Including Indigenous Knowledges and Pedagogies in Science-Based Environmental Education Programs

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Abstract

In exploring ways to respectfully include Indigenous Knowledges and pedagogies within environmental education programs, the challenge is to ensure strategies used will meaningfully support learning while reflecting local cultural traditions, languages, beliefs, and perspectives. In this paper, key components for science-based environmental education programs that include Indigenous Knowledges and pedagogies are considered, along with a possible means to evaluate the effectiveness of attempts to make these programs more culturally responsive. Ininiwi-kiskānītamowin, a model for science and math programming in Indigenous settings, is applied to a culturally relevant environmental education program called Bridging the Gap (BTG). Evaluating BTG within the context of the Ininiwi-kiskānītamowin model generates an enlightening illustration of the nature of the model as a process of lifelong learning, and suggests the need to consider alternative pedagogies and educational frameworks when developing and evaluating culturally relevant environmental education programs.

Résumé

L'étude des moyens d'incorporer le savoir et la pédagogie autochtone dans les programmes d'éducation environnementale a pour défi de mettre au point des stratégies appuyant efficacement l'apprentissage tout en cadrant avec les traditions culturelles, les langues, les croyances et les perspectives locales. Cet article examine les éléments essentiels des programmes d'éducation environnementale axés sur la science et incorporant le savoir et la pédagogie autochtone, ainsi que sur les moyens possibles d'apprécier la valeur des tentatives de rendre ces programmes plus culturellement adaptables. Ininiwi-kiskānītamowin, un modèle de conception scientifique et mathématique en contexte autochtone, est appliqué à un programme d'éducation environnementale culturellement approprié intitulé Bridging the Gap (BTG). L'évaluation de BTG dans le contexte du modèle Ininiwi-kiskānītamowin illustre de façon révélatrice la nature du modèle, soit un processus d'apprentissage permanent, et préconise l'étude d'autres méthodes pédagogiques et structures éducationnelles servant à l'élaboration et l'évaluation de programmes d'éducation environnementale culturellement appropriés

Keywords: Indigenous Knowledges, environmental education, science education, program evaluation

Introduction

Canadian society is becoming increasingly complex. As our country becomes more urbanized and more ethnically and linguistically diverse, researchers and practitioners are called to consider questions of decolonizing environmental education and finding meaningful ways to respectfully include Indigenous Knowledges and pedagogies (Lowan, 2009). As practitioners and researchers in environmental education and Indigenous science education, we feel challenged to move beyond the goal of advancing our field to begin to "participate in and help… shape the larger movement for cultural and ecological renewal and transformation" (Greenwood, 2010, p. 16). We also believe that environmental science education can play a vital role in decolonizing Eurocentric education by including Indigenous Knowledges and pedagogies that will help broaden all peoples' understandings of interconnected relationships with the earth, human and non-human animals, and living and non-living entities in the environment and beyond.

Mainstream educational programming has not served Indigenous learners or communities well in the past or present, whether in the inner city, urban centres, or First Nation reserves (Aikenhead, 1996; Cobern & Aikenhead, 1998). There are alternative worldviews and ways of knowing that would help reach Indigenous learners in both urban communities and reserve settings, instead of always centering the Euro-Western scientific view (Aikenhead, 1996; Cobern & Aikenhead, 1998). Unlike Western science, which places humanity apart and above the natural world, free to exploit the physical world and its resources (Aikenhead, 2007), Indigenous science evolved to allow human beings to fit into the natural world, rather than outside of it, with a relationship of respect and a sense of responsibility to keep it healthy (Cajete, 1999). Furthermore, there is a conflict between the importance of localized knowledge in Indigenous science and current science curricula. The motivation for developing knowledge about nature is fundamentally different in the two cultures (Aikenhead, 2000). Current science curricula often emphasizes the importance of conclusions that can be generalized beyond the local context, de-emphasizing the importance of localized knowledge, an integral component of Indigenous science. Many advocates for a more multicultural representation of science have argued that a universalistic stance is not a true representation of science, and that there is a need to find respectful ways to compare Eurocentric and Indigenous ways of knowing and include both in contemporary modern education (Battiste & Barman, 1995). These complex issues must be considered when designing and teaching science-based environmental programs.

