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Two-Eyed Seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing

Cheryl Bartlett · Murdena Marshall · Albert Marshall

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Abstract This is a process article for weaving indigenous and mainstream knowledges within science educational curricula and other science arenas, assuming participants include recognized holders of traditional ecological knowledge (we prefer "Indigenous Knowledge" or "Traditional Knowledge") and others with expertise in mainstream science. It is based on the "Integrative Science" undergraduate program created at Cape Breton University to bring together indigenous and mainstream sciences and ways of knowing, as well as related Integrative Science endeavors in science research, application, and outreach. A brief historical outline for that experiential journey is provided and eight "Lessons Learned" listed. The first, namely "acknowledge that we need each other and must engage in a co-learning journey" is explained as key for the success of weaving efforts. The second, namely "be guided by Two-Eyed Seeing", is considered the most profound because it is central to the whole of a co-learning journey and the article's discussion is focussed through it. The eighth lesson, "develop an advisory council of willing, knowledgeable stakeholders", is considered critical for sustaining success over the long-term given that institutional and community politics profoundly influence the resourcing and recruitment of any academic program and thus can help foster success, or sabotage it. The scope of relevance for Two-Eyed Seeing is broad and its uptake across Canada is sketched; the article also places it in the context of emerging theory for transdisciplinary research. The article concludes with thoughts on why "Two-Eyed Seeing" may seem to be desired or resisted as a label in different settings.

> *Traditional Indian education is an expression of environmental education par excellence*. It is an environmental education process that can have a profound meaning for the kind of modern education required to face the challenges of living in the world of the twenty-first century (Cajete (2010), p. 1128, emphasis as in original).
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> As two-eyed seeing implies, people familiar with both knowledge systems can uniquely combine the two in various ways to meet a challenge or task at hand. In the context of environmental crises alone, a combination of both seems essential (Aikenhead and Michell (2011), p. 114).

Keywords Indigenous knowledge · Traditional knowledge · Two-eyed seeing · Integrative Science · Transdisciplinary · Cross-cultural education

Introduction

Two of the three co-authors of this article are aboriginal elders from the Mi'kmaw Nation. Murdena is the clan mother of the Muin (Bear) Clan, wife to Albert, mother of 6, grandmother of 14, great grandmother of 5, and godmother of 8. She is also a spiritual leader for the Mi'kmaw Nation and a retired Associate Professor of Mi'kmaw Studies at Cape Breton University (CBU) in Sydney, NS, Canada. Albert is from the Moose Clan, husband to Murdena, and (as for Murdena) a father, grandfather, and great grandfather. He is the designated voice on environmental matters for Mi'kmaw Elders in Unama'ki-Cape Breton and the person

C. Bartlett (✉)
Canada Research Chair in Integrative Science,
Cape Breton University,
PO Box 5300, Sydney, NS, Canada B1P 6L2
e-mail: cheryl_bartlett@cbu.ca

M. Marshall · A. Marshall
Eskasoni Community, Mi'kmaw Nation, Cape Breton University,
PO Box 2001, Eskasoni, NS, Canada

who, in 2004, brought forward the guiding principle of "Two-Eyed Seeing" featured in this article. The third co-author, Cheryl, is a biologist at CBU and close friend of Murdena and Albert. She has worked collaboratively and professionally with them for almost two decades to weave indigenous and mainstream knowledges within science curricula and related research projects. Her expertise in science began in wildlife parasitology. Through many years and for diverse audiences, we three have presented on Two-Eyed Seeing, sometimes together, most often as two, and occasionally alone.

Our introductory statement of relationship follows Mi'kmaw tradition, a custom shared with many other Indigenous cultures. The "we" voice employed throughout this article denotes the authors' common understandings and/or achievements although the words are those of Cheryl. In strategic places, the direct words or paraphrased thoughts of Elders Murdena and Albert are provided.

We stand with and in support of individuals who encourage efforts to weave indigenous ways of knowing and knowledge systems into today's post-secondary educational curricula for environmental studies/sciences and sustainability studies, as per the above quoted statement of Cajete (2010, p. 1128), the above quoted encouragement from Aikenhead and Michell (2011, p. 114), and this special issue of the Journal of Environmental Studies and Sciences. We also concur with the cogent appeal of Kimmerer (2002) for doing so within biological education. Her article figured prominently in the call for papers for this special issue and she also provides excellent synoptic information on Traditional Ecological Knowledge (TEK).

