CHAPTER 3: WAYS OF KNOWING

"There is no logical way to the discovery of these elemental laws. There is only the way of intuition."
Albert Einstein (in Plank, 1932)

The concept of *ways of knowing* is one that has, only of late, received increased attention in the academic literature as students of all cultures, especially First Nations, Métis and Inuit students, demonstrate learning that is occurring in sometimes difficult and challenging situations within the current predominately Eurocentric-based conventional schooling system. There is recognition in the literature that "… despite our varied place-based cultures and knowledge systems, we live in the world together with others and must constantly think and act with reference to these relationships. Any knowledge we gain about the world interweaves us more deeply with these relationships and gives us life" (Donald, 2009, p. 7). As Donald implies, curriculum designers need to have a better understanding of what *ways of knowing* means and what it means for curriculum.

While the literature found on this concept examines primarily Aboriginal or Indigenous *ways of knowing*, it is important to note that there is research that looks at other *ways of knowing*; e.g., gender-related; subject/discipline, embodied and intuitive, as well as cultural beliefs not associated with Indigenous epistemologies. What follows is an exploration of this concept through the available literature at this time.

THEORETICAL FOUNDATIONS

Inherent in the understanding of *ways of knowing* is the notion of epistemology and ontology. Epistemology relates to what *is* knowledge and is believed to be true about a given body of knowledge. Epistemologies are often equated with rationality and intellect, while ontology is the classification system used to categorize the concepts that form that body of knowledge. Both are used to describe thought processes on an individual basis and cultural beliefs and practices on a larger scale.

The understanding of what it is meant by *ways of knowing* rests mostly within literature that is theoretical in nature. These epistemological paradigms focus largely around the tension that exists between Western society and Indigenous peoples, such as the First Nations, Métis and Inuit peoples of Canada.

Discipline-specific Ways of Knowing

It is recognized that each discipline has what is called a *body of knowledge*–content knowledge that is specific to that domain of study. Within each discipline there also lies the notion of *knowing about* the discipline (conceptual knowledge) and *knowing* how, which represents what Carter (2007) calls "active ways of knowing" or procedural knowledge related to the discipline. According to Carter, the notion of

disciplinary ways of doing is the link to discipline-specific *ways of knowing* and the skill of writing[9] within and across disciplines. He calls this "bridging the outside/in gap" (p. 387). To contextualize this notion of the gap, Carter (2007) states:

> It is this relationship among knowing, doing, and writing that is concealed by the disciplinary focus on conceptual knowledge. Doing is the middle term that links writing and knowing in the disciplines, thus the challenge in reframing the disciplines as ways of knowing, doing and writing is to find a means of describing in convincing terms the ways of doing that characterize the disciplines" (p. 389).

In his work with university faculty members, it became clear that, in identifying what students should know and be able to do through the use of outcome-based statements, "certain ways of doing were repeated in general terms across a variety of disciplines: responses to academic learning situations that call for problem solving, for empirical inquiry, for research sources, and for performance" (Carter, 2007, p. 394). It was also evident that even though these *ways of knowing* appeared to be similar across disciplines, there were enough differences to identify discipline-specific *ways of knowing* through the types of written activities that students were required to produce.

Embodied Knowing

This area is growing as researchers and philosophers question the notion of what knowledge is and how it is that one comes to know. According to Dall'Alba and Barnacle (2005):

> … the notion of knowledge as foundational and absolute has been extensively challenged. A transformation and pluralisation has occurred, such that knowledge has come to be seen as situated and localized into various 'knowledges.' At the same time, the status of the body has taken on renewed significance in epistemological debates. Rather than thinking of knowledge as transcending the body, the embodiment of knowledge has become a key factor in understanding the nature of knowledge and what is means to know (pp. 719–720).

From a phenomenological point of view (Merleau-Ponty, 1962/1945, 1998/1964 as cited in Dall'Alba & Barnacle, 2005) the meaning of coming to know involves the body as a whole that is not disassociated from the brain, as is often the view affirmed by the Cartesian model of knowledge acquisition. Instead the body perceives not only what is perceivable on the outside but also within. As is stated by Dall'Alba and Barnacle (2005), "Meaning making and the associated production of knowledge are essential features of meaningful learning. Regarding learning merely as something to be managed overlooks its potentially transformative nature whereby learners engage with, and embody what they learn" (p. 730).

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[9]   Carter's paper is specifically about the writing process and the difference between writing as a universal skill versus writing that is specific to the disciplines. He purports that writing as a general skill can be used to develop the ways of writing that are specific to a discipline.

This is now more prevalent than ever, as technology becomes ubiquitous in today's society. Examples of embodied *ways of knowing* are being discussed in the literature, as it relates to mobility and spatiality— "embodied ways of knowing and learning by 'being mobile' in physical and mediated spaces" (Enriquez, 2011, p. 39). Enriquez (2011) states that "Strictly segregated spaces and social organizations of everyday life are increasingly undermined and re-ordered by the permeability and fluid modalities of emerging network and mobile technologies" (p. 39). In her view, the concepts of mobility and spatiality are in the midst of being deconstructed and the notion that there is more than one type of "presence" that exists in today's technological environments shrouds society with the feeling of omnipresence more than any other time in history. Enriquez suggests that technology, including the Internet, has given individuals an "exit option" and that mobile technologies in particular have shifted one's sense of "place, home, self, identity and bodies" (p. 40). She goes on to say that by using a mobile phone, for example, people can "exit" their physical spaces, avoid those who are physically "present" around them and be elsewhere with those who are "absent" in that same space.

Enriquez (2011) presents two perspectives on mobility—interaction and context—within a framework that examines embodied users and owners of mobile devices and the Internet. Within each perspective of mobility, she outlines the different dimensions of human interactions, including:

Spatial mobility: refers to the physical movement of people, objects, symbols and space itself.

Temporal mobility: refers to the non-linear coordination that media technologies afford in human activities beyond clock-time slices and allocations.

Contextual mobility: refers to the mediated situation in which individuals are considered to be relatively free of the contextual constraints of computer-mediated interactions in largely different contexts (p. 41).

In her closing, Enriquez (2011) states that "how we learn is not just an encounter of intellects mediated by tools, but a bumping into of bodies in spaces as part of the ways of knowing in motion" (p. 50). She reiterates the importance of learning from the various perspectives of mobility that knowledge is not constructed solely from travelling from place to place but also from staying still. Thus, the era of the digital age brings with it a "new" notion of time, space and place. As such, this new *way of knowing* is increasing the "distance" between generations, as each generation comes to know these new realities and learns new knowledge in different ways and within their personal realm of experience.

