The Virtual Hawaiian Lo‘i:

Applying Second Life to Cultural and Environmental Education

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Abstract: Ample evidence suggests that both experiential and theoretical learning is necessary for subject mastery and retention. However with traditional Hawaiian kalo *(taro)* farming instructional techniques there is often sufficient field time but a lack of formal environmental education that accompanies the place-based learning. The Virtual Lo‘i instructional design module is focused on providing an alternate learning space for the practice of kalo variety recall within a simulated three-dimensional lo‘i *(wetland taro patch)* environment. The modules’ educational setting is a hybrid of culturally based and immersive designed elements within Second Life to encourage user reference engagement and environmental literacy. Image driven immersive-based design and plant family grouping techniques were used as the design foundation for the instructional design module. The data was collected using pre- and post- recall testing and attitudinal surveys over a two-month period, consisting of fourteen participants across five age groups and three Hawaiian Islands. Preliminary testing results suggest that virtual environments could provide a space for environmental education and traditional knowledge transference.

Keywords: Cultural Design, Environmental Education, Place-based Learning, Kalo Farming, Second Life, Virtual Learning Environments.

Introduction

The first depictions of Hawai‘i, by Captain James Cook in 1778, reveal the ingenuity of Hawaii’s food systems, which sustained a population upwards of 800,000 *kānaka maoli* (Native Hawaiians) in the most remote inhabited archipelago in the world (Stannard, 1961). Yet, political and historical forces over the last two centuries have caused a breakdown in Hawaii’s traditional food system, leading its traditional agriculture to become severely endangered, in knowledge and practice. The ramifications of this have been enormous in terms of cultural knowledge loss, environmental degradation, resource mismanagement, health decline, and food insecurity, by which 95% of foods are imported (Howes & Osorio, 2010). Solutions to this crisis do not require the creation of new knowledge; rather they point back to reviving enduring systems of traditional knowledge, which can be achieved like never before through virtual worlds.

There is nothing culturally inconsistent in blending traditional knowledge with modern technology. Cultures and societies have evolved and survived for thousands of years by exchanging and adapting knowledge, tools, and applications through innovative problem solving (Goleman, 2009). Yet surprisingly, traditional ecological knowledge, or

indigenous knowledge, has scarcely been taught within Second Life. Possible reasons for lack of engagement may include: assumptions of cultural taboo; a general disconnect between elders (the keepers of traditional knowledge) and younger generations (the developers of Web-based content); and a former apprehension in using virtual environments as educational tools.

Mainstream education has now begun to successfully extend learning through virtual environments such as Second Life. Second Life is a free three dimensional virtual world launched by Linden Labs in 2003. By logical extension, traditional ecological knowledge could be another content area benefited from this modern educational tool. At a time when nations are calling for widespread environmental education to counter global environmental crises and environmental experts are looking to traditional ecological knowledge as a basis for designing sustainable communities, integrating traditional knowledge with virtual worlds may help to encourage applications for real world sustainability.

To gauge this capacity, educators must create and test instructional designs around virtual worlds and traditional knowledge. This paper highlights the creation and testing of one instructional design grounded in Hawaiian traditional ecological knowledge, the Second Life virtual *lo'i* (taro wetland agriculture).

Literature Review

Both hands-on environmental education and immersive technologies can combine to form a comprehensive and supportive educational structure. Digital technology, according to Cavallo (2000), allows for customization around culture. By taking a bilateral approach to culture and technology, the educator enables the transference of traditional knowledge through engaging the learner on duel planes. For the virtual lo'i to be successful it was therefore necessary to bring the traditions, tools, and skills of *ka wā kahiko* (the past) into the future by immersion via a hybrid educational approach. This was achieved relatively easily by observing a few caveats.

When integrating traditional knowledge into Second Life, the motion control and interaction techniques of the virtual environment are critical to user success (Bowman & Hodges, 1999). The virtual lo'i achieved this by allowing a non-linear learning approach based on user preference and an environment that elicits avatar interaction with the learning material. Also critical to user success is the quality of the design within Second Life, which serves as either a primary learning environment or a supplementary learning environment to a place-based class. The virtual lo'i was designed to support user success by incorporating Wang's (2011) five elements of Analysis, Design, Development, Implementation, and Evaluation "ADDIE" within Second life including: 1) warm up, 2) readings, 3) exploration, 4) interaction, and 5) reflection Within this instructional design module, warm up is taking the pretest, readings is examining the modules directional elements, exploration is interacting with the learning modules, interaction means clicking or listening to the educational content, reflection is taking the post test and attitudinal survey.