We believe an important question must be asked when encouraging or attempting to weave indigenous and mainstream knowledges together within today's educational curricula, namely: what can curriculum developers do to ensure that efforts remain true to the ways of knowing and knowledge systems of indigenous peoples? This is exceedingly important because, as Elder Albert points out, there is great temptation today for some people to "just make it up" and so "validation, by recognized community Elders and Knowledge Holders, of that which is brought forward is exceedingly important."

And thus, this article is our contribution to the larger goal of weaving curricula—it is about process in which participants include recognized Elders or Knowledge Holders for TEK (recognizing the holistic nature of the latter we prefer IK for indigenous knowledge, or TK for traditional knowledge, and use them herein equivalently) as well as individuals with expertise in mainstream knowledges. The insights we share herein, configured as "Lessons Learned", draw upon almost two decades of effort to weave IK and mainstream science within a collaborative, co-learning journey called "Integrative Science". We provide a brief historical overview of this journey, a list of our lessons, and then focus discussion through lesson learned #2, namely two-eyed seeing. Two-eyed seeing is the overarching guiding principle for our collaborative work and has been picked up by diverse others across Canada.

In curricular weaving efforts, we need to acknowledge that today's mainstream knowledges and educational approaches are products of decades of diligent efforts to scrub spirituality and religion out of ways of knowing and out of curricula—and keep it that way. Words from both Elders Murdena and Albert provide, therefore, a glimpse into the challenge presented for weaving IK into modern curricula. Murdena says: "Possessing knowledge which is traditional or tribal, is a mirror image of your own spirituality. There is nothing that we cannot understand this way. Science can explain many things, but in the tribal world, there is another realm. Yet we value knowledge and we combine it with assistance we seek from the spirit world. One should not be afraid to seek assistance to develop a thought. In our world, you are a physical being and you are a spiritual being" (Marshall 2011, p. 175). Albert says: "So this is what we truly believe. This is what reinforces our spiritualities: that no one being is greater than the next, that we are part and parcel of the whole, we are equal, and that each one of us has a responsibility to the balance of the system" (Hipwell 2001, p. 253, based on an interview in 1997).

Experiential background for developing "Lessons Learned": yearnings, vision, history, and accomplishments of the Integrative Science academic program

Elders Murdena and Albert have deeply pondered the traditional understandings of their Mi'kmaw people and how such living knowledge might find a place in today's educational efforts, although Murdena has been on that road much longer than Albert. As the granddaughter of the Grand Chief, she was trained in traditional ways at home and attended an off reserve public school. Later, she attended Harvard University, then became a community school teacher, and later a professor at CBU. In regards the latter, Murdena was instrumental in establishing the university's Mi'kmaw Studies program. Albert, on the other hand, was an inmate of the Canadian residential school system throughout most of his youth and thus was denied opportunities to learn traditional ways until later in life. Over the past two decades, Murdena and Albert have worked closely together for the preservation and promotion of the Mi'kmaw culture including its language, knowledge, and spirituality. They were awarded Honorary Doctors of Letters by CBU in 2009 in recognition of this work in conjunction with their passion in encouraging cross-cultural dialog, understanding, and healing. Both have been key participants in the Integrative Science co-learning journey at CBU and beyond.

An ability to identify meaningful "Lessons Learned" requires lived experience. Indeed, placing one's past actions "in front of ourselves, like an object, for examination and discussion" is an enactment of our "Lesson Learned #5" identified later. Moreover, "Mi'kmaw teachings of indirect teaching and non-interference suggest that the best we can do is offer up our experience to those who will listen" (Iwama et al. 2009, p. 8). It is within the spirit of these understandings that we provide the historical background below.