Indigenous Knowledge and Ways of Knowing

Donald (2009) discusses the need for First Nations, Métis and Inuit people to come to recognize their own epistemological roots. He describes what is the typical state of learning for First Nations, Métis and Inuit people as the colonial frontier logics that stem from "fort teachings," an artifact from the past which "represents a particular four-cornered version of imperial geography that has been transplanted on lands perceived as empty and unused ... adhering to the myth that forts facilitated the civilization of the land and brought civilization to the Indians ..." (p. 3). This history that he refers to has had and

continues to have a dramatic influence on the educational contexts that both Aboriginal and non-Aboriginal students find themselves in and on the stories they are told about Aboriginal-Canadian relations. This colonial frontier logic continues to perpetuate the notion that Canadians and Aboriginal peoples live in separate social and spatial realities, even though they live on the same land and within the same space. He states that the "historical, social and cultural understandings of the fort and frontier have become conflated with ways of organizing and separating people according to race, culture and civilization" (p. 4).

Battiste (2010) speaks to learning (as Aboriginal people have come to know it) as holistic, lifelong, purposeful, experiential, communal, spiritual and alive with language and culture. First Nations, Métis and Inuit peoples' *ways of coming to know* and *coming to be* occurs through learning spirits who travel with and guide people along their earth walks, offering inspiration that helps them realize the potential to be who they are. In the current educational system, however, Aboriginal peoples across Canada are either marginalized by or assimilated into the English language and predominately Eurocentric culture that constitutes Canadian schools today. Battiste (2010) indicates that:

> Today, Indigenous peoples around the world continue to feel the tensions created by a Eurocentric educational system that has taught them not to trust Indigenous knowledge, but to rely on science and technology for tools for their future, although those same sciences and technologies have increasingly created the fragile environmental base that requires us to rethink how we interact with the earth and with each other (p. 16).

In this vein, Battiste continues to speak about the importance of conserving Indigenous knowledge and the role it can play in helping to solve problems in today's world, rather than just conserving the stereotypical view of Aboriginal peoples—their dances, food and cultural practices. Rather, national and international studies are revealing the significance of Indigenous knowledge and the inherent value that lies within these knowledge systems, not just for Aboriginal students but for all students.

McKnight, Hoban and Nielsen (2011) also describe this *knowing* as coming from experience and being transmitted through storytelling. These *ways of knowing* are, however, very particular to the place from which they came and cannot simply be transplanted to another place without losing meaning. According to Birrell (2006, as cited by McKnight, Hoban & Nielsen, p. 42), "the land holds stories and Aboriginal *ways of knowing* that involve less emphasis on the intellectualization of the stories, and rather more emphasis on the emotional feeling and observed nature of the story." Thus, Indigenous knowledge lies in the individual's learning journey in relation to the land and in relations to other entities: story, dance, art, respect and lore.

This notion is further illustrated by Snively and Williams (2008) as they describe the current state of Aboriginal students in British Columbia. According to their study, using data from the British Columbia Ministry of Education (2002), "… in British Columbia schools the majority of students of Aboriginal ancestry are underrepresented in science courses and underrepresented in the sciences" (Snively & Williams, 2008, p. 112). They identify the source of the problem as being related to "a type of science education in which Aboriginal science knowledge is rarely acknowledged and Aboriginal content is

considered a token addition or is seldom, if ever, legitimatized" (Snively & Williams, 2008, p. 112). Battiste (2002, as cited in Snively & Williams, 2008) states that Aboriginal knowledge is structured through the various Aboriginal languages and to understand Aboriginal knowledge one cannot be an outsider looking in.

Literacy from an Aboriginal perspective means learning that covers a lifespan and goes beyond the typical Western notion of literacy (reading, writing and numeracy, especially in print form) to include oral speaking, storytelling, singing, dancing, symbols, artwork and ceremonies (Snively & Williams, 2008). Different forms of literacy will also affect knowledge that is acquired and shared. In Aboriginal cultures, the knowledge gained from observing the land is shared orally. This transmission of knowledge permits other members of the culture to develop "an intimate and current knowledge of the land … building up a collective database and updating traditional stories of the environment" (p. 114). The researchers go on to further state that "Indigenous languages have their own schema and categorization systems that reflect what they value in their world; for example, Indigenous taxonomies may use function, colour, significant feature … These taxonomies are constructed as a result of a deep, observant, and intimate relationship with the environment" (p. 115). As such, learners coming into the traditional school system bring their previously acquired knowledge from the home culture and use it as a way to make sense of what they are coming to learn. When students have an opportunity to share this knowledge in the context of the learning they are involved in, they become recognized and validated.

Scientific literacy from a Western cultures' viewpoint is defined as "the traditional sense of being knowledgeable about science and the fundamental sense of being literate in the discourse of science" (Norris & Phillips, 2003, as cited in Snively & Williams, 2008, p. 115). This means, in essence, that students are able to use the typical discourse forms of scientific inquiry that are prominent in traditional science classrooms (e.g., questioning, describing, explaining, hypothesizing, debating, clarifying, elaborating, verifying, sharing results), which are in direct conflict with social discourse patterns in many Aboriginal cultures. From an Aboriginal perspective, scientific literacy involves applying Aboriginal scientific knowledge that is found in a wide range of examples and using it with what is known in Western science, while maintaining the values and ethics required to sustain communities and the environment (Snively & Williams, 2008, pp. 115–116).

To add further complexity to worldviews of science, the nature of language plays a significant role, as languages set the manner in which meaning is shared. In Western science, for example, the notion of observation occurs through the five senses; for Aboriginal peoples, "observation" views the relationship of the human mind and nature as one. Therefore, to ask Aboriginal students to "observe" a natural phenomenon would be to bring out notions that would be different from what a student of Western science would "see." The manner in which nature is viewed by Aboriginal peoples comes through "thousands of seemingly unrelated pieces of information … organized through complex webs and levels of metaphor that are utterly alien to Western taxonomies" (Snively & Williams, 2008, p. 117), whereas Western science students would describe what they "see" through the lens of a knowledge system that is compartmentalized.

Auger (1997) adds further support to the notion of Indigenous knowledge and *ways of knowing* as he discusses the Sakaw Cree worldview that describes speaking of the power of unspoken communication, learning without spoken words and learning in the crossing and sharing of knowledge, both old and new. According to Auger, knowledge comes from many sources. He states:

> A Sakaw Cree worldview acknowledges the Elders, the Animals, the Land and the Spiritual dimension as primary sources of knowledge. These sources do not exist in isolation of each other but are deeply intertwined or interrelated. To 'educate' a child using these sources of knowledge involves a process that interweaves, or interrelates, the child in among all these sources. Such an educational system is not foreign to the child, for the child comes into our world already able to tap into these sources of knowledge (p. 339).

Lightening (1992) continues this notion of knowledge as he addresses the nature of the mind, as expressed by the late Elder Louis Sunchild. The mind exemplifies humility and respect in engagement with Elders, knowledge and learning and describes holistic learning as an important *way of knowing*. Lightening further describes this learning as intellectual and emotional learning and states that there is a need for people to understand the mind; that great care should be offered to it and that the source of existence is directly associated with it. He suggests that all Elders are saying the same thing—from generation to generation, the people have taught human truths and principles for the holistic survival of everyone. He contends that the message is one and the same, but is expressed from many different perspectives and multiple angles. He stresses the importance of protocol in the transfer of knowledge between peoples, noting that with that transfer comes the responsibility to honour the *ways of knowing* delivered from the Elder. The transfer of knowledge (Lightening's suggested *ways of knowing*) from generation to generation is the key to ensuring people's survival and, according to the author, "what we do today will affect generations to come" (p. 251).

