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CULTURING MARINE EDUCATION: INDIGENOUS LEARNING SYSTEMS AND WESTERN SCIENCE

Karen Matsumoto

Suquamish Tribe, kmatsumoto@suquamish.nsn.us

ABSTRACT

The author currently works as a teacher for a Tribal school in Washington State. Her experience has shown that there must be a paradigm shift in teaching and learning science for today's young people. In particular, it is essential to include indigenous learning systems in place-based marine education programs for Native American communities. Marine science education can, in this way, be made highly engaging and relevant, both to students' understanding of their world and of their culture's place in it. One proven approach is to incorporate indigenous language and learning systems, new technologies, and best-practice experiential science learning approaches. This results in the cultivation of deep respect for cultural values and differences coupled with learning necessary Western science skills. This paper provides examples from multicultural and Indian education programs of how Western science can be incorporated into indigenous formal education programs while preserving traditional worldviews. The author's experience in formal and informal marine education shows how this has the potential to create a learning environment both relevant to indigenous students and conducive to a deeper understanding of environmental justice and equity issues.

Key Words: indigenous learning systems; traditional ecological knowledge; experiential learning; Washington tribes; marine science; environmental justice; multicultural education; Western science

INTRODUCTION

Tribal people consider their environment as their 'home' in the deepest possible sense, where stories and cultures originate, shaped over generations by their culture. The first peoples of the Pacific Northwest have lived on the rivers, shorelines, and marine waters for over 10,000 years. They have depended for survival on hunting, fishing, gathering shellfish and plant foods, and serving as stewards and cultivators of their homelands (NWIFC, 2013). The evolving knowledge acquired by local peoples through direct contact with the environment has allowed them to live sustainably for millennia. Traditional ecological knowledge (TEK), defined as the accumulated understanding of how culture, economy, and the natural world interact, develops only in societies that have learned to live in harmony with their world.

With over five million people now living in Western Washington alone, we now see degradation of ecosystems and the ways of life for many indigenous communities through increased population growth and the attendant pollution from stormwater runoff, climate change, and artificial changes to rivers, shorelines, and estuaries. For Tribes to continue their way of life and to be able to exercise their treaty rights to harvest salmon and shellfish, the next generation of environmental scientists, biologists, and natural resource managers must be able to "walk in both worlds" of Western science and indigenous culture.

Most of those who teach science to Tribal youth based their curricula on the principles of Western science and the scientific method: observation of natural phenomena, development of hypotheses, collection and interpretation of data, and further investigation to test what has been understood. Tribal students often have difficulty, however, making connections between Western science and indigenous ways of understanding nature and the environment, which sometimes seem to contradict each other. To make matters more complex, research has shown that there are significant differences in cognitive processes that can be attributed to culture and worldview (Nisbett, 2003). Resource managers are increasingly using TEK as a model for conservation biology and ecosystem management (Damour, 2012; Greenwood, 2011; Whiting et al., 2011), but it has not yet been brought into public school curricula so as to have an equal place in science teaching and learning.

WHAT IS TRADITIONAL ECOLOGICAL KNOWLEDGE?

Traditional ecological knowledge (TEK) is *the evolving knowledge acquired by local peoples through direct contact with the environment*. This knowledge (1) is always specific to a location; (2) emphasizes connection to place; (3) yields an understanding of the complex relationships within ecosystems; and (4) anchors community values and cultural identity to a deep understanding of sustainability (Greenwood, 2011).

TEK comprises knowledge accumulated in a local context over a multi-generational time period, handed down through generations by cultural transmission, usually oral tradition. It is based on enduring relationships of living beings with one another and with the environment. TEK is the cultural embodiment of sustainability, not just a collection of interesting data. TEK cannot be fully apprehended without an acknowledgement of the value systems and cosmological context within which the traditional knowledge was generated and in which it makes sense (Houde, 2007; Kimmerer, 2002, 2013). In both Western and in traditional indigenous cultures that “knowledge from the past is key...to all forms of learning, whether it be scientific or passing down our traditions to younger generations.” (Salomon, Huntington, and Tanape, 2011)

Houde (2007) describes “six faces” of traditional ecological knowledge, illustrated in the diagram below (See Fig. 1). These include the following: (1) factual observation; (2) management systems (sustainability); (3) factual knowledge about past and current uses of the environment; (4) ethics and values; (5) TEK as a vector for cultural identity; and (6) cosmology. These six interconnected and mutually informing aspects of TEK help identify areas of difference and convergence that are important to consider when bringing two ways of thinking and knowing together - western and indigenous learning systems.

