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Prairie Research Centre

Final Report

The Impact of Indigenous Knowledge in Science Education on Urban Aboriginal Students' Engagement and Attitudes toward Science: A Pilot Study

UAKN Prairie Regional Research Centre

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The Urban Aboriginal Knowledge Network, the UAKN, is a community driven research network focused on the Urban Aboriginal population in Canada. The UAKN establishes a national, interdisciplinary network involving universities, community, and government partners for research, scholarship and knowledge mobilization. This research was funded by a SSHRC Partnership grant entitled Urban Aboriginal Knowledge Network: research for a better life, for more information visit www.uakn.org.

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Abstract:

This pilot study examined the impact of Indigenous knowledge (IK) in science education on urban Indigenous students' engagement with and attitudes toward science. The failure of schooling to meet Indigenous learners' needs in science means few Indigenous people pursue science careers, diminishing our capacity for economic development and decision-making regarding health, resource management, and education. This study was conducted in partnership with the University of Saskatchewan, Saskatoon Public Schools, Whitecap Dakota First Nation, and the Central Urban Métis Federation Inc. It involved two classes of mostly First Nations and Métis students (Grades 4/5 and 9) whose teachers were paired an elder or knowledge keeper to collaboratively develop and deliver a unit including IK. Pre- and post-unit evaluations (surveys, circles) and ongoing evaluations (conversations, classroom observations) were employed to collect data. Evidence was also collected on the effectiveness of collaborative work between teachers, elders, and knowledge keepers. Results include a notable increase in students' ability to connect science with Indigenous knowledge and recognition that learning IK is a new and valuable experience for many students that is worthy of further investigation. Lessons learned through this pilot have informed the design of a larger study including ten classes and teachers over a full year, providing professional development, and collecting data on achievement and identity.

Research Questions/ Objectives:

This research sought to:

- Generate knowledge regarding processes (among teachers and Elders and/or knowledge keepers) designed to respectfully include Indigenous knowledge in science education.
- Collect evidence on how respectfully including Indigenous knowledge in science education impacts urban Aboriginal students' engagement and attitudes toward science.

Literature Review/ Conceptual Framework:

Formal education has failed to meet the needs of most Indigenous learners, a situation even more pronounced in science education.[1] The literature on IK and science education has grown substantially since science and science education were identified as cultural phenomena in the 1980s (Maddock, 1981). Early work by Indigenous and non-Indigenous scholars acknowledged IK as scientific (Waldram, 1986), described science education as cultural assimilation for Indigenous learners, and suggested the development of curriculum and pedagogies that acknowledged Indigenous students' distinct worldviews (McIvor, 1995). Other research has shown that engagement and achievement

[1] http://www.ccl-cca.ca/pdfs/LessonsInLearning/Feb-01-07-The-cultural-divide-in-science.pdf

improve for all students when their worldviews are reflected in what they are learning (Aikenhead & Elliott, 2010). The Saskatchewan Ministry of Education is working to address these recommendations (2010), and IK has recently been introduced to curricula across subject areas and grade levels.[2] Subsequently, the professional development of teachers to respectfully include IK in their teaching has arisen as a significant challenge. Recent work in professional development with post-secondary educators identified the need for foundational knowledge of Indigenous peoples, worldviews, and perspectives to minimize appropriative or simplistic add-on approaches to inclusion (Baker, Ewert-Bauer & Yu, 2013). Research with teachers on science education as a cross-cultural phenomenon introduced the idea of teachers as "culture brokers" who can help students bridge the cultures of Western and Indigenous science (Aikenhead, 2001). Indigenous scholars have also written on pedagogies for teaching IK in science education through their own understandings of "Indigenous science" (Cajete, 2000; Michell, 2007). More recently, the notion of "two-eyed seeing" has been introduced as a goal for Indigenous science education, helping all students to comprehend the natural world from both Indigenous and Euro-Western scientific perspectives (Hatchet et al., 2009). This research builds on prior foundational work of Saskatoon Public Schools, with concepts of "culture broker," "Indigenous science," and "two-eyed seeing" offering modalities for focusing this work, depending on the participants' positioning and preferences.

