A Culturally Relevant Agricultural and Environmental Course for K–12 Teachers in Hawaii

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ABSTRACT A Hawaiian cultural-based agricultural and environmental science professional development course was transformed based on the precepts of situated learning in communities of practice, and offered to K–12 teachers. In this article we describe the format and content of the transformed course based on lessons learned from previous years offered to K–12 teachers. We also describe the teachers' responses to the course and students' response to curricula implemented by teachers. Hawaiian ways of learning are experience-based, embedded in real-life purpose and context, highly interpersonal, and location specific. Our goal in transforming this course was to help teachers to incorporate important topics related to the environmental and agriculture science fields into their curricula, and to make that content relevant to their students' lives and backgrounds, especially those of native Hawaiian decent. Based on observations, written and oral evaluations from teachers, student assessments, and student involvement in community projects, we feel that we have attained that goal. Some of the important factors for effective learning and implementation of this new culture–science curriculum by teachers are: (1) culturally relevant course format that provides meaningful, effective social interactions among instructors and teachers/students; (2) development of a "community of practice"; (3) a team of instructors, each knowledgeable in different areas, such as science, agriculture, Hawaiian culture, all experienced in problem-based teaching; (4) excellent models of problem-based and culturally based projects/curricula; and (5) continued support from peers and instructional team throughout the academic year.

Hawaii, with its tropical climate, has a strong farming history, dating back to the islands' first inhabitants (Abbott, 1992). For the indigenous people of Hawaii, strong relationships to the *'aina* (the land), the *'ohana* (immediate and extended family), and the community were the foundation for their vibrant society, and provided the context for learning (Kawakami and Aton, 1995; Meyer, 1998; Puku'i, 1983; Feinstein, 2004). Farming in Hawaii experienced a shift from small-scale sustainable farming in the pre-western contact period to the industrial scale farms of the post-western contact period. Today, the plantation-scale farms have declined and small-scale and diversified farms are increasing (State of Hawaii, 2009). Much of commercial agricultural production has involved the use of fertilizers, pesticides, water, and other inputs that have impacted the soil environment and can potentially harm human and ecosystem health. However, recently organic farming is becoming more prevalent. Teaching Hawaii's students about the small-scale, sustainable farming practices of the Hawaiians, which are based upon some of the same concepts as organic farming (Handy et al., 1991), and how these can address Hawaii's environmental concerns, can help students connect their culture to their learning experiences and could direct them to their future careers.

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Hawaiian ways of learning are experience-based, embedded in real-life purpose and context, and highly interpersonal, focusing on developing an individual's knowledge base supported by cultural values and practices relevant to specific locations (Meyer, 1998). Hawaiians acquired and used scientific knowledge within problem and community-based contexts, using their powers of observation and their deep knowledge of plants, animals, and the environment to meet everyday needs, such as food production, resource management, and resolution of social issues, such as water rights and distribution. Knowledge was transmitted through observation, modeling, and apprenticeships in the context of practicality and a responsibility to be good stewards of their islands, which contain limited resources (Meyer, 1998).

Hawaiian practices of learning are similar to Wenger and Lave's concept of situated learning in communities of practice (Wenger, 1998, 2006; Lave and Wenger, 1991). Communities of practice are "groups of people who share a concern or passion for something they do, and learn how to do it better as they interact regularly" (Wenger, 2006). This concept is based on the following assumptions: (1) we are social beings, (2) knowledge is a matter of competence with respect to valued enterprises, and therefore knowing is a matter of participating in these valued enterprises, and (3) learning should produce meaning and an ability to experience and engage the world around us. Based upon Wenger and Lave's concept of situated learning, the most transformative learning takes place as individuals engage in their personal communities of practice, whether it is with their peers at school, their families, or their co-workers. Problem and inquiry-based activities—which encourage a community of practice that pursues solutions to highly valued, real world problems, and connects science to culture, place, and community—can be used to implement this concept (Chinn, 2007).