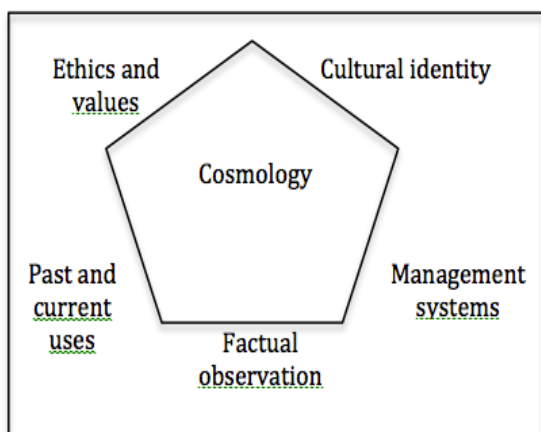


Fig. 1. Six faces of traditional ecological knowledge as described by Houde (2007).

Western science identifies most readily with the three bottom faces of the pentagon in Fig. 1, while the upper faces in the Figure - ethics and values, cultural identity, and the unifying cosmology - reflect the most challenging aspects of integrating TEK into science education programs for Western science trained educators.

Traditional ecological knowledge has many parallels with Western scientific knowledge; both traditions come from systematic observation of nature. Each embraces a different value system, however, and is interpreted within its own specific cultural context. To generalize, we could say that TEK is holistic, qualitative, and interwoven in a social and spiritual context, while Western science is reductive, quantitative, and isolated from the natural world. (See Table 1.)

Table 1. Comparison of traditional ecological knowledge and Western science (Based on Greenwood, 2011).

Traditional Ecological Knowledge	Western Science
Oral tradition	Written tradition
Holistic, integrated, mutualistic	Reductive, dualistic, compartmentalized
Based on observation and experience	Based on observation and analysis
Derives from cumulative, collective experience	Derives from laws and theories, model-building
Mostly qualitative	Mostly quantitative
Data from resource users	Data from “experts”
Long time in one location, continuous	Short time series, often in a wide range of study sites
Applied to daily practices	Research often isolated
Rooted in sustainability and cultural values	“Objective” and value-free
Interwoven with social and spiritual context	Humans considered as apart from the natural world

TRADITIONAL ECOLOGICAL KNOWLEDGE AS A FOUNDATION IN MARINE EDUCATION FOR INDIGENOUS YOUTH

Performance data for Native American students in US public education reveal a failure in the educational system. Native students have some of the lowest high school graduation rates and highest dropout rates, exceeding those of other major ethnic groups in their primary states of residence. They also show higher rates of participation in special education and other programs for children with educational challenges. Native students also score significantly lower across all basic subjects - reading, writing, math, and science - and across all grades on standardized tests when compared to their European American counterparts. (National Indian Education Association, 2010.)

Over the past decade, there has been a movement among Washington indigenous communities to reestablish cultural teaching of traditional knowledge in school curricula. This has included the teaching and learning of native languages, combined with traditional cultural practices such as dance and music, canoe journeys, native food sources and food sovereignty, and other connections with traditional knowledge. Washington State has developed a Tribal Sovereignty curriculum, which honors indigenous knowledge systems and links local tribal histories with Washington State social studies curricula and Common Core Standards.

Traditional ecological knowledge represents a tradition of honoring relationships in the natural world. Indigenous students are too often confined to classrooms with standardized curricula that do not provide meaningful interactions with their environmental and cultural surroundings. By incorporating traditional ecological knowledge when learning about ecosystems, students can develop a deeper bioregional understanding of their local environment, which can help to shape their cultural identity as well. Using the marine environment as a context for sharing, students can connect with their surroundings, fostering cultural responsibility based both on traditional local knowledge and on the findings of modern science.

