Making Science Assessment Culturally Valid for Aboriginal Students

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Developing visible and meaningful connections between Western school science and Aboriginal science will bring school science closer to home experiences for Aboriginal students, giving them greater confidence, increased self-esteem, more initiative, and creativity (Cajete, 1994; Shizha, 2007). Developing these connections is achieved in part through creating culturally responsive assessment practices in science classrooms from a sociocultural perspective. Such a perspective sees knowledge and learning in terms of the relationship between an individual and his or her environment (Gee, 2008; Mislevy, 2006). It is imperative that science assessments reflect the idea that culture and society play a critical role in cognitive development (Solano-Flores & Nelson-Barber, 2001). Science assessments related to Aboriginal experiences and developed in collaboration with Aboriginal community members will have greater cultural validity and develop the connections between Western and Aboriginal science. Attaining greater cultural validity in science assessments occurs when the focus of school science changes from a positivistic, assimilative perspective to a more sociocultural perspective.

Integrating Aboriginal with Western science will encourage teachers to incorporate a sociocultural perspective in their assessment processes, from the planning stages of each assessment to the final interpretation of the results. This infusion of Aboriginal cultural perspective could help erase cultural bias and establish a need for integrating the reasoning consistent with a sociocultural perspective in assessment practices (Solano-Flores & Nelson-Barber, 2001).

The proportion of the school-aged population with Aboriginal identity is significant and growing, especially in Canada's cities and in some provinces and territories (*Education Indicators in Canada*, 2005). Between 1996 and 2006, the Aboriginal population grew by 45% compared with 8% for the non-Aboriginal population (Statistics Canada, 2006). Most research on measuring Aboriginal student success focuses on the educational deficits of Aboriginal people; high school and postsecondary education; formal educational settings; and years of schooling and performance on standardized tests as indicators of success in school (Canadian Council on Learning, 2007). As more Aboriginal communities gain control over their own educational programs and create culturally relevant curricula, their leaders have a need "to identify appropriate measurement tools that will help them assess what is working and what is not" in their schools (p. 2). Despite gaining greater control in education, Aboriginal students still face challenges in their goal to achieve parity with non-Aboriginal students (UNESCO, 1997). One of the measurement tools that might help Aboriginal leaders determine what is working and what is not is the measure of the degree of cultural validity of assessments used in science classrooms. In this article, we argue that Western science and traditional ecological knowledge (TEK) can be combined in schools to develop meaningful and visible connections between the two. Also, we argue that current science assessments can be modified to give the assessments greater cultural validity, a subset of science assessment validity in general. We believe that integrating Aboriginal science into Western science is particularly important for schools with relatively few Aboriginal students. It is imperative that schools with mainly Aboriginal students do the reverse by integrating Western into Aboriginal science. Integrating Aboriginal science into Western science is especially important for non-Aboriginal students in order to bring Aboriginal scientific knowledge into the epistemological framework of non-Aboriginal students. Non-Aboriginal students can benefit from learning Aboriginal ways of understanding nature. The idea of reciprocity is important, and integrating Aboriginal science and including Aboriginal people in the learning process may increase Aboriginal student achievement in school science. Snively and Corsiglia (2000) echo this sentiment when they note that reforming the science curriculum to include diverse cultural perspectives and traditions of science are important changes that would be equally important to mainstream students. Barnhardt and Kawagley (2005), in discussing the broader issue of integrating knowledge systems, state,

> Native people may need to understand Western society, but not at the expense of what they already know and the way they have come to know it. Non-Native people, too, need to recognize the coexistence of multiple worldviews and knowledge systems, and find ways to understand and relate to the world in its multiple dimensions and varied perspectives. (p. 9)

As well, the Alberta Ministry of Education (2002) program, Aboriginal Studies 10-20-30, was developed to provide a conceptual framework for all students to learn about the diverse Aboriginal cultures in their local areas, Canada, and the world. We believe that the main purpose of student assessment is for learning and that small changes in science assessment practices may lead to big changes in improved Aboriginal student learning.