Methodology:

This research honoured Indigenous principles of relationality and holism and protocols were followed where appropriate (e.g., tobacco and gifts for Elders and knowledge keepers, food and smudging at community events). Relationship building between the teachers and Elders/knowledge keepers preceded unit development, and community partners provided guidance via an advisory committee. An Indigenous graduate student assistant was hired, providing an opportunity for a future Indigenous education researcher to gain valuable experience. Ethics approval was obtained from Saskatoon Public Schools and the University of Saskatchewan's Behavioural Research Ethics Board, and the research followed institutional and Indigenous protocols regarding anonymity, confidentiality, and intellectual property rights.

1. Participant recruitment and unit topic selection: Two participants were recruited who had completed relevant SPS Professional Development training and were teaching a second semester science class with a high percentage (i.e., more than 50) of Indigenous students. (September 2015)
2. Connecting Elders/knowledge keepers with teachers: The research team and community partners selected Elders and knowledge keepers (one for each teacher) who worked with teachers to develop the unit and work with students to the degree they were able. (October 2015)
3. Unit development: Six three-hour meetings were scheduled for the teacher, researchers, and Elder/knowledge keeper to develop units of 4–6 weeks in duration. Teacher release time was covered by SPS and Elders/knowledge keepers' remuneration

[2] To view these renewed curriculum documents visit http://www.curriculum.gov.sk.ca/

by this grant. Indigenous learning approaches will be encouraged, including land-based, hands-on experiential learning and an emphasis on storytelling and Indigenous languages. (November 2015–January 2016)
4. Obtaining consent and student pre-survey: Teachers and researchers introduced the project to students and a meeting with parents was held to introduce the research, answer questions, and distribute and collect consent forms. Indigenous and non-Indigenous students were invited to participate (data was also collected regarding impacts on non-Indigenous students). Prior to the unit students were given a survey of Likert-scale and open-ended questions that assessed engagement and attitudes toward science. Prior to use the survey was be tested for clarity and ease of use with a peer group. (February 2016)
5. Teaching the unit, case study conversations, student observations, and student post-survey: Teachers and Elders/knowledge keepers worked through the unit with students. Two students from each class were selected as case studies, and were engaged in weekly conversations with the researchers to collect data on their experiences. Classroom observations were also conducted. At the conclusion of the unit a similar post-survey was delivered to collect data on changes in engagement and attitudes toward science, as well as provide opportunities for self-reported changes in these attributes. (March-May 2016)
6. Survey and case study analysis and debrief conversations: Pre and post surveys were analyzed for impacts on students' engagement and attitudes toward science. Case study students (two from each class), teachers, and Elders/knowledge keepers participated in debriefing conversations, which focused on what worked, what didn't, how to improve, and critical incidents during the development and delivery of the unit. (June 2016)

Research Findings:

Our research was successful in providing an opportunity to test the process of having teachers and Elders/knowledge keepers work collaboratively to include IK in a science unit and to test a number of data collection methods. While few significant findings were apparent from this small study, that was not its intent. The experience of conducting this pilot research will significantly inform the design of the larger follow up study.

Surveys: Due to the small number of students in the participating classes (n=18) few statistically significant findings could be derived from the pre and post surveys. These include a notable increase in students' understanding of connections between Indigenous knowledge and science (+33%), an increase in male students' enjoyment of learning IK at school (+29%), and an increase in male students' interest in learning more about IK (+28%). The pre and post surveys will be revised for the larger study, where the larger data set should provide a greater number of significant findings.

Circles: Most Gr. 4/5 students shared very positive feelings about learning science and Indigenous knowledge, with some acknowledging the importance they placed on learning the knowledge of their ancestors. More nuanced responses were provided by the Gr. 9 students, who shared mixed feelings about learning science but more positive feelings about learning Indigenous knowledge. A few Gr. 9 students had good understandings of Indigenous knowledge although referred to it as something from the past rather than contemporarily relevant. One Gr. 9 student referred to racism and stereotyping as

preventing science and Indigenous knowledge from learning from each other. In the follow-up study these circles will be replaced with smaller circles of students identified by their teachers and the survey results.

Classroom Observations: Classroom observations found students exhibited a moderate to high level of engagement during the lessons pairing school science with IK. The Gr. 4/5 students tended to display a higher level of engagement during the lessons than Gr. 9 students. A highlight of the observations was the lesson on weaving for students in the Gr. 4/5 class, which generated a very high level of engagement.