“CULTURING” MARINE EDUCATION PROGRAMS IN INDIGENOUS EDUCATION PHILOSOPHY AND PEDAGOGIES

As educators, it is important to prepare ourselves to understand the cultural barriers that may keep students from engaging with and participating in science. In many cases, for example, students perceive the culture of Western science to be unwelcoming, exclusionary, and hostile to traditional ways of knowing (Kimmerer, 2002). Native Americans are the least represented group in the American scientific community but teaching based on traditional ecological knowledge can encourage greater inclusion of tribal students.

There are several basic strategies that can make marine education programs more inclusive while honoring and reflecting indigenous learning systems. One is to include tribal elders as experts and primary sources of information whenever possible, because Native culture and tradition honors and respects elders in the community, who are witnesses to significant changes in the local environment. These firsthand observations are extremely valuable in understanding the ecology, behavior, and demographics of local marine life. Elders may also be able to relate stories, songs, and poems from the oral traditions that elucidate important connections in the local ecosystem. Important local knowledge of the culture and natural systems is often embodied in native language (Gross, 2007). Combining native language revitalization with indigenous learning systems and Western science may give students insights into regional ecology, which can support the link between conservation of biodiversity and conservation of cultural diversity (Kimmerer, 2002).

Teachers can also use native instructors and scientists to provide students with role models and local examples of possible career paths in science. Many tribal biologists employed by the Tribes are European Americans, but they may understand the environmental challenges faced by local tribes from a scientific perspective. With the help of tribal scientists, educators can design marine programs with appropriate content, issues, and local case studies and hands-on fieldwork that students can relate to.

Traditional teaching and learning methods such as mentoring or process-based learning can be used in combination with traditional knowledge to facilitate access to Western science concepts. Traditional knowledge incorporates multiple ways of understanding the world and shares the foundations of the learner's cultural experience. Traditional interpretations of the natural world add to the depth of students' learning about the local environment through science.

It should be noted that it is not easy to incorporate traditional ecological knowledge into Western marine science education. Patience is required and the teacher must make space for student conflict, concern, and confusion between Western science and traditional knowledge. Connecting students with people who “walk both worlds” can help to transcend cultural conflicts.

APPROACHES TO INCORPORATE TRADITIONAL ECOLOGICAL KNOWLEDGE INTO MAINSTREAM SCIENCE EDUCATION

Current science curriculum has to undergo major reform if it is to incorporate traditional ecological knowledge and indigenous pedagogies into marine science education. James Banks (2001) suggests four approaches to the integration of ethnic content into the curriculum generally, which can also be applied to the reform of marine education programs. The four approaches are summarized below, illustrated in Fig. 2.

The higher-level approaches, such as program transformation and the social action approach, can be effective in helping indigenous students develop the identifications necessary to function in mainstream science education.

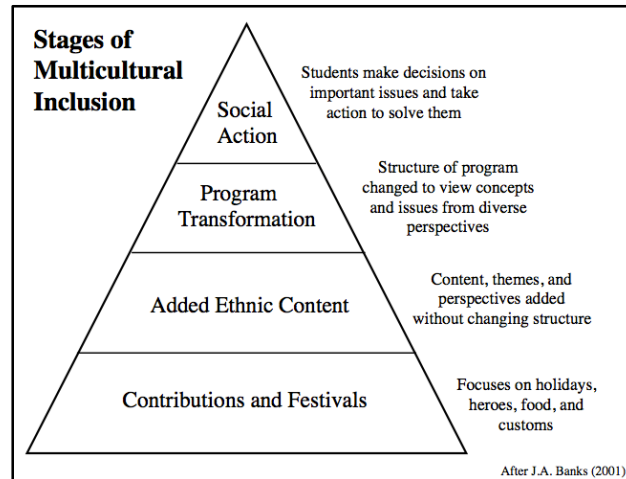


Fig. 2. Science reform based on James Banks' model for the stages of inclusive multicultural reform (Banks, 2001).

Contributions and Festivals

This approach is characterized by the addition of "science heroes" or the celebration of holidays, based on Western criteria for inclusion into the curriculum. The mainstream curriculum remains unchanged in regard to its basic structure, goals, and characteristics. This approach can result in the trivialization of cultural meanings or in tokenism, and may reinforce stereotypes and misconceptions.

Added Ethnic Content

The integration of ethnic content to the curriculum is the addition of content, concepts, themes, and perspectives to the curriculum, without changing its basic structure, goals, or purposes. An example is the addition of a story, unit, or course to the curriculum without other substantive changes. This approach generally fails to help students view society from a Native perspective and often views Native content from the perspectives of mainstream scientists.