The successful transference of traditional agricultural knowledge falls within a broader field of environmental education. The United Nations agree that given the current global situation, there is urgency for environmental education to be present within all

disciplines of the education system, not simply an adjunct to a particular discipline such as science (UNESCO, 1978).

Teaching environmental education within formal or informal environment has been an important and worthwhile endeavor, but it has faced its share of challenges. A primary challenge has simply been defining Environmental Literacy, the object of Environmental Education. Harvey (1977) noted that after an extensive review of the literature, involving many hundred items, "there was no single, generally accepted substantive structure available for environmental education" (p. 66). Several writers continued their attempts to clarify and redefine the meaning of environmental literacy, with Roth (1992) exclaiming a decade and a half later that "we are still relatively vague about what it is we are trying to do through environmental education" (p. 8).

All new disciplines take time to develop, over years of dialog, research, and praxis. But what is unique about environmental education endeavors is the scope (sources capable of widespread environmental education), the breadth (a holistic and systematic approach), and the depth (an interdisciplinary focus on the sciences (science, technology, engineering), and the social sciences (culture, history, politics).

Nevertheless, environmental education can be defined as an educational aim of producing a citizenry that is knowledgeable concerning the natural environment and its associated problems, aware of how to help solve these problems and motivated to work toward their solution (McBeth & Volk, 2010). Within the virtual loʻi design, this meant striving to perpetuate traditional Hawaiian agriculture as one educational means toward reinvigorating Hawaii's food systems. Environmental literacy was defined as the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems; generally summed up in four strands: knowledge, skills, affect, and behavior (Roth, 1992). In this virtual loʻi design, environmental literacy could be developed through acquiring knowledge of kalo varieties, skills in constructing a loʻi, appreciation for the importance of traditional Hawaiian agriculture, and the perpetuation of taro farming.

Volk & Cheak believe that cultural environmental education is most effective when it is student-driven and collaborative in nature, mirroring the cultural learning styles of native students. When technological learning environments are locally and culturally grounded, they can be rich supplements to physical classes by extending knowledge acquisition, collaboration, and critical thinking (Volk & Cheak, 2003). Virtual environments provide "safe" learning environment for students to view themselves as active and participating members of a community and practice their knowledge acquisition for real world application. Culturally inclusive modalities, the exploration of relevant local issues, student collaboration, community partnerships, experience in exercising social responsibility, and the positive feelings of having made a difference are defining factors of success in environmental education programs (Volk & Cheak, 2003) and these are applied within the virtual loʻi.

Background

Historically in Hawaiʻi, the primary method of sustainable food production was *loʻi kalo* (wetland taro) (Handy-Craighill, Handy-Green, & Pukui, 1991). Today, however, it can be difficult to locate a traditional loʻi or traditional Hawaiian farmer. The

cost of accessing land and water, in addition to a lack of time and knowledge all play a part in the disappearance of Hawaii's loʻi. Furthermore, a general lack of environmental literacy by the current generations creates additional barriers in teaching food production and sustainability. Instruction at the University of Hawaiʻi Mānoa Hawaiian Studies Department seeks to help rectify this.

Content for this instructional design was drawn from HWST 351: Mahiʻai Kalo (taro farming), a prerequisite course for a Hawaiian Studies bachelor's degree. Course competency for HWST 351 is measured by how successfully students are able 1) identify the families and varieties of *kalo* (taro), 2) Identify, construct, and maintain a traditional loʻi, and 3) understand the anatomy and features of the kalo plant. Identification is required in both English and Hawaiian languages. Anecdotal evidence by students suggests that the course does not allow for sufficient time in a hands-on natural environment to achieve subject mastery. With few loʻi in the community for students to access outside of class and print and online reference materials being both dated and finite, students are at risk for lowered learning outcomes.

Purpose

The overall purpose of this instructional design module was to create a virtual loʻi within Second Life, which serves as an online "outdoor" lab providing virtual "hands-on" experience in traditional Hawaiian agriculture. It was specifically designed for Hawaiian Studies college students studying *mahiʻai kalo* (taro farming) at the University of Hawaiʻi Mānoa (UHM), based on their needs for more hands-on experience.

