models for school (formal) – community partnerships exist (Moll *et al.* 1992; Zeichner *et al.* 2016), there is little guidance regarding partnership building with communities so as to design informal learning environments or learning environments for museums. Even though informal learning institutions are positioned to support community needs and have flexibility in terms of educational programing design, many informal learning institutions find it challenging to engage community members as a part of the design process or as knowledge

providers (Chittenden 2011). For example, the role of community members is often limited either to being a participant in the educational program or to being a consumer of knowledge provided by the designers of the informal learn-ing environment (Bell *et al.* 2009; Hawkins & Pea 1987; Hoadley, Honwad & Tamminga 2010).

The Weaving Strands of Knowledge prototype sought to develop a co-design process where community members were invited to become knowledge providers as a part of the learning environment. This museum–community partnership was positioned to support co-constructing knowledge about climate change in both the South Asian and Bhutanese region as well as in the New England area of the United States, whereas traditional models of science museums' relations with communities entail *providing* information to publics and seldom involve *gathering* and *integrating* local knowledge into museum exhibits and other presentations of valued knowledge and insight. There are relatively few examples in the learning sciences and informal education field where one can observe community members being involved as a part of the design process or where knowledge from the community is leveraged to optimize learning. As Chittendin (2011:1550) observes, "From my perspective as a museum educator and administrator for the past 32 years, to understand why more museums have not attempted to do more serious public engagement around current issues is to appreciate the chronic challenges and institutional realities that museums and informal learning centers face." For example, in the field of informal science education, most science museums and centers are focused on designing exhibits that deliver an understanding about well-established science phenomena and do not engage in thinking about local community needs or about the ethical implications of science (Rogoff, Callanan, Gutiérrez & Erickson 2016).

Building successful partnerships between community members and educators is often a challenging process (Kern, Honwad & McClain 2017). Although there are some examples of how community members are successfully involved in co-designing efforts with informal educators, we recognize that there are several difficulties that can arise when building a community partnership for co-designing any learning environment. For example, community members from minoritized and nondominant socio-economic backgrounds may find their points-of-view alienated during the design process, or they may not have the time, ability, or interest in engaging with the design process.

While there are various pathways through which community members can be engaged in the process of designing informal learning environments, we drew on epistemological and methodological insights from interpretative qualitative research to mitigate the common tendency to "search for truth" in the reports, stories, claims, and accounts of community members in both rural Northeastern US and rural Bhutan (Packer 2018). In assembling interview excerpts from community members on environmental change and climate change topics students were guided in asking, "What is this person's perspective on the problem or issue? What guides their thinking and action?" rather than a more positivistic orientation concerned with the veracity of their knowledge with formal (and Western) climate science as a single standard for valid knowledge or ways of knowing (Medin & Bang 2014). Again, when climate change is viewed as simultaneously

a scientific, cross-cultural, and sociopolitical equity issue all perspectives' truths are valid and can contribute insight.

Drawing from these frameworks, the principles guiding our design of effective partnerships between community members and informal learning environments such as museums and science centers were: Designers, researchers, and practitioners of formal/informal learning must work collaboratively with communities to co-design and co-implement educational programs in different sociocultural contexts across the world. Formal/informal learning environments must be designed to leverage local cultural knowledge within the community that they serve so that community members take on the role of knowledge providers.

Partnership building and project activities

Drawing on the three guiding facets of climate change as a complex socioscientific issue – (a) scientific understanding, (b) cross-cultural coordination, and (c) sociopolitical equity – we designed the Weaving Strands of Knowledge project to accomplish the following action-oriented objectives:

1. Engage rural communities in Bhutan to understand how community members resolve issues related to environmental change in their everyday lives.
2. Collect stories/narratives from local people about how they observe and react to environmental sustainability situations in the their communities.
3. Convert the stories into digital format and prepare podcasts to highlight aspects of environmental decision-making and environmental change
4. Using the two museums as community gathering spaces, to listen and share stories about environmental change as observed by the local communities.

