

Animating Indigenous Knowledges in Science Education

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In this article, we explore how Indigenous knowledges can be used to inform science education and the development of school science curricula and pedagogy. Specifically, we explore how the concept of animating Indigenous knowledges (performing Indigenous identities, languages, and cultures and values) can be used for constructing pluralistic science classrooms. Finally, we present the notion of critical thinking in science education and discuss the issues surrounding criticality and possibilities for incorporating Indigenous epistemologies and ontologies into teaching and learning practices.

Introduction

We recognize that science as a school-based content area is an artificial construction that counters the holistic approach with which Indigenous peoples have developed understandings of the world. Therefore, this article attempts to move beyond the artificial margins of socially constructed science and outside the constraints of most academic writings in science, which discourage the use of the first person. Toward this effort, we weave reflections (in italics) of each of our own experiences with theory and others' writings. This structure illustrates important conversations that have taken place between us about teaching, doing research, and how our constructions of science have changed over time.

Janine: I am a Mi'gmaq from Listuguj and a PhD student at McGill's Faculty of Education. I speak Mi'gmaq, English, and French. My research interest in Indigenous knowledges, language revitalization, and science education stems from my postsecondary studies and employment experiences in health and science.

Gale: I am a white female who grew up in an urban environment in the United States and was a high school science teacher for 17 years. My work has mainly been with low-income, African-American youth who remain largely marginalized by school science.

We begin with a discussion of how the science education literature has responded to perceived differences between Western science and Indigenous science. We then discuss colonialism in school and in science education and describe some efforts that have been made by educators to decolonize education through the use of Indigenous languages, stories, and cultural values. Finally, we consider the need for more critical engage-

ment with pluralistic science (Norris & Korpan, 2000) and question what *critical* means in the context of education for Indigenous people. Our goal is to explore how teachers and students can animate Indigenous knowledges (Battiste, 2008) in science classrooms, which we interpret as creating environments where various science world views are brought to life through actions and interactions in the classroom. Furthermore, given that language and world view are interconnected and play an important role in sense-making, we suggest that recognition of Indigenous languages and Indigenous ways of knowing may be a vehicle for doing this.

The need for change in science education stems from a long history of Western perspectives of science being put forth in schools, with little, and often no, emphasis on other ways of knowing science. The literature on Indigenous science is of particular interest as one of these ways of knowing, but the treatment of Western science and Indigenous science as binary in the classroom is problematic. As we discuss in the next section, we have also experienced this dichotomy and are seeking ways to move beyond the binary.

Western Science and Indigenous Science as a Binary

Janine: As an Indigenous person trained in Western science, I have experienced first hand the tensions between these different world views. I first perceived differences in the various ways of knowing during my undergraduate studies in science. Although I could not explain them at the time, I knew there were other world views about science besides the Western model taught in schools and universities.

Gale: As a non-Indigenous person also trained in Western science, that was all I knew for many years. It was not until I had been a high school science teacher for many years and returned to graduate school that I began to question the primacy of the Western modern science I was taught and participated in. In my subsequent work with inner-city Black youth in the US, I began to see how science as it was taught in school marginalized them and continued their oppression. Having moved to Canada now, I see how science works in the same way with Indigenous youth here.

We embrace a pluralistic view of science education and recognize that there are numerous science world views. In this article, we begin by examining the Western Science/Indigenous Science binary and then argue for a move beyond this binary. In the literature, many authors dichotomize Western Modern Science and Indigenous Science as two relatively distinct forms that are often incompatible with each other. Of the two, Western Modern Science has the privileged status as "the most dominant science in the world" (Snively & Corsiglia, 2001, p. 8). Aikenhead (1997) summarizes how Aboriginal and Western scientific knowledge differ in their social goals, in their intellectual goals, and in their association with human

action and reminds us that “they even differ in their basic concepts of time: circular for Aboriginals, rectilinear for scientists” (p. 220).