This simulated loʻi strived to benefit students by enabling 24/7 online lab access, thereby extending the traditional means of cultural and environmental education beyond time and space. Also, it sought to engage students in a dynamic set of self-guided learning activities, such as kalo identification and recall. The goal was not only to support subject mastery, but also to develop environmental literacy.

While no reference material can replace the benefits of a natural laboratory, a hybrid design model provides the opportunity for blended learning. The purpose of this instructional design module is to provide a culturally grounded immersive environment that utilizes mixed media to support kalo recall and develop cultural environmental literacy. Thus, it can be used as both a formal reference and informal study supplement for students of Mahiʻai Kalo that require additional time and resources outside of the loʻi.

Research Questions

The use of virtual worlds like Second Life in traditional knowledge transference and environmental literacy development is relatively untested. At the start of this study it was unknown whether a cultural and experiential traditional knowledge course such as kalo farming could even be coherently applied to a virtual environment like Second Life, let alone whether it could serve as an educationally enhancing learning tool. There are two main questions that this study hopes to answer:

1. Does an immersive three-dimensional environment facilitate student identifying techniques and recall of kalo families and varieties?

2. What roles might virtual worlds play in teaching environmental education and traditional knowledge?

Project Description

Project Participants
Research participants consisted of fourteen diverse people across five age groups, three island locations, varied educational and professional backgrounds, and subject knowledge. All of the participants had a background in farming/gardening or culture or both. Participants were recruited for this study using the Hawai‘i Island Natural Farming Listserv and meeting, University of Hawai‘i at Hilo Leoki Listserv, University of Hawai‘i at Mānoa Hawaiian Studies email list, and Garden Web Hawai’i forum Listserve.

Instructional Design
The instructional design includes several elements visual, auditory, tactile, and simulated immersive settings to elicit learner engagement and response. Utilizing high quality digital images, 3D plant modeling, embedded supporting video, virtual realistic settings, and cultural foundations I was able to create a comfortable and connecting space *(see Figures 1 & 2)*. A combination of Adobe Photoshop CS5, Jing, Audacity, Scratch, Second Life scripts, and the in-world build editor were utilized to build the model. From a cultural perspective elements such as native hardwoods, *kapa* (bark cloth), basalt, and indigenous and native plants were used to create an organic feel. The use of *‘ōlelo no’eau* (proverbs & sayings), *‘ōlelo Hawai’i* (Hawaiian language), and traditional images were also incorporated in order to facilitate a more culturally immersive environment. The goals for the design module were:

1) Culturally-sound – a culturally accurate and appropriate representation of traditional knowledge
2) Intellectually engaging – a learning experience that was challenging, dynamic, and fun and which was meaningful enough to motivate participation
3) Aesthetically pleasing – a multisensory space that was enjoyable to see, hear, and interact with

Figure 1: Kalo Family and Varieties

Figure 2: Simulated Virtual Lo'i

Data Collection

Testing and Surveys

All of the test and surveys were conducted within Second Life, which provides the option to link out to an external URL for larger print. Tests and survey were created and tabulated with Google Forms using the Google Forms With Images "GFWI " script. The GFWI script was necessary component in order to embed images into Google Forms, as it was not a native option.

The data was collected over a two-month period. Multiple methods of data collection, including pre- and post-Ipsative recall tests and a Likert attitudinal survey were utilized. Ipsative recall tests are based upon subject memorization and cognitive recall of subjects. Ipsative method of testing was used since more than half of the questions were image based. Likert surveys measure attitudes along a five-point scale of: strongly agree, agree, neutral, disagree, and strongly disagree.

Participant demographic data was gathered anonymously including: geographic residence, age, gender, occupation and educational standing. The Ipsative recall test questions used a combination of images and pull down, fill-in the blank answers to gauge the participant's knowledge, pre- and post-test. The pre- and post- recall tests were identical with the exception of gender, geographical, and personal group identifier information. A five-point Likert scale was employed to gauge participant attitudes, and at the end of it, a text paragraph space was provided for additional written comments.

Results

Demographics

Of the fourteen participants that took the pre- and post-tests 43% were from O'ahu, 43% were from Hawai'i Island and 14% were from Kaua'i. 86% percent identified themselves as male, while 14% identified themselves as female. Ages were relatively equally divided between those ages 27-35 (36%), to those ages 18-26 (29%), those ages 45-53 (21%), and those ages 54-62 (14%). Only one participant identified

himself or herself as a kalo farmer. The other participants identified themselves as current or former University of Hawai‘i students (57%) or gardeners (36%). No landscapers took the tests.

