Sense of Place and Perspective:

Incorporating Native and Western approaches in marine science education

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Abstract

Indigenous understanding of the natural world (i.e. Native science) and European-based approaches to science and technology (i.e. Western science) provide valuable means of making sense – through observation and deduction – of natural phenomena and patterns. These different approaches and perspectives frequently complement one another in advancing our understanding of the natural world (e.g. impacts of climate change on natural systems, environmental degradation), yet there are also critical areas in which these perspectives on interpreting and understanding natural phenomena differ. It is critical for students, educators, and scientists alike to recognize and accommodate these distinctions as they engage in marine science education and research. This is particularly important for Western-identified scientists collaborating with Native communities and/or Tribal Colleges. As part of an NSF-funded marine geoscience project and ongoing research collaboration between Western Washington University and Northwest Indian College, we have been exploring strategies for bringing together Native and Western science for a more effective integration of these into coursework and research objectives. These proceedings offer examples of integrating these perspectives in marine science courses and provide insight for enhancing the cultural competency of scientists engaged in research and education with Native communities and Tribal colleges.

Rationale

Native American Tribes and First Nations are important stakeholders in the sustainability and integrity of the Salish Sea Ecosystem, yet remain disproportionately absent from positions in environmental management, marine science, and research. The goal of this presentation is to provide insight and strategies for scientists and educators to engage more effectively with Native communities in both education and research and in doing so work towards a more effective engagement of these communities in the health, function and stability of the Salish Sea.

The Nature of Native and Western Science

Indigenous understanding of the natural world (hereafter Native Science) and European-based "modern" science and technology (hereafter Western Science) both provide a means of making sense – through observations and deduction – of phenomena and patterns in the natural world. There are many ways in which these respective sciences complement one another in advancing our understanding of the natural world (e.g. climate change), yet there are also fundamental ways in which they differ and Western science is often at conflict with Native understanding of natural processes (Riggs and Semken 2001). A variety of terms have been used to capture the essence of Native Science, including "traditional knowledge", "traditional ecological knowledge", "traditional knowledge and wisdom", "local and traditional knowledge (LTEK)", "indigenous

knowledge", and various combinations of these words and their acronyms (Cajete, 2000; Wildcat, 2009) . As defined by students at faculty at Northwest Indian College, Native Science is:

> *A way of understanding the natural world and humankind's inherent place within it, based upon a foundation of traditional Indigenous values, beliefs, and knowledge – while incorporating what is useful and appropriate from Western mainstream science.*

In contrast, Western Science refers to the empirical, positivist and experimental approach to understanding the natural world and explaining how and why things happen, based on a Western European worldview and value system.

While Native science is more holistic and draws on the spiritual, emotional, physical, mental realms of understanding, Western science dwells predominantly on the physical and mental (Simonelli 1994). There also exists a healthy (and perhaps deserved) skepticism about Western science and the ills that have befallen the natural world with science as a tool for prosperity and productivity (Sommer et al 2004; Aikenhead 1997). It is important for students – as well as educators and scientists – to recognize that these different worldviews exist and to strategically incorporate an understanding of each into teaching and learning. Indeed, as educators we need to be able to effectively facilitate these frequent cultural "border crossings" (Aikenhead 1997; Rowland and Adkins 2003). From a cognitive and constructivist perspective, development of bicultural scaffolding that integrates both Native and Western science is a much richer schema for understanding the processes in the natural world (Rowland and Adkins 2003). However, with respect to true integration, others suggest that Native and Western Science philosophies cannot be meshed, rather they each need to stand on their own and respected for what they each have to offer (Nancy Maryboy and David Begay, NWIC Climate Summit 2010).

Because of these differences in cultural worldviews, Native American students studying science must navigate a complex landscape of information, concepts, beliefs and perspectives on the natural world. Scientific content or information that is in conflict with an existing Native worldview may be *rejected*, *assimilated*, or *acculturated* (Riggs and Semken 2001). While assimilation is the act of replacing currently held beliefs (and thus an undesirable outcome), acculturation is the modification of cognitive schema in a way that values preexisting knowledge but also incorporates new scientific knowledge. There are many approaches to helping students learn in this environment, with most writings converging on three basic principles (Roland and Atkins 2003). These include 1) developing a strong understanding of the cultural and functional differences between Native and Western Science philosophies, with each being presented on an *equal basis*; 2) incorporating contributions made by Native people to science and understanding of the natural world, and 3) recognizing the strong connection of Native people to the land [and sea] and science education on studies of the environment (e.g. land, sea, water, air). In this regard, we seek to develop an approach to integrating Native and Western Science in a way that establishes a strong foundation in the cultural beliefs and perspectives of Native science, into which Western science is incorporated. This constructivist approach to learning will be more effective at both maintaining cultural values and facilitating learning and understanding of science principles and is reflected in the outcomes, lesson plans, and content of the NSF geosciences project.