A vision of such a chasm between Western science and Indigenous science has led educators to suggest the need for border-crossing by students and teachers (Aikenhead, 2001). But such a vision is not without problems. Despite attempts to the contrary, the binary of these two “sciences” often forces students and teachers to feel that they have to choose one or the other. Coupled with the power imbued in Western science by society at large and the educational system, this choice is not free, and it commonly continues the marginalization of Indigenous students.

Le Grange (2007) suggests that world views such as those embedded in Western and Indigenous sciences are incommensurate only if we view science as representations of knowledge. School representations of Western science are intended, even when they include multicultural links, to “lead students to particular (pre-determined) explanations” (Malcolm, 2002, cited in Keane, 2008, p. 589). Le Grange provides an alternative conceptualization of Western and Indigenous sciences when he recognizes that “science is not universal but locally and culturally produced” (p. 577). So we can view science as something that is continually produced in action. Thus science is not about representation or knowledge as object, but rather about performance or performative knowledge.

We take up this alternative non-dichotomous view and add to it the consideration that cultures are tentative, changing, and often variable and with porous boundaries (Sewell, 1992). Considered this way, we can imagine classrooms as spaces where Indigenous knowledges can exist and interact with other knowledges, including those of Western science. Although cognizant of the power imbalance between Western science and other ways of understanding the natural world, we hold hope for the reconstruction of science in pluralistic ways. Like Snively and Corsiglia (2001), we argue for the need to broaden the definition of science along with views of how school science is done and taught; they explain that the “intention is not to demean WMS, but instead to point out a body of scientific literature that provides great potential for enhancing our ability to develop more relevant science education programs” (p. 8). Acknowledging the plurality of knowledges and recognizing all sciences as performance compels us to consider alternative ways of teaching science that move us beyond both privileging Western science in schools and propagating the unproductive dichotomization of Western and Indigenous science.

Colonialism in Science Education

Janine: Having had the experience of learning only Western science in academic settings, I am now questioning those narratives as they play out in the classroom. By shifting the culture of the classroom and finding strategies for decolonizing education, teaching of science can become more relevant for the

next generation of Indigenous students. Like Snively and Corsiglia (2001), I feel that a culture-based curriculum needs to be explored because "each culture has a science, a system for adapting in an environment. The solutions are different from those of Western science, but they are by no means inferior" (p. 21).

Gale: Just as traditional African knowledge was deliberately obliterated from the Black populations in North America during slavery, a similar situation exists with Indigenous populations. We have begun to recognize that within Black populations, new Funds of Knowledge have emerged that are historically developed and accumulated strategies (e.g., skills, abilities, ideas, practices) or bodies of knowledge that are essential to a household's functioning and well-being (González, Moll, & Amanti, 2005). This idea may be useful in thinking about how to build pluralistic science curricula.

Colonization in Science Education

Residues of colonization persist in many arenas, and schools are no exception; they remain strongholds of internal colonization. Hermes (2000) noted that the lack of forward movement of the culture-based curriculum movement in Native American education could be "traced to internally accepted ideas about what *culture* is and what *schools are*" (p. 388, italics in original). Internalized colonial epistemologies are evident, sometimes even among Indigenous students themselves. One teacher explains,

When I teach kids nowadays, they think that science and culture are isolated, that they can't be merged and that you can only learn one without the other. But I try to point out that science and culture are interconnected, no matter how much people want to separate them. And I want to show them that science has always existed within the Mi'kmaq community; it wasn't introduced by Europeans or the white man. I try to point out that science has always been with us in different forms, in medicine, fishing or in terms of navigation using star charts. It's always been there in terms of the ocean, the forest and the atmosphere. Science is culturally relevant, and vice versa: you can't separate the two. (Orr, Paul & Paul, 2002, p. 340)

Janine: When I was learning about Western science in school, it never occurred to me to share examples from my own lived experiences outside of the classroom and within my own community. And yet I remember family members, relatives, and community members regularly sharing stories about medicines, hunting, fishing, basket making, etc. In school, I think I also kept science and culture separate. I rarely (if ever) brought any of my Indigenous culture into the classroom. Only now, as a graduate student, am I making more meaningful connections with my Indigenous knowledge and what I'm learning at university.