As part of the process of developing effective pedagogies to better align learning experiences with the diverse realities of students' lives, it is necessary to evaluate existing models of teaching and learning and their underlying epistemologies, to determine if they match the students or if there is a need to

consider alternative pedagogies. In exploring ways to respectfully include local Indigenous Knowledges and pedagogies within environmental science education programs, the challenge is to ensure that the strategies used will meaningfully support learning while reflecting local cultural traditions, languages, beliefs, and perspectives.

Ladson-Billings (1995) summarized research in cultural education in the mid-1990s to argue that "cultural compatibility," "cultural congruency," and "cultural appropriateness" are pedagogies that accommodate a child's home culture to meet the requirements of the school culture. She describes a theoretical model that "not only addresses student achievement but also helps students accept and affirm their cultural identity while developing critical perspectives that challenge inequities that schools (and other institutions) perpetuate" (p. 469). A culturally relevant pedagogy, as described by Ladson-Billings (1995), would do three things: (1) produce students who can achieve academically, (2) produce students who demonstrate cultural competence, and (3) produce students who can both understand and critique the existing social order. Culturally relevant curriculum is place-based and adapts to meet the local needs of a community, justifying the inclusion of local culture and language into science instruction with a focus on creating learning environments that better match the home environment (Gay, 1988). Findings suggest that creating culturally relevant learning environments in science education contribute to better student engagement (Nelson-Barber & Estrin, 1995; Snively, 1990) and greater family involvement (Hagiwara, 2002).

What are the generative conditions and culturally relevant components for science-based environmental education programming to move towards respectful inclusion of Indigenous Knowledges and pedagogies? How do we determine or evaluate if we are shifting towards a more culturally relevant or Indigenized environmental education program? Together as two educators committed to addressing these issues, we analyze an informal science-based environmental education program for urban, Indigenous youth called Bridging the Gap (BTG).

In this paper, we explore key components for science-based environmental education programs that include Indigenous Knowledges and pedagogies, along with a possible model to evaluate the effectiveness of attempts to make environmental education programs more culturally relevant. As part of this collaborative effort, we bring together components of our individual work: Dr. Dawn Sutherland's work involves exploring the relationship between culture and science education in Indigenous communities, with a goal to see the teachings of Indigenous cultures incorporated into school curricula in order that science education is more meaningful, interesting, and relevant for Indigenous students. She was involved in creating a lifelong learning and assessment model for science and math programming in Indigenous settings, called Ininiwi-kiskānītamowin. Natalie Swayze is the founder and curriculum development manager of a unique, culturally relevant, nonformal, science-based environmental education program for inner-city youth called Bridging the Gap (BTG). She

brings a dedication and a diverse range of skills, knowledge, and perspectives to BTG, drawing on her Métis heritage and experience working as a nonformal environmental educator and classroom teacher in Winnipeg's inner-city. In this paper, Ininiwi-kiskānītamowin, Dawn's assessment model, is applied to Natalie's BTG program, several years after ongoing attempts have been made to make the program more culturally relevant. The purpose of the Ininiwi-kiskānītamowin assessment was to identify BTG's strengths and weaknesses from a culturally relevant perspective, based on the criteria outlined in the Ininiwi-kiskānītamowin model.

Overview of the Bridging the Gap Program

Bridging the Gap (BTG) is a year-long program that provides inner-city students from Winnipeg, Manitoba with free, culturally relevant, science-based environmental education programming. Activities include full-day field trips to local natural areas, in-class activities, as well as opportunities to experience and learn about nature first-hand by participating in inner-city gardening and stewardship initiatives. The BTG program content brings together environmental education and local Indigenous Knowledges and pedagogies (see Swayze, 2009).