Our journey began as a grass roots effort by a few individuals from the Mi'kmaw community of Eskasoni First Nation and a few scientists from CBU. Our overall goal was twofold: (1) to reverse the situation at CBU (also broadly existent across North America) whereby there was an almost total absence of aboriginal students in science and science-related programs by (2) making science curricula more appealing to aboriginal students in the region by including Mi'kmaw and other IK and ways of knowing side-by-side with mainstream knowledge and ways of knowing in post-secondary science curricula (see Bartlett et al. 2012; Institute for Integrative Science & Health (IISH) website, http://www.integrativescience.ca). The vehicle we created to move towards this goal was a suite of new science courses called MSIT (Mi'kmaw for "everything together") and these as a component within a new, 4-year undergraduate science program that we called Integrative Science (in Mi'kmaw, *Toqwa'tu'kl Kjijitaqnn* for "bringing our knowledges together"), which itself was a concentration within an established, 4-year Bachelor of Science Community Studies (BScCS) degree at CBU (Bartlett 2011; Bartlett et al. 2012; IISH website, http://www.integrativescience.ca). The MSIT courses provided 24 of the degree's 120 required credits, which can also be stated as four of the degree's 20 required courses. The original vision for the Integrative Science academic program also allowed for additional mainstream science and/or Indigenous knowledge content by way of compulsory courses in the degree's core and concentration, elective courses that students could select, and mandatory work placements (see IISH website, http://www.integrativescience.ca). It is important to note that although the Integrative Science academic program was intended as a general science degree (for our view of "science" see Bartlett et al. 2012 and also "Lesson Learned #3"), it was never targeted towards a broad base of interested science students; rather, our intended audience was Mi'kmaw aboriginal students, for the reason indicated above, although students of any ethnicity were welcome and a few non-native students did elect to take courses at various levels.

We were the key conceptual and tending parents for the new Integrative Science academic program, having envisioned it in the early–mid 1990s, proposed it in a formal document in 1997, and worked diligently to ensure its final approval by CBU in June 1999, its implementation (as a pilot) in Fall 1999, its definitive approval by the Maritime Provinces Higher Education Commission in February 2001, and then its operation as an accredited university degree program beginning in Fall 2001. From conception to definitive approval and beyond. We were the "core journey participants" within efforts for the academic program; beginning in 2002 our team expanded a little and we began to undertake additional collaborative research that sought to nourish, expand, and promote the existence of Integrative Science. We were the proud teachers (Bartlett completely and Marshalls occasionally) within the early 5–6 years of the academic program after which time our focus became the expanding research dimension of the initiative, as we moved Integrative Science into the arenas of science research, application, and outreach to youth and community. Other people became the in-class instructors; unrelated to the latter development, the program began to experience various new challenges along with others present from the outset. We voiced, to no avail, concerns in 2005–2008 about the academic program's viability and its shifting nature within the challenging environment of institutional politics ("including inconsistencies and insufficiencies at the administrative, faculty, budgetary and recruitment levels" (Bartlett 2012)). However, the academic program floundered and no students have enrolled since 2007. In 2008, its first year courses were disarticulated from their larger context of program and degree, and taught within access programming for aboriginal students indicating interests in a BA degree, rather than science. Concurrently, curricula in these disarticulated deliveries increasingly shifted to the fundamentals of mainstream science. Such curricula are meritorious in their own right but not congruent with the original vision for the MSIT courses as vehicles wherein weaving of IK and mainstream scientific knowledge could occur. As of July 2010, we three were no longer associated with the academic program of Integrative Science; however, we have continued our local to national work as researchers and promoters for Integrative Science in ways other than its past existence as a functional science undergraduate program at CBU. Information about our presentations, workshops, gatherings, projects, and other activities over many years is available on the website for the IISH website, http://www.integrativescience.ca.

Of further note is the fact that the Integrative Science academic program was controversial within CBU throughout the whole of the time period above. And, although one of us (Bartlett) attempted to steward it from within the Department of Biology, it was never assigned a formal academic home department (or budget) until it became the responsibility of CBU's new Department of Indigenous Studies in July 2010.

The achievements of the Integrative Science academic program—while still functioning within its original vision—were remarkable. Twenty-seven Mi'kmaw First Nations students, all with some relationship to Integrative Science, have

graduated with a science or science-related degree at CBU (fewer than five without Integrative Science affiliation had/have ever graduated before or during this same time period). Thirteen of the 27 graduates are from the BScCS degree's Integrative Science concentration. Most now hold key positions (e.g., school principal, research scientist or assistant, job coach, natural resource management, nurse, teacher) in their communities. Many other Mi'kmaw students who started university indicating interest in science and who took Integrative Science's first year MSIT courses during 1999–2005 later switched degrees and graduated with a BA or BACS (BA Community Studies) degree. And others left university, a few indicating intent to return. Mi'kmaw Integrative Science undergraduates have presented at academic conferences in Canada and internationally. Thirteen prestigious Natural Sciences and Engineering Research Council of Canada undergraduate summer research awards went to Mi'kmaw Integrative Science students. Up to 2007 and in total, about 100 Mi'kmaw students experienced first-year Integrative Science's MSIT courses, many recruited by the Mi'kmaw Science Advantage Program run by CBU's then Mi'kmaw College Institute. And yet we realize that, beyond a numbers perspective for framing success/failure, we need also to find ways to welcome Elder Albert's perspective that "seeds germinate when the environment is right", i.e., that many of these 100+ students could awaken later in life to traditional teachings even from such short exposure to IK/TK and/or in ways we will likely never know.