The setting up of a project of this nature requires planning and partnership building. Even though the Weaving Strands of Knowledge project lasted for about one year; however, partnership building had begun several years before this project materialized. Two of project leads (from Bhutan and US) had known each other for a decade at a personal and professional level. The other lead members who came on board later drew on this long-term partnership in establishing trust and a sense of shared commitment. For example, two of the project leads travelled to Bhutan early in the project to meet with the project partners in Bhutan. The project team from the US also made a second trip to Bhutan to visit and get to know the communities where student exchange was going to take place. These face-to-face visits and efforts were appreciated by the partners in Bhutan, and served as a solid foundation for the student work which took place a few months later. Along with the project leaders from Bhutan and the US we also recruited 5 students from the US and 5 from Bhutan to work with us on the project. These students were undergraduates who were interested in global environmental issues. Once all 10 students, in total from Bhutan and USA, were chosen to participate in the project, they were introduced to one another in early April via Zoom videoconference and shared their work on an Edmodo virtual classroom site. Over the course of four video exchanges, the students exchanged bios and conversation on their culture and countries. Hopes and wishes for what each wanted to experience in the visiting country, and how environmental conservation

Fig. 1. Vegetable vendor in Bhutan. Photograph by Greg DeFrancis.

is a focus of their university studies, were discussed through the Edmodo site. The videos were scheduled late at night/ early morning due to the 10-hour time change, so flexibility was required of all students.

Students from the US traveled to Bhutan early summer in May and the students from Bhutan traveled to the US in same summer in July. During these summer exchanges students recorded stories from community members in Bhutan and the US. These stories were then converted into podcasts. The community-based story telling activities were broad in their scope. Both project staff in Bhutan and US collaborated to have a consistent focus in each country, to engage in the acquisition of information pertaining to climate change. The design of each activity allowed students to engage with local voices, interact with the land, reflect on information gathered and connect new knowledge systems. Using audio equipment and editing software, 10 audio stories were complete by the final day of the project.

The students collected stories in the US and Bhutan from several different community members. Community members in the US and Bhutan included but were not limited to farmers, vegetable vendors in farmers markets, school teachers, and government officials.

A common theme among these conversations and interviews was the importance of and reliance on the surrounding community. The sharing and passing of knowledge about sustainable cycles of water conservation, land use, farming techniques, hunting, and logging not only brought an environmentally efficient perspective to climate change mitigation, but also the importance of environmental stewardship for future generations.

The design of the project, with students meeting with and talking directly with people whose livelihoods depending on the land, encouraged conversation about stewardship that transcended environmental science as it was communicated through a sociocultural lens. The US and Bhutanese students were open to experiencing the culture of this region and cross-layered this global awareness into their projects.

After the students and project personnel reviewed and edited the podcasts they were

Fig. 2. Teacher in Bhutan. Photograph by Greg DeFrancis.

curated for the general public consumption. The general public heard and learned about this project through these edited audio stories, photographs, as well as climate science and history of the project during a Climate Day Festival organized in the US museum grounds and later at the Folk Heritage Museum in Bhutan. All podcasts produced (listed below) fit under three themes:

Theme 1: Conversations about the future

- A visit with students in rural Bhutan
- Listening to children
- Rural-to-urban migration

Theme 2: Living and farming in rural New England and Bhutan in the face of climate change

- Impacts of climate change on farming
- The changing landscape of pests and disease
- Climate change resiliency and mitigation practices on the farm
- Protecting our soils: a shared goal across the world

Theme 3: Our relationship to the land

- Land stewardship and our relationship to the environment
- The role of art in conserving nature
- Sharing knowledge across generations
- Developing a relationship with nature

Along with the two museums the Royal Thimphu College celebrated a two–day *Sustainability* event with 130 students and faculty from all departments. The audio stories and presentations focused on RTC students' acquisition of knowledge through the project on a different culture and how acquiring information on environmental sustainability has impacted their lives. Environmental consciousness was shared across the campus, which enabled conversations to begin about how social, biological and climate science are intertwined.