When BTG began, the program content was ecology-based and designed to address learning outcomes from provincial science curricula—specifically from the Manitoba Grade Four life sciences cluster entitled "Habitats and Communities." The program content focused on exploring the concept of habitat (meeting needs for food, water, shelter, space, air) while also seeking to support the development of environmentally responsible behaviour and sustainable living practices (Swayze, 2009). Since 2005, the program focus has been continually modified in an effort to embrace the unique social, environmental, and economic contexts of its Indigenous participants because Winnipeg is home to the largest urban Aboriginal population in Canada (Hanselmann, 2001; Mays, 2005) and the highest percentage of Winnipeg's Aboriginal youth attends school in the inner city (Statistics Canada, 2003). Therefore, the objective in revising the BTG program was to make it more place-specific and culturally relevant.

The BTG program was initially revised in 2005 to emphasize a program based on Gruenewald's critical pedagogy of place (2003), where critical pedagogy is concerned with power structures and decision-making in education while place refers to connecting learners with local, social, cultural, and ecological communities. Applying place-based learning theories to environmental education programs for Indigenous learners has been critiqued for encouraging learners to seize onto Western notions of "getting back to nature" and ignoring important social and cultural dimensions (Friedel, 2011). Gruenewald's critical pedagogy of place challenges educators to consider the nexus of culture, environment, and education, unique to specific places, while renewing and creating local traditions that support social justice and ecological sustainability. We found

that a critical pedagogy of place was best able to meet the BTG program's objective of helping to rekindle traditional Indigenous values of sustainable living for the urban, largely Indigenous participants who have been affected by historical issues related to colonialism, such as the disruption of culture and loss of connection to land (Aikenhead, 2001; Cajete, 2000).

As we revised the BTG program, we wondered how we could evaluate the overall success of the revised program. What criteria would be used in the next assessment? Ongoing evaluation is an important component of any education program, and finding a suitable means to evaluate the new BTG program is an essential part of ensuring the program's continuing success. In the case of BTG, including Indigenous Knowledges and pedagogies with science-based environmental education outcomes requires consideration of alternative educational models and evaluation frameworks. Swayze needed to find an evaluation model that would be complimentary and understanding of the unique environmental science program that she had designed in order to extend its potential, rather than diminish or divert its direction of growth. Ininiwi-kiskānītamowin, a lifelong leaning model for science and math programming in Indigenous settings, was chosen as an evaluative framework to examine the Indigenous components present or absent in the revised place-based BTG program.

The Ininiwi-kiskānītamowin Model: A Framework for Indigenous Science Education

In the process of creating a lifelong learning model for Indigenous science education, Sutherland and Henning (2009) identified several foundational components for authentic and successful science education programming in Indigenous cultural contexts. The framework was called "Ininiwi-kiskānītamowin," which translates from the Swampy Cree language[1] as "the knowledge of the people in how we understand the earth" (Sutherland & Henning, 2009, p. 174). The process of creating the model involved a review of relevant research literature followed by a facilitated discussion with Indigenous educators. During a conference held at the University of Winnipeg, Indigenous and non-Indigenous educators involved in the development and delivery of science programs for Indigenous students were given a presentation on the literature review and then asked: "What are the necessary components in science programming for Indigenous students?" The educators were then grouped according to the age of their student populations, and each presented on their respective science education programs and discussed the components that were similar in all the programs at that age level. All the educator age groups came together at the end of the conference and identified the components that were common to all the programs across age groups. This process was an attempt to blend some of the current literature on science education with the important components identified by both non-Indigenous

and Indigenous educators teaching science in their communities.

In creating the final model, four developmental levels were identified from the literature as important: (1) coming-to-know, (2) cross-cultural pedagogy, (3) social and ecological justice, and (4) ecological literacy; in addition to four recurring themes or pillars identified by the conference participants: (a) Elders, (b) culture, (c) language, and (d) experiential learning. These levels and themes are described below and illustrated further in Figure 1: The Ininiwi-kiskānītamowin framework and Bridging the Gap.