The inscrutability of Western science and its focus on knowledge as object is strong even in schools serving Indigenous students, and it has led to perceptions that studying Western science is scholarly and academic, whereas studying Indigenous science is not. For Indigenous students, this implies having to choose one or the other. Among these students, "the false distinction between academics and culture promotes student failure" (Hermes, 2000, p. 391) when they resist the formal academic system for

fear of having to choose between a mainly white society and their own cultural identity.

Gale: During a recent visit to a school serving Indigenous high school students, we saw cultural artifacts and symbols in many classrooms where they created an ethos of cultural inclusion. But the science classroom had a different feel. There were no signs of Indigenous experiences or the lived world outside the school. We can only wonder why efforts were not made to value Indigenous knowledge, life, and experiences in the science classroom and if it is related to this false distinction that "real" science must be Western science.

When Western science is privileged, other ways of knowing science are ignored or seen as having little value. Teachers and administrators often perpetuate this ideology of privilege for Western science in untold ways such that "in many educational settings where Western modern science is taught, it is taught at the expense of indigenous science, which may precipitate charges of epistemological hegemony and cultural imperialism" (Snively & Corsiglia, 2001, p. 7).

Being schooled in a system that does not incorporate Indigenous knowledges, languages, history, and cultures can result in Western science being privileged over Indigenous science, which is considered a form of "cognitive assimilation" (Battiste, 1986) or "cognitive imperialism" (Battiste, 2008).

Gale: I wonder about the term cognitive imperialism and the direction it points us in attempting to decolonize schools. Viewing it as cognitive tends to construct it as something that is relatively fixed and attributed to an individual's mind, and therefore seen as a problem of an individual, for example, a student. But colonial epistemologies do not exist solely in an individual mind; they are played out in day-to-day interactions between participants in classrooms and other locations. And it is there that we can look to change them.

Changing colonial epistemologies can perhaps happen if we start "bringing back" (Miller, 2009, p. 35) Indigenous cultural elements (e.g., Indigenous knowledges, world views, languages, and practices) and begin to resist the reliance of school science on a science as representation. Fortunately, we are beginning to see examples for integrative science programs that are bringing back Indigenous cultural elements to foster holistic curricula, co-learning, and transformative education (Hatcher, Bartlett, Marshall, & Marshall, 2009). Some educators are gaining deeper insights into Indigenous ways of being and ways of understanding the natural world by collaborating with Indigenous community members and going through their own process of decolonizing their thinking and teaching practices to make science education relevant, meaningful, and respectful for Indigenous students (Belczewski, 2009). In addition to decolonizing activities, we suggest identity construction as a fruitful avenue through which to consider how colonization continues to shape and constrain

what goes on in schools and how attention to science as performance can counter this.

Colonization and Identity

Gale: It is helpful to view identity as something constructed in action. As people act, they draw from a set of schemas, resources, and practices that they have acquired over time from a multitude of sources and experiences. It is with and from these that they construct their identity, which is fluid but nonetheless constrained by the limits of what their kit of resources provides. So it may or may not enable their participation in school science in normative ways; for students from marginalized populations, it often does not.

Messages that students pick up both in and out of school afford and truncate identity construction as they interact with each other and with their teachers in school. Hermes (2000) notes that relationships between teacher, students, curriculum, and identity in a class outweigh content in enabling students to reinvent themselves in ways that are connected with science. Issues of cultural identity among Indigenous students need to be considered in the light of, among other things, the messages they are getting from the dominant society. Acknowledging the power of dominant (usually negative) discourses about Indigenous relationships and world views, Hermes (2000) suggests the need to:

validate students' identity as Anishinabe [Ojibwe] while still recognizing there is a dominant discourse which is a little (sometimes a lot) different, and this is useful to learn too, but not without qualifying it first, recognizing where it comes from and not hiding, confusing or otherwise allowing it to replace the knowledge that has been home grown. (p. 393)