Program Transformation

The basic assumptions of the curriculum are changed, which may enable students to view concepts, issues, themes, and problems from other points of view. This approach requires a strong commitment to educating students in ways that are not just culturally appropriate, but also culturally inherent (Simpson, 2002). When teaching Western science, for example, it could be introduced as the "added" curriculum, with TEK as the foundation to which it is added. In ecosystem studies, the emphasis could be on how the environment gradually emerged from complex interactions of mainstream and Native societies, not just on ways Native Americans have lived sustainably.

Social Action

A skillful combining of all the elements of the Transformation Approach can enable students to make decisions and take actions related to local social and environmental issues and problems, and helps them develop useful alternative perspectives. Not only thinking globally and acting locally, but thinking "locally" in a deep sense, valuing the rich sources of traditional environmental knowledge, local understandings, and experiences that derive from traditional culture (Kato, 2002). Major goals of this approach are to teach students thinking and decision-making skills, empower them, and help them understand their place in the world.

INSTRUCTIONAL STRATEGIES FOR SUCCESSFUL INTEGRATION OF INDIGENOUS LEARNING INTO MARINE CURRICULUM

Native American methods of teaching and learning include experiential and placed-based learning; storytelling (learning by active listening), ceremony and traditional rituals, apprenticeship (mentor-mentee relationships), and artistic creation (Cajete, 1986; Stephens, 2000). Effective teachers can create curricula using these learning styles, with hands-on, project-based instruction as the ideal.

- Introduce students to basic Western science - observation, classification, and generalization - by using familiar events, issues, and locally identified topics. Build on students' innate interests and curiosity. Compare processes in both cultures – Native knowledge and Western science.
- Expose students to learning environments rich in reference to the “language of science.” Use field trips, local experts, guest speakers, hands-on activities, and interdisciplinary learning (arts, social studies, technology).
- Teach Western science as one teaches a second language – introduce vocabulary and protocols as if they were the grammar of a new way of communicating, and use graphic representations generously.
- Engage in ongoing authentic assessment, which can subtly guide instruction and deeper cultural and scientific understanding, reasoning, and skill development tied to standards.
- Discover who your students are culturally, socially, and individually. Avoid stereotyping students and above all, honor their knowledge and culture. Expect and encourage excellence and success, and students will respond accordingly.

PROTOCOLS AND APPROPRIATE USE OF TRADITIONAL ECOLOGICAL KNOWLEDGE IN MARINE EDUCATION

Traditional ecological knowledge represents the collective intellectual contributions of local peoples over long periods of time, so it is imperative that local protocols and appropriate use of knowledge and materials always be respected and observed. Non-native people may be surprised to learn that Native communities own intellectual property rights to their traditional knowledge, just as a writer or artist owns rights to her or his creations. Many Native American tribes have designed research and education guidelines to protect intellectual property rights of their tribal communities (Greenwood, 2013). Local control over traditional knowledge is essential to maintaining the cultural viability of local communities, so the identities of informants and respectful acknowledgment of local ownership of stories, information, and artifacts should always be made, with appropriate credit given.

To be sure you are following proper protocol with respect to traditional knowledge of a local Tribe, it is important to identify a Tribal mentor or contact. You must plan for and implement a mutually beneficial relationship, and you should be willing to pay for any services you solicit. For most indigenous communities, you will need permission from Tribal government to use or incorporate traditional knowledge into your curriculum, and a Tribal mentor can help you negotiate the necessary permissions and access to resources. Be sure to follow the tribe's research or educational protocols carefully, and hire tribal resource people when you can. This will help ensure that the traditional knowledge is not taken out of context or misrepresented.

The need for Native youth to be trained in science and resource management and their present underrepresentation in these types of careers speak to the need for a paradigm shift in how we in the marine science education field approach our work. To be effective and to make a lasting contribution to the challenges now facing people throughout the world, we must change how we conceptualize the relationship between culture and environment, and how we bring culture and environment into the education of our youth. Reframing marine science education around a deeper sense of sustainable culture and the traditional ecological knowledge it engenders will enhance the potential for TEK to help build a sustainable future for human beings and for our planet Earth.

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