Although there is a movement toward collaborative professional development rather than just the dissemination of knowledge, there are conflicting descriptions of whether the learning that takes place is a result of models constructed by the individual or a result of the social interactions between individuals (Butler et al., 2004). We take the position that it is both (Butler et al., 2004). Therefore, we have transformed a culturally relevant agricultural and environmental professional development course based on these precepts, and the examples of others who have implemented them (Englert and Tarrant, 1995; Palincsar et al., 1998, Glazer and Hannafin, 2006). Our goal in transforming this course was to help teachers to incorporate important topics related to the environmental and agriculture science fields into their curricula, and to make that content relevant to their students' lives and backgrounds, especially those of native Hawaiian decent. Today, Native Hawaiian students are underrepresented in college enrollment and science and engineering occupational sectors (Kana'iaupuni et al., 2005); therefore, in addition to those goals stated above, we also intended to better prepare teachers to teach and inspire native Hawaiian students to pursue and succeed in these fields of study. In this article we briefly describe this course as it was taught during the first 2 years of offering and then describe the lessons learned and the format and content of the transformed course offered in the third year. We also describe the teachers' responses to the transformed course.

Course Description

The general structure of the course throughout all years consisted of a short instructional summer class followed by teacher implementation of curriculum projects during the ensuing academic year, and culminating with the sharing of their projects and their students' reactions to the curriculum with fellow teachers at a year-end get together. Course grades were based on response papers, journals, and most heavily on the curriculum project that the teachers developed and delivered in their classrooms. During the first 2 years, our primary focus was to teach teachers about new environmental technologies for the agricultural industry, such as bioremediation, and to draw comparisons to traditional Hawaiian practices (funded by the Agriculture-Based Remediation Program, U.S. Department of Defense, and USDA). Much of the delivery of the course content during the first 2 years was done through lectures, classroom activities, and field trips. Teachers developed their curriculum project ideas, and received feedback from a panel that included the instructors of the course as well as representatives from private businesses and government agencies. Informal contact between the course instructors and teachers was maintained throughout the following academic year, and the course was concluded at a final meeting during the following summer where presentations about the classroom implementation of their project-based curricula were delivered by the teachers. Contact time included 7 days (8 hours a day) for the first year, and was changed to 3 days a week, afternoons only, for 6 weeks in the second year. The schedule was altered in the second year based on teacher feedback and availability, but absenteeism increased, and therefore the schedule was altered again for the third year.

In the third year, we changed our focus from primarily content driven toward improving pedagogy. Our goal was to assist teachers in making their agriculture and/or environmental curriculum more relevant to their students (especially native Hawaiian students), their community, and their geographical location. A grant from the Native Hawaiian Education program called *Malama I Ka Aina* (Caring for the land) under the U.S. Department of Education funded Year 3 (and beyond).

The schedule and teaching style for the third year was substantially altered based on suggestions from a planning group of elementary, middle, and high school teachers. These teachers had completed the course during 1 of the 2 previous years, and were called "site teachers." These site teachers were "seasoned" elementary, middle, or high school teachers who were familiar with problem-based learning, had implemented a culture-science curriculum in their classrooms, and were willing to provide instructional outreach to their colleagues. The curriculum for the third year was based on exemplary units and lessons developed by the "site teachers." Given that teachers could take the course for credit or no credit and few were enrolled in graduate programs requiring grades, something more was needed for teachers to persist and to change their instructional content and pedagogy. Planners for the third year suggested the incorporation of models of practice and greater interpersonal support because they recognized that in addition to content, teaching strategies and practice would be important tools for successful incorporation of interdisciplinary and cultural content into the classroom. Planners also felt that learning should be situated in communities of practice in which experts and novices worked toward shared goals of learning more about Hawaiian culture and science and inspiring students in science (Wenger, 1998).