The colonial structuring of school curriculum creates a dichotomy whereby Indigenous students feel "they are forced to choose between a Native and an 'assimilated' identity" (Hermes, 2000, p. 389). Mainstream media and schools routinely construct and present science as open only to those who have a certain appearance and think in a certain way. Thus Indigenous youth acquire and act on images of themselves as being necessarily outside science, and as such they dis-identify with science and careers in scientific fields. In fact, any student who does not relate to the dominant school science identity may demonstrate his or her rejection of this identity by expressing dislike of science or by dropping out of science courses (Hughes 2001). Highlighting success stories to counter this with occasional posters and speakers on career days is often unsuccessful in counteracting the plethora of near daily messages that exclude Indigenous youth and other marginalized students from certain opportunities.

Gale: Thinking back on my aunt who was a nurse—talking with her helped me see science in the world around me, at least in relation to health and disease. But could I see myself becoming a doctor? Of course not. That also was for other people, not for someone whose father worked the night shift in a factory. I just

could not see myself in that position, and so I majored in biology, but had no vision of what I would do with it.

Janine: As a teenager, I remember seeing posters of Native role models and some of the slogans associated with those role model programs. These posters, often distributed by government agencies, were used to simultaneously promote a healthy lifestyle (e.g., alcohol and drug prevention) and higher education (e.g., professional health careers) for Indigenous youth. Some of the slogans were memorable, yet still quite vague (e.g., "If you have it in you to dream, you have it in you to succeed"). Seeing someone else succeed in any given field didn't tell me much about how to do that myself. Reflecting back, I also wonder what was meant by the word success. (Would I have to abandon my language, my culture, and my home community in order to be successful?) I needed to hear stories from people that I knew well, particularly people from my own family and community, with whom I had meaningful day-to-day interactions.

Decolonizing Education Through Stories, Indigenous Languages, and Values
Teachers play a key role in animating Indigenous knowledges and working toward decolonizing education in the classroom. But what might this look like, and more important, what might these performances look like in a science classroom? In this section, we offer several ideas and examples in an attempt to answer these questions.

Animating Indigenous Identities and Experiences in the Classroom

We envision the classroom as a site of animation where students can feel free not only to try out a range of identities, but also to interrogate how identities are formed. In a classroom setting described by Hermes (2000), the teacher invites students to ask questions and make meanings in the class based on participation and trust. In this approach to curriculum, students become aware of the dynamic nature of identity formation because they are allowed "to explore meanings and identities, that is, they are supported to bring all of their experiences into the room" (p. 395).

Teachers' personal journeys to understand diverse ways of knowing, being, and doing (Martin, 2003) can provide students with options throughout their own educational journeys. By sharing their experiences, teachers recognize in front of their students "the inadequacies and pains of their own schooling" (Orr et al., 2002, p. 337), thereby addressing "their students' needs in the face of poverty, identity dislocation, and colonialism" (p. 337). Expressing stories about experiences is a way to animate Indigenous identities. In other words, teachers can bring to life the meanings behind cultural knowledge and values. One teacher recounts how in teaching she tries to remember what she was taught in her youth: "I tell my students stories about when we were small and how we were told to respect our elders" (p. 337). Another teacher made use of a talking circle as a regular classroom activity and explained to students, "If one person is talking, then we show respect and listen to that person.

Whatever they say, you listen to them and you don't interrupt. We talk about our parents, our homes and how we should respect" (p. 343).

Hatcher et al. (2009) similarly used learning circles for sharing stories in an integrated science program for university students. As a result, classrooms became places where students could express their cultural knowledge and their own emerging science identities. As noted by Snively and Corsiglia (2001), cultural elements such as languages, myth, and ritual "generally articulate culturally and ecologically located conceptions of self in relation to others and communicate a sense of the connections which bind their communities together and to the land" (p. 16). Expressing and animating Indigenous knowledges through stories—locating the self in relation to others and the environment—can thus help students to connect and identify with aspects of school science that would otherwise not be available to them.