Impact of the project

As mentioned above the goals of the project were to highlight community-based knowledge as an important aspect of resolving bigger environmental problems such as climate change. The discussions captured by the students with those working closely with the land represented the varying perspectives that are imperative to be heard if we are to address climate change and environmental conservation at the global level. The conversations the project team had were truly two-way exchanges, and we found those in the community were equally engaged in the perspective and commitment of the younger generation who were conducting the interviews. It was clear from the conversations in both countries, along with the products created through this project, that the program met the goals of the project and the needs of our communities. This work helped global community members merge scientific data with local narratives on climate change. And, with over 84 interviews collected, plus the success of the culminating festival days in each country, the project vastly succeeded in engaging members of our respective communities in these important environmental sustainability conversations. It also met the needs of the students to be better able to connect their environmentalism to a sociocultural framework, both within their own communities and globally. This experience has provided the preparation these students –

our future environmental scientists, managers, and policy makers – need to better listen to their communities and to work collaboratively to strengthen environmental awareness and solve our global sustainability problems.

A further focal point of this project was to help students understand the importance of weaving different knowledge systems to facilitate community-based science learning and conversations. An international team of 10 students embarked on this project with little experience abroad and little experience in acquiring narrative research. Throughout the project the students expanded their perspectives both culturally and scientifically through travel, inquiry, hands-on experience, and trial and error and conversation. A common theme among the exit interviews with students was their recognition that their interviewing skills and comfort with conversation grew exponentially – the awareness of leading a discussion through scientific questions gave deeper meaning to the narratives on climate change. The effect of the students co-curating the final stories together was a magnificent but hidden treasure of the project. Their collaborative process was strengthened when working side by side with their different cultural and linguistic perspectives.

Each student in the program grew in different ways. A student from the US who grew up on a family farm where eight generations have lived on the same piece of land said:

> I learned some things about myself… I remember getting home and feeling different. It helped me find my roots, and reconnect with the environment. This has helped me recognize the importance of my family's land. It has made me want to protect it and take care of it so I can continue to pass it to future generations.

The student's "reconnection" and natural sense of ownership to her family's land oc-curred during her conversations with the faculty, students and interviewees. The generational commitment to preserving and conserving the land and its ecosystems was reinforced by the deep commitment she felt from the narrative interviews.

A student from Bhutan who is an environmental management major from Thimphu, Bhutan came from a family with a history of caring for the environment. Both her father and grandfather are foresters, and their commitment to the protecting the environment has been passed down to her through family conversations and trips to the forests. However, she always felt like she did not have the communication skills to pass on the need for environmental stewardship to others:

> Through this project I learned how to communicate with people. Interviewing the people was very challenging at first, but through this project I learned I could approach people and have conversations with them.

Through interacting with community members and other adults on the project the student from Bhutan gained some confidence to approach people and present an argument.

Another student from the US who was majoring in marine sciences considered herself a young scientist who looks at the world through a very objective lens of hard data and experimental observations said at the end of the project:

> I think one of the most influential things that I learned - especially being a scientist, and a person who is always thinking scientifically - was from being

surrounded by so many people that think in different ways. That was really valuable to me.

She was surprised how much this project allowed her to learn new ways of thinking about environmental and development topics. She now recognizes that acquiring and synthesizing knowledge to create solutions to our environmental sustainability problems, including climate change, requires listening to others with different perspectives and experiences, and connecting issues to social and cultural contexts, in addition understanding the science underlying biological and climate processes.