Definitions

Aboriginal people refer to people of Canadian First Nations, Inuit, and Métis origin. *Aboriginal science* is defined as a metaphor for a large range of Aboriginal processes of thinking, acting, and perceiving that has evolved through human experience with the natural world. Aboriginal science "is a map of natural reality drawn from the experiences of thousands of human generations" (Cajete, 2000, p. 3). A subset of Aboriginal science is *traditional ecological knowledge*, or *TEK*. Snively and Corsiglia (2000) note that TEK is a recent term, but that the practices implied by TEK have been in use for thousands of years. Snively and Corsiglia discuss TEK as being guided by traditional wisdom and using observation, questioning, predicting, classifying, interpreting, and adapting in its methodology. TEK, therefore, is defined as representing "experience acquired over thousands of years of direct human contact with the environment" (p. 11). *Indigenous knowledge* is defined as the educational method of learning through demonstration, observation, and thoughtful storytelling of the natural processes, adapting modes of survival, and obtaining the necessities of life from plants and animals (Barnhardt & Kawagley, 2005). Aikenhead (2001) provides our definition of *Western science* as an ideology that is objective, empirical, non-humanistic, universal, socially sterile, and unencumbered with human bias. The term *science assessment* refers to assessing in both sciences, Western and Aboriginal, as they are integrated into one entity. *Culture* in this context is defined as those values, beliefs, norms, and expectations that a social community shares in common (Aikenhead & Jegede, 1999). *Validity* is a summary of the existing evidence and the potential consequences of test [assessment] score interpretation and use (Messick, 1989). Last, *cultural validity in science assessments* is defined as the ability of science assessments to address the sociocultural influences that guide how students make sense of scientific concepts and how they respond to them (Solano-Flores & Nelson-Barber, 2001).

Traditional Ecological Knowledge (TEK) and Western Science

Aboriginal science is built on respect for and connectedness with the land. A Lakota saying, "*mitakuye oyasin* (we are all related)," focuses on relationships and metaphorically personifies what Aboriginal people perceive as community (Cajete, 2000). One of the connections between Aboriginal science and Western science is in the study of ecology through TEK, which can be received directly from the natural surrounding. TEK accepts intuitive knowledge and looks for a holistic world view that helps explain it, even if the explanation is spiritual (Dyck, 2001). Archibald (2001) discusses the importance of finding Elders who have acquired TEK and have experience passing on this knowledge to younger generations. She delineates the pedagogy she refers to as storywork: the combination of the story, the storyteller, and the listener. Archibald emphasizes the importance of prayer, ceremony, song, and the repetition of these rituals to develop a learning atmosphere where students start to appreciate the importance of their rituals. "The understanding of the web of relationships in the 'household' of Nature, is not modern science's sole property. Understanding the relationships scientifically is not enough—living and nurturing these relationships is the key" (Cajete, 2000, p. 95). In the following three sections, we discuss how we can integrate TEK and Western school science; why we should; and some of the challenges of doing so.

How Can We Integrate TEK and Western School Science?

Barnhardt and Kawagley (2005) illustrate the common ground where traditional Native knowledge systems and Western science overlap by using a Venn diagram. Under the heading of *Knowledge*, in the overlap region of the diagram, the authors name plant and animal behavior, cycles, habitat needs, and interdependence, among other topics. Snively and Corsiglia (2000) create a more specific list related to a number of examples where TEK and Western science could be integrated for school science, including biology, ecology, botany, horticulture, agriculture, and medicine. The authors describe an example in northwest Manitoba where biologists and chemists performing field analysis confirmed that traditional practitioners were often able to detect minute changes in water quality more effectively than contemporary testing equipment. TEK can play a vital role in helping solve global environmental issues through its focus on sustainability and restoration (Kimmerer, 2002; Shizha, 2007). At the State University of New York, case studies about salmon restoration, forest management, and fire ecology are being used to compare perspectives of Indigenous groups with Western scientists (Kimmerer). Another example comes from Snively and Williams (2006) in the description of their *Aboriginal Knowledge and Science Education Research Project*. Students learned a wealth of Aboriginal culture through studying culturally modified trees (CMTs) on Hansen Island on the coast of British Columbia. The students also gained insight into a model of traditional sustainable forest use as they studied and learned about the cedar forests that have been tended by Aboriginal people for "over 1,200 years" (p. 241).