Animating Indigenous Languages in the Classroom

In the above section, we mention how stories are an important way of showing how language, land, and identity are linked. Gardner (2000) recalls hearing and reading that the Elders said, "The language is central to our identity ... the land is the culture ... and our world view is embedded in our language" (p. 9). Because traditionally this information is transmitted orally through descriptive names, stories, and metaphor, the use of Indigenous languages is crucial for animating this knowledge.

Teachers can create sites of animation in the classroom by promoting Indigenous language use whenever it is feasible. For example, Orr et al. (2002) wrote about a teacher who "knows her students' use of their Mi'kmaw language is closely related to their identity as Aboriginal peoples and she encourages even the most fledgling speakers to use their ancestral language as part of their classroom experiences" (p. 341). Using both English and Indigenous languages can also transform the learning environment into one that encourages students to see diverse patterns, categories, and orientations as the languages themselves reflect varied world views in their structures.

Animating Indigenous Cultures and Values in the Classroom

In an effort to decolonize education and to create sites of animation for Indigenous knowledges in the classroom, we can think of culture "as a complex web of relationships, not just material practices, and enact this in our schools in a way that is central to the curriculum" (Hermes, 2000, p. 389). Through cultural practices, we can animate Indigenous values and bring them back as a means of decolonizing school structures. Relationality and spirituality, two cultural elements of particular importance, are discussed in the following subsections.

Relationality

The expression *all my relations* is “a phrase many Aboriginal people use to acknowledge that we are in relationship with one another in this world, and to remind ourselves of this in whatever activities we are engaged in” (Brown, 2003, n.p.). Martin (2003) describes such relationships between entities as a relational ontology.

All things are recognised and respected for their place in the overall system. Whilst they are differentiated, these relations are not oppositional, nor binaric, but are inclusive and accepting of diversity. These relations serve to define and unite, not to oppose or alienate. (p. 207)

Gale: From my perspective, culture only exists as it is enacted by actors within a social setting. So it is not about viewing culture differently, but acknowledging that culture does not exist outside of the engagement of social beings in actions and interactions. Perhaps this is a useful theoretical contribution of non-Indigenous scholars such as Sewell (1999), who view culture in this way. This seems to fit with the needed emphasis on relationality.

Janine: I am becoming more aware of the importance of relationality as I think about how Indigenous people introduce themselves, particularly in public settings such as conferences, meetings, and community workshops. For instance, in Mi'gmaq communities, I've seen speakers introduce themselves by stating, “Tle'iawi [insert name of home community].” In general, this means, “I belong to [insert name of home community]” which establishes your connection to a place. By locating yourself, others know how to place you and therefore relate to you. In addition, it is common to describe your relationships (e.g., usually by stating parents' and grandparents' names and the places to which they belong). This is how I now introduce myself when speaking in public, as a means of animating my Indigenous knowledge of language, identity, and place.

Sometimes missing from school science settings is an appreciation for this way of being and belonging: existing in a complex web of relationships that permeates Indigenous world views and reaches beyond the physical world. To illustrate, in Mi'gmaq, *g'mitginu* translates as “our land/territory” but what it really signifies is that we are a part of the land, not separate from it, but connected to it. Similarly, Gardner (2000), from the Stó:lo Nation, describes how she first learned from a classmate about the meaning behind the term *S'óhl Téméxw* (*S'óhl* = Our, Respectful or Sacred; *Téméxw* = Country, Land, or World; *méxw* = Us, the People). The classmate also pointed out that “Us, the People, are included in our term for the Land” (p. 9). Gardner explains her understanding of the interrelationships this way.