Henry Lickers' speech (2010) given at the Fresh Water Summit provides a powerful example of how Indigenous knowledge can provide insight into a world problem:

> As the leaders of the world meet to discuss water and the world, the human and spiritual aspects of water can be forgotten. To the native people of the world, water is sacred. The rivers and lakes are a place of spiritual contemplation and reverence. … These understandings of water come in direct conflict with economical, political and structural aspects of the modern world. Dams, river modification, dredging and filling in the water of the world are seen as progress to some. Water to the modern world is only important when we can assign a monetary value or make it a commodity for world market. As a result, we are losing our understanding of our place on Mother Earth. … Unless we begin to understand water and use the knowledge that was given to us by the Earth and the Creator, we will be dooming our children to a bleak and dry future. There is hope. Now let us talk about our responsibilities to the Water and all Creation.

Whether or not the beliefs of many men and women in a specific culture constitutes a particular *way of knowing*, as well as whether or not those beliefs "can (and should) be taught as 'African *knowledge*'" (Horsthemke, 2010, p. 30), are questions Horsthemke asks. The idea of *African ways of knowing* constitutes a part of the challenge for occidental belief systems and, therefore, the traditional account of the terms *knowing* or *knowledge* is not only a complex concept, it is also one that is rarely without controversy. Horsthemke states that these terms are "commonly coupled with 'traditional,' 'local,' and the like, and are contrasted with 'universal,' 'global,' 'world,' 'Western,' 'Eurocentric,' etc." (Horsthemke, 2010, p. 32). This leads to the term *African ways of knowing* to be "something of a misnomer" (Horsthemke, 2010, p. 32). Ruitenberg (2008, as cited in Horsthemke, 2010, p. 33) explains that "claims about 'ways of knowing' often mask claims about and in favour of particular worldviews and 'issues far beyond epistemology.'" He explains that various ideas are covered by the phrase *ways of knowing*, including various types of beliefs. For example, spiritual beliefs, beliefs about human beings as well as beliefs about the relation between reason and emotion could all be misrepresented by the phrase *ways of knowing* when, in fact, these beliefs signal a "concern with the broader ontological and metaphysical beliefs of worldviews" (Ruitenberg, 2008 as cited in Horsthemke, 2010, p. 33).

Horsthemke (2010) states that the use of the term *knowledge* in educationally relevant situations must be distinguished between "theoretical" and "practical" knowledge. He believes that there is often a difference made in such situations between "knowledge" of "that" or of "how" to do something "compared to 'knowing-that' and 'knowing-how'" (pp. 37–38). Having the skills and abilities to accomplish a task is considered to be *practical knowledge*, whereas the "'real stuff' of epistemology, concerning not only what I can know but also … under what circumstances or conditions I can claim to know that something is or is not the case" (p. 38). The author concludes that in order to know what is true, one must have a complete understanding of what is considered to be *knowledge*, *knowing* and *truth* and that this understanding must be as dependable as it is coherent. It is only then that society can "learn to avoid falsehoods and error and, in so doing, get closer to [knowing] the way things really are—or were, for that matter" (p. 47).

Intuition and Estimation as Ways of Knowing

Immordino-Yang and Faeth (2010) describe intuition as a part of the emotional signals received by the brain that informs cognitive processes. A growing body of neuroscience research is demonstrating the importance of emotions and learning. The authors state that:

> students' accumulation of subtle emotional signals guides meaningful learning, helping them to build a set of academic intuitions about how, when, and why to use their knowledge. ... As students learn to notice and refine these signals, learning will become more relevant and meaningful to them ... (p. 82).

Güven (2010) identifies intuition as a *way of knowing* that plays a key role in thinking and learning (citing Bruner, 1960). According to Cappon (1994, as cited by Güven), intuition is viewed as a key element to discovery, problem solving and gaining understanding. In the initial stages of inquiry, intuition can be "considered as a basic source of evidence to support a theory and also during the justification

procedure" (p. 75). Fischbein (1987, as cited by Güven) theorizes that intuition plays an important role in the development of students' mathematical thinking. He identified two types of intuitive knowledge: primary intuitions, developed through personal experience in informal settings, and secondary intuitions, knowledge acquired through a schooled experience that is intentional in nature (p. 75).

Galdwell (2005, as cited by Hartesis, Koch & Morgenthaler, 2008) explains that intuition is the first spontaneous impression that derives from implicit knowledge, which is developed and enriched through years of experience. To add to this explanation, Harteis, Koch and Morgenthaler (2008) point out that the capability to act or decide on any given situation in an appropriate way without first consciously evaluating the alternatives, weighing the various options and, perhaps, without any awareness at all, is the definition of *intuition*. In essence, it is the "rapid responses to developing situations based on the tacit application of tacit rules" (Harteis, Koch & Morgenthaler, 2008).

The notion of intuition as a *way of knowing* is further exemplified in the world of business where intuition and rationality play key roles in finding success in business. According to Sadler-Smith and Shefy (2004), "Executive intuition is the skill of focusing on those potentially important but sometimes faint signals that fuel imagination, creativity and innovation and feed corporate success" (p. 76). They go on to say that "Intuition is a capacity for attaining direct knowledge or understanding without the apparent intrusion of rational thought or logical inference" (p. 77).

Many philosophers and psychologists recognize that intuition is a unique and valuable *way of knowing*. Although it is very difficult to describe, it is easily recognizable by all as that "gut feeling" that is not necessarily entrenched in what is perceived to be rational or logical thought. As research develops in this field, two forms of intuition are emerging "as a form of cognition that operates in two ways: 'knowing' (… intuition-as-expertise and the related notion of intuition as an aspect of sense-making) and in a way that connects mind and body through 'feeling' (… intuition-as-feeling)" (Sadler-Smith & Shefy, 2004, p. 81). Intuition-as-expertise involves the acquisition of knowledge that is gained passively, most often incidentally, and is stored in long-term memory. This knowledge comes to the surface seamlessly when a person is confronted with a complex problem and this tacit knowledge assists in quickly assembling the gathering of facts in a meaningful way to come to a decision. Intuition-as-feeling, on the other hand, is what most people recognize as the "gut" feeling or, as Sadler-Smith and Shefy (2004) indicate, as the "intuitive signals that manifest themselves as automatic somatic alarm bells" (p. 84), the notion that "something tells me that this is just not right." Sadler-Smith and Shefy (2004) best sum up intuition in this manner:

Intuition is a composite phenomenon that incorporates expertise and feeling, and as such is linked to mental processes both in the cerebellum and the limbic system and to bodily felt senses. It is not simply educated ('smart') guessing; it is more than 'flight or fight' (instinct) and is distinct from 'eureka' experiences (insight). It resides at a level below consciousness, arises cognitively, affectedly and somatically and is manifested as a 'hunch' or 'gut feel.' … When used intelligently, intuition has the potential to enhance executive judgement and decision making (p. 87).

