Infusing Traditional Knowledge and Ways of Knowing Into Science Communication Courses at the University of Hawai'i

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ABSTRACT

We describe a philosophy and process by which cultural awareness and traditional ways of knowing were incorporated into courses on communicating ocean sciences for college and graduate students in Hawai'i. The result is a culturally relevant framework that contextualizes the course for Hawai'i audiences while also enabling students to better understand the host culture. We offer an overview of the similarities and differences between Western and Native Hawaiian worldviews as they relate to science, exploration, and explanation. Our approach focused on two main elements of science communication and pedagogy in Hawai'i: (1) people and relationships, and (2) place and culture. As the foundation for all scientific endeavors—Western or Native Hawaiian—people and relationships were used as a natural and critical starting point for bringing cultural context to science education and communication. Similarly, the significance of place in Native Hawaiian and other traditional knowledge systems and the importance of allowing space for viewing science through a cultural lens were explicitly explored throughout the course. Open class discussion, understanding different cultural approaches to education, and personal interaction with Native Hawaiian scholars and experts were all important elements in students' development of cultural awareness and sensitivity in teaching science, as evidenced by course evaluations. Although our courses focused on ocean sciences, this commentary offers ideas on how traditional ways of knowing might be incorporated into communication or education courses in any science discipline. [DOI: 10.5408/12-416.1]

Key words: traditional knowledge, Hawaiian knowledge, cultural awareness, science communication, science pedagogy

INTRODUCTION

In 2009 and 2010, we implemented courses at the University of Hawai'i (UH) in Communicating Ocean Sciences based on a course that had been developed at the University of California, Berkeley (Halversen and Tran, 2010). "Communicating Ocean Sciences" (COS) and its sister course, "Communicating Ocean Sciences for Informal Audiences" (COSIA), were designed to teach university science students about pedagogical principles and teaching strategies to more effectively communicate ocean science concepts to audiences in formal (COS) or informal (COSIA) educational settings. We combined these two courses into one composite curriculum to allow UH students to conduct their teaching practicum in either a formal classroom setting or an informal science education center, such as a public aquarium or museum.

The "COS/IA" course was taught at the UH at Mānoa to science and science education graduate students under course designation OEST 696, and at UH Maui College to undergraduate students under the course designation OCN 270. Graduate students in OEST 696 were mostly Caucasian (eight total with five Caucasians, one Native Hawaiian, and one each from South America and Guam), as were undergraduates in OCN 270 (10 total with six Caucasians, three Native Hawaiians, and one from Guam).

In addition to addressing the needs of audiences in different educational settings, we also sought to provide COS/IA students with a relevant, cultural framework for their learning. By integrating Native Hawaiian and traditional ways of understanding with Western scientific ways of understanding, we contextualized the course for Hawai'i audiences while also enabling many COS/IA students to better understand the host culture. This allowed COS/IA students who were less connected to the local culture to view culturally responsive science curriculum as a way of connecting what is known about Western science education with what is known and valued by local people and communities. These objectives stem from our National Science Foundation (NSF)–funded collaborative project with the Center for Ocean Sciences Education Excellence California (COSEE CA; www.coseeca.net), known as "Pacific Ocean Literacy for Youth, Publics, Professionals, and Scientists" (POLYPPS).

POLYPPS is based on the Native Hawaiian concept of cosmology in which the coral polyp is among one of the first organisms to appear from the dark depths of the ocean. The Hawaiian genealogical chant—the Kumulipo—tells that story. It describes a familial relationship among Native Hawaiians to land, sky, ocean, and forms of life contained within those realms. It describes an order to the universe, as it unfolded eons ago, similar to the Western concept of evolution, but dissimilar in that it also references the metaphysical (Beckwith, 1951; Kanahele, 1997; Kanahele et al., 2011). The central premise of POLYPPS is that to

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increase understanding and stewardship of ocean environments, science education must draw not only from the latest advances in Western science and technology but also from the cultural contexts in which the learners are imbedded. The integration of cultural awareness into the COS/IA courses was, therefore, a natural outgrowth of that philosophy. This commentary describes our process of integrating Native Hawaiian learning systems and cultural practices into the COS/IA courses in hopes of stimulating ideas about how traditional ways of knowing might be incorporated into COS/IA courses in other locations as well as in science communication courses of other disciplines.