I am discovering that *S'óhl Téméxw* is not just words, is not simply a representation of the physicality of the World. *S'óhl Téméxw* is a representation of a holistic concept that links the people spiritually to the physical world, to each other, and to all our ancestors and is expressed best through our Halq'eméylem language. These interrelationships define our culture, define who we are as Stó:lo people, and in fact define our world view. (p. 10)

The above-mentioned examples again point to particular world views embedded in languages and the window that the words can provide to various understandings of science. Linking spirituality to nature and the physical world “may be stretching the Western notion of science” (Hermes, 2000, p. 393). However, integrating Indigenous epistemology (e.g., intuition and spirituality) into science curriculum can become especially constructive “if it makes connections—makes what students read in a textbook come to life with meaning, connects what they have lived to what they are learning, and connects to past traditions” (p. 393).

Spirituality

Some teachers may question the role of spiritual ideology in the classroom, particularly in a science classroom. For Indigenous students, however, honoring their languages, traditions, and world views also means honoring the spirits of everything surrounding them; as discussed above, everything is interrelated and interconnected. Unlike Western science, where the focus is on working toward objectivity, Indigenous ways of knowing acknowledge connections and interrelatedness in the natural and spiritual world. Johnson and Murton (2007) provide an example from the field of geography that aims for objectivity.

The activity of describing geography and identifying floral and faunal structures is an asocial narrative in which the human presence (European and Indigenous) is absolutely marginal. People are included in the accounts but they inhabit a separate textual homeland where they are the objects of formal ethnographic description. Frequently this involved locating and containing the Native presence at specific sites, detaching them from the landscape which was then encountered and described as devoid of human occupation. In other words, the complex social-ecological world traversed by the travellers was divided into neat unambiguous categories: primitive culture and pristine nature. (pp. 122-123)

In contrast with the asocial narrative described above, “The Native individual is spiritually interdependent with the language, folk history, rituals, and geographical sacredness of his or her people” (Cajete, 2000, p. 86). This spiritual interdependence is sometimes misunderstood, but exploring Indigenous languages can provide deeper insight into the concept of spirit or powers of nature.

The Katzie, a Downriver Halkomelem-speaking people, believed that animals and plants, and perhaps even rocks, possessed power and *smesti:yexw*, a word that means *vitality* and *thought* combined, for there was no conception of one without the other. The water, wind, the sun, the moon and the stars also possessed power, vitality, and thought, and people could share in these powers of nature. (Gardner, 2000, p. 10)

Janine: Listening to Elders and other fluent speakers, and reflecting on the words they use, is helping me to better understand words and the spiritual essences associated with those words. By exploring Mi'gmaq ways of knowing through language, I am also realizing that by revitalizing Mi'gmaq language use, reclaiming it as a community language, we honor the spirit of our community and our connections within it. There is no better classroom for

learning about Indigenous knowledges and our spiritual connections and animating them than in our natural world, our own environment, or gm'tginu, our land.

In science classrooms, taking a closer look at Indigenous languages can also reveal more than one explanation for the unique classification systems in various languages. For example, Inglis (2004) explains how "in the Mi'kmaq language there is an underlying semantic theme based on a dichotomy of 'connectedness' or 'belonging to a greater wholeness' or 'oneness' versus 'lack of connection' or 'disconnection' " (p. 394).

Janine: In the Mi'gmaq classes taught in my home community, one of the first things students learn is that nouns are categorized as being either animate or inanimate. This type of noun classification (animate/inanimate) is unique to certain Indigenous languages and not present in the English language. Students who are learning Mi'gmaq as a second language are often surprised to learn that certain objects such as feathers, shirts, potatoes, and containers are considered animate entities in Mi'gmaq. Some students express frustration when they realize their misunderstandings of these categories as meaning "alive" and "not alive." Personally, I have seen similar linguistic confusion with masculine/feminine nouns in French. Studies of language and thought suggest that "people's thinking about objects can be influenced by aspects of grammar that differ across languages" (Boroditsky, Schmidt, & Phillips, 2003, p. 77). Linguistically, noun classification is important to understand because it affects how we refer to those entities. Culturally, it speaks to our world view and how we connect or relate to our social and physical environments.