Note on Terminology

There are many terms used in the literature to describe both Indigenous Knowledges and Western science (Brayboy & Castagno, 2008). In this paper, the working definition used of Western science is similar to Garrison's (1995) and Garroute's (1999), and discussed in Brayboy and Castagno (2008), where Western science is viewed as "a certain style of thinking and a certain way of asking questions and finding out answers" (Garrison, 1995, p. 4). In Ininiwi-kiskānītamowin, Indigenous Knowledges, Indigenous science, and Native science are used interchangeably. Cajete (2000) defines Native Science as:

> a broad term that can include metaphysics and philosophy; art and architecture; practical technologies and agriculture; and ritual and ceremony practiced by Indigenous peoples both past and present… Native science extends to include spirituality, community, creativity, and technologies that sustain environments and support essential aspects of human life… When speaking about Indigenous or Native science, one is really talking about the entire edifice of Indigenous knowledge. (p. 3)

Traditional ecological knowledge in Ininiwi-kiskānītamowin is considered a subset of Indigenous Knowledges that focuses on ecological explanations of how the world works.

The following is an overview of the key components conceptualized by Sutherland and Henning (2009) in the development of the Ininiwi-kiskānītamowin framework.

Four Levels of Ininiwi-kiskānītamowin

Ininiwi-kiskānītamowin includes four levels or components that are described in additional detail in the following section:

- *Learning science wholisitcally by "coming-to-know"*: perspectives that identify how individually, Indigenous students uniquely engage with Western science and Indigenous knowledge;

- *Culturally relevant approaches to teaching science*: suggested pedagogical approaches to teaching science in Indigenous settings;
- *Social and ecological justice*: approaches to teaching for social and ecological justice in science; and
- *Ecological literacy*: the inclusion of incorporating values into science instruction with the overall goal of ecological literacy.

Level 1: Learning Science Wholistically by "Coming-to-Know"

Indigenous scholars (Cajete, 2000) and non-Indigenous scholars (Aikenhead, 2002) have written about the importance of understanding how knowledge is transferred in Indigenous communities and how this may influence overall learning. In Indigenous communities, the process by which understandings of the interrelationships of humans and nature are developed is assigned as much importance as the knowledge itself (Cajete, 2000). Thus, a focus on the learning process is a primary component identified within this lifelong learning framework. Mechanisms by which Indigenous Knowledges are transferred, such as "coming-to-know," learning through culture, and two-eyed seeing are included in descriptions of learning in Indigenous contexts.

The concept of "coming-to-know" is a term used to describe the process of developing understandings in Indigenous science (Cajete, 2000; Colorado, 1988; Peat, 1994). Peat (1994) describes "coming-to-know" as, "entering into relationship with the spirits of knowledge, with plants and animals, with beings that animate dreams and visions and with the spirit of the people" (p. 65). "Coming-to-know" reflects the idea that understanding is a journey, a process, a quest for knowledge and understanding (Cajete, 2000; Colorado, 1988) and that there are responsibilities attached to the application and sharing of this deep knowledge.

Coming-to-know explains learning through an internal reflection or personal conceptualization of the balance between one's Indigenous self and the views presented in Western science. The personal reflection is consistent with Ermine's (1995) description of an Aboriginal epistemology where the journey to understand the reality of existence and harmony with nature is obtained by turning inward. As Ermine (1995) explains:

> In their quest to find meaning in the outer space, Aboriginal people turned to the inner space. This inner space is that universe of being within each person that is synonymous with the soul, the spirit, the self or the being. (p. 103)