In our treatment, we are careful to distinguish our approach of integrating traditional ways of understanding into the COS/IA courses from efforts that aim to incorporate "traditional knowledge" into Western science. Although we support the open, equitable, and mutually respectful sharing of Western science and indigenous knowledge systems to address complex issues, in our approach to teaching COS/IA, it has become increasingly clear that the term "traditional knowledge" is inadequate to represent all the necessary considerations for contextualizing the courses to Hawai'i. Any serious treatment of integrating Western science and indigenous knowledge systems into effective educational models must include a discussion of values, philosophies, and worldviews, in addition to the actual knowledge held by the respective communities of practice (i.e., scientists and cultural practitioners). In the COS/IA courses, we came to realize that the important comparisons we were making in relation to pedagogies and teaching practices had more to do with "ways of understanding and knowing" rather than the ocean knowledge itself. The ways in which people learn best have much to do with their cultural context. Effective communication or teaching practices need to reflect that context, taking into account those values and philosophies that define the place and culture. Our discussion from here focuses on the cultural context, values, and philosophies that distinguish Western and Native Hawaiian ways of understanding, based on our own limited perspectives as scientists and educators.

Values, Philosophies, and Worldviews

Numerous scholars have adeptly outlined both similarities and differences between Western science and Indigenous or Traditional knowledge (Snively, 1990; Cajete, 1994; Snively and Corsiglia, 2001; Barnhardt and Kawagley, 2005; Bang et al., 2007; Gagnon and Berteaux, 2009). Differences frequently involve aspects of place versus paradigm, methods of observation, values, transferability, and context. Convincing arguments can also be made that the two knowledge systems are more alike than distinct (Agrawal, 1995). Nevertheless, a rich body of literature explores the ramifications of culturally different ways of knowing on science education and consistently indicates a need for science instruction that is culturally grounded (Nelson-Barber and Estrin, 1995; Cobern and Loving, 2001; Aikenhead, 2001; Riggs, 2005; Semken, 2005; Aikenhead et al., 2006; Kuwahara, 2013). Although a broad review of those studies is beyond the scope of this commentary, we attempt here to discuss a few of the disparate elements of Western and Native Hawaiian values, philosophies, and worldviews that we believe have strong relevance for teaching science students about culturally sensitive approaches to science education and communication.

One very important distinction between the philosophical tenets of Western and Native Hawaiian knowledge systems is how people understand and interact with the natural world. Western science culture considers only those elements of our environment that are physically tangible or can be directly measured or manipulated. Metaphysical phenomena are excluded because they are not approachable through hypothesis testing. In Native Hawaiian culture and worldview, the physical and metaphysical may be considered one in the same (Kanahele, 1978). Physical and metaphysical phenomena cannot necessarily be distinguished, nor should they be, and, therefore, metaphysical explanations for observable phenomena are entirely valid. The challenge for teachers of indigenous students from a Western science perspective is allowing (and encouraging) space for culturally valid worldviews that venture into areas not explored by science and acknowledging the affiliated perceived limitation of a scientific worldview. From a Native Hawaiian perspective, *'A'ohe pau ka 'ike i ka hālau ho'okāhi* (All knowledge is not taught in the same school), i.e., there are many sources of knowledge (Pukui, 1983). Thus, one of the goals of culturally responsive education would be for students to sustain respect for the integrity of their own cultural knowledge while having meaningful opportunities to make new connections among other knowledge systems (Native Hawaiian Educational Council and Ka Haka'ula o Ke'elikōlani College of Hawaiian Language, 2002).