The above illustrates that we worked collaboratively for almost two decades within the Integrative Science co-learning journey in all its arenas: science education, research, application, and outreach. Moreover, it shows that the understandings we draw in order to identify "Lessons Learned" in the next section are both as insiders (emic view) and outsiders (etic view) for the Integrative Science post-secondary program, even as we recognize that many of our perceptions are richly entangled between the two and also with understandings gleaned during related work in non-educational arenas. Our small working group has always included aboriginal elders as living sources of IK/TK, even as we have also made use of the growing literature about TEK/IK/TK.

"Lessons Learned" for weaving IK and mainstream science

Over the years, we have frequently spoken about "Lessons Learned" towards "facilitating the 'talking and walking together' of indigenous and mainstream sciences". We list these below for the first time, drawing upon our presentation at an international science conference in 2008 (Bartlett et al. 2008). We also add herein, for the first time, an eighth. Earlier versions can be found in Bartlett (2006), Bartlett et al. (2007), and Bartlett (2011, for a conference in 2005).

1. Acknowledge that we need each other and must engage in a co-learning journey
2. Be guided by Two-Eyed Seeing
3. View "science" in an inclusive way
4. Do things (rather than "just talk") in a creative, grow forward way
5. Become able to put our values and actions and knowledges in front of us, like an object, for examination and discussion
6. Use visuals
7. Weave back and forth between our worldviews
8. Develop an advisory council of willing, knowledgeable stakeholders, drawing upon individuals both from within the educational institution(s) and within Aboriginal communities

We believe Lesson Learned #1 is key for the successful weaving of indigenous and mainstream ways of knowing and knowledges in all arenas. Nonetheless, we suggest that Two-Eyed Seeing (Lesson Learned #2) is the most profound of our eight lessons because it is central to the whole of the co-learning journey and, thus, Two-Eyed Seeing is the lead phrase in this article's title. It is also the focus of the entire next section.

In further regards to Lesson Learned #1, we believe that if participants do not or cannot acknowledge that they need each other and that they need to engage in meaningful co-learning, then an attempt to weave IK and mainstream knowledges and ways of knowing is destined to evolve into mere show, the only question being how long that might take. Iwama et al. (2009, p. 7) indicates that "as we learn together, the journey offers the sacred gift of humility" and that "once new members realize what Integrative Science requires of them, the number of willing participants can shrink." Moreover, Elder Albert has commented many times about the tendency for the mainstream to assign IK holders a role akin to Hollywood Indians whereby someone else writes your script or relegates you to entertainment status. No wonder he indicates there is great temptation for some people to "just make it up". Especially when there is payment for services.

Lesson Learned #8 emerges from our reflections on the collapse of the Integrative Science academic program. Collapse occurred in spite of the apparent success the program initially realized in achieving the first part of its twofold goal, namely, to attract and retain aboriginal students into/in post-secondary science. We recognize that this intent for our weaving efforts means that part of our goal differs from what Kimmerer (2002) envisioned. Collapse additionally

occurred in spite of substantial achievement towards the second part of our goal, namely to weave curricula and, finally, also in spite of raising our concerns at an early juncture. Although obvious in hindsight, we suggest that environmental (institutional and community) politics can and do profoundly influence the resourcing and recruitment of an academic program and can help foster success, or sabotage it. We suggest, therefore, that strategies to acknowledge and influence environmental politics are exceedingly important for those working to weave Indigenous ways of knowing and knowledge systems into any post-secondary educational curricula.

Bartlett (2012) states the case for the eighth Lesson Learned (although not calling it such): "I believe it essential to find better ways to enable collective stewardship and participation by interested Elders, educators and others from the Aboriginal community, alongside constructive and critical institutional input. Consultation with Elders, wherever traditional aboriginal knowledge has a role, is congruent with formal recommendations made by Elders from Mi'kmaw, Wolastoqiyik, Innu, and Inuit communities in Atlantic Canada and approved by the Atlantic Chiefs in September [2011]." These Elders stated: "Post-secondary institutions should be compelled to seek guidance from the Elders Council to develop appropriate curriculums related to Traditional Knowledge for relevant post-secondary programming". Their statement is a subpart of formal recommendation #7 within the 2009–2011 research project entitled "Honouring Traditional Knowledge" (see APCFNC, Atlantic Policy Congress of First Nation Chiefs (Canada) website, http://www.apcfnc.ca/en/resources/HonouringTraditionalKnowledgeFinal.pdf). Our Lesson Learned #8 is succinctly stated in the list above. Later, we return briefly to it within the context of transdisciplinary research.