Level 2: Culturally Relevant Approaches to Teaching Science

The second level of the model examines the external factors that influence learning. These factors include a child's family, community, and school. Many educators are interested in and committed to making the teaching environment at

school more culturally relevant and appropriate with the culture of the student, especially children whose home environment differs in language and social norms (Ladson-Billings, 1995; Martin, 1997; Phuntsog, 1998; Wlodkowski & Ginsberg, 1995). For Indigenous students, the Western science perspective on nature may not fit well with their own worldview (Aikenhead, 1997, 2006) and a science classroom absent of any references to Indigenous perspectives may seem like a foreign culture (Aikenhead, 1996; Sutherland, 1998; Sutherland & Dennick, 2002). Research suggests that creating culturally relevant learning environments in Indigenous science education contributes to better student engagement (Nelson-Barber & Estrin, 1995; Snively, 1990) and greater family involvement (Hagiwara, 2002). Therefore, a second component of the framework for Indigenous science education includes a focus on developing culturally relevant learning experiences in science education for Indigenous students.

Level 3: Social and Ecological Justice

Coming-to-know and culturally relevant science education are approaches that emphasize the importance of place in science teaching. Yet Indigenous students will also eventually benefit from being able to look beyond their own context to understand their local experience in relation to the global, while developing their abilities to evaluate or critique more global views using their personal experiences. Therefore, the third level of Ininiwi-kiskānītamowin includes the more distal influences in science education: issues of social and ecological justice. At this level, "land" is no longer the central focus but the base from which to analyze the power relationships in education that often offset the balance or coexistence of two knowledge systems. In general, social justice in science education works to open up possibilities for youth from underrepresented groups to take on identities as science learners, to shape the goals and purposes of science learning, and to improve student achievement in science (Maulucci, 2010).

The environment has not traditionally been included in social justice discourse. This is one of several critical arguments made by Bowers. Bowers (2001) proposes an "eco-justice pedagogy" as a critical framework for educational theory and practice. Eco-justice pedagogy focuses on: the relationships between ecological and cultural systems (which more often than not translates as the relationships between the exploitation of nature and the oppression of cultural groups), environmental racism, revitalizing traditional practices of cultural groups that support sustainability, and the adaptation of our lifestyle towards stewardship for future generations (Bowers, 2001). Eco-justice is not simply combining social and environmental justice. Eco-justice considers issues of social justice to be inseparable from, and even embedded in, questions related to ecological well-being (Martusewicz, Lupinacci, & Schnakenberg, 2010). In addition, as Tippins, van Eijck, Mueller, and Adams (2010) explain:

[Eco-justice] recognizes the appropriateness and significance of learning from place-based experiences and Indigenous knowledge systems rather than depending on some urgent 'ecological crisis' to advocate for school and societal change. The idea is that schooling is a small part of the larger educational domain in which we live and we learn. (p. v)

Eco-justice pedagogy is included in Ininiwi-kiskānītamowin to recognize power dynamics and the significance of learning from Indigenous knowledge systems and/or place-based experiences, rather than depending on the affective ethical imperatives for environmentalism (Mueller, 2009).

Level 4: Ecological Literacy

Ecological literacy is the final level and the ultimate goal in the Ininiwi-kiskānītamowin model for lifelong science learning. Orr (2005), as well as others (e.g., Stone & Barlow, 2005), have argued that ecological literacy is the goal of education. Orr (2005) states:

An ecologically literate person would have at least a basic comprehension of ecology, human ecology and the concepts of sustainability, as well as the wherewithal to solve problems. Taken to its logical conclusion, the goal of making all of our students ecologically literate would restore the idea that education is first and foremost a large conversation with technical aspects, not merely a technical subject. (p. xi)