The bulk of the meeting time for the course in the third year was held in the summer during the "Kohala Immersion," where teachers spent 5 days and 4 nights, 24 hours a day, eating, sleeping, and working together. During this time, teachers were immersed in culturally relevant science associated with Hawaiian cultural practices and values. Scientific concepts and terminology were presented as ways to think about and connect familiar Hawaiian practices to their school science program. Science concepts covered in the course included the nitrogen cycle and the related plant and microorganism functions; ecosystems and the importance of species interactions; plant and microorganism categorization and naming; and geology of the Hawaiian Islands. During the Kohala Immersion, teachers lived together at Kohala High School (3 nights) and an isolated mountain area (1 night), developing deeper personal and interpersonal relationships. They were familiarized with problem-based learning through simulated group exercises, and learned about a real life environmental problem at Kohala High School's agriculture program: compliance with environmental regulations for the treatment of wastes from farm animal production programs. Teachers learned how the Kohala High School agriculture program had previously developed practical, scientifically based, yet culturally relevant solutions for their problem.

The agriculture program at the high school raised three breeding pigs and produced about 100 piglets a year for sale. Large amounts of water were used to clean out these pens, and then discharged into the sewer system. This was not only expensive, but wasted a precious natural resource. Kohala High School's agriculture science teacher and his students designed a system that directed the wastewater through a septic tank where solids were collected, and then through several tanks, some containing plastic shavings that provide a surface on which microorganisms colonize and bioremediate the nutrient-rich water that flows through these tanks. Some of the tanks also contained *Makaloa*, a native sedge, which takes up much of the nitrogen in the water. The water flows through a UV treatment, and then is ready to be used again. The agriculture class calculated how much money was saved by recycling the water, and how this improved their profit margin for their piglet sales. This program is an example of how schools can teach students to solve complex, real-world problems involving science, technology, the environment, and economics, namely, problem-based learning. The growing of *Makaloa*, which is used for weaving in the Hawaiian culture, also provided an ideal opportunity for students to learn about Hawaiian culture in the context of science and agriculture.

In addition to the problem-based activity, the teachers engaged in traditional restoring and planting of taro terraces guided by a Native Hawaiian teacher, and learned about traditional Hawaiian pedagogical and communication strategies from Native Hawaiian teachers who teach Native Hawaiian students. They sang Hawaiian songs at night; studied the stars, tides, and seasons in relation to agriculture and the environment; and developed camaraderie based on their shared goals of learning more about Hawaiian culture and science and inspiring students in science. Since many of the teachers were not of Native Hawaiian decent (about two-thirds), they were encouraged to discuss and learn more about their own cultures in connection with the culture of Hawaii. Many teachers were descendants of immigrants who came to Hawaii to work during the days of large plantations, and had many stories about their ancestors who worked in agriculture. These sharing times not only helped the teachers make a greater connection to agriculture and the land, but also helped them to see the connections between their own culture and others, including that of Hawaii. Through these activities and times of sharing, they were encouraged to become a community of practice (i.e., the practice of teaching), studying and practicing lessons they would later share with their own students.

Over the next school year, meetings that focused on topics of interest to teachers (i.e., examples of local watershed restoration projects) and sharing of curricular projects (in person and over the project website) continued to support a learning and teaching community. Instructors visited and co-taught lessons on request and site teachers invited colleagues to their schools. Site teachers and instructors were available to mentor each teacher in the development of a culturally and problem-based curriculum for their classroom throughout the school year.

The two main instructors for the course throughout the 3 years were university faculty from the College of Education and the College of Tropical Agriculture and Human Resources. The rest of the instructional team varied from year to year, each bringing a different expertise into the group: Hawaiian culture, biotechnology, microbiology, bioremediation, and information technology. All were teaching or previously taught K–12 science. High school agriculture teachers from the first and second years were important members of the instructional team for the third year, providing the facilities and real-life problems and settings upon which the curriculum was based.

Twenty-four teachers enrolled in the third year. Four were agriculture teachers, nine were middle or high school science teachers, and 11 were elementary teachers. Qualitative observations, written and oral evaluations, and pre- and post-surveys provided the basis for assessment of the course.