Estimation, another *way of knowing*, involves approximating "the worth, size, or amount of an object, or quantity that is present in a given situation" (Mitchell et al., 1991, as cited in Güven, 2010, p. 75). The process is carried out quickly and is also often used to make rapid decisions. According to educators and researchers, it is a highly important skill that supports understanding and development of number relationships and many other mathematical concepts (Güven, 2010, p. 75). Coburn and Shulte (1986, as cited by Güven, 2010) indicate that those students who are good at estimating also tend to have a deeper understanding of number sense.

This is further illustrated by the work occurring in the neurosciences. Dehaene (2010) cites the study of Gilmore, McCarthy and Spelke (2007) in which preschoolers were asked to indicate, through the use of word problems, which person had more of something. Even though the students had no instruction in addition or subtraction, they were able to identify, through approximation, the correct answer. Thus, as stated by Dehaene (2010), "the ability to approximate gives students an 'intuition' for problems they have never experienced before and therefore a head start in arithmetic" (p. 183).

QUALITATIVE AND QUANTITATIVE STUDIES

Each of the studies described in this section is preceded by the theoretical underpinnings that support the work carried out by the researchers. Further forms of *ways of knowing* are presented here.

Connected and Separated Ways of Knowing

Khine and Hayes (2010) undertook a study to determine if young college women in the United Arab Emirates preferred to be connected knowers or separated knowers as a *way of knowing*. The researchers indicated that in order to understand the importance of connected or separated knowledge, it is important to understand the personal epistemological beliefs to ascertain how this *way of knowing* can influence learning. They state that "Research in personal epistemology looks into ways of knowing, focusing on the nature of knowledge (certainty, structure and source of knowledge) and beliefs about learning (speed and ability to learn)" (p. 105). As such, they state that:

> Women's Ways of Knowing (WWK) proposed five epistemological perspectives by which women know and view the world. These are [i] silence, [ii] subjective knowing, [iii] received knowing, [iv] procedural knowing, and [v] constructed knowing. Procedural knowledge as an epistemological position indicates that knowing does not rely on intuition or information gathered from the content but requires conscious, systematic thinking (Brownlee, Boulton-Lewis, & Purdie, 2002, as cited in Khine & Hayes, 2010, p. 106).

Connected knowing and separate knowing are a part of procedural knowledge. Connected knowers seek to understand another person's point of view while not passing judgement. They also have difficulty in separating feelings from thought and, according to Schommer-Aikens and Easter (2009), they often tend to adopt the position of the other person. Separated knowers, on the other hand, tend to detach themselves and look to analyze critically another's point of view by often arguing, debating or "shooting holes in another's position" (Schommer-Aikens & Easter, 2009). The researchers cite the work of Belenkly et al. (1986) and Gallotti et al. (1999) whose studies have shown that neither connected

knowing or separated knowing have significant effects on cognitive performance; rather, the learner's epistemological approach will more likely affect how the learner learns than the amount of what is learned. Both forms of knowing support critical thinking. What is different, however, is the approach taken to understand the content.

Schommer-Aikens and Easter (2006, as cited in Schommer-Aikens & Easter, 2009) show that gender can make a difference in terms of connected knowing and separated knowing, but it is not the only factor that dictates a preference. Their studies demonstrated that men are more likely to be separated knowers and women connected knowers and, as such, "... can contribute to different patterns in women's and men's knowledge and approaches to learning" (Hayes, 2001, as cited by Khine & Hayes, 2010, p. 107). However, the researchers reiterated that neither approach was better than the other in terms of acquiring knowledge.

Schommer-Aikens and Easter (2009) delved deeper into the study of connected knowing and separated knowing. They hypothesized that the more students ascribe to separated knowing the more likely they were to willingly engage in argumentation (p. 122); that is to say, separated knowers view argumentation as a positive form of communication. They also affirmed the flip side of the coin, that connected knowers where less likely to engage in argumentation, because they tend to show more empathy toward the other person and often even take on that person's position. The researchers also wanted to test out two other hypotheses: 1) students with high scores in both connected knowing and separate knowing may be more willing to argue; and 2) students with high scores in both connected knowing and separate knowing may be more likely to define the word *argument* as a constructive form of communication.

The study showed, through two survey instruments and an open-ended question relating to the definition of *argument*, that if a student leans more toward separated knowing, he or she is more willing to engage in argumentation. They further confirmed findings from other demographic studies as follows: male students are more willing to argue than female students (consistent with the 1994 findings of Nicotera & Rancer); students from the west coast of the United States are more willing to engage in argumentation than those from the midwest (consistent with the 1996 findings of Infante & Rancer) and there are also differences noted by age—younger students show more willingness to argue than older students (consistent with the 2003 findings of Schullery & Schullery). They further noted that connected knowing was not a good predictor of a student's lack of willingness to argue, showing that connected knowing and separated knowing are not direct opposites (p. 129). The results also indicated that if students demonstrated high scores in both connected knowledge and separated knowledge, there was a higher correlation in their willingness to argue. When students provided their definition for *argument*, those who were more willing to argue defined it as a constructive means of communication, whereas those who defined it is as verbal aggression and saw argumentation as a destructive form of communication (emotionally charged with the view of causing psychological harm) were less willing to engage in argumentation.

Embodiment as a Way of Knowing

Freiler (2008) describes *embodiment* as a *way of knowing* that essentially involves "being attentive to the body and its experiences" (p. 40) as a way of constructing knowledge. Freiler describes embodied learning as being related to body–place relations. She cites the Sommerville (2004) study, which describes miners' "pit sense" as occurring when the senses are highly engaged, while depending on fellow miners to provide further evidence of changes in the workplace, creating a heightened sensitivity for survival purposes. She also describes the Mokens in Thailand, who seemingly went unscathed in the 2004 tsunami, by being perceptually attuned to their environment and reading the warning signs of the impending disaster. As Freiler (2008) explains, "embodiment needs to be viewed within a broader movement toward holistic, integrative learning approaches wherein the body is made more visible as a source of knowledge and site for learning through objective and subjective realms of knowing" (p. 44). Context and sociocultural factors need to be considered and valued, while bringing together the various other *ways of knowing* that coexist within an individual.

A research study by Johnson-Glenberg, Birchfield and Usyal (2009) describes the use of the Situated Multimedia Arts Learning Laboratory (*SMALLab*) that allows the learner's body to become actively engaged in learning by moving freely in space while interacting with the environment. This environment allows student to "immediately SEE how their actions affect the space and are projected on the floor, FEEL the results, HEAR feedback, and be interactive and manipulative with projected imagery on the floor" (p. 269). The researchers hypothesized that students' learning could be optimized and retention increased when exposed to learning in a multiple modalities environment that encourages collaboration between students and the teacher.