Additional discussion about the contextual evolution and the conceptual, experiential, and theoretical significance of these lessons within Integrative Science as a whole is found in Bartlett et al. (2012) although Bartlett (2011) is the better reference for discussion about Lesson Learned #4.

Two-eyed seeing (lesson learned #2)—highlighting the fundamental lesson with enriched discussion

As mentioned above, we suggest that Two-Eyed Seeing (Lesson Learned #2) is the most profound of our eight lessons. Indeed, it has become our major guiding principle and, as we indicate later, has now been picked up by diverse others across Canada. Two-Eyed Seeing was first brought forward in Fall 2004 by Elder Albert when he felt that participants within the Integrative Science co-learning journey could benefit from more encouragement towards the "it's us, together" consciousness (Lesson Learned #1) needed for meaningful collaboration (Bartlett et al. 2012). Albert indicates that Two-Eyed Seeing is the gift of multiple perspective treasured by many aboriginal peoples and explains that it refers to learning to see from one eye with the *strengths* of Indigenous knowledges and ways of knowing, and from the other eye with the *strengths* of Western knowledges and ways of knowing, and to using both these eyes together, for the benefit of all (Bartlett 2006, 2011, 2012; Bartlett et al. 2012; Hatcher et al. 2009; Iwama et al. 2009; Hatcher and Bartlett 2010; Marshall et al. 2010; IISH website, http://www.integrativescience.ca). Two-Eyed Seeing further enables recognition of IK as a distinct and whole knowledge system side by side with the same for mainstream (Western) science (Iwama et al. 2009; Bartlett et al. 2012).

Elder Albert additionally indicates that we need to learn to weave back and forth between our knowledges (Lesson Learned #7) because in a particular set of circumstances, it may be that one has more applicable strengths than the other, yet with changing circumstances this can easily switch (Bartlett et al. 2012). The ability to identify and discuss strengths within contextual circumstances draws upon Lesson Learned #5 which, in turn, draws upon our understandings of knowledge as being a system and also of knowledge systems as having ontology, epistemology, methodology, and axiology. Some or all of the latter four words often emerge in academic discussions and appear frequently in the rapidly growing literature for TEK/IK/TK as it interfaces with other knowledge systems and/or research methodologies. Selecting just ontology and epistemology and using books, four examples include Brown and Strega (2005), Arbon (2008), Denzin et al. (2008), and Wilson (2008). Sometimes, the words do not appear in a relevant book's index, e.g., Berkes (1999), Menzies (2006), Geniusz (2009), and Smith (1999). And, curiously new (to minds and consciousnesses conditioned with only mainstream philosophy) words such as Coyote, Raven, and Trickster appear in others, e.g., Cajete (2000), Cole (2006), Archibald (2008), and Absolon (Minogiizhigokwe) (2011). Guided by Two-Eyed Seeing, we (Bartlett et al. 2012) have chosen to render in simple text and visual (Lesson Learned #6) form some basics for ontology, epistemology, methodology, and knowledge objectives (visuals are available in Bartlett et al. 2012 as well as the IISH website, http://www.integrativescience.ca). These "big pictures" help enable placing our knowledges in front, like an object, for examination and discussion (Lesson Learned #5). Their richer use is as mind tools that can help us weave back and forth between knowledge systems and, furthermore, help us bring IK/TK into the present.