Case Study Conversations: The case study conversations provided the most persuasive source of evidence from this study. The process of meeting weekly with two students in each class allowed the researchers to develop relationships with the students and provided opportunities for students to check in on what they had been learning in their classes. One student indicated that the weekly conversations provided motivation to think about what was being taught throughout the week to prepare for the weekly conversations. (All names are pseudonyms).

Kal-el, a Gr. 4 student, was initially very interested in science but those feelings changed as he learned more about Indigenous knowledge: *I like science only a little bit now...because there's more things in Indigenous knowledge that I don't know than in science, because I've been learning science for a long time.* The newness of Indigenous knowledge and its connection to his ancestry were reflected on in other conversations: *Now that I know that it was Indigenous knowledge, I feel grateful and just want to keep on going on with that. Not like with science non-stop, I don't want to go with science non-stop but I would like to keep going with science, but I'd like to do it with Indigenous knowledge even more because it's in my blood n stuff.*

For Jean, a Gr. 9 student, the unit influenced her connection to land and deepened her understandings of Indigenous knowledge: *I feel like I respect the earth more. Like I see the world differently since I've been in this class. Now when I look at an animal, I don't just think, an animal, it's a cat or it's a dog. I think that animal is here for a purpose, like my dog, he has a reason, there is a reason why he was brought to my front door step, there's a purpose why that happened.* She was also able to come to a deeper understanding of connections between Indigenous knowledge and science: *I'd say it brings a new perspective. I feel the way the earth has started.. I've heard the scientific way, and I've heard it the spiritual way... And they are both the same it's just the spiritual way is with different words and it sounds more, uh, meaningful to the people who are saying it. It's all the same story, it's all the same thing, it's just told different.*

Melanie's (Gr. 5) understanding of Indigenous knowledge and science was focused on processes of schooling and routine: *They both can include circle time, you can read books about both of them, and people can read and talk about both of them.* When asked about connections between Indigenous knowledge and science at the unit's conclusion she stated: *There was Indigenous knowledge in our textbooks, like how the voyagers and the Indigenous peopled traveled on land and on water and like the animals, and how the weather is changing, like what Trapper Mike was talking about animal behaviour and how they acted weird when the weather was changing.*" Melanie shared how knowing that science and Indigenous knowledge can be connected made her more

excited about science. When asked what her favorite part of learning about science and Indigenous knowledge was she stated, *reading textbooks*, because she could connect to the stories, experiences and activities shared by elders.

During a final conversation with Darla (Gr. 9) she spoke about learning how science and Indigenous knowledge could share the same space: *It feels pretty cool. I didn't really know this before until Darlene came in and told us about her Dakota ways and told us her stories and like about the stars and everything in creation, that's kinda what made me start, kinda start to understand about how they could be compared and similar and connect.* When asked if that would make her more interested in science and Indigenous knowledge she replied: *I was always interested in Indigenous knowledge, the science part and my interest in science, ... is a new thing*.

Teacher and Elder/Knowledge Keeper Conversations:

Feedback from teachers, elders, and knowledge keepers was overwhelmingly positive. While some issues common to this work were raised (e.g., scheduling issues, health concerns, funding for additional speakers and land-based activities), all those involved found the process of working together to be valuable both personally and professionally, with one teacher finding a new personal elder in the process. Other comments derived from these conversations included; experienced teachers taking a mentorship role in this work, especially when elders are knowledge keepers are scarce; exploring the use of multi-disciplinary units (rather than science-only) to reflect the holism of Indigenous knowledge; the need for ongoing professional development opportunities; and a suggestion to move the end of the next project and community gathering to May to avoid the busyness of the end of school season.

Knowledge Mobilization Activities:

A community gathering was held on June 23rd to share preliminary results from the research with teachers, students, parents, members of partner organizations, and other community members. A traditional meal was served to those in attendance and some student work was also showcased. Preliminary results were also shared at the Canadian Association of Studies in Indigenous Education portion of the Canadian Social Sciences and Education annual conference in Calgary, AB, and the Canadian Indigenous and Native Studies Association's annual meeting in Regina, SK. Copies of this report will be distributed to partner organizations, and an academic publication on this work will also be published and shared with our partners. This work will also significantly shape the design of a larger follow-up study that will include ten teachers and classes, involve four full days of professional development, and include impacts on student achievement and identity. With the assistance of a further grant from the Prairie Research Centre of the Urban Aboriginal Knowledge Network, we will be launching the next Phase of this research in September 2016.

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