Teachers' Response

Based on written and oral evaluations from teachers enrolled in the first- and second-year courses, they felt that preparing lesson plans were more useful than taking field trips during the summer instruction portion of the course. Although the instructors offered to provide one-on-one interaction and support, only a few teachers felt comfortable with that kind of interaction, even if they perceived potential benefits. Many felt incompetent and unprepared to teach this type of project-based curriculum in their classroom, and felt unfamiliar with the agriculture and environmental science concepts presented.

Several of the teachers in the first- and second-year courses were interested in and implemented lessons that involved the development of a natural ecosystem to treat a waste stream. The model system consisted of fish tanks as the source of the wastewater and a "wastewater treatment system," which consisted of a series of tanks with natural ecosystems containing plants and microorganisms. The microorganisms break down the organic fish waste to carbon dioxide and NO_x compounds, which can then be taken up by the plants. The "clean" water is then recycled back into the fish tank. One such system is shown in Fig. 1. Scientific concepts, such as the nitrogen cycle, ecosystems and plant and animal biology, and traditional Hawaiian concepts such as the *ahupua'a* (ancient Hawaiian land divisions) and various types of ancient Hawaiian agricultural practices were incorporated into these lessons. This set of lessons was one of the exemplary lessons that were incorporated into the curriculum for the third year of this course.

Twenty-two of the 24 teachers who enrolled in the third year of this course implemented a new curriculum into their classrooms. Pre- and post-course self assessment surveys

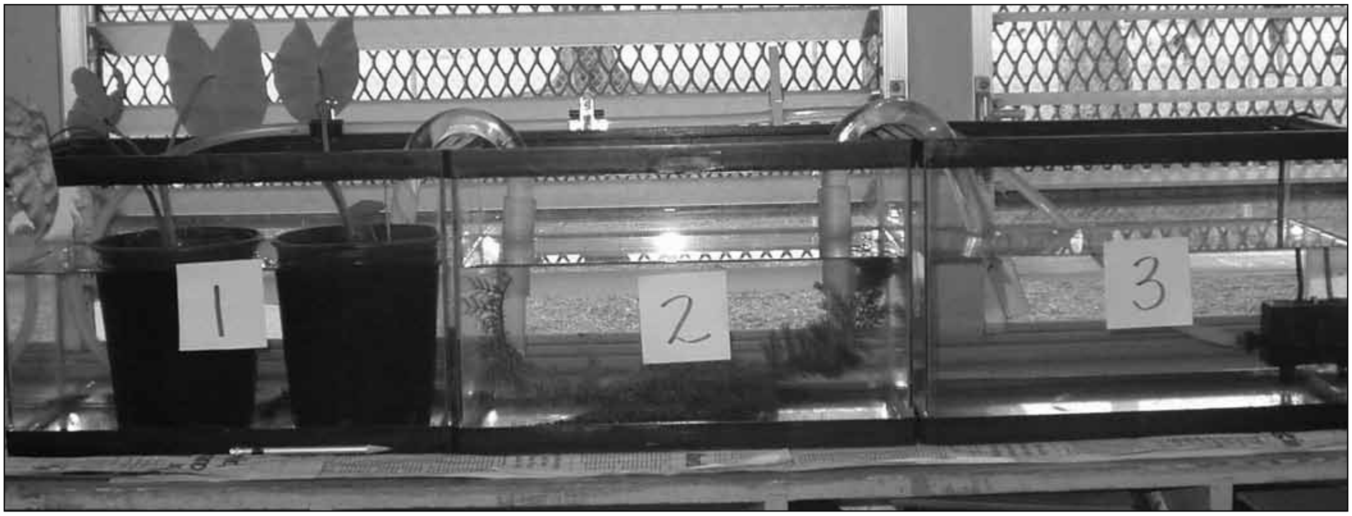

Fig. 1. Example of a system designed by teachers that housed a natural ecosystem and treated aquarium wastewater. Tank 3 contains fish, the waste producer. Tanks 2 and 1 contain aquatic plants and substrates (rocks) for microorganisms.

were administered for the third-year course. All teachers who completed the survey appeared to initially feel confident in their own abilities to develop curriculum and to provide instruction at their grade levels. This indicated that the teachers enrolled in this course were not "rookies," and were experienced and competent in their teaching abilities. Based on statements in the post-course surveys and group and individual discussions, the confidence of the teachers' cultural knowledge and attitude, their ability to make culture–science connections, and their understanding of the material and energy cycles improved as a result of the course.