Disproportionate Underrepresentation of Native Americans in STEM Careers and Education

Native Americans are among the most disproportionately underrepresented minority groups in STEM education and careers (Akweks et al 2009; Aikenhead 1997). In order to engage Native American students more effectively in marine science, it is important to recognize some of the drivers of this underrepresentation. There are many common barriers to engaging in STEM among minority and underrepresented groups, including geographic and socio-economic isolation and limited access to academic and technological resources. However, there are also factors that are unique to Native communities that lead to a disenfranchisement from Western science. These include:

- *Distrust of scientists,*
- *Perceived adverse effects of Western science on the environment and natural world,*
- *Importance of prayer and ceremony in maintaining the health and integrity of natural living systems,*
- *Conflict of ethics regarding the treatment and inherent value of all living organisms,*
- *Absence of Native scientist role models,*
- *Perspective that humans are an integral part of ecosystems and obliged to stewardship,*
- *Holistic approach where understanding of the natural world is <u>not</u> attained through reductionism, experimentation, dissection, and manipulation of living entities.*

Figure 1: Top eight images resulting from a Google search for "scientist", illustrating that Native scientist role models are lacking and currently held stereotypes regarding scientists offer limited opportunity for Native American students to identify with them as a career option.

There is often a cultural skepticism of scientists driven in part by the belief that most of the ills and misfortunes that have befallen then natural world have been at the hands of Western science. Western science is also seen as a means by which humans are able to exploit nature for prosperity, benefit, and economic advancement. Although this is not the explicit purpose of Western science, it is an outcome of using Western science as a tool. Indeed, there are many branches of science focused on exploitation of natural resources for human benefit (e.g. fisheries science, forestry science, hydrocarbon research).

Motives for Engaging Native Communities in Marine Science

Partnerships between Tribal Colleges and Universities (TCUs) and mainstream Western-identified institutions can play an important role in advancing education and research in Tribal communities. These partnerships are challenging to establish and maintain, but provide an opportunity for scientists to have a lasting, positive

influence on American Indian communities (Riggs and Semken 2001). The motives for collaboration between Western-identified scientists and educators with Native communities are multiple and complex. Although the dramatic underrepresentation of Native people in science alone is a powerful motivator for educators and scientists to engage more effectively with Native communities, there are many other important goals and outcomes that can be achieved. These include:

Technological: Promote the use of the tools and technology of Western science to address culturally important issues or environmental and economic problems that Native communities face (e.g. water quality, public and environmental health, fisheries management, conservation).

Professional/workforce development: Provide training for students in these tools to enhance their knowledge and skill-set and become an asset to Tribal communities. Eventually, Native students would replace frequently white-dominated resource management and upper science positions. The goal is not to create Native scientists, rather Native people who can navigate the landscape of Western science while maintaining traditional values and principles of Native communities and bringing this perspective into their professional work.

Pedagogical – Integration of perspectives: The accessibility of science courses can be greatly enhanced by basing content and curriculum on Native knowledge and practices and using this as the context for teaching elements of Western science. Native Americans have been doing engineering, chemistry, biology, ecology, and physics for thousands of years – it just hasn't been called that. These practices can form the basis and content for integrating Western science principles within the context of Native worldview and also more effectively engage Native students in learning about science. This is a *Native-centered* approach to integration and Native and Western ways of knowing.

Pedagogical – Western-centered context: There is a tendency to integrate Native content into existing Western-structured science curriculum, such as traditional ecological knowledge , traditional stories, etc. Although this brings Western and Native perspectives together in the classroom, it runs the risk that Native content serves as "window dressing" and fails to elevate the cultural knowledge and perspectives on equal ground with Western knowledge. This would be a *Western-centered* approach to integration of Native and Western ways of knowing.