In the opening chapters of Orr's book, *Earth in Mind* (2004), he writes about the education problem and asks the question: "What is education for?" In response, he argues that currently education emphasizes "theories, not values; abstractions rather than consciousness; neat answers instead of questions; and technical efficiency over conscience" (p. 8). He suggests a few principles that lead to a re-thinking of education which also resonate with the eco-philosophy of Native Science. Orr's first principle states that "all education is environmental education," and argues that pedagogical decisions reflect an understanding of how we interact with the natural world. For example, separating economics from ecology reinforces the idea that these disciplines are mutually exclusive. His second principle for educational reform argues that education should emphasize mastery of one's person, rather than content. Finally, his third and fourth principles emphasize the idea that knowledge "carries with it the responsibility to see that is it well used in the world" (p. 13), similar to the principles found in Native Science.
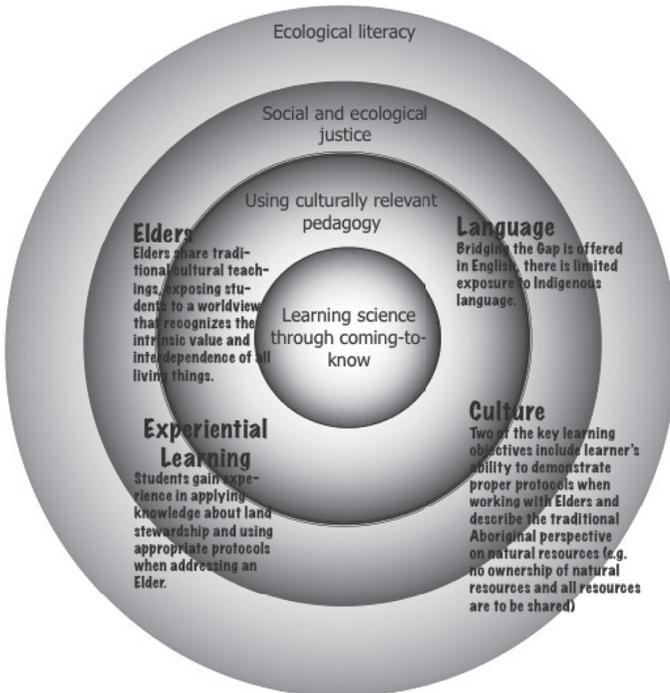
Recurring Themes: The Four Pillars

Through facilitated discussion (for further description of this process, see Sutherland & Henning, 2009), educators involved in science education programming in cultural contexts identified four recurring themes: (a) Elders, (b) culture,

(c) language, and (d) experiential learning. These themes were identified as the most important elements in Indigenous science education programming. These four pillars were placed within the core of the framework to reflect the importance of place in any lifelong learning framework for Indigenous science education.

Bridging the Gap Program Through the Lens of the Ininiwi-kiskānītamowin Model

Assessing and examining Bridging the Gap (BTG) within the context of the Ininiwi-kiskānītamowin model generates an enlightening illustration of how a culturally relevant science-based environmental education program can be evaluated and improved. In applying the Ininiwi-kiskānītamowin model's four levels as well as its four recurring themes/pillars, the strengths and areas for improvement of BTG are illustrated here:

Figure 1. The Ininiwi-kiskānītamowin Framework and Bridging the Gap.

Ininiwi-kiskānītamowin's four pillars of Elders, culture, language, and experiential learning are embedded within the BTG program, though with varying degrees of emphasis. As an informal environmental education program, BTG is inherently experiential: both the outdoor habitat studies and opportunities to work with Elders on traditional crafts or activities are illustrations of this pillar. At present, the use of traditional languages within BTG is fairly limited, based primarily on the capacity of the program developers and the preference of language by the participating Elders.

The role of Elders and culture in BTG is very significant and one of the program's greatest strengths (Swayze, 2009, 2011; Swayze & Kazina, 2009). The presence and wisdom of Elders have been effective ways to preserve and foster traditional knowledge in BTG. The Elders' involvement has also provided opportunity for intergenerational knowledge sharing and has enabled learners to practice "respect," using proper protocols for working with Elders. This has helped to close generation gaps created by legacies of residential schools,[2] while strengthening Aboriginal pride and kinship. Elders share traditional cultural teachings, exposing students to a worldview that recognizes the intrinsic value and interdependence of all living beings and spiritual entities. When involving Elders, they are not viewed as tokenistic or symbolic. Rather, they are acknowledged as leaders, repositories of traditional knowledge and primary providers and transmitters of language and Indigenous worldview. They are treated as professionals and respected for their expertise, unique knowledge, and skills, and they are respected as authoritative community stakeholders in developing BTG's culturally relevant Indigenous science curricula.

