

Expanding the conversation: further explorations into Indigenous environmental science education theory, research, and practice

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Abstract Indigenous environmental science education is a diverse, dynamic, and rapidly expanding field of research, theory, and practice. This article highlights, challenges, and expands upon key areas of discussion presented by Mack et al. (Cult Stud Sci Educ 7, 2012) as part of the forum on their article *Effective Practices for Creating Transformative Informal Science Education Programs Grounded in Native Ways of Knowing*. Key topics discussed include the integration of Western and Indigenous knowledge in educational programs, embodied approaches to Indigenous research, and further examples of practice from Canada and other regions of the world.

Keywords Indigenous · Environmental · Science · Education · Intercultural

I believe that the authors' discussion of Indigenous science and environmental education theory, research, and practice will be enhanced through further presentation and exploration of perspectives from other nations, particularly Canada. In order to recognize and honour the importance of certain cultural terms and concepts (e.g. Indigenous, Aboriginal, Western, Elder), I follow Graveline's (1998) example by capitalizing them throughout this text. In the following sections, I highlight and expand upon Mack et al.'s exploration of key concepts such as the integration of Western and Indigenous knowledge in educational programs, argue for embodied approaches to Indigenous research, and provide further examples of practice from Canada and elsewhere.

This is a review essay of: Mack, Augare, David, Different Cloud-Jones, Quiver Gaddie, Honey, Kawagley, Little Plume-Weatherwax, Lone Fight, Meier, Pete, Rattling Leaf, Returns From Scout, Sachatello-Sawyer, Shibata, Valdez & Wippert (2012).

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Integration: a controversial concept

As Mack et al. (2012) note, Indigenous environmental science education is a rapidly expanding area of theory, research and practice in North America and internationally. As the field develops, several issues are rising in the literature as common points of discussion and debate. One key issue mentioned by Mack et al. is the fundamental importance of effectively integrating Western and Indigenous knowledge in educational programs. They suggest that:

By integrating multiple ways of knowing into science classrooms, students will learn the value of traditional ways of knowing and Native language, learn to utilize a conceptual ecological perspective, and acknowledge that learning and understanding is part of a complex system that includes student experience, culture, and context, as well as mainstream materials that are taught in the classroom.

While statements such as this seem promising, leading Indigenous scholars such as Marie Battiste (2005), Leanne Simpson (2004) and Mary Hermes (2000) contest the integration of Indigenous knowledge *into* previously established Western-style educational programs or curricula. As Mack et al. themselves recognize, intense pressure to conform to Western standards often arises due to government-mandated curricula and standardized testing, inhibiting the genuine efforts of educators attempting to give voice to Indigenous perspectives:

Though many scholars and some educational institutions do recognize that Native American students bring extensive knowledge of science and the natural world into their classrooms, this knowledge is not always recognized in formal classroom settings. One reason for this is that the preparation for standardized testing, due to government mandated curriculum and education regulations, takes up so much classroom time that there is little time to include culturally relevant materials in formal science curriculum.

In response to these kinds of concerns, Battiste (1998), Simpson (2004) and Hermes (2000) all suggest that, in order to avoid the subjugation or “watering down” of Indigenous knowledge, Indigenous educational programs must be developed from an Indigenous perspective *first* before considering how they might meet be tailored to meet Western standards, rather than the opposite. By employing such a strategy, Indigenous knowledge will be centrally acknowledged from the outset, rather than added on to a previously established Western framework. Reflecting on this tension often leads to questions such as, “What are the differences and/or similarities between Western science and Indigenous knowledge?” and “How can they be combined philosophically and in practice?” These kinds of questions are the focus of the following section.

Is Indigenous knowledge science?

Reflecting extensive discussion in the literature, Mack et al. (2012) challenge what counts as “science” They comment:

The science taught in formal school is scientific knowledge that has largely been developed by Eurocentric cultures. Masakata Ogawa posits that the—‘science’ in [formal mainstream] science education normally refers to Western modern science,

which is only one of the sciences that civilization has produced (1995, p. 583). He argues that formal science education fails to include indigenous science, which is knowledge held by a specific cultural group which may be tacitly transferred from generation to generation through daily social and cultural events (Ogawa 1995, p. 586). In addition, formal science education largely fails to align the science being taught to the worldviews, contexts, and culturally appropriate learning strategies of the students who are learning it (Wood and Lewthwaite 2008).