Ecological and Cultural preservation: Because indigenous cultures are intimately linked to the land, sea, and air (i.e. place-based), the preservation of natural resources is *essential* for preservation of the associated People and their culture. Western science that seeks to understand, mitigate and remedy major environmental problems contributes to the other Native efforts (e.g. prayer and ceremony) that are being made by indigenous people to preserve their land, sea and culture. Climate change, overfishing, and sea-level rise are a few examples of major environmental catastrophes that will threaten the very existence of culture – because culture is tied so intimately to the plants and animals that rely on healthy ecosystems (Wildcat, 2009).

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and important insight (e.g. climate change) of different but complementary spatial and temporal scales. Others partnerships may arise out of an intrinsic, more philanthropic and inclusive approach to education and science, motivated by the fact that Native students are one of the most underrepresented groups in science (Akweks et al 2009; Aikenhead 1997) and wanting to provide this opportunity to Native communities. The third type of partnership – and perhaps the most detrimental and exploitative – arises out of the well-intended efforts of funding agencies to make the broader impacts of research more inclusive and broader reaching with respect to non-scientist communities and underrepresented groups. For better or for worse, Native American communities have become a prime target for these broader impacts. This creates an environment where extrinsic (e.g. financial) motives drive engagement of tribal communities in a way that is disingenuous and the partnerships are not balanced – with the benefits of association with tribal entities far outweighing the benefits that are transferred to tribal communities. In many cases, 11th hour collaborations go no further than the proposal stage and Tribal Colleges are uninvolved once funding is received. Many partnerships are also culturally one-sided, with Western values and priorities being imposed upon the TCU partner. Such relationships have been called "clobberations" rather than collaborations (Dr. Cheryl Long Feather, pers. com.).

Building Cultural Competency in Western Scientists and Educators

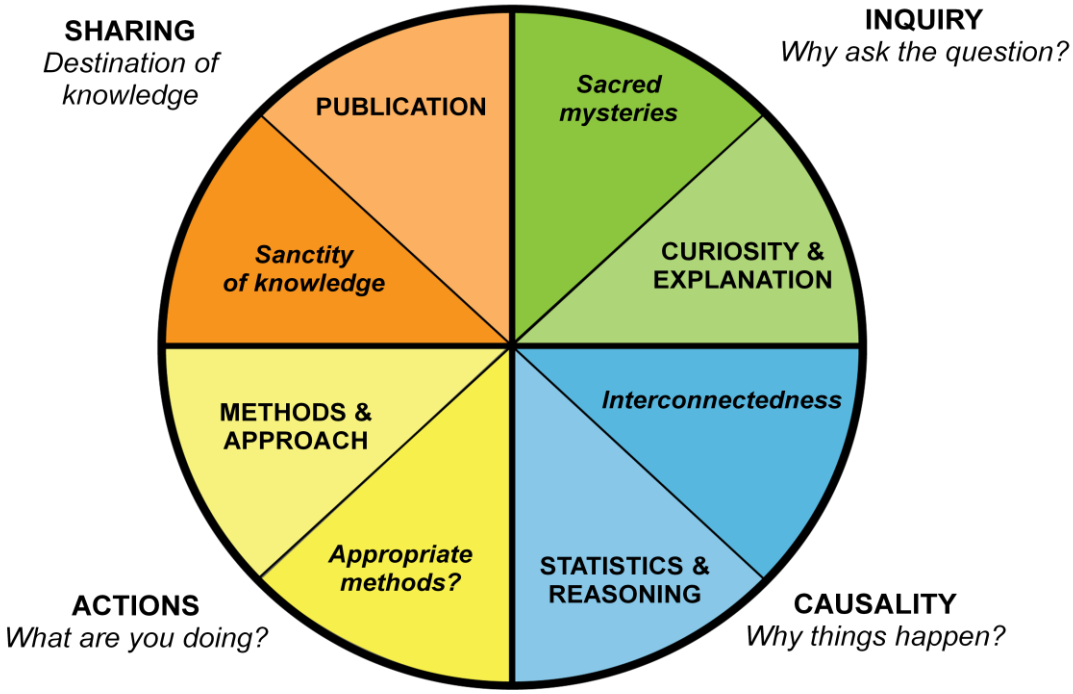
Important differences between Native and Western Science are outlined in Table 1. These represent the outcome of activities with students at Northwest Indian College over the past few years, supplemented by discussions at a 2009 conference in Washington DC that brought together Tribal Colleges (TCUs) and the Biological Directorate at NSF.