An example of the need to address both cultural and metaphysical components occurred at a recent COSEE Coastal Trends Coral Reef and Climate Change workshop for teachers on the Hawai'i Island (in which A.C. participated). The first exercise in the workshop was for participants to make a sketch of their personal concept of a coral reef. Most participants drew sketches of corals as well as other reef invertebrates and fishes. As people shared their ideas with the group, most concepts appeared to be based on an eco-scientific viewpoint and included relationships between members of the reef community, trophic levels, energy flow, and human interactions. One teacher asked to share and introduced himself as a member of the *Kahuawaiola* Indigenous Teacher Education Program at the UH at Hilo. He explained how his "concept" of a coral reef is tied to the traditional concept of corals, which considers corals in a spiritual sense to be one of the most essential and basic components of traditional Hawaiian cosmology. This awareness is reflected in the following 'Ōlelo No'eau, or ancestral proverb: *He pūko'a e kani ai ka 'āina* (A grain of coral eventually grows into land). This can be said metaphorically of a person who begins in a small way but gains steadily until he or she becomes firmly established (Pukui, 1983). Ultimately, the sharing by this teacher allowed other educators in the workshop to expand their understanding of both coral reefs and Hawaiian culture.

Another distinction between Western and Native Hawaiian worldviews is the relationship between humans and other entities of the natural world. Many Native Hawaiians view themselves as genealogically related to all other living things. This holistic worldview has profound consequences in terms of how Native Hawaiians may view what Western scientists call "subjects." In other words, entities being studied, whether organisms or rocks, are not

merely objects, but are also living relatives and ancestors, possessing spirits as well as the ability to communicate metaphysically (Veary, 1989). Cultural protocol thus requires a personal relationship with that entity. A person cannot completely understand an entity (organism, community of organisms, or an ecosystem) without a personal relationship and the concomitant respect it mandates. Similarly, in-depth knowledge of a place requires the cultivation of a long-term relationship with that place. The consequence is that "objectivity," as valued by Western science, may be considered exceedingly limited from a Native Hawaiian perspective.

Moreover, where Western science often looks to generalize across scales, Native Hawaiians value the specialized ability of individuals familiar with a place to perceive and understand aspects not apparent to outsiders. Western science agrees that there is sensory perception beyond the five senses (sight, sound, smell, touch, and taste) and that there are vast differences in the sensitivity of people's senses. A Western example is a sommelier who can detect and describe subtle nuances of the soil from a particular region and relate it to the kind of wine that was produced. Only a few people develop that level of taste sensitivity, and although most people would not have the same "results" when experimenting with tasting wine, it is not discountable. Thus, when we distinguish between Western science and Native Hawaiian science, it is relevant to consider the idea that what is clearly perceptible among one group of people, whose genealogical lineage is rooted in one part of the world, may be totally unperceived by those of a foreign lineage.

As intellectual endeavors, a shared objective of both Western science and Native Hawaiian knowledge is the ability to predict natural events through empirical observation and documentation of natural cycles and phenomena (Kimmerer, 2002). Western science, however, seeks to explain and predict "universal truths" about the natural world *explicitly* through theories and principles, whereas traditional Hawaiian knowledge embeds "universal truths" about the natural world *implicitly* through language and culture, e.g., *ʻōlelo noʻeau* (metaphors), *kaʻao* (stories and legends), *oli*, *hula*, and *mele* (chants, dances, and songs), and *kākāʻōlelo* (oratory). Whereas what is referred to as modern Western science originated as a branch of Western philosophy (Moore, 1993), with only nominal relevance to survival, traditional Hawaiian knowledge originated out of practical needs for human sustenance. In ancient times, Native Hawaiians focused on determining and predicting local patterns and phenomena as an applied practice because a lack of appreciation for place-based knowledge and idiosyncrasies could be devastating. Therefore, highly contextualized, local knowledge was relevant and valued. Thus, Hawaiian knowledge is born of a fundamentally empirical approach, whereas the conception of Western science is rooted in theory. Understanding these historical differences between science and traditional knowledge, and the societal drivers that affected their development, is an important lesson for culturally aware science educators.