Renowned Tewa scholar Gregory Cajete (2000) also suggests that Indigenous North Americans have always been scientists. Cajete explains that, traditionally, developing both a metaphoric *and* a rational mind was encouraged in Indigenous North American societies. The metaphoric mind encompasses the world of storytelling, spirituality, and metaphysics. Nakoda Chief John Snow (1977/2005) explains that developing the rational mind entails studying the world to reveal truth and that, “the man who learns well the intricate pattern of nature will live a good life and a useful one to his people” (p. 204). Blackfoot scholar Leroy Little Bear (2000) also suggests that:

If science is a search for reality and if science is a search for knowledge at the leading edges of the humanly knowable, then there are “sciences” other than the Western science of measurement. One of those other sciences is Native American science... In order to appreciate and “come to know” in the Native American science way, one has to understand the culture/worldview/paradigm of Native American people (p. x).

Little Bear alludes above to the interconnected nature of Indigenous knowledge; you do not simply study the natural world as an objective observer; you observe to understand more about yourself and your relationships to other creatures.

Euro-Canadian scholar Gloria Snively (2009) supports Little Bear’s view. She argues that various forms of science exist in all cultures, reminds us that the original Latin root for science (*scientia*) simply means “knowledge” (p. 33), and states that “Indigenous science is an interpretation of how the world works” (p. 34).

Attempting to allay the concerns of those who question the validity of Indigenous science, well-known critical pedagogues Joe Kincheloe and Shirley Steinberg (2008) also state:

In this context, the Western analyst confronts the need to reassess the criteria for judging knowledge claims in light of the problems inherent in calling upon a transcultural, universal faculty of reason. Questioning and even rejecting absolute and transcendent Western reason does not mean that we are mired forever in a hell of relativism (p. 137).

Similar to Mack et al.’s (2012) assertions, they describe the promise of what they term “transformative science”:

Once individuals come to believe that Western science is not the only legitimate knowledge producer, then maybe a conversation can be opened about how different forms of research and knowledge production take issues of locality, cultural values, and social justice seriously... The goal of such a learning process is to produce a transformative science, an approach to knowledge production that synthesizes ways knowing expressed by the metonymies of hand, brain, and heart... A transformative scientist understands that any science is a social construction, produced in a particular culture in a specific historical era (p. 153).

Anishnaabe scholar and activist Winona LaDuke (2002) emphasizes the ancient roots of Indigenous knowledge and argues for its inclusion in contemporary ecological discourse:

Traditional ecological knowledge is the culturally and spiritually based way in which indigenous people relate to their ecosystems. This knowledge is founded on spiritual-cultural instructions from “time immemorial” and on generations of careful observation within an ecosystem of continuous residence. I believe that this knowledge represents the clearest empirically based system for resource management and ecosystem protection in North America... Frankly, these native societies have existed as the only example of sustainable living in North America for more than 300 years (p. 78).

However, other Indigenous scholars express concern about *how* traditional ecological knowledge (TEK) is included in mainstream dialogue and action. For example, Anishnaabe scholar Leanne Simpson (2004) describes the somewhat tense relationship between Western science and TEK when she states:

Over the past fifteen years Traditional Ecological Knowledge (TEK) has received much attention in the United Nations–sanctioned forums concerned with biodiversity and sustainable development, and this has sparked the curiosity of scientists working in these areas. Those aspects of TEK that are most similar to data generated by the scientific method are seen as a potential resource, holding answers to the environmental problems afflicting modern colonizing societies, while the spiritual foundations of IK and the Indigenous values and worldviews that support it are of less interest often because they exist in opposition to the worldview and values of the dominating societies (pp. 373–374).

Simpson also suggests that many efforts to integrate TEK and Western science have failed due to the perpetuation of colonial attitudes by well-meaning Western scientists. She notes that:

This has not gone unnoticed by Indigenous Peoples, and interactions around TEK and resource management, conservation, sustainable development, and biodiversity have become important sites of resistance and mobilization for Indigenous Knowledge holders and political leaders advocating for Indigenous control over Indigenous territories and Indigenous Knowledge and promoting a decolonized and just approach to the coexistence of Indigenous and non-Indigenous nations.

Simpson (2004) also relates her frustration with what she describes as a continued lack of acknowledgement by Western scientists of the validity of TEK. She relates that much of her own research has been discredited as non-scientific and barred from publication in Western science journals. Simpson notes that mainstream interest in TEK often stops when sociocultural questions are raised relating to, for example, *why* it is currently endangered (colonialism). She suggests that Western scientists are often reluctant to acknowledge the sociological, spiritual and cultural aspects of TEK.