Table 1. Comparison of principles and approaches in Native and Western Science

	Native Science	Western Science
SCALE	Holistic Long-term time scales	Reductionist Often short-term time scales
PERSPECTIVE	Place and culture-based	Process-based
INFORMATION TRANSFER	Oral knowledge (TEK) Personal ownership of knowledge	Written word, publication
UNITY & CONNECTIVITY	Spiritual, ecological	Newtonian (physical, ecological) Separate components of a whole
APPROACH	Observational	Observational & experimental
MOTIVE	Understand patterns, solve problems, live in harmony	Acquire knowledge, understand patterns, solve problems, exploit nature
ROLE OF TECHNOLOGY	If necessary or appropriate	Frequent (although ethics driven)
SPIRITUALITY/CAUSALITY	Strong spiritual presence	Newtonian
ORGANIZATION OF KNOWLEDGE	Integrated, holistic	Compartmentalized (e.g. biology, chemistry, physics)
STEWARDSHIP	Implicit	Not implicit (advocacy is a bias)

As partnerships build between Tribal communities and mainstream research institutions and universities, it will become increasingly important for Western-trained scientists to develop the cultural competency to work effectively with Native students, faculty and researchers in a way that honors Native Science and Native ways of knowing. A first step in this process is developing an understanding of the similarities and differences between Native and Western perspectives on the process of science. Although for the most part these are complementary processes, there are some fundamental tenants of Western Science that are in conflict with how Native students were taught to understand the world (Riggs and Semken 2001). Some of the fundamental differences in the intent of Native and Western science are summarized by Aikenhead (1997) and include social differences (i.e. survival of a people vs. power and exploitation of nature through knowledge) and intellectual differences (e.g. respecting sacred mysteries vs. seeking explanation for everything).

Figure 2: The Nature of Native and Western Science – differences in fundamental areas. These include motives for inquiry (green), perspectives on determining causality (blue), methods of inquiry (yellow), and the manner in which knowledge is shared (orange). Darker shades of each color represent Native perspectives.



Differences in some of the fundamental aspects of Native and Western Science are illustrated above (Fig. 2). These include motives for inquiry, perspectives on determining causality, methods of inquiry, and the manner in which knowledge is shared. With respect to inquiry, Native Science holds that many of the mysteries in nature should be celebrated but are also sacred (Aikenhead 1997), whereas Western Science is driven by curiosity, quest for knowledge, and desire to find rational and empirical explanations for natural phenomenon (green quadrant). Western Science identifies empirical (often mechanistic) relationships between factors to explain the cause of natural phenomena using statistics and quantitative reasoning (blue quadrant), while there is an element of unexplainable, often spiritual connectivity between all living things that governs patterns and

relationships. The methods that are employed in conducting Native versus Western Science are vetted through different entities and involve different degrees of technologies. Although each of these abides by its own set of ethics, there is greater reverence for all living organism among Native vs. Western culture. This is especially evident with use of living organisms in science experimentation. Methods in science among Native communities have scientific, cultural and spiritual guidelines and should always engage elders for insight. Finally, the manner in which information is shared and the degree of credibility which knowledge receives differs between Native and Western Science culture (orange quadrat). The primary means by which information is communicated, validated, and gains credibility in Western Science culture is through the written word and a well-established peer-review process. As a result of this there is an almost dogmatic reverence for written over spoken information. As a result, Western scientists have typically rejected traditional ecological knowledge as anecdotal and unscientific (Sommer et al 2004). However, there is evidence that this is improving as Western scientists learn about the strict ritual and protocol that maintains the integrity and factual accuracy of oral knowledge over long periods of time among Native communities.

General Recommendations for Engaging Native Students in Science Education

There are several recommendations for scientists and educators to engage Native students more effectively in both classroom and field settings. These include:

1. Place tremendous emphasis on place and culture-based knowledge and learning, teaching new information or research questions within the context of local land, water, and tribal priorities;
2. Include hands-on, experiential activities as a teaching strategy;
3. Include explicit involvement and cooperation of indigenous community members, either as sources of information for building appropriate instructional content or as guest speakers providing first-hand indigenous knowledge and perspectives;
4. Include relevant indigenous knowledge wherever possible, specifically in questions or lessons related to climate and long-term ecological change;
5. Employ a constructivist approach to teaching that values prior knowledge and alternative worldviews, establishing appropriate scaffolding to integrate both Native and Western ways of knowing.

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