Applying Traditional Knowledge to the COS Courses

The following is a synopsis of the steps we took to integrate traditional knowledge and cultural practices into the COS/IA courses. We provide the rationale for each step, followed by a critique of the strategies we used, specific examples, and recommendations for future use. Our hope is that this synopsis will provide a starting point for the incorporation of traditional knowledge not only into COS/IA courses in other locations but also into the incorporation of traditional knowledge into other disciplines.

People and Relationships Are Important

People are the foundation of our human knowledge system. It is from people that we learn and with people that we share information. Within the context of traditional knowledge, especially in communally oriented cultures, the human element in learning, sharing, and collaborating is of utmost importance. With this idea in mind, we began our integration of traditional knowledge with people themselves.

Our process paralleled scientific-inquiry learning cycles as we investigated the questions of why people are significant, what types of people and types of knowledge are valuable to learning and teaching about ocean sciences, and how to involve people and culture as educational resources. We deliberately, and openly with our COS/IA students, invited traditional knowledge experts to be resources for knowledge and as staring points for discussion about science, education, and communication topics. These could be Native Hawaiian elders with generational knowledge about traditional practices or other respected members of the community that hold specific expertise recognized as valuable (by the community) to Hawaiian cultural identity. We then applied the ideas, background, knowledge, and cultural connections of our traditional knowledge experts to synthesize and further explore information and concepts with our COS/IA students.

Recommendations for Selecting Traditional Knowledge Experts

The knowledge, enthusiasm, and personality of guest speakers in a classroom are a large factor in the success and intended effect of the guest. Indeed, the traditional knowledge expert may have very different ideas and approaches to sharing information than expected or desired (we recognize that this is true of many guest presenters, regardless of their expertise). For example, individuals may be sometimes reluctant to share their expert information (such as fisher people), prone to inflammatory ideas (e.g., advocacy groups), unfamiliar with Western science (e.g., lack of formal science training), or uncomfortable in classroom settings (perhaps never having attended formal school or having been out of school for a long time).

We found that personal contacts worked well as guest speakers in our COS/IA courses because we were able to discuss freely with the expert the goals of our course and to dialogue about the purpose of the guest interaction and the type of information that would be shared. For long-term interactions and developing partnerships for student opportunities, we found it beneficial for partners to have some familiarity with both science and traditional knowledge. Moreover, traditional knowledge experts familiar with education proved to be exceptionally valuable.

In addition to external resources, using the skills and expertise of our COS/IA students as indigenous people was critical. One of the most rewarding connections of the UH Mānoa COS/IA course was the advent of a Native Hawaiian traditional knowledge teaching assistant (TA). The cultural

TA (C.K.V.C.) was chosen because of her extensive background in Hawaiian studies (much more than the COS/IA instructors), which not only lent credibility to the course but also validated the cultural perspectives of other COS/IA students, some of whom had backgrounds in the Pacific region and others who had backgrounds more rooted in mainland U.S. culture. We were thus able to extend the connection from students in our classes to their families at home, further deepening the place-based connection and personal relevancy.

Student responses to the participation of a cultural TA in the Mānoa course was overwhelmingly positive—all eight indicated that the TA stimulated them to explicitly think about cultural aspects of the course, and seven out of eight thought that the TA broadened their understanding and grasp of course content. The response to guest speakers was more mixed, with six of the eight Mānoa graduate students indicating that the guest speakers contributed significantly to the course. We hypothesize that some of this apathy may be attributed to our own failure to adequately prepare one or two of the guest speakers, underscoring the need to develop personal relationships and dialogue with external experts well ahead of time. Individual evaluation elements for each speaker in the future should help us more accurately assess and adapt this aspect of the course.