They carried out two studies to test their hypothesis, using geology scenarios (one related to layers of rock formations and the other related to mapping contours). In one study, the Grade 9 students were pretested for knowledge of the subject matter, received a lecture from the teacher and then spent time in the *SMALLab.* The second study involved students in understanding map contouring, following a similar structure. In both studies, in the post-testing stage, students with different learning profiles showed increases in retention. One of the groups, identified as students not maximizing their learning potential, however, showed significant increases in retention. The researchers felt that the use of sound, visual stimuli and auditory feedback, which are not typically stimulated in a traditional learning environment, can contribute to significant gains in sustaining student engagement and optimizing learning. As further research in embodiment is carried out, a better understanding of cerebral connections will guide better learning in virtual and traditional learning environments.

Indigenous Ways of Knowing

Barnhardt and Kawagley (2005) identify three interrelated themes of study in which research in Indigenous knowledge systems have been undertaken. These themes are: 1) Indigenous knowledge systems are beginning to be articulated and documented; 2) epistemological structures and learning/cognitive processes that are associated with *ways of knowing* are being defined; and 3) strategies for integrating Western and Indigenous *ways of knowing* are being developed and assessed. Barnhardt and Kawagley discuss the following major research initiatives on Indigenous *ways of knowing*:

Native Ways of Knowing or Indigenous Epistemologies speak to research that is being done in identifying the inner workings of various Indigenous knowledge systems and the need for better understanding of these knowledge systems. It is hoped that by attempting to find common ground these knowledge systems can be better understood on a worldwide basis.

Culturally Responsive Pedagogy or Contextual Learning looks at how Indigenous knowledge and *ways of knowing* can be integrated into curriculum, citing the 1998 work of the Alaska Native Educators (*Alaska Standards for Culturally Responsive Schools* and *Guidelines for Respecting Cultural Knowledge*, as cited in Barnhardt & Kawagley, 2005, p. 18) as a promising innovation in integration.

Ethno-mathematics is a new area of research that has done a cross-analysis of the mathematical sciences to gain a better understanding of what is mathematical knowledge and how it is constructed. Again, Barnhardt and Kawagley (2005, p. 18) cite the work done in Alaska where educators have taken Indigenous constructs, such as the construction of a fish rack, and tied it to mathematical knowledge, in order to contextualize this knowledge for Indigenous students. The results could have significant impact on learning and performance on state assessments.

Indigenous Language Learning is seen as an integral part of understanding Indigenous knowledge systems. Barnhardt and Kawagley (2005) urge researchers to delve into not only the language system itself, but to gain a deeper understanding of Indigenous languages so as to better understand Indigenous students' thought processes.

Cross-generational Learning/Role of Elders/Camps is being viewed as an important and valuable aspect of developing the knowledge system of young Aboriginal students. However, there is very limited research in this area with regard to the types of strategies, both pedagogical and curricular, that can support student learning in a cross-generational context.

Place-based Education is viewed as being of important significance for Indigenous students. Barnhardt and Kawagley (2005) cite the research work carried out by Cajete (2000) who describes local environments as an essential ingredient for developing an interdisciplinary pedagogy of place.

Native-Science or Sense-making looks at the way in which knowledge is constructed, organized, used and communicated in both Indigenous populations and in Western science. There is some convergence conceptually, but the divergence occurs in how knowledge is learned and applied.

Two other themes are *Cultural systems*, *Complexity and Learning* and *Indigenizing Research in Education*. Both areas of research relate to how a better understanding of knowledge systems within these domains can benefit learning for Aboriginal and non-Aboriginal students. Their feeling is that Indigenous scholars can devise their own research methodologies when they better understand the context in which the research needs to be carried out.

The following studies, although not carried out by Indigenous scholars, do provide insight into Indigenous *ways of knowing*.

Yunkaporta and McGinty (2009) describe a participatory action research project in an Indigenous community in western New South Wales, Australia, which is in keeping with the way in which Indigenous peoples observe and reflect on the world. The study involved the introduction of Aboriginal perspectives into the curriculum, with the view of strengthening relationships between the community and school, and with the goal of increasing literacy, attendance and Aboriginal student engagement. The research focused on how to operationalize the interface between Western curriculum knowledge and Indigenous knowledge, which involved participants being engaged in "negotiating a space where common ground could be determined and built upon in culturally safe, yet challenging ways" (Yunkaporta & McGinty, 2009, p. 56). The project centred on Aboriginal knowledge of land and place at the juncture of a river, which then became a metaphor for the "overlap between multiple social realities and ways of knowing" (Yunkaporta & McGinty, 2009, p. 56). This overlap presented itself in a challenge between accepting local Indigenous knowledge as valuable and trustworthy and dismissing it as limited to the "levies that enclose the town." The researchers sought to use the theory of cultural interface to bring together Western and traditional knowledge to create a juncture of new knowledge, identified by the researchers as "contemporary local knowledge." The research project involved three spirals or phases. The first phase involved the Indigenous facilitator working with the community, organizations, students and teachers to identify local knowledge, protocols and relationships to develop learning units. These units were then shared with students to gauge their reactions and choices to inform the next phase, which involved a similar process, only larger in scope and with students being more involved in the decision-making process. The final stage involved observations and reflections on the process as well as a presentation of student work and findings.

Yuckaporta and McGinty (2009) identified teacher conflict, student/community conflict and curriculum/organization conflict as three key themes emanating from their findings. The first theme, teacher conflict, involved cultural discomfort and perceived deficits in the Aboriginal students, such as their inability to learn without the presence of the Aboriginal facilitator and the notion that the units were "slack" in content when in fact they contained deep Indigenous knowledge and pedagogies. The researchers ascertained that teachers' negativity related to their discomfort with the content and student behaviour. However, when teachers were persistent in following the unit and believed in the interface concept, the results were more positive. Students showed more self-direction and self-regulation as teachers came to realize that what they had initially perceived as knowledge "lacking logic" now showed structure that maintained a "balance between direction and autonomy" (p. 65).

The second theme, student conflict, came between what was perceived by teachers as having already been attained in the community and the reality that this Indigenous knowledge had not necessarily been transferred. Another source of conflict, much to the surprise of the researchers, was that poor behaviour ensued when the cultural interface content and pedagogy were abandoned or when the move from activities that involved deep knowledge used for higher-order thinking was replaced with shallow knowledge. Community conflict revolved around the keepers of local Aboriginal knowledge and what was considered to be pertinent knowledge, whether from the past or present, with the past being viewed (even amongst certain Aboriginal members) as being primitive and confined to "the softer areas of curriculum" (Yuckaporta & McGinty, 2009 p. 67). However, the researchers in the study indicated that the Indigenous knowledge presented to the students involved higher-order thinking skills and was grounded in, what they termed as, "Indigenised learning protocols." The deep knowledge activities helped students gain confidence and a sense of well-being in learning, while decreasing behaviour problems and increasing student engagement.

The final theme related to the perceived notion of rigour. Teachers in the study felt that "low expectations were communicated informally through the curriculum, the school design and the organizational structure ... [yet] participants agreed that the curriculum was something within their sphere of influence that could be both observed and changed, particularly at the level of the classroom organization and pedagogy" (p. 70). As a result of observations and reflections, the following six teaching pedagogies were identified as having the most in common with Aboriginal epistemologies: self-direction, self-regulation, social support, connectedness to the world, narrative, and cultural knowledge (p. 71). From the students' perspective, they developed a joint definition for their local "way of learning" as being able to observe first, being a participant for small portions of the activity (social support) and then being able to take on larger parts when they felt ready (self-direction).