Discussions of crop production of corn and wild rice and natural fertilization are some specific examples of agricultural science that can be topics of integration. Cajete (2000) notes that the production of corn is one of the most important achievements in agriculture as Aboriginal people learned how to grow, sow, harvest, and prepare corn for eating or storage. Drying corn properly was an important skill that allowed it to be replanted or used to make bread and sugar. Aikenhead (2001) describes the *Wild Rice* unit, which involves local rice harvesters from northern Saskatchewan coming to the classrooms to speak to the students about growing wild rice and connect the students to the local culture. The students visit areas that the local harvesters have identified as fertile ground for growing and gain respect for traditional knowledge. The Western science content, such as concepts of habitat, niche, pH, and percent germination, enhance and enrich the local knowledge through broadening students' perspectives. Specific methods for nitrogen fixation, fertilization, and insect control are crop production techniques that came from TEK. The planting of the "three sisters" of corn, beans, squash, with marigold in the same small area called a milpa provided nitrates for the soil from the beans, shade for the beans from the corn stalks, which also allowed bean and squash vines to grow. The marigolds produced a chemical known now to reduce insects harmful to the crops (Cajete).

Aboriginal people who have worked with the land for many millennia have generated a vast amount of botanical medical knowledge. Almost 80% of the world's population uses herbal medicine in their primary health care, and approximately a quarter of today's pharmaceuticals are directly derived from plants, and half of today's pharmaceuticals are modeled on plants (Ausubel, 1999). Cajete (2000) notes that health was about living in harmony, and corn, tobacco, peyote (a trance-inducing plant), and sage were a few of the plants that played an essential role in connecting the sick with the spirit world and helping restore their balance. Herbal medicine combined with spiritual and psychological counseling, massages, heat treatment, sweat baths, and other forms of physiotherapy treatments were often used to restore good health.

Why Should We Integrate TEK and Western School Science?

Aboriginal people are underrepresented in science, mathematics, technology, and health-related programs and careers (Aikenhead & Jegede, 1999; MacIvor, 1995; Snively & Williams, 2006). Aboriginal students experience high dropout rates from high school; they are heavily represented in special education classes; and few are in gifted programs (Binda, 2001). Specifically for science classes, Aboriginal students tend to avoid science courses or perform poorly in them (Ezeife, 2003; Hollins, 1996; MacIvor). Snively and Williams note that of the Aboriginal students in British Columbia who take grade 11 science courses, a low percentage take the approved science courses for admittance to postsecondary institutions, and this creates barriers for science-related careers. According to the same authors, "This situation arises from a type of science in which Aboriginal knowledge and wisdom are rarely acknowledged and Aboriginal content is seldom if ever legitimized or is considered a token addition" (p. 229). There exists a real need for Aboriginal students to gain expertise in the sciences. MacIvor notes that science education can contribute to Aboriginal students' intellectual growth, facilitate better decision-making, and generally prepare them for jobs in today's economy. She argues that conventional [Western] science needs to be one way to understand our world, but not the only way. In addition, MacIvor argues that land claim settlements that have given control over the management of traditional lands back to the Aboriginal people have represented a huge economic and political victory for some Aboriginal people. Furthermore, TEK provides significant information and perspectives that are missing from [Western] scientific approaches (Kimmerer, 2002).

What Are Some of the Challenges?

White (2006) notes that one of the challenges in merging TEK with Western science stems from the tendency for people to emphasize the differences in orientation and methodology between the two and not their shared perspectives. White notes that even using the term *traditional* is debated because it carries misleading connotations of static, antiquated knowledge from days gone by. Ignas (2004) discusses the feeling of inferiority that Aboriginal students often have when TEK is contrasted with Western science with "The implication being that only [Western] science is fully epistemologically adequate" (p. 55). The problem is countered in part by the designers of the *Forests for the Future* program: a program of study that dwells on exploring and focusing on the common themes that are uncovered in how TEK and Western scientific knowledge are acquired and communicated (Ignas). Gaining knowledge through intuition and personal experience runs counter to the Western science perspective, which values objectivity, linear ways of thinking, and the compartmentalization of knowledge and disciplines (Cajete, 2000; Dyck, 2001).

In the context of Western school science, Aikenhead and Jegede (1999) discuss the culture clash that can occur when students from non-Western cultures like Aboriginal cultures are confronted with the language and conventions of many Euro-American teachers in science classrooms. The transition from one social community to another has been identified by Aikenhead and Jegede as *cultural border crossing*, and many Aboriginal students encounter challenging cultural border crossings when engaged in school science. According to Aikenhead and Jegede, student success in school science can be measured by how effectively students negotiate the crossing of cultural borders and the degree of cultural difference that students perceive between their life-world and their science classroom. Ezeife (2003) remarks that students from Western and non-Western cultures share a feeling of foreignness toward school science, but non-Western students feel the alienation to a greater degree. The connection between TEK and Western science should help reduce the feeling of alienation as well as give Aboriginal students a satisfactory reason for holding onto the concepts discussed in science class without discouraging their own cultural views of nature. Holding onto the concepts means that students should understand the science concept, not necessarily accept the scientifically accepted notion of the concept. Students should be able to explore the differences and similarities between their own beliefs and Western science concepts (Snively & Corsiglia, 2000). This type of learning that involves two or more conflicting schemata held at the same time by a person is called collateral learning. There are four types of collateral learning: secured (optimal), dependent, simultaneous, and parallel (Jegede & Aikenhead, 1999). The challenge to educators is to help Aboriginal students attain secured collateral learning in an integrated school science program.