At a sharing/discussion session held at the end of the Kohala culture–science immersion (recorded on video), teachers reported a deeper understanding of Hawaiian culture and a better understanding of the science behind Hawaiian environmental and agricultural practices. As a result of this experience, many felt better prepared to teach these concepts in their classrooms, and were surprised and amazed that they understood the connection between science and Hawaiian practices. The hands-on activities and models from site teachers enabled the teachers to adapt the curriculum to their classrooms more easily. Teachers developed deeper interpersonal relationships than in the first 2 years and felt more comfortable asking instructors and site teachers to visit their classrooms and for advice and help in developing curricula, presumably because of the relationships that were built during the immersion.

During the third year, the relationships that developed between agriculture and science teachers were particularly interesting. These relationships were most obvious in one instance when teachers collaborated to help an agriculture teacher apply the concept of bioremediation to his large aquaculture system. With the assistance/guidance from an expert (whose correspondence began on one of the field trips), the agriculture teacher designed a system of tanks through which the effluent from the aquaculture tanks were flowed and bioremediated. These tanks contained rocks and plants. The rocks provided substrates for microorganisms, and the plants provided a substrate for the microorganisms in addition to taking up some of the nutrients in the waste stream. Science teachers assisted the agriculture teacher by incorporating the nitrogen and carbon cycles and organism interdependence into lessons that addressed state educational standards. This community of teachers and experts seemed to follow the example of the Hawaiians by solving a problem based on scientific concepts, and transmitting knowledge through observation, modeling, and apprenticeship, within the context of practicality and a responsibility to be good stewards of their land (Meyer, 1998). This community of teachers also displayed attributes that matched Wenger and Lave's (Wenger, 1998) community of practice, which can manifest itself in three ways: (1) what it is about, in this case, teaching; (2) how it functions, in this case the contribution of each teacher's unique capabilities toward the development of effective curricula for every teacher in this community; and (3) what capability it has produced, in this case the ability to incorporate culture and science into their agriculture and environmental curricula and effectively engage Hawaii's students.

Teachers developed assessments of student performance for their newly developed curricula. The results indicate good student understanding of the concepts. Teachers indicated that most students enjoyed these project-based activities more than classroom work. Teachers have also observed greater participation by students in environmental projects, such as beach and park clean ups. This may be an indication that students do grasp the relevancy of this content to their lives. Some teachers have even expanded upon their original curricula and developed school-wide and community-wide programs. Curricula have been compiled, printed, and disseminated to teachers and schools throughout Hawaii. This course format has continued to be used in subsequent offerings of this course, with similar success. A follow-on project was funded by the U.S. Department of Education to develop school-based learning centers from which this same kind of learning takes place.

Conclusions

Based on observations and evaluation of teachers and their curriculum project presentations, our goal of transforming this Hawaiian culture-based agricultural and environmental course to help teachers incorporate important content into their curricula and make that content more relevant to their students' lives and backgrounds seems to have been accomplished. Teachers indicated that they grasped the relevancy of the content to their personal lives and experiences. Based on teachers' evaluation of students, the students also grasped the content and enjoyed the activities. Lastly, increased student participation in environmental clean-up projects indicates that students grasped the relevancy of the content to their lives.