Chandler (2010) believes that educational gaps between Indigenous and non-Indigenous learners in Canada are a result of the "different ways of knowing that set Indigenous knowers apart from their non-Indigenous counterparts" (p. 1). He states that those who are raised in different cultures and with different belief systems from the economically dominant ones are constantly told to "frame and defend" their understandings of truth, thereby implying that said truths are not accepted by the dominant culture. This mistrust often causes a collision between the two cultures and continually promotes the misunderstandings, tensions and conflicts. Ironically, these differences are seen more readily in schools—the very places citizens should celebrate diversity and learn to live and work together. The unquestioned dominance of Eurocentric *ways of knowing* results in lost opportunities for Canadian children and society.

According to Chandler (2010), there are three "steps" required to close the gaps between Indigenous and non-Indigenous learners. The notion of epistemology is the first of the three steps. The author explains that to "better understand the distinctive 'ways of knowing' characteristic of Canada's … [Indigenous peoples] requires first getting clear about what, exactly, is 'epistemology'" (p. 3). Chandler further argues that there is a need to ask some difficult, yet vital questions about the acquisition of knowledge to begin to address the conflicts that exist between the cultures. He asks, for example, "how, in this culture versus that, is it to be decided what constitutes bona fide knowledge?" and "Is truth context-specific or is 'real' knowledge universal, equally true in all places and for all times?" (p. 2).

The second step compares what constitutes the current thinking about Indigenous epistemologies with the non-Indigenous ones. It articulates the following unique claims of Indigenous epistemologies:

> Indigenous epistemologies tend to be holistic rather than analytic; are context-sensitive and responsive to lived experiences and the social reality of Indigenous authenticity and voice; view knowledge as ecologically situated and unique to specific settings; employ physical geography as a foundation stone of Indigenous knowledge building; … regard, not just individuals, but whole communities as 'epistemological agents' and, consequently, view true knowledge as the result of a process that can only be validated by cultural groups (p. 4).

The third step explains that the tensions and collisions between cultures are first and most often felt in the schools. This is because schools are responsible for the "cultivation of new knowledge" (Chandler, 2010, p. 4) and if Indigenous students are forced to assimilate to foreign epistemologies then "trouble is automatically afoot, and school failures and lost opportunities are sure to follow" (Chandler, 2010, p. 4).

Chandler (2010) concludes by citing an example from the First Nations researcher Stephany Fryberg. Fryberg's work examines two different accounts of learning: "incremental" and "entity-based." In the "entity-based" learning model, competencies in students are assumed to be fixed and academic successes are considered "proof" of a student's abilities. By contrast, according to Fryberg, Canada's Indigenous communities maintain an "incremental" view of learning and "assign success to effort, and treat failure as a signal that still more effort is required" (Chandler, 2010, p. 5). He proposes that Fryberg's work be used as template for future studies and have curriculum documents that commit to an incremental view of learning so that students, both Aboriginal and non-Aboriginal, do not "find themselves out of step with the pedagogic models favoured by their teachers" (p. 5). He suggests that by following some of the studies of Indigenous scholars, curriculum designers could be better able to "accommodate demonstrated differences" in the two epistemologies.

In Saskatchewan, a group of Aboriginal and non-Aboriginal stakeholders came together to research the importance of Indigenous knowledge in school science as a way of understanding the natural world and a way of including different perspectives and worldviews of Indigenous knowledge into the curriculum (Michell, Vizina, Augustus & Sawyer, 2008). The research examined how educators and education systems viewed place-based Indigenous science and its incorporation into the already established Saskatchewan science curriculum. The perspectives of Aboriginal peoples have been previously marginalized in the development of curriculum, and this research showed that changes in the content of

the science curriculum, in particular, were necessary to accurately reflect and respect the community's Indigenous knowledge.

The authors explain the notion of Multiple Domains of First Nations Knowledge as being of particular interest because First Nations knowledge systems and perspectives emerge from multiple domains and, as such, certain types of knowledge have been found to connect to certain places of origin. For example, one domain from which knowledge is said to originate is tied to the natural world. The First Nations *ways of knowing* are related to geographical differences with relationships with certain animals and those relationships can be incorporated into science curricula as "a start based in exploring the diversity of life in particular ecosystems" (Michell, Vizina, Augustus & Sawyer, 2008, p. 78). Their research suggests that if Indigenous knowledge is included in the science curriculum, the stories and relationships of animals and plants that occupy a particular place will enhance scientific learning while reinforcing and promoting the cultural heritage of First Nations peoples.

Wishart's (2009) study examines the policies related to a disenfranchised urban population of Aboriginal students in an Alberta inner city high school with a high Aboriginal student population. According to the researcher, "Greater integration of policies, and of policy with practice, would lead to increased academic successes for Aboriginal youth" (p. 480). She explains that the majority of disenfranchised youth in today's urban school settings are of Aboriginal background and that despite some significant attempts to meet the educational needs of these youth, there has been little improvement in terms of high school completion rates. Shor (1987, as cited in Wishart, 2009, p. 470), "points to a need to situate formal learning in students' cultures." The study finds that this notion has not been happening in public schools in Alberta, as both Aboriginal and non-Aboriginal youth, alike, report that they experience the same lack of attention from both their peers as well as their teachers.

The results of Wishart's study (2009) show that the tensions between policy and educational practice still exist and that more pedagogy should include the lived experiences of students, both Aboriginal and non-Aboriginal, in order to tap into the "important insights about how students define their own success" (p. 477). Those who are at risk of leaving school early will continue to do so unless there is a translation between what the policy documents are telling teachers is important for student success and what is actually happening in schools, not just in Alberta but nationally and internationally. Wotherspoon (2002, as cited in Wishart, 2009, p. 477) explains that, until now, little attention "has been paid by educators, policy makers and researchers to the hidden reserves of knowledge and capabilities that students possess."

While this work does not directly speak to *ways of knowing* in its purest form, it does speak to the implication for curriculum that supports the inclusion of various *ways of knowing* into future curricular documents to see high school completion rates improve among disenfranchised Aboriginal youth.

IN PRACTICE

The following section describes practices that are being used to consider or incorporate multiple *ways of knowing*.

Mitchie (2002) describes his participation in the development of a science program of studies and compatible learning resources in Australia. The intent was to make the curriculum inclusive of both Aboriginal and non-Aboriginal perspectives; however, he stipulates that the approach used needs to be non-tokenistic and culturally sensitive, demonstrating that Indigenous knowledge is valued and is valuable.