Elder Murdena is passionately firm in saying that IK/TK "was never meant to be static and stay in the past; rather, it must be brought into the present so that everything becomes

meaningful in our lives and in our communities". To facilitate understandings towards such, but using an approach dramatically different than outlined above for terms that configure discussions in mainstream philosophy, she explains the *system* that is IK/TK with the aid of a visual model consisting of four concentric circles and an unnamed medicinal plant. She labels the circles, outermost to inner, as physical knowledge of the medicine, personal connection to the medicine, respect for the medicine, and sacred nature of the medicine (visual available in Marshall 2008 on IISH website, http://www.integrativescience.ca). Murdena indicates that mainstream science and IK/TK are able to share, without problem, understandings at the level of the outermost circle, since such are largely empirical. The middle two circles require personal relationship and respect for the plant, something not included in mainstream science which as a way of knowing has maximally diminished the role of the subjective. These two middle levels likely are familiar to and comfortable for any scientist whose passions include natural history, however. The innermost circle, wherein sacred knowledge resides, can only truly be understood within the language of the particular aboriginal or indigenous peoples of the area; it is not possible to translate this knowledge into another language. Once the genius of Murdena's model is grasped and used in conjunction with the "big picture" understandings for TEK/IK/TK and mainstream science, the pathway becomes much clearer for a Two-Eyed Seeing effort to weave back and forth between knowledges (Lesson Learned #7).

It is the innermost circle of her model that Elder Murdena has in mind when she indicates she is not overly concerned about intellectual property rights in regards Mi'kmaw TK, because the knowledge at its core, its heart, cannot be translated out of Mi'kmaw. Elder Albert further indicates that "knowledge is spirit", not a property or a commodity … and that elders have a responsibility to pass their knowledge along (indeed, the health of the community's children depends upon such, see Blackstock 2007). He encourages that these additional points also be considered when discussion turns to intellectual property rights. We respect the concern of Kimmerer (2002, p. 437), concurring strongly that "The identity of the practitioners, informants, and the community should always be fully referenced and acknowledged …". The latter is additionally important (beyond the issue of intellectual property rights) because some aspects of understandings can and do vary among individuals and communities, given the intimate interconnectiveness (Murdena's word) of land, language, and people (Marshall et al. 2010; Sable and Francis 2012), to say nothing about the detrimental impact on TEK/IK/TK caused by language loss. Moreover, the importance of the particular, traditionally occupied ecosystem (the land) must be recognized because there exists an ecology of the sacred among the human and more-than-human consciousness in a particular territory, as Sheridan et al. (2006) explain within the environmental philosophies of the Haudenosaunee.

Elder Albert further indicates that "Two-Eyed Seeing adamantly, respectfully, and passionately asks that we bring together our different ways of knowing to motivate people, Aboriginal and non-Aboriginal alike, to use all our understandings so we can leave the world a better place and not compromise the opportunities for our youth (in the sense of Seven Generations) through our own inaction". More recently, on the basis of several years experience in explaining the principle, Albert adds: "Two-Eyed Seeing is hard to convey to academics as it does not fit into any particular subject area or discipline. Rather, it is about life: what you do, what kind of responsibilities you have, how you should live while on Earth … i.e., a guiding principle that covers all aspects of our lives: social, economic, environmental, etc. The advantage of Two-Eyed Seeing is that you are always fine tuning your mind into different places at once, you are always looking for another perspective and better way of doing things" (Bartlett et al. 2012).

In putting forward Two-Eyed Seeing, Elder Albert has passionate concerns for the well-being and future of aboriginal peoples and their traditional knowledges, as is evident when he states what happens in its absence: "When you force people to abandon their ways of knowing, their ways of seeing the world, you literally destroy their spirit and once that spirit is destroyed it is very, very difficult to embrace anything—academically or through sports or through arts or through anything—because that person is never complete. But to create a complete picture of a person, their spirit, their physical being, their emotions, and their intellectual being … all have to be intact and work in a very harmonious way" (Bartlett et al. 2012).

In explaining Two-Eyed Seeing, we use a visual (drawing upon Lesson Learned #6) in which two eyes are positioned behind two connected pieces of a jig-saw puzzle (visual available on IISH website, http://www.integrativescience.ca). This followed Elder Albert's encouragement that we emphasize that Mi'kmaw understandings are but one view in a multitude of aboriginal and indigenous views … and similarly that of the mainstream/western sciences … and that all of the world's cultures (which we take to include mainstream/western science) have understandings to contribute in addressing the local to global challenges faced in efforts to promote healthy communities. Thus, one might wish to talk about Four-Eyed Seeing, or Ten-Eyed Seeing, etc. Furthermore, Albert indicates "the two jig-saw puzzle pieces help remind us that, with respect to TK, no one person ever has more than one small piece of the knowledge." Thus, there is a need to recognize that TK draws upon the community of elders and other knowledge holders, as well as the collective consciousness of the people. So, here too, one might wish to talk about multiple-eyed seeing (Bartlett et al. 2012).