Students expressed themselves several times over about how this experience gave them perspective that was valuable not only for the duration of the project but also for life. Another student from Bhutan expressed how he feels accountable to the land, that the land must be protected. His acquisition of a communication skills, and introduction to the fields of transportation planning and environmental engineering while in US, coupled to commitment to environmental stewardship has led him to pursue a career in the field of urban planning.

For both the US and Bhutanese students, this was an opportunity for them to meet and talk with people that make a living off the land.

The cultural exchange trip to the US proved to be a valuable experience for the Bhutanese students and gaining a greater understanding of the diversity of people, and diversity of viewpoints among Americans. A common notion among the Bhutanese participants was that people in the US have huge carbon footprints and care less about climate related issues than the rest of the world. However, after interacting with people in rural United States, the students from Bhutan were pleasantly surprised to discover that many people in US share similar feelings towards the nature and the environment that are shared by most Bhutanese.

The US students were struck by the generosity and kindness of the people they visited in Bhutan. The examples of shared humanity, whether it was rural villagers opening their doors to the project team, providing warm tea and even a warm bed to strangers from faraway land, to market farmers in Thimphu insisting on giving our students samples of exotic fruit, the lessons on goodwill, crossing international borders and language barriers, will be hard to forget.

Although the project's primary participants were the university students from UNH and RTC, the program design allowed for members of each partner's community to be integrally involved in our project activities. The excitement among members of the public on both sides of the globe to be involved in project activities as interviewees or hosts was palpable. Farmers at the height of the growing season in rural US were willing to share their knowledge and participate in the project, and gave extended interviews to members of the project team – often lasting an hour or two – and shared freshly picked strawberries, peas, and other produce with the visiting students. They were willing to share their own personal stories and reflections on important and, at times, controversial, issues of environmental sustainability, climate change, and economic sustainability.

Likewise, the village leaders, farmers, teachers, and students in rural Bhutan who we met with participated in the project without hesitation. Often, due to unexpected travel delays, the team would show up an hour late for a pre-arranged interview, and the hosts would spend an hour or more with us.

The final stories created were equally well-received by members of the public. In Thimphu, people enjoyed listening to an audio recording of schoolchildren talking about their hopes and dreams for the future and attracted the most of the visitors at the Royal Thimphu College Sustainability day.

Conclusions

The Weaving Strands of Knowledge project opened up a cultural pathway between the discussion on global environmental sustainability and data science. The need for conversation from a vast array of perspectives, but with a shared vision, led to a collaborative process that could be replicated with institutions that promote inquiry. The role of combined planning and promotion from the two museums and Universities drove the project to completion. Each cohort believed in and supported the decision-making process, the open environment/collaborative process, the community participation and student engagement with all constituencies.

The role of students working together, in one another's countries, on this unique project and on a shared product made the cultural exchange more impactful. The ability to sit side by side with your peer, have in-depth discussions on social, political, environmental issues affecting your country, is the tangible effect of acquiring new knowledge.

On top of learning how to interview and record, processing this knowledge into output for audio stories required an enormous amount of editing – a task that was new to everyone involved. The students rose to this challenge and did an outstanding job for student-led work. For museum quality, daily interaction exhibits, professional expertise for editing is still required. That said, the students, faculty, and museum staff were very proud of the output for such a short course and newly acquired skills. The project was successful because each of the five institutional partners involved not only believed in the goals of the project and the shared vision of the work, but also was able to articulate and succeed in meeting one or more important strategic objectives for their own organization.

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Dr. Sameer Honwad
Assistant Professor,
sameervhonwad@gmail.com

Dr. Andrew D. Coppens
Assistant Professor, University of New Hampshire, USA
Andrew.coppens@unh.edu

Greg DeFrancis
Director of Engagement, MIT Museum, USA
greg.defrancis@gmail.com

Marcos Stafne
Montshire Museum of Science, VT, USA
marcos.stafne@montshire.org

Dr. Shivaraj Bhattarai
Dean, Royal Thimphu College, Bhutan
bhattaraisr@gmail.com