I believe that the most important aspect of this conversation is the recognition of TEK as a valid way of knowing and understanding the world without forcing it to conform to the norms and values of Western science. Snively (2009) and Little Bear (2000) argue that TEK is its own form of “science”; as Snively suggests, it is useful to distinguish *Indigenous Science* from *Western Science* as they most certainly descend from different cultural and methodological origins, but, the root meaning of “science” is simply knowledge of how the world works. While Western Science has come to denote a prescribed empirical

process to approaching problems (e.g. hypothesis, testing, results, conclusions, further testing), Indigenous Science has its roots in a wider understanding of the world that includes disciplined observation of Nature, for example, but that is also enhanced through deeper spiritual and philosophical elements that extend to ontologies of daily life (Barnhardt and Kawagley 2005). As will be explored in the following section, it must also be acknowledged that there are a growing number of scholars, both Western and Indigenous, who are striving to find authentic and respectful common ground between Western and Indigenous knowledge and philosophies of Nature.

Exploring the third space: in search of common ground

Despite, or perhaps, due to the tension between Western and Indigenous science, scholars such as Gregory Cajete, Ray Barnhardt, and Angayuqac Oscar Kawagley are also seeking what Métis Canadian scholar Catherine Richardson (2004) calls the Métis or “third space”, an existential and epistemological meeting place between Western and Indigenous knowledge. Cajete (2001) describes this search for common ground as healing the “split head” of our collective society. Snow (1977/2005) goes so far as to suggest that the future success of our societies will require the combined wisdom of Indigenous and non-Indigenous cultures.

Alaskans Barnhardt and Kawagley (2005) suggest that commonalities between North American Indigenous ecological knowledge and Western science include concepts such as a unified universe; personal qualities such as perseverance, curiosity, and honesty; empirical observation of nature; and a desire to understand the behaviour and patterns of plants, animals and other natural phenomena. Differences include Indigenous trust in inherited wisdom contrasted with Western skepticism, Indigenous holism compared to Western compartmentalism, the Indigenous belief in the link between the metaphysical and physical worlds as opposed to the Western science focus on the physical world only, and the Indigenous tradition of seeking understanding in order to apply it to daily living versus the Western science value of seeking understanding for its own sake (Barnhardt and Kawagley 2005).

However, in another publication, Kawagley and Barnhardt (1999) also acknowledge that there are Western intellectual traditions other than science that are more closely aligned with Indigenous epistemologies, but they do not provide any detailed descriptions. Following this line of inquiry, I would propose that if we were to challenge the perceived dichotomy between Western and Indigenous epistemologies by considering well-established Western philosophical traditions such as deep ecology (Naess and Rothenberg 1990) and bioregionalism (Dodge 1981) alongside science, the distinctions between Western and Indigenous approaches diminish and more similarities emerge. For example, drawing from the traditions of deep ecology and bioregionalism would allow us to expand the concept of Western knowledge to include tenets such as respect and recognition of cultural and ecological diversity, the inherent value of all beings, spiritual forces, long-term multi-generational thinking, the embedded and relational position of human beings in the circle/web of life, locally-focused and responsive living, practical application of principles, local traditions, and acknowledging Indigenous territories and sacred landmarks.

If the aforementioned values were used to modify and expand the Western side of Kawagley and Barnhardt’s (2005) examination of the relationship between Western and Indigenous science, we would find that significantly more similarities now existed than differences. Reflections on the relationship between Western and Indigenous knowledge

and inquiry also relate to the methodologies employed in Indigenous research endeavours, the focus of the following section.

Embodied Indigenous research

I was intrigued by the research methodology employed by Mack et al. (2012). The initial stages of their study that involved internet and literature searches and interviews were not especially surprising, however, I found their development of a “Consensus Advisory Committee (CAC)” composed of recognized Indigenous and non-Indigenous experts to consider and summarize the findings very engaging. While they state that the idea to develop a CAC grew out of previous initiatives by the National Research Council of the National Academies, I was struck by the similarity of their approach to North American Indigenous political and conflict-resolution traditions. As Canadian philosopher John Ralston Saul (2008) notes, the continued influence of these traditions has largely been forgotten and/or ignored by contemporary North American society. Unfortunately, Mack et al. do not explicitly identify, discuss, or expand upon this congruence.

Embodying Indigenous traditions in Indigenous research methodologies is a growing area of focus and interest. Building on the foundational work of earlier scholars such as Linda Tuhiwai Smith (1999) from Aotearoa/New Zealand, researchers like Margaret Kovach (2010), a Cree and Saulteaux scholar from the University of Saskatchewan in the Canadian prairies, are further articulating and enacting Indigenous research methodologies.