In line with the question we posed in the "Introduction", Elder Albert's additional thoughts about the challenges for TK within weaving efforts guided by Two-Eyed Seeing are provided below. He particularly sees the need to create appropriate joint aboriginal community and institutional mechanisms to ensure ongoing attention to them as more and more efforts pop up towards inclusion of TEK/IK/TK within educational curricula at all levels.

1. *Authenticity of TK.* We need to recognize the great temptation for some people to "just make it up". Validation, by recognized community elders and knowledge holders, of that which is brought forward is exceedingly important.
2. *Appropriate sources for particular topics within TK.* We need to acknowledge that elders and knowledge holders … each one of us … has certain expertise, yes, but none of us knows everything. This is also why TK is collective knowledge.
3. *Nourishment of the living relationships within TK.* We need to recognize that stories, songs, crafts, practices, family, community, language, ceremonies, and connectivity with the land are important in the transmission of TK. It is not a book-based process of learning. Most importantly, TK is *living* knowledge.
4. *The lifelong learning journey for TK.* We need to instill in all learners the understanding that TK is acquired over the whole of a person's life journey; it is not a 3–4 year process akin to a university degree.

Two-Eyed Seeing and other lessons learned: fit with emerging theory for transdisciplinary research

Our efforts and research for Integrative Science fit the outline of Pohl (2011, p. 620) for "Concept B" transdisciplinary (TD) research. He suggests three characterizing *features*: (1) it relates to socially relevant issues PLUS (2) transcends and integrates disciplinary paradigms PLUS (3) includes non-academic actors (i.e., includes participatory research). Concept A has only the first two features while Concept C omits the third and adds the feature (4) of searching for a unity of knowledge. However, Pohl (2011) indicates that features are not necessarily helpful for TD researchers per se; more benefit for them can be had with articulated *purposes* for TD research. He says (p. 621) "in order to be relevant and useful for societal problem handling, TD researchers have to frame, analyze and process an issue in such a manner that: (1) they grasp the complexity of the issue; (2) they take the diverse perspectives on the issue into account; (3) they link abstract and case-specific knowledge; and (4) they develop descriptive, normative, and practical knowledge that promotes what is perceived to be the common good." He further indicates that the fourth purpose "means that one of the specific challenges for TD researchers is to ensure that value systems do not operate in the shadows and instead are clarified by jointly developing the meaning of [specific topics or concepts] for the research project's context."

The originating intent for the Integrative Science academic program that it try to "reverse the situation whereby there was an almost total absence of Aboriginal students in science and science-related programs" matches the first feature above by Pohl (2011). The additional originating intent that the academic program bring together indigenous and Western scientific knowledges and ways of knowing matches the second feature, while the composition of the integrative science team matches the third. The nature of the different knowledge backgrounds of the three core participants on our journey maps to the first, second, and third purposes of Pohl (2011). Our abilities to take on those purposes were enriched through the participation of other Mi'kmaw elders and educators, additional university-based researchers including students, and various individuals in the numerous community workshops and various research projects that Integrative Science undertook (see IISH website, http://www.integrativescience.ca). And, in that we have long indicated that Two-Eyed Seeing intends that individuals learn to "use both eyes together, for the benefit of all", it also maps to the fourth purpose identified by Pohl (2011). Our Lessons Learned similarly match understandings embedded in the features and purposes of Pohl (2011): Two-Eyed Seeing (Lesson Learned #2) and Lessons Learned #5 and #7 fit Pohl's second purpose and Lesson Learned #4 the fourth purpose. Lesson Learned #5 ensures that "value systems do not operate in the shadows", which Pohl indicated is a specific challenge for TD research.

Pohl (2011, p. 621) goes on to suggest that Ludwik Fleck's concept of "thought styles" (dating to the first half of the last century) is a particularly suitable starting point (much more so than Kuhn's paradigms) for TD research as it enables participants to be seen and to engage "as experienced in their perspective" and "to be keen to learn about the different thought-styles and their underlying assumptions. In doing so a solid basis is laid for understanding different knowledge claims, for making informed evaluations of knowledge and for integrating knowledge". We suggest that our great emphasis over many years on "co-learning" and within such our repeated efforts to promote (for diverse audiences) "big picture" understandings of four basic aspects in our different ways of knowing, in both text and visual format (as mentioned above, also see Bartlett et al. 2012 and IISH website, http://www.integrativescience.ca), is congruent with Pohl's (2011, 621) pointing to Fleck's thought styles as an approach more useful for TD research than "the idea that philosophers of science should primarily provide intellectual foundations of science". As Pohl (2011,

p. 621) further emphasizes, it is people who are interacting and "Fleck's approach frames knowledge production as a collective process of historically and socially embedded thought-collectives." Elder Murdena's words in the "Introduction" section, along with her model for IK as a system, speak directly to this understanding of the person and of the collective.