Aikenhead and Elliott (2010) cite a number of practical situations in which Indigenous knowledge has been a part of curriculum change. Of note are projects in Africa that speak to the collaboration between science educators and local African communities in integrating local knowledge into school science. This collaboration has led to the involvement of the community in developing activities that unite aspects of Eurocentric science with Indigenous knowledge, as has occurred in post-Apartheid South Africa (Keane, 2008, as cited in Aikenhead & Elliott, 2010, p. 327). They also identified practices in Canadian jurisdictions that have attempted to recognize Indigenous *ways of knowing*, such as the Saskatchewan science curriculum with its 2005 renewal project that focused on the integration of Indigenous content, perspectives, *ways of knowing* and place-based learning, and the Nunavut program of studies that promotes bringing together the Inuit ways of living with nature with Eurocentric science.

Learning resource development has also been successful in bringing Indigenous knowledge to the classroom (e.g., *Forest and Oceans for the Future Project* in British Columbia and the *Rekindling Traditions* in Saskatchewan) and actual textbook development with a Canadian publisher. The latter involved a process that melded traditional textbook development with input from Elders and Knowledge Keepers. The process produced "knowledge *about* Indigenous perspectives on nature because specific Indigenous knowledge is mostly gained experientially on a holistic pathway toward wisdom-in-action—the process or journey known as coming to know" (Cajete, 1999, 2000, as cited in Aikenhead & Elliott, 2010, p. 333).

CONSIDERATIONS FOR CURRICULUM

Battiste (2010) affirms the need to look at curriculum to "... examine the connections between—and the framework of meanings behind—what is being taught, who is being excluded, and who is benefiting from public education" (p. 17). This requires viewing things from a different lens, one that removes curriculum designers from Eurocentric perspectives to one which allows an immersion into meaning systems that go beyond those already preconditioned and preconceived. Battiste refers to this as the untangling of the knowledge knots that currently exist in people's minds and the reweaving of this knowledge into diverse patterns of coherent thought; in other words, there is a need to rethink what is knowledge. Finally, she refers to what Elder Albert Marshall called, "Two Eyed Seeing: that is to normalize Indigenous knowledge in the curriculum so that both Indigenous and conventional perspectives and knowledge will be available—not just for Aboriginal peoples, who would be enriched

by that effort, but for all peoples" (Battiste, 2010, p. 17). To achieve this means having to unlearn things (that are an inherent part of society), such as racism and the sense of Eurocentric superiority, and instead learning to value and respect new *ways of knowing*, to accept diversity and to lay, as a foundational part of education, the notions of equity and inclusion.

Donald (2009) proposes the following solution to curriculum change:

> What are [*sic*] required are curricular and pedagogical engagements that traverse the divides of the past and present. Such work must contest this denial of historic, social and curricular relationality by asserting that the perceived civilizational frontiers are actually permeable and that perspectives on history, memory and experience are connected. To do so would foster the creation of an 'ethical space' ... [that can] help colonize curriculum and foster the creation of a transactional sphere of public memory ... (p. 5).

He speaks to a philosophy of curriculum sensibility that he has termed *Indigenous Métissage*, which involves juxtaposing mythic historical perspectives (viewed as common sense) with Aboriginal historical perspectives that are woven together to create a new "braid." To achieve this means recognizing the biases that one has and the willingness to see the connection these biases have with the relationships that are espoused to create a new ecology—one that "relies on collaboration and collective authorship." These texts represent a combination of perspective texts that are not exclusive of one in favour of another, but are rather a narrative that seeks to create a new collective whole. Indigenous Métissage is a place-based approach to curriculum reform through an ecological and rational understanding of the world. It attempts to illustrate a different *way of knowing* than has previously been examined.

The choice of "decolonizing," as a concept by Aikenhead and Elliot (2010), is a call for a "considerate" curriculum—both for all students (in this case Aboriginal students) and for educators, who the authors believe should themselves become more self-critical. The authors imply that, if educators are not self-critical about the unconsidered Western biases within curriculum and pedagogy, they are neither engaging in full curriculum reform nor acting out opportunities for social justice. They gently encourage educators to disrupt colonizing ideas embedded deeply in curricula, citing the work of Saskatchewan as an example (pp. 329–332). A cross-cultural science curriculum not only improves science instruction for Indigenous students but also for non-Indigenous students. The authors, nonetheless, suggest that further study is required by other education departments.

Snively and Williams (2008) state that, "epistemological and ontological positions have substantial implications for curriculum, instruction, societies and cultures. Science educators need to understand deeply the consequences that the philosophical view of knowledge prevalent in curriculum and pedagogy have on the relevance of their teaching for their students and for society" (p. 121). To achieve a balance between the two knowledge systems, science educators need to recognize that Aboriginal science (Indigenous knowledge) can provide an integration model for viewing and understanding the world through one's relationship with the natural world, both animate and inanimate.

To this end, Snively and Williams (2008, pp. 124–125) recommend the following principles to better understand Indigenous knowledge:

1. *Context of Scientific Study* – Placed-based knowledge represents the interconnectivity of knowledge with the place in which it is embedded; "nothing exists in isolation" (pp. 124–125).
2. *Multiple Perspectives* – The Elders teach that the more viewpoints involved in the gathering of data and construction of knowledge, the deeper and more meaningful the understanding will be.
3. *Everything in the Universe Lives* – According to Aboriginal beliefs, all creatures of the universe, including inanimate objects, possess a spirit.
4. *Focus on Balance* – It is important to recognize the balance between nature and human life. In the Aboriginal world, there is a kinship between humans and plants, animals and the elements. Learning from the plants, animals and elements teaches balance and harmony in the web of life.

They propose that educators contemplate a science curriculum that promotes a two-way knowing system, referred to by Aikenhead (2001, as cited by Snively & Williams, 2008) as border crossing. This type of educational model entails teaching Indigenous knowledge in parallel with Western science knowledge, with neither knowledge system deemed more important than the other. Rather, this process allows students to come to know about natural phenomena from various perspectives, respecting each knowledge system accordingly, and critically thinking about the values inherent in a particular culture's view of the world. By coming to know from another perspective, students are able to explore and test their own assumptions of the world as they have come to know it and to create a new knowledge base, without compromising their cultural beliefs.

Michie (2002) reinforces this notion in work that he has done with Aboriginal people in Australia. He states that "the aim of the science curriculum should be to promote consideration of the differing worldviews, not solely to enrich Western science but to facilitate a two-way exchange of knowledge and cultural understanding" (p. 37). Further, Michie provides insight into the way in which knowledge has been created in a Western world in comparison to an Indigenous world. According to Michie, Western knowledge has been divided into its various disciplines, creating the disadvantage of being separate and then requiring it to be reconstructed from the various disciplines for differing purposes. In contrast, Indigenous knowledge is holistic, with the whole being greater than the sum of its parts.

Aikenhead and Elliott (2010) also support this same notion through a view of learning science that moves away from learning *about* science to one that involves coming *to know* science in a manner that views scientific knowledge as wisdom for living and not just as an acquisition. They explain that the majority of students, including Aboriginal students, are unable to take on the conventional persona in the science classroom of thinking like a scientist, behaving like a scientist and believing like a scientist (Aikenhead & Elliott, 2010, p. 323). Rather, most students come to science class with "worldviews [that] differ, to varying degrees, from the Eurocentric science worldviews conveyed by conventional school science" (Cobern & Aikenhead, 1998, as cited in Aikenhead & Elliott, 2010, p. 323).