The UH Maui College COS/IA course featured several cultural practitioners from the community who were invited to speak to the group about how they learned about the marine world in their particular places and the importance of the ocean in their lives. Students were inspired by those speakers and, at the invitation of the cultural experts, contacted them as they incorporated cultural aspects into their lesson plans. Evaluations indicated that the students felt that all the speakers were excellent. The Native Hawaiians in the class were also very open about sharing their own experiences, and they frequently mentioned ways that their families involved them in cultural practices as they learned about the ocean and its resources. These first-hand reflections from their peers offered another avenue for non-Native students to better understand Hawaiian ways of knowing.

Place and Culture Are Important

Hawai'i is a unique place, physically, biologically, and culturally. As such, we deemed it critical to incorporate activities and exemplars that were relevant to the Hawaiian context. We attempted to include course elements that would highlight the importance of Hawai'i as a place, both physically and culturally. "Physical place" elements were those intended to help COS/IA students better understand and connect with the local geography, ecosystems, and natural phenomena of the islands as well as those elements that help COS/IA students incorporate place-based modifications into their teaching to create stronger relevance for learners. An example of one such element would be including a discussion of unique brackish water systems in Hawai'i when teaching about the properties of water. "Cultural place" elements were those intended to help COS/IA students better understand the importance of Hawaiian history, customs, practices, and philosophies for teaching science concepts to local learners. These elements tended to focus on Native Hawaiian epistemology and approaches to inquiry.

Multiple Ways of Knowing and Learning: Hawaiian Approaches to Inquiry

A discussion at the beginning of the COS/IA course on different knowledge systems and ways of knowing is highly recommended and extremely useful in helping students understand both scientific endeavors and scientific knowledge as cultural constructs. The discussion also helps students recognize that learners approach science with a particular cultural lens or viewpoint. As mentioned above, we invited experts to come speak to our classes about Native Hawaiian knowledge and ways of knowing. These perspectives were considered and integrated into our discussions about the nature of science and inquiry.

Direct observation and active engagement are shared aspects of Western and Hawaiian knowledge systems. However, certain approaches to learning and teaching, especially those related to questioning and inquiry, may be seen as substantially disparate (Table I). Educators working with indigenous Hawaiian students must fully appreciate those differences in cultural approaches to learning and teaching and adjust both their methodologies and expectations if they wish to connect with and engage their audience. The difference between Western and Hawaiian knowledge systems can perhaps be most succinctly summed up by the Ōlelo No'eau, "Nānā ka maka, ho'olohe ka pepeiao, pa'a ka waha" (Observe with the eyes, listen with the ears, don't talk; Pukui, 1983). In the Hawaiian educational tradition, the student does not question the teacher until fairly late in the learning cycle—*after* careful observation, experiential participation, and demonstration under the teacher's guidance.

A traditional Hawaiian learning progression would include the following steps: (1) observation, (2) listening, (3) personal reflection, (4) doing, and finally, (5) questioning (Chun, 2006a). Students accustomed to that approach may not be comfortable either posing or answering questions early on in the learning cycle nor may that be a necessary element of teaching through inquiry. It is important that an educator coming from the Western tradition of inquiry-based learning understand the reasons and value of the Hawaiian learning cycle and recognize it as an equally valid approach to "hands-on, minds-on learning." In the words of Malcom Chun (2006b):

> *This is an economical usage of the master's time and helps the child develop self-teaching abilities. The end results are the mastery of skills and the gaining of knowledge; the expression of independent learning under careful guidance; creation of a sense of belonging as the transmission of skills and knowledge from one generation to the next is done through interpersonal relationship; and the fostering of a desire for generosity in sharing one's skills and knowledge with those willing to learn. In addition to teaching a child specific skills, this system teaches a process that serves the child well through the transition from adolescence to adulthood.*

In a recent discussion with teachers of Native Hawaiian students, the use of statements was brought up as an alternative to questions in drawing out students' ideas and input. In this approach, the teacher offers factual statements and allows adequate space and time for the student to consider ideas and provide input in a way that prompts critical thinking. For example, if a teacher is trying to prompt

TABLE I: Phases of inquiry in Western and Hawaiian learning.[1]