Pohl (2011) clearly indicates that a thought-style approach is not an effort "to democratize science". This might cause initial disfavor in regards our Lesson Learned #5 (view science in an inclusive manner). We suggest that disfavor or fear can be allayed by reading our exploration for a broadened view in Bartlett et al. (2012).

We are formally suggesting Lesson Learned #8 for the first time with this paper, given the flounder and falter of the Integrative Science academic program. At the td-net conference in Bern, Switzerland, in September 2011 (see td-net website, http://www.transdisciplinarity.ch/e/conference/international/2011/), the one of us (Bartlett) who attended noted the striking resonance with that lesson as different keynote speakers emphasized the importance, for the successful and ongoing conduct of TD research, of having supportive and informed institutional administration.

We suggest that TD research approaches might be useful considerations for those involved in efforts to weave IK into curricula for environmental studies/sciences and sustainability studies. Williams et al. (2012, p. 3) point to the challenges faced when "the predominant and implicit conceptualizations" of the relationships between humans and their natural, social and created environments remain "grounded in Cartesian ontology wherein humanity is not seen as an implicit part of biodiversity embedded in a vast web of mutual and symbiotic interrelations".

Two-Eyed Seeing: uptake across Canada

We have explained Two-Eyed Seeing many times and across Canada, having now delivered close to a hundred presentations (IISH website, http://www.integrativescience.ca). We have witnessed its immediate resonance, in particular, with Elders from diverse Aboriginal nations and Two-Eyed Seeing, by that name, is gaining traction across the country. Significantly, Two-Eyed Seeing was adopted by King (2011) for the business case prepared in 2011 by the Canadian Institutes of Health Research–Institute of Aboriginal Peoples' Health for programming in its next 5-year plan. Moreover, Two-Eyed Seeing is/has been part of the collaborative environmental planning in Cape Breton, the Government of the Province of Nova Scotia's 10-year strategic plan for natural resources, land-based summer camps in Nunavut, Mi'kmaw band-operated schools in Cape Breton, species-at-risk draft policy in Ontario, salmon commission submissions in British Columbia, and global celebrations during the International Year of Astronomy 2009 (see IISH website, http://www.integrativescience.ca). In our awareness, one academic thesis at Dalhousie University (Martin 2009) and another at Royal Roads University (Collier 2012) have featured it. In addition, the First Nations Lifelong Learning Model developed in 2007 by the Aboriginal Learning Knowledge Centre within the Canadian Council of Learning placed IK and Western Knowledge side-by-side at the model's core (see CCL website, http://www.ccl-cca.ca/CCL/Reports/RedefiningSuccessInAboriginalLearning/RedefiningSuccessModels.html), congruent with "Two-Eyed Seeing" although not using the phrase.

Two-Eyed Seeing: some like the phrase while others resist

Elder Albert indicates that Two-Eyed Seeing is the gift of multiple perspectives treasured by many aboriginal peoples; we suspect this may be why (at least in part) the phrase, once explained, seems so readily embraced by aboriginal elders. We have also experienced open acceptance of the phrase among other people (aboriginal and other) and yet at other times an awkward resistance even when the merit of the guiding principle per se is acknowledged. An exploration of such reluctance, while beyond the scope of this paper, invites a few thoughts. Marshall et al. (2010) explain how mainstream discourse about the natural world has come to favor metaphors that represent a language of containment and separation whereas Mi'kmaw stories collapse the distance between human and animal. Williams et al. (2012) note the pervasive tendency of academic knowledge to overlook our interrelations within the web of life while Stewart-Harawira (2012, p. 80) mentions the understanding that "biologically-derived methods and assumptions have … fallen out of favor among sociologists". It may be that reawakening comfort with the close up, biologically-derived phrase Two-Eyed Seeing will require exploring or undertaking decolonizing work (regardless of one's cultural background) such as Geniusz (2009) describes for botanical Anishinaabe teachings or, another option, experiencing increased exposure to the radical approaches for human ecology proposed in Williams et al. (2012).

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