The research cited by Aikenhead and Elliott (2010) shows that many students are keenly interested in learning about science in the early school years, but by the time they reach high school, they are alienated by the foreignness of the scientific language used and the lack of relevance and meaning of concepts to their daily lives. Only a small proportion of high school students are able to relate to science and go on to study the various disciplines in post-secondary settings. This dissociation with Eurocentric science is even more prevalent with Aboriginal students who "must suppress such [Indigenous] knowledge to meet the conventional goal of thinking, behaving and believing like a scientist … Values, assumptions and ideologies embedded in Eurocentric science content can conflict with values, assumptions and ideologies of Indigenous ways of living in nature … Knowledge in Eurocentric science expresses an *intellectual tradition* of thinking, whereas Indigenous knowledge expresses *a wisdom tradition* of thinking, living and being" (pp. 324–325). There is also an implied cultural shift in the two ways of thinking: intellectual thinking places more emphasis on an individual's cognition, whereas wisdom traditionally focuses on a collective way of being and living in the world.

To achieve better results in science, especially at the higher levels, Aikenhead and Elliott (2010) suggest that cross-cultural science programs be developed that respect multiple worldviews and provide students with access to conventional science, in conjunction with Indigenous knowledge to permit students to "gain access to Indigenous cultural capital essential for wisdom-in-action for their country's sustainable growth" (Glasson, Mhango, Phri & Lanier, 2010, as cited in Aikenhead & Elliott, 2010, p. 326). The goal of a cross-cultural science program would be to help students better understand scientists' thinking, behaving and believing without the expectation that they do so themselves. In this way, students gain a deeper understanding of scientific *ways of knowing* while developing respect for two knowledge systems that complement each other, rather than being considered mutually exclusive of each other.

This is further reinforced in an Alberta Initiative for School Improvement provincial research review, where it was recommended that to improve curricula the inclusion and celebration of the contributions of Aboriginal history and culture and the approach used by professionals in the classroom should be a reflection of Aboriginal learning styles and *ways of knowing*. According to Gunn, Pomahac, Good Striker and Tailfeathers (2009), the involvement of stakeholders from the First Nations, Métis and Inuit community in curriculum consultation and its development is key to ensuring that it is an accurate representation of their cultures and that an "adding-on" approach is not used. This strategy, also known as the "beads and feathers approach," should be avoided in future curriculum development as it is regarded as a "mildly placating, status quo approach to Aboriginal education" (Gunn, Pomahac, Good Striker & Tailfeathers, 2009, p. 13). The importance of providing First Nations, Métis and Inuit students with accurate portrayals of their historical knowledge and permitting the acquisition of Aboriginal languages was also pointed out in this research as vital for these students to gain a sense of pride and an increased respect for and understanding of their own culture.

The review also highlighted that changes in curriculum need to occur in order for First Nations, Métis and Inuit students' needs to be addressed and ultimately met. It found that for the students to be more interested in achieving higher results academically, they had to feel that First Nations, Métis and Inuit history, worldviews and culture were meaningfully incorporated into the daily curriculum. Student

attendance was said to be better when these needs were met and they were more successful than previously recorded because of the opportunity to "walk in both worlds; in other words, carry the knowledge of both worlds" (Gunn, Pomahac, Good Striker & Tailfeathers, 2009, p. 25).

To coincide with this research, according to McKnight, Hoban and Nielsen (2011), an important part of any preservice teacher education program is the "fostering of an appreciation for cultural diversity and different ways of knowing" (p. 51). They mention that although this notion of appreciation for diversity is "taught," there is greater challenge in coming to understand different *ways of knowing*, especially as it pertains to Indigenous populations. Their research on the creation of an animated story through the use of slowmation, permitted the preservice teachers to "look deeper into aspects of the exploration of their special place" (a place of special meaning) to reflect on their own journeys as learners. Their two-day excursion with an Indigenous Elder also had an impact on gaining a better understanding of Indigenous peoples' connections to the land, and of the importance of storytelling and the relational approach to learning. Changes in curriculum, then, will need to reflect these diverse *ways of knowing*, while taking into consideration preservice and inservice teacher training.

This is further supported by the *Guiding Principles for WNCP Curriculum Framework Projects* (2011) that call for all Western and Northern Canadian Protocol curriculum frameworks to respect, include and maintain the distinctiveness of the cultures of western and northern Canada, for "knowledge itself is multicultural, not monocultural. This cultural diversity is inherent in the living character of knowledge itself and there is no culturally, historically or linguistically neutral landscape in which learning occurs" (p. 10).

Therefore, curriculum needs to:

- take into account the "living knowledge of the world to the functioning and well-being of a democratic, diverse, multicultural and First Nations, Métis and Inuit society" (p. 13)
- reflect the "linguistic and social origins, and reflect the multicultural and First Nations, Métis and Inuit realities of western and northern Canadian culture itself" (p. 10)
- "embrace and sustain multiple ways of knowing and learning, including Indigenous ways of knowing; multiple modes of evidence; assessment; design and presentation" (p. 9).

Sadler-Smith and Shefy (2004) and Immordino-Yang and Faeth (2010) all agree that intuition as a *way of knowing* can be taught and further developed. Rational thinking (a conscious state) and intuition (an unconscious state) are parallel *ways of knowing*, tied strongly to emotion and feelings. What will be important for curriculum designers is to find ways through curriculum to "weave the two together and integrate intuition with rationality in order to make *intelligent* use of intuitive judgements" (Sadler-Smith & Shefy, 2004, p. 88). Immordino-Yang and Faeth (2010) iterate a similar thought by stating, "neuroscience suggests that in the long run, learning may be more effective if teachers judiciously build into their curricula opportunities for students to develop skilled intuition. Without the development of sound intuitions, students likely will not remember the material over the long term" (p. 81).

The research clearly demonstrates that *ways of knowing* is tied to both individual and cultural epistemologies and belief systems. This means that curriculum designers will need to be cognizant of the implications for content choice, as it will be affiliated with a particular personal or worldview as well as the relationship this content selection has to the *ways of knowing* the disciplines. Further, it will be important to consider the fine balance between acquiring discipline-specific *ways of knowing*, which can lead to in-depth knowledge of the discipline (e.g., the writing processes used within a specific discipline) and broad skills (e.g., the writing process which can cross over disciplines). It will also be critical for designers to ensure that students develop these active *ways of knowing* in a concerted fashion within and across disciplines so as to solidify development of broad skills (e.g., reading and writing process) and skills specific to the discipline (e.g., laboratory reports in science and expository writing in English language arts). As well, designers will need to consider the ubiquitous nature of technology and how embodied knowing can be further developed through and with emerging technologies.

The challenge, then, will be to develop curricula which meet these diverse worldviews and the multiple *ways of knowing* and coming to know. Possibly, Aikenhead and Elliott's (2010) notion of a "third space"—a metaphor for describing the place where people from diverse communities come together to negotiate common or new understandings on a particular topic—may be the first place to begin.

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