The Indigenous cultural attributes of BTG are embedded in the program goals and embraced proactively as integral components of the environmental education program, rather than afterthoughts or add-ons. The overall learning objectives for the BTG program include the original ecological concepts and skills from the Manitoba Grade Four science curriculum (those originally in the BTG), but with equal emphasis on relevant learning outcomes from Manitoba's new *Aboriginal Languages and Cultures Curriculum Framework* (Manitoba Education, 2007). Accordingly, key learning objectives for the revised program include the learner's ability to: (a) recognize how knowledge of plant and animal populations and interactions helped Aboriginal peoples to survive in the past, (b) demonstrate proper cultural protocols when working with Elders, and (c) describe the traditional Aboriginal perspective on natural resources (e.g., no ownership of natural resources and all resources are to be shared) (Swayze, 2009).

A continued emphasis in the revised BTG approach is to reinforce the concept that humans are animals: a concept aligned with the traditional Indigenous view of humans' relationship with the natural world. This required that the BTG program assume the distinct viewpoint where all humans, perceived as animals, are part of a larger ecological system. Learners involved in BTG are encouraged to view themselves as human animals, an integral and interdependent part of

the environment—not removed from it. Rather than having a distinct or superior status to other life forms, all human activities are discussed as integral aspects of the environment.

As an environmental education program taking place within a city, the concept of an "urban habitat" is embraced in BTG. Learners are guided to discover ways in which "nature" exists within an urban context, and they are encouraged to consider human dependence on the natural world and our use of its natural resources. Learners also explore their roles as residents of an urban habitat and what it means to live respectfully from the land within a city. For example, learners are guided to reconsider common misconceptions of human relationships with the land (i.e., food does not "come from the store" and water does not "come from the tap"). Learners discuss some of their own needs for food, water, and space after discussing how wildlife within local natural areas meet their own habitat needs. Learners also explore some of the traditional ways that humans have met their habitat needs (e.g., traditional plant use, trapping, hunting) and asked to consider the ways in which these needs have changed over time in urban settings (Swayze, 2009).

Ininiwi-kiskānītamowin's four levels: learning science wholistically by "coming-to-know," culturally relevant approaches to teaching science, social and ecological justice, and ecological literacy are interwoven into BTG. BTG has a premise consistent with the third and fourth levels of the model (social and ecological justice, and ecological literacy respectively) due to the gaps that prompted the creation of the program: BTG was created for students living in inner-city neighbourhoods who have few opportunities to visit and explore high quality, urban natural areas, coupled with a lower economic status and family instability which commonly persist in inner-city neighborhoods. Despite this foundation, the actual program content and structure is tailored to early years learners and considers the limits of what can be accomplished within the context of one informal environmental education program.

"Reinhabiting and decolonizing" education for place (Gruenewald, 2003) takes time and involves significant work in the face of local and global pressures. BTG's goals acknowledge that coming-to-knowing is a lifelong journey—one that will not be accomplished through one program alone. Children are not expected to instantly develop "pro-environmental" behaviours as a result of participating in BTG. To measure the success of BTG based on such an ambitious goal would fail to account for some of the important achievements that the program does make. BTG therefore has realistic goals of what the program seeks to accomplish, as well as more achievable objectives for assessing the ability of learners to engage in Indigenous knowledges.