Pre-test Analysis

Pre-test data results regarding image based identification of kalo varieties were well distributed between all varieties. The highest correct pre-test variety was Piko Lehua with 71% of participants correctly identifying the variety. Second highest pretest identification score was Uahiapele with 64% of participants correctly identifying the variety. Kalo anatomy had mixed results, including the highest number of incorrect answers at 57% of the time. Identifying parts of the Lo‘i in English and Hawaiian also had mixed results.

Pre-test results may show that the two highest scoring varieties of kalo are also the most identifiable by either name or varietal factors. Piko Lehua at 71% or 10 participants is the primary kalo variety used for the production of poi that is commercially available at supermarkets. One additional factor that may have led to the high testing result of Piko Lehua is that it was the default variety from the selection box on the question. Therefore, even if a participant that didn't know the variety if they did not select any other variety they would have got the answer correct. With regard to Uahiapele being selected as the second highest scored kalo variety it is also the most unique looking of all of the images and varieties. The possibility that an educated guess based upon the image could account for a majority of participants correctly identifying the variety.

Kalo anatomy had interesting results, as it was not image-based but textual. The questions were asked using either the English or Hawaiian vocabulary. The two kalo anatomy questions asked in Hawaiian language with the English as the answer faired poorly in the pretest results. Whereas, the highest scoring pretest question was again also the default answer from the available pull down answers menu.

Post-test Analysis

Post-test results with regard to the identification of Piko Lehua did not vary significantly enough from pre-test results to be counted as significant. The primary area of consequence was that 14% of the learner population was able to improve with regard to correct family from the non-family variety of ‘Apuwai. Post-test results for the identification for Uahiapele by participants substantially improved with a correct identification rate of 93% up from 64% on the pretest. The area of most interest to the designer is in the pre- and post-testing of the Piko Uaua variety of kalo. Pre-test results for kalo identification were scattered whereas post-test results showed improvement in kalo identification, especially at the family identification levels.

Implications

1. Can an immersive three-dimensional environment facilitate student identifying techniques and recall of kalo families and varieties?

Analysis of the data indicates that image based instruction may possibly assist with information recall. Additionally, pre- and post-Ipsative testing is a practical assessment methodology for image acquisition and retention. While the results are limited to a number of participants the pre test and posttest denote an increased accurate response across all participants.

2. What roles might virtual worlds play in teaching environmental education and traditional knowledge?

While the test results are inconclusive as to the direct role of virtual worlds in environmental education and traditional knowledge transference. The majority responses to the attitudinal survey were positive toward the usefulness of the module. Question five had a strong response of 71% in favor of using the virtual lo'i as a resource to help support them as kalo farmers, while question two had 86% respond that the module did help them to identify the parts of the kalo plant. The feedback from the comments section were helpful and generally positive:

"More fun then websites" "Was neat", "Is a good resource that is using newer technologies", "There should be a posting section like GardenWeb where you can ask questions about taro", "Make a way to build a lo'i or plant kalo", "Putting the varieties together made it easier to see similarities. The words in the boxes go by too quick to read sometimes"

The most critical feedback also came within the comments section where a few participants stated:

"This is not practical for everyday use and identification. It is interesting and has some useful information" and *"Good fun but not as good as a real lo'i",*

The combined results of the attitudinal survey could be reasonable indicator that there may be a place for immersive learning environments. Second Life has many cultural and national representations within its sphere, what has been in short supply are traditional cultural simulations. While the three dimensional environment of Second Life is not exact nor perfect it does provide another immersive facet that instructional designers, educators, and cultural practitioners can tap into. As cultural and traditional knowledge weans Second Life offers an additional repository for information conveyance.

Conclusion

This instructional design module provided an immersive learning experience for kalo identification and recall while both formally and informally supporting culturally based environmental education. The mixed media approach was appreciated by a majority of learners. Comments from the attitudinal surveys indicate that they appreciated the module for its interactivity that cannot be found with many websites. However, some learners stated that the module is impractical for consistent and normal use.

The test results of the module illustrate that it may be possible to enhance recall of kalo varieties at the family level utilizing image-based learning. However, the duration of the modules test data collection would need to be extended in order to facilitate further understanding of this subject. If virtual environments like Second Life can serve as alternative immersive classrooms and knowledge warehouses, then communities, which require additional repositories for traditional knowledge, may want to consider theses spaces to assist in perpetuating culture.

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