In my own recent doctoral study (Lowan 2011a, b) that explored the cultural and ecological identities, philosophies, and practices of intercultural environmental educators in Canada, I employed a methodological *métissage* that comprised a blend of Indigenous and interpretive research approaches. As a Métis scholar, this approach was an embodiment of my own mixed Aboriginal and European ancestry. Inspired by Kawagley and Barnhardt’s (2005) exploration of the relationship between Western and Indigenous science, I examined the relationship between Indigenous and interpretive research methodologies. Following this line of inquiry revealed that there are very strong similarities between Indigenous and interpretive qualitative research approaches.

Through examination and enactment of interpretive and Indigenous research approaches, I found that one way to examine the relationship between them is through a critical lens constructed through questions such as: Was this research done in “a good way?” (Kovach 2010, p. 141) and/or has this research done “good work in the world?” (Willinsky 2006, p. 440).

My observations of the strong similarities between the criteria for interpretive and Indigenous research methodologies are presented below in tabular format as well as in Fig. 1 that employs the infinity symbol which, to the Métis people of Canada, represents the inextricable blending of the European and Aboriginal nations (Dorion and Préfontaine 1999). Key criteria informing both approaches include:

As Table 1 above illustrates, the only significant distinction between Indigenous and interpretive approaches is the importance of following and respecting tribal customs in Indigenous research (Kovach 2010). This is especially relevant to researchers who are conducting research within a specific Indigenous community, geographic and/or cultural, and/or attempting to embody their own cultural traditions in their methodology. For example, Kovach (2010) incorporated a significant amount of Cree language and concepts in her doctoral research despite the fact that her participants came from a variety of Indigenous backgrounds.

Fig. 1 Indigenous and interpretive research: an infinite relationship

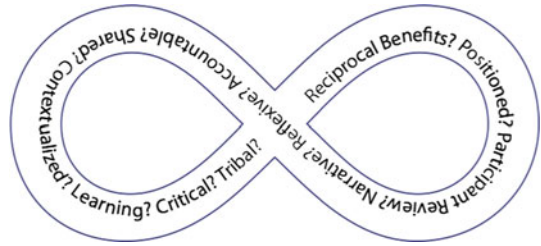


Table 1 Comparing and contrasting Indigenous and interpretive approaches

Key questions	Indigenous	Interpretive
Was the research reciprocal? <i>Were there benefits for both the researcher(s) and the participants?</i>	✓	✓
Was it explicitly positioned? <i>Who is conducting/participating in this research?</i>	✓	✓
Was their participant review? <i>Did the participants approve of how they are represented in the final text?</i>	✓	✓
Was a narrative approach employed? <i>Have both the researcher(s) and the participants shared stories and reflections?</i>	✓	✓
Was the research reflexive? <i>Is there evidence of learning by the researcher(s)?</i>	✓	✓
Has community accountability been satisfied? <i>Have/will the findings been shared publicly in an accessible format?</i>	✓	✓
Was it place-based/contextualized? <i>Is there evidence of ecological consciousness?</i>	✓	✓
Have critical issues been problematized?	✓	✓
Were tribal customs followed and respected?	✓	X

In my own doctoral study, the researcher (myself) was Métis and the participants came from a wide variety of cultural backgrounds: Indigenous, Métis, Euro-Canadian, and Asian-Canadian. As previously discussed, I attempted to embody my own Métis perspective in my theoretical and practical approach. On a theoretical level this involved drawing from a wide variety of Indigenous and Western sources. On a practical level, I attempted to embody my own perspective while still respecting the culture of every participant. As Kovach notes:

It is pertinent to note that Indigenous knowledges can never be standardized, for they are in relation to place and person. How they integrate into Indigenous research frameworks is largely researcher dependent (p. 56).

In my doctoral study such an approach involved, for example, offering tobacco along with institutional consent forms to all participants, a common practice amongst most Indigenous North American cultures for requesting the sharing of knowledge (Lickers 2006) with which all participants were familiar.

Whether it was intentional or not, I believe that Mack et al. (2012) have satisfied the aforementioned criteria for embodied Indigenous research. Review of their article reveals awareness of and enactment of principles such as reciprocity, reflexivity, community accountability, critical reflection, ecological consciousness, contextualization, and a narrative approach. However, as previously mentioned, one area that would merit further articulation is how Indigenous traditions were embodied in their methodology. Specifically, I would be curious to explore the development of the Community Advisory Committee (CAC) and its relationship, whether intended or not, to Indigenous traditions for solving problems and seeking consensus.