Western Learning[2]	Hawaiian Learning[3]
Questioning	Observation and listening
Exploration	Reflection
Analysis	Doing
Reflection	Questioning

[1]Although individual phases are similar, they are not identical. Note also the difference in placement of questioning within the two progressions.
[2]Based on Bybee (2002).
[3]Based on Chun (2006b).

extended thinking about marine organisms, rather than asking a question such as "Do anemones have properties that are similar to any other organisms you know about?" the teacher might say, "Anemones are similar to sea jelly medusas in the way that they feed." In the same way that an effective question requires sufficient response time, an effective statement also requires response time. Given time and encouragement, the student would be expected to add additional observations about anemones and sea jelly medusa, including their similarities and differences as well as possible connections to other Cnidaria. This approach of teachers using statements rather than questions can allow the student to feel more comfortable in the learning environment and provide an opportunity for students to share the information and knowledge that they have. Similarly, fostering an environment where students themselves are encouraged to make statements and observations rather than (or in addition to) asking questions may help students to participate more fully in scientific learning.

We advocate the inclusion of a class field trip that focuses student attention on cultural knowledge and knowledge systems early on in the semester. For the UH Mānoa course, that was accomplished with a field trip to the Bishop Museum's renovated Hawaiian Hall. Fortuitously, a special Educator Night event celebrating the opening of the hall was held during our normal class meeting time. Students were not only able to explore Hawaiian culture but also to experience it within an explicit educational context, helping them to reflect on effective teaching and communication practices within an informal learning environment as they interacted with museum educators and docents. We suggest having an explicit learning objective for the field trip to focus students' attention on a specific concept. For the UH Mānoa course, we gave the students the prompt for follow-up discussion during the next class period, "Based on the readings about learning from museums and field trips as cognitive motivators, what do you think teachers could do to make a field trip to Bishop Museum (or other informal learning environment) an effective learning experience for students"? We also asked students to participate in a moon-phases scavenger hunt activity conducted on the third floor of Hawaiian Hall during the event. This tied in with a phases of the moon activity taught during the course, exemplifying constructivist learning theory and practices.

Student evaluations were strongly supportive of the cultural field trip to Bishop Museum—all of the students that participated in the field trip responded (agree or strongly agree) that it was a useful learning experience. Other comments in the evaluation indicated that students valued the open class discussion, learning about different learning styles and cycles, and designing a lesson (e.g., "The most valuable aspects were the activities in class that demonstrated different learning styles among students or different approaches to the same lesson…"). Course evaluation data also suggest that the open, two-way dialogue in class was effective for student learning: most students (at least 75%) felt that they actively participated in class discussion, developed an ability to communicate clearly about the subject, and learned to value new viewpoints.

CONCLUSION

Ultimately, both Western science and Traditional ways of knowing are human endeavors heavily tied to culture. In Western science, that culture tends to be academic and formal; in Traditional knowledge, the culture is social, spiritual, and relational. In a course about science communication and pedagogy, a multicultural learning context and explicit recognition of the different cultural approaches to science and learning help set the stage for innovative thinking, diverse approaches, and rich discourse among students about the teaching and learning of science. In our courses, we found that dialogue was important in communication, whether through questions or statements, to allow students to fully explore the role of cultural perceptions in learning. Discussions in our course about the perspective of different ways of thinking and knowing enabled students not only to better understand the perspectives of those viewpoints but also to connect their personal perspectives, which were most often unique to their experience and cultural background. In summary, we found that the act of structured, open discourse and sharing was extremely valuable in integrating Traditional knowledge into the communication of ocean science and in helping to make our students more-effective educators. Although this article focuses on Native Hawaiian culture in the context of science education and communication, we hope the approaches we discuss will be useful to a broader audience interested in blending Traditional knowledge into their courses. Culture and tradition, although grounded in place and the knowledge of the past, are constantly evolving systems, which together with other disciplines are fundamental in addressing global issues of the present and the future.

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