"Critical" Indigenous Science Education: Is That the Answer?

Given the various knowledge systems in pluralistic science, how can teacher education programs be designed to equip teachers with tools and skills to teach students how to animate Indigenous knowledges in classrooms? Snively and Corsiglia (2001) suggest that there is a need for critical thinking among students so as to enable them to understand how Western modern science (WMS) is "a particular way of thinking about the natural world, rooted in Western culture, and how the purposes of WMS could be changed to create future sciences that better meet the needs of diverse societies" (pp. 22-23).

Snively and Corsiglia (2001) ask, "Should we develop a teaching approach that merely develops an appreciation for TEK (Traditional Ecological Knowledge) and IK (Indigenous Knowledge) or one that goes further into the implications of racism, history, and definitions, and attempts to deconstruct old prejudices" (p. 24). Delving deeper into some of these areas can be challenging. For some Indigenous people, being critical can denote a lack of respect for the other and thus violate relationality, which is based on inclusive relations and acceptance of diversity. In some cases, it does not always feel appropriate to apply curriculum theories such as

critical theory or resistance in an Indigenous context. As Martin (2003) expresses,

My belief as an Aboriginal researcher is that I actively use the strength of my Aboriginal heritage and do not position myself in a reactive stance of resisting or opposing western research frameworks and ideologies. Therefore, I research from the strength and position of being Aboriginal and viewing anything western as "other," alongside and among western worldviews and realities. (p. 205)

Janine: As an Indigenous academic, I am familiar with the dilemma faced by those trying to perform theories of decolonizing research and view science education critically while working within it. Some suggest viewing science through two different lenses—what Marshall and Bartlett (2009) refer to as two-eyed seeing. Others deal with conflicting feelings toward criticality by turning to Indigenous traditions and protocol for guidance on how to proceed (Kaomea, 2004) so as to be reflexive and critical, but also ethical, respectful, and humble (Smith, 1999).

Gale: And this is what we have attempted to do as co-authors in this article and in our relationship as two women (one Indigenous and one non-Indigenous) sharing life experiences in science, an interest in science education, and concern with the marginalization of oppressed groups from mainstream science. As a result of our discussions and interactions, we now view science education and Indigenous ways of knowing with more complexity, more depth, and more detail.

Conclusion

In this article, we explore how Indigenous knowledges can be used to inform science education and the development of school science curricula and pedagogy. The concept of animating Indigenous knowledges—which we interpret as performing Indigenous identities, languages, and cultures and values—is useful for moving beyond the Western Science/Indigenous Science binary by constructing pluralistic science classrooms. The history of colonization has affected Indigenous education and identity-formation in detrimental ways, so there is a need to decolonize school science and challenge the privileging of Western modern science. We suggest that animating knowledges is a strategy that may benefit science curricula and pedagogy not only for Indigenous students, but also for all students by making science education for everyday life more humanistic (Aikenhead, 2006).

In addition to decolonizing education, animating Indigenous knowledges can be particularly meaningful for Indigenous students because it broadens the views of how school science is done. By considering science as performance rather than just representation, students engage with school science in ways that honor their identities, languages, cultures, and values. Indigenous languages in particular open new possibilities for understanding other ways of understanding the natural environment. For science educators and researchers, the inclusion of relationality and

spirituality in the science classroom may be of particular value as these two elements help to illustrate how school science can be transformed to become more meaningful by exploring day-to-day interactions and interconnections.

Finally, we present the notion of critical thinking in science education and discuss the issues surrounding the notion of criticality. In some cases, critical theories and critical thinking are problematic in that they create conflicting feelings as diverse world views come up against each other in an individual.

After considering the various ways of animating Indigenous knowledge in the science classroom presented in this article, researchers may wish to explore other ways of performing science and consider how these reconceptualizations contribute to pluralistic science for all students.

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