Further examples of practice

In closing, I would like to add to Mack et al.'s (2012) discussion of contemporary Indigenous science and environmental education programs that was primarily focused on the United States along with some mention of initiatives in New Zealand. There are also many strong examples of programs here in Canada and in other nations such as Bolivia, Thailand, and Japan.

Programs in Canada

The field of Indigenous science and environmental education is flourishing across Canada. Programs range from formal classroom-style approaches to informal outdoor experiential formats; some serve primarily Indigenous students while others welcome students from all cultural backgrounds.

For example, interpreters representing various Aboriginal groups (e.g. Innu, Algonquin, Abenaki, Huron) from around the province of Québec share ethnobotanical knowledge and cultural traditions at *Le Jardin des Premières Nations du Jardin Botanique de Montréal* (the First Nations' Garden at the Montreal Botanical Gardens) (Pardo 2009). The garden is open to the public and structured programs are delivered to a range of ages from school children to adults.

Métis educators Deanna Kazina and Natalie Swayze (2009) lead a program called "Bridging the Gap," that works predominantly with Aboriginal inner-city youth in Winnipeg, Manitoba. Bridging the Gap strives to integrate Western and Aboriginal approaches to learning about the natural world in an informal setting that is highly experiential. Kazina and Swayze instill authentic cultural awareness in their students through lessons such as the offering of tobacco and how to respectfully approach the Elders who are a strong part of their program.

Takako Takano (2005) also describes a community-developed land-based cultural education program based in Igloolik, Nunavut. Takano, a Japanese researcher, participated in Paariaqtuqtut, a 400 km journey through the community's ancestral territory in May 2002. Paariaqtuqtut means "meeting on the trail" in Inuktitut and was developed by a group of community members and Elders. Paariaqtuqtut aims to connect young people with cultural skills and teachings in a land-based context. Takano (2005) found that community members in Igloolik were concerned that many youth were losing connections with their land and culture. Those interviewed observed that this leads to youth feeling lost between two worlds, disconnected from their community and culture, yet unprepared to live in the Western world. Takano also recorded the experiences of several participants who felt that Paariaqtuqtut had helped them to reconnect with their Land and culture.

International examples

There are also inspiring examples of Indigenous education programs around the world. For example, David Lertzman (2002) of the University of Calgary in Western Canada and Thom Henley (1989) describe the Rediscovery program, a global family of intercultural outdoor and environmental education programs based on local Indigenous traditions. Henley (1989), one of the program's original founders, states, "Rediscovery brings together people from many different racial backgrounds... when people from different races have the opportunity to talk to one another, to work and play together, then inevitably they begin to learn about each other's lives and cultures" (p. 35). Rediscovery programs have been founded across North America and around the world (e.g. Wales, Thailand, Bolivia, Guyana, Siberia, Hong Kong) in various forms. Some are very small and based in one particular Indigenous community while others such as Ghost River Rediscovery (Lertzman 2002) in Alberta, Canada, are large multi-faceted programs that host and coordinate international exchanges.

Yuko Oguri (2010) of Kagoshima University in southern Japan also reports on a "living village" developed in Minamata, a small city famous for its remarkable recovery from widespread mercury poisoning in the 1950s. The living village initiative was designed to revive, preserve, and share traditional farming, fishing, and forest skills, knowledge, and beliefs. Oguri reports that the citizens of Minamata have been surprised by the interest shown by people from larger urban areas who now regularly visit the village to learn traditional skills and philosophies that have been lost in other areas of Japan.

Concluding thoughts

Indigenous environmental science education is a diverse and rapidly expanding field of theory, research, and practice. As is evident through examination of Mack et al.'s (2012) investigation of Indigenous environmental science education programs across the United States, every program takes a slightly different approach depending on the geographical context, background, and philosophies of the Elders, educators, and students involved. This diversity is appropriate as it is representative of the regional diversity of Indigenous peoples in North America and elsewhere in the world (Cajete 1994). It should be encouraged, rather than abandoned in the name of uniformity. As Chief John Snow (1977/2005, p. 23) notes, "The creator created diversity amongst plants, animals, and people. So isn't diversity a good thing?"

Discussion and sharing in-person and in writing through forums such as this are extremely valuable approaches to strengthen and advance the field of Indigenous environmental science education for the benefit of Indigenous and non-Indigenous peoples alike. Through discussing general principles of research and theory and examples of practice such as those presented here, we learn from each other and may subsequently interpret this learning in our respective contexts. Thank you for the opportunity to contribute to this forum.

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