Culturally Valid Assessments in Science

Solano-Flores and Nelson-Barber (2001) stated, "cultural validity refers to the effectiveness with which science assessment addresses the sociocultural influences that shape student thinking" (p. 555). The example below demonstrates how analyzing school science assessments can help us measure the cultural validity of the interpretations of assessment scores used to determine achievement in science.

Solano-Flores and Nelson-Barber (2001) analyzed questions from the 1996 National Assessment of Educational Progress (NAEP). One of the questions they studied was on the idea of erosion. The question gives a diagram of two mountain ranges with a river flowing through a valley between the peaks. One of the mountain ranges is drawn with lower, smooth peaks whereas the other has higher, jagged peaks. The question asks to indicate the picture that shows how the river and mountains look now as opposed to millions of years ago. Solano-Flores and Nelson-Barber interviewed a Latin-American girl who incorrectly chose the jagged mountains. The girl did not remember learning about mountains in school, and she had no experience of seeing them except for once when she saw mountains on the west coast of California. She did not use the concept of erosion in her explanation, only her personal experience with mountains. The authors argue that the test question privileges students with first-hand experience with flatter mountains and that everyday life experiences are an important influence in student performance. Hinkle (1994) argues that cultural influences on testing can be minimized only through increased awareness, training, and assessment item development. Gorin (2007) observed that most first-year graduate students in educational psychology had a simplistic view of the concept of validity, and Popham (1997) also agrees with this lack of understanding of validity as he states that "most of our teachers and school administrators have, at best, only a murky notion of what validity really is" (p. 10).

From a historical viewpoint, evidence of validity is one of the basic requirements of any measurement process. Early discussions of validity were entrenched in the need to measure a variable of interest for each person as accurately as possible. Validity was defined in terms of the accuracy of this estimate (Kane, 2001). Wilks (1961) defined validity as the extent the process yields a "true" measurement of the object. More current validity theory addresses both the consequential, or value, implications of test interpretations and the test use, or social consequences (Messick, 1989). Low scores should not result from missing information that is important to a group of people that if present, would allow them to demonstrate their competence, nor should low scores result from the presence of irrelevant information that might interfere with the affected student's ability to show his or her competence (Messick, 1998).

From an analytical and constructivism viewpoint, evidence of validity can refer to measurements, or it can refer to a process of legitimizing one's findings. There are various kinds of validity including criterion, concurrent, content, cultural, consequential, and construct validity. It is not the assessment itself that must be validated, but the inferences made from the assessment scores and the implications for action based on these scores. Teachers should create assessments with knowledge of students' social situations as well as their cultural backgrounds. Creating assessments based solely on cultural stereotypes or a single cultural model will not achieve a high degree of cultural validity. This would assume that all students from a particular culture have the same knowledge base associated with the culture, which would be incorrect. Assessments, therefore, must be developed from a sociocultural perspective, combining both the social and cultural contexts, as both play an important role in shaping a student's thinking.

Evidence of validity is always specific to some particular use, and no assessment is valid for all purposes. Validity involves an overall evaluative judgment, and evaluation of valid results must be justified by supporting evidence in terms of the consequences and uses of the interpretations (American Educational Research Association, 1999; Kane, 2006; Linn & Gronlund, 1995). The interpretation refers to the construct or concepts that the assessment is intended to measure. More often than not, however, educators use assessment scores for many purposes, and the same assessment data are used to implement many actions in a school, and invalid inferences made from assessment data have disadvantaged Aboriginal students.