Some of the important factors for effective learning and implementation of this new Hawaiian culture–science curriculum by teachers are:

1. Science and culture immersion at school and community sites, to provide meaningful, effective social interactions among instructors and teachers/students
2. Development of a "community of practice" where members have a common goal and are able to support one another in attaining this goal
3. A team of instructors, some of whom are knowledgeable in science, others who are knowledgeable in agriculture, others who are well versed in the Hawaiian culture, all of whom were knowledgeable in problem-based teaching
4. Excellent models of problem-based and culturally based projects/curricula, which incorporate practical, real-life problems and allow the teacher/student to develop meaning and value around the topics they are learning
5. Continued support from peers and instructional team for technical content and practical advice throughout the academic year

In conclusion, through the development of this Hawaiian-culture based agricultural and environmental science course for teachers, it became apparent that incorporating situated learning in communities of practice is effective in motivating and supporting teachers to implement a problem- and culturally based curriculum with their students. In any teacher professional development course, this is the ultimate goal—not only that the teachers complete the course, but that they also implement the practices learned in the course with their students. Instruction in culturally relevant, problem-based lessons and activities in school and community settings should include model lessons and projects and should engage the learners (teachers in this example) with knowledgeable people in their fields, thus making the teachers feel comfortable and more prepared to bring the lessons and projects into their classroom, schools, and communities.

References

Abbott, I. 1992. La'au Hawai'i: Traditional Hawaiian uses of plants. Bishop Museum Press, Honolulu, HI.

Butler, D.L., H.N. Lauscher, S. Jarvis-Selinger, and B. Beckingham. 2004. Collaboration and self-regulation in teachers' professional development. Teaching Teacher Educ. 20:435–455. doi:10.1016/j.tate.2004.04.003

Chinn, P. 2007. Decolonizing methodologies and indigeneous knowledge: The role of culture, place and personal experience in professional development. J. Res. Sci. Teaching 44:1247–1268. doi:10.1002/tea.20192

Englert, C.S., and K.L. Tarrant. 1995. Creating collaborative cultures for educational change. Remedial Special Educ. 16:325–336. doi:10.1177/074193259501600602

Feinstein, B. 2004. Learning and transformation in the context of Hawaiian ecological knowledge. Adult Educ. Quarterly 54:105–126. doi:10.1177/0741713603260275

Glazer, E.M., and M.J. Hannafin. 2006. The collaborative apprenticeship model: Situated professional development within school settings. Teaching Teacher Educ. 22:179–193. doi:10.1016/j.tate.2005.09.004

Handy, E.S.C., E.G. Handy, and M.K. Pukui. 1991. Native planters in old Hawaii: Their life, love, and environment. Bishop Museum Press, Honolulu, HI.

Kana'iaupuni, S.K., N. Malone, and K. Ishibashi. 2005. Ka huaka'i: 2005 native Hawaiian educational assessment. Kamehameha Schools, Pauahi Publications, Honolulu, HI.

Kawakami, A.J., and K.K. Aton. 1995. Ke A'o Hawai'i (critical elements for Hawaiian learning): Perceptions of successful Hawaiian educators. Pacific Educ. Res. J. 11:53–66.

Lave, J., and E. Wenger. 1991. Situated learning: Legitmate peripheral participation. Cambridge University Press, London, UK.

Meyer, M. 1998. Native Hawaiian epistemology: Sites of empowerment and resistance. Equity Excellence Educ. 31:22–28. doi:10.1080/1066568980310104

Palincsar, A.S., S.J. Magnusson, N. Marano, D. Ford, and N. Brown. 1998. Designing a community of practice: Principles and practices of the GIsML community. Teaching Teacher Educ. 14:5–19. doi:10.1016/S0742-051X(97)00057-7

Puku'i, M. 1983. 'Olelo no'eau: Hawaiian proverbs and poetical sayings. Bishop Museum Press, Honolulu, HI.

State of Hawaii. 2009. State of Hawaii facts and figures. Available at http://hawaii.gov/dbedt/info/economic/library/facts/state (verified 25 Nov. 2009). Dep. of Business, Economic Development and Tourism, State of Hawaii, Honolulu.

Wenger, E. 1998. Communities of practice: Learning, meaning and identity. Cambridge University Press, Cambridge, UK.

Wenger, E. 2006. Communities of practice: A brief introduction. Available at http://www.ewenger.com/theory (accessed 15 June 2007, 5 June 2009; verified 25 Nov. 2009).