Within levels one and two of the Ininiwi-kiskānītamowin model (learning science wholistically by "coming-to-know" and culturally relevant approaches to teaching science respectively), the strengths of BTG are clear. BTG was designed to be locally relevant with the sequencing of activities as well as the instructional

and assessment strategies based on a sound rationale for place-based education, while also following a set of guiding principles for integrating Indigenous Knowledges and pedagogies in science. BTG emphasizes local ecological places and embraces cultural attributes, requiring that place-specific elements are used as the starting points when developing teaching and learning activities, unlike the formal science curriculum. Accordingly, selected Specific Learning Outcomes from the provincial curricula must be tailored to: (a) be relevant to the types of natural areas that are studied in the program (wetlands, tall-grass prairie, and aspen parkland forests), (b) address the specific issues involved in preserving and protecting these natural areas (as well as the resident plant and animal populations within the urban setting), (c) provide suitable connections to the Elder's cultural teachings, and (d) align with specific Indigenous knowledge bundles or themes.

Summary

Evaluating BTG using the framework of Ininiwi-kiskānītamowin proved effective for the purposes and aims of each researcher and program. The Ininiwi-kiskānītamowin framework outlined specific criteria to guide an assessment of BTG and allowed the BTG designers/implementers to identity BTG's strengths (e.g., involvement of Elders) and weaknesses (e.g., limited meaningful use of Indigenous languages). Conversely, the BTG program allowed the Ininiwi-kiskānītamowin framework to prove its utility and application to many different education programs.

The Ininiwi-kiskānītamowin framework's alternative form of evaluation created an opportunity to consider which aspects of the BTG program should be preserved and what areas for improvement exist. For example, finding additional ways to include traditional languages in BTG programming will be a particularly important area for program improvement. The "lifelong learning" component embedded in Ininiwi-kiskānītamowin also inspires environmental educators to consider the potential to expand the breadth of BTG. With increased capacity, BTG would ideally be able to provide programming for additional grade levels and more opportunities to involve Indigenous parents and community members.

As a program that has operated for close to a decade, a commitment to ongoing evaluation and program improvement has been an important contributor to BTG's success. Also critical to this success has been a willingness to explore alternative pedagogies and educational frameworks when designing and planning learning experiences. Using Ininiwi-kiskānītamowin as an evaluation tool for BTG enabled the environmental educators to understand Indigenous Knowledges and pedagogies as enlightening concepts and important emphases for reform, while concurrently immersing them in new, inclusive ways of thinking and designing environmental education.

Notes

1. Swampy Cree, also referred to as the n-dialect, is a rendition of the Algonquian language spoken in many communities in Northern Manitoba and Central Northeast Saskatchewan and along the coast of the Hudson Bay and James Bay.

2. The residential school system was established in Canada in the late 1870s with a primary objective of assimilating Aboriginal peoples into Euro-Canadian and Christian society. While the federal government began phasing out the system in the 1960s, the last residential school closed its doors in 1996. Testimony by former students has revealed extremely harsh and hazardous living conditions at the schools including poor heating and sanitation, hunger and malnutrition, inadequate clothing, and exposure to contagious diseases. Many students suffered sexual, physical, and emotional abuse by the teachers and staff responsible for their care, as well as by their fellow students. The lack of proper treatment and conditions in the schools contributed to the deaths of thousands of children (Troniak, 2011).

Notes on Contributors

Dawn Sutherland's work involves exploring the relationship between culture and science education in Indigenous communities, particularly in Manitoba. She incorporates traditional Indigenous Knowledges into science lessons, and is collaborating with colleagues from around the world to develop an academic framework for teaching science to Indigenous students and to establish a research centre. Involvement with Bridging the Gap fits with her goal to see the teachings of Indigenous cultures incorporated into school curricula so that science education is more meaningful, interesting, and relevant for Indigenous students. **Contact:** d.sutherland@uwinnipeg.ca

Natalie Swayze is the Bridging the Gap founder and manager of curriculum development. Natalie has a strong background in community-based nonformal education, with a particular strength in Indigenous approaches. She brings a diverse range of skills, knowledge, and perspectives to Bridging the Gap, drawing on experience working as a classroom teacher in the inner city and her academic background in Environmental Science, Geography, and Education. She also has experience working as an environmental educator, ecologist, and project manager. **Contact:** nswayze@gmail.com

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