Whether teachers are using assessment data to make instructional decisions or to judge if a student is gaining mastery of certain skills, the consequences and actions taken are possibly unsound if the results-based decisions about the student's achievement are invalid. Hence much depends on the validity of a teacher's assessment practice and knowledge. Stiggins (2001) discusses a series of studies that he completed to understand more completely the complexity of classroom assessment processes. He uncovered a multitude of uses for school assessment data. Often the same data are used to detect individual students' needs, clarify achievement expectations, assign grades, control behavior, and evaluate the effectiveness of their instruction. Parents use the same data to decide whether to reward or punish, to seek additional tutoring, and how to allocate family resources. The same study revealed that teachers used a variety of assessment methods, but "few teachers, however, understood how to align these different assessment methods with different kinds of achievement to be assessed, how to sample properly, or how to avoid bias when using the various methods" (p. 9). Teachers need to be aware of the potential biases in their assessments and strive to eliminate them from their practice, or risk continuation of the cyclic perpetuation of failure for many Aboriginal students.

Modifying Science Assessments

In order to develop science assessments that have greater cultural validity, educators need access to the necessary information, as well as meaningful parental and community participation in assessment development. Science teachers need to begin with what the students know, believe, and practice in their daily lives and focus their instruction and assessment toward new learning (Ezeife, 2003). Educators must collaborate with their cultural communities to develop appropriate assessments that will stem from culturally sensitive instructional practices in order to achieve appropriate learning outcomes and demonstrate that knowledge can be uncovered by both empirical and non-empirical means (Dyck, 2001; Qualls, 1998).

An example of the importance of understanding the communication and socialization style of a culture comes from Solano-Flores and Nelson-Barber (2001), who sought input from Western Alaska's Yup'ik Elders to help design a hands-on assessment about making kayaks according to body measurements. Little discussion took place when the Elders were asked to solve the kayak problem individually and provide feedback. The teacher involved was uncomfortable in the role of appearing to question the Elders' knowledge. Meaningful discussions took place when the Elders were asked to solve the problem as a team and offer guidance to the teacher as she solved it out loud. Collaboration with the Yup'ik Elders was critical, but changes to the kayak assessment would not have been possible if the communication and socialization styles of the Yup'ik leaders were not understood and honored.

Teachers need knowledge and an understanding of Aboriginal science in order to integrate TEK into the science curriculum so as to assess students in ways that are culturally valid for Aboriginal students. Developing links between Aboriginal cultures and the science curriculum must start, however, with educators becoming aware of the factors that distinguish their own culture (assuming it is different) from that of the students, while maintaining a positive regard for both cultures. This will contribute to improved cross-cultural communication and facilitate more culturally relevant assessments while also eliminating cultural bias in assessments. Nelson-Barber, Huang, Trumbull, Johnson, and Sexton (2008) analyze science test items for linguistic and cultural loadings as possible sources of item bias. Using this idea from Nelson-Barber et al. to reflect on the following statement from the *Programme for International Student Assessment*, or *PISA* (2006), we can see how the statement is biased against Aboriginal students; hence any questions based on it would lack cultural validity.

> Tobacco is smoked in cigarettes, cigars, and pipes. Research shows that tobacco-related diseases kill nearly 13 500 people worldwide every day. It is predicted that, by 2020, tobacco-related diseases will cause 12% of all deaths globally. Tobacco smoke contains many harmful substances. The most damaging substances are tar, nicotine and carbon monoxide. (p. 59)

Two of the questions about the above statement relate to the negative health consequences of tobacco smoke, but for Aboriginal students tobacco is one of the most sacred plants and historically was used in medicinal and healing rituals, as well as ceremonial and religious practices (Struthers & Hodge, 2004). If a test for item bias were performed on the questions about the adverse affects of tobacco smoke, we might find that Aboriginal students had lower scores as a group. Estrin and Nelson-Barber (1995) suggest that science educators can achieve greater cultural validity from their science assessments if they follow a few guidelines. They suggest that science assessments should use cultural resources with which the children are familiar, use open-ended questions and avoid multiple-choice and true/false questions, and also give students plenty of time to complete the task. In addition, they suggest giving students choice about how and when they will be assessed, giving them opportunities to practice, and using cooperative assessment strategies as well as individual strategies to determine an accurate measure of their scientific knowledge of Aboriginal students.

Solano-Flores and Nelson-Barber (2001) note that the cultural validity of science assessments may be increased if cultural differences are considered early in the planning stages of assessments. Hollins (1996) remarks that student learning must involve situated learning experiences that are inquiry-based and initially embedded in Aboriginal cultural practices. A good example of this is discussed in Sutherland (2005), which describes a study with Cree students in Manitoba. The author discusses giving students more opportunity to select their approach to a science topic, including their experiences and their family's while in the bush. Sutherland identified some students as secured collateral learners as they were able to distinguish between science and Indigenous knowledge and views. Students felt that assignments containing the knowledge of their Elders, on moose for example, would get a better grade because of the authority of knowledge that came from those who have plenty of first-hand experience on the topic. This illustrates the positive effects of sociocultural influence on learning for these Aboriginal students as they hold the apprenticeship model of learning and the experiential knowledge of their Elders in high regard.

We believe that assessments should guide learning and help teachers make informed decisions about their pedagogy. "Viewing assessment as intrinsic to the instructional process represents a position that, though discrepant with conventional practice, is highly consistent with the first principle of assessment—to make inferences about students that support useful decisions in educational contexts" (Duschl & Gitomer, 1997, p. 39). Duschl and Gitomer also discuss how effective teachers must manage not only materials and behavior, but also reasoning, ideas, and communication. This shift, however, assumes that teachers have access to relevant information that would make it possible to manage reasoning, ideas, and communication. The *Pan-Canadian Protocol for Collaboration on School Curriculum* (Council of Ministers of Education, Canada, 1997), in its vision statement, emphasizes that all Canadian students should develop an evolving combination of the science-related attitudes, skills, and knowledge that they need to acquire inquiry, problem-solving, and decision-making abilities. Duschl and Gitomer posit that assessment activities in classrooms can help to achieve this goal and provide insight into the progress toward it. Less emphasis must be placed on on-demand performance assessments, and more emphasis must be placed on establishing a classroom environment that facilitates the acquisition of information that teachers can examine and use to help students learn how to do science.

Little has been done in the past few decades to remedy the dearth of tests that draw on Aboriginal cultural content and learning processes (Estrin & Nelson-Barber, 1995). If current classroom science assessments are developed from Western science perspectives, with little or no integration of Aboriginal science perspectives, the interpretation of Aboriginal students' scores will not be a valid reflection of their scientific knowledge. Standardized tests are similar to classroom science tests with respect to their development from Western perspectives only. Standardized tests have presented difficulties with inappropriate content, tightly timed format, reliance on verbal information, and on-demand testing. The content of most standardized tests does not reflect common experiences for Aboriginal students, and this jeopardizes the content validity of inferences for the assessment (Estrin & Nelson-Barber). Common and Frost (1992) noted that time-limited tests penalize students from cultures that value reflection of thought over quick response for measuring intelligence. In another study, Common and Frost (1994) argued that "standardized measures of intelligence developed for use with one cultural group could not be fairly used with another cultural group unless it was demonstrated that the two cultures were very similar" (p. 70). Because Aboriginal and mainstream Canadian cultures have not been shown to be similar, Common and Frost concluded that it is not appropriate to use standardized IQ tests with Aboriginal people.

We contend that it is critical that assessments be developed in a culturally responsive perspective that allows assessment developers and/or teachers to identify the important cultural influences that shape students' perceptions of science. We agree with Solano-Flores and Neslon-Barber (2001) that assessments need to be developed with an understanding of the subtle nuances of a culture that shapes the world view of a student. This method of developing assessments will allow students to understand what they are expected to do and how they might approach the problem or question in order to solve it.

Summary

Students from Aboriginal cultural backgrounds are immediately disadvantaged in science classrooms when Western cultural values are given prominence. Many Aboriginal students feel alienated when they realize that the science curriculum has no connection to their cultural experiences. This feeling can lead to frustration, disempowerment, underperformance, and possibly withdrawal from school science (Ezeife, 2003). Science educators need to create a more inclusive curriculum for cultures other than Western culture as our world continues to see large population shifts, multicultural classrooms, and a greater percentage of students from minority and Aboriginal communities. Science teachers need to work toward creating culturally valid assessments that enable Aboriginal students to bridge their cultural world view smoothly with their school science curriculum and make cultural border crossings easier for Aboriginal students. Canadian science educators must aim to develop assessment tasks that are relevant to Aboriginal students and give them a satisfactory reason for holding onto the concepts discussed in science classes without discouraging their own cultural views of nature. Canada's science education curricula need to integrate traditional ecological knowledge into classroom lessons and ensure that cultural perspectives are taken into account when assessing learners. Cultural perspectives must be integrated from the beginning stages of planning an assessment through to the scoring of the assessment. Canadian science educators require access to relevant traditional ecological knowledge and meaningful community collaboration with Aboriginal Elders and other leaders in order to develop appropriate assessments founded on culturally responsive instructional and assessment practices.

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