Encouraging Environmental Literacy on Campus:

A Case Study of the Kukui Cup

Sara K. Cobble

Hawai'i Pacific University

December 2, 2012

Certification Page

The Professional Paper submitted by this student has been reviewed and is deemed to have met the Professional Paper (GLSD 7100 and GLSD 7200) requirement for Hawaii Pacific University's College of Humanities and Social Sciences

Student Name:	Sara Cobble
Title of Professional Paper:	Encouraging Environmental Literacy on Campus: A Case Study of the Kukui Cup

_____ _____

Art Whatley, Ph.D. Date
Professor and Program Chair, MA/GLSD

Table of Contents

List of Tables and Figures

Abstract

Environmental literacy measures a person's understanding of ecological principles and the ways in which human systems interact with the environment. It falls on a continuum of varying degrees of aptitude, from nominal to functional to operational, and includes behaviors, attitudes, concerns and knowledge about the environment (Roth, 1992). This skill-set comprises both cognitive and affective types of knowledge. A high level of environmental literacy will be necessary to navigate a future in which these skills are needed (King, 2000). Unfortunately, only 1-2 percent of American adults are considered environmentally literate (Coyle, 2006).

Environmental education, the key for producing environmentally literate citizens, has been on the rise since it emerged in the 1970s. At the university level, the number of sustainability programs and initiatives is inspiring (Shephard, 2006). However, many of the changes in higher education have been on physical campuses and not inside the classroom, and sustainability is seen more as a prescriptive fix than a radical change in attitude, concern, knowledge and behavior (Sherman, 2008; 2011).

A recent trend on university campuses has been energy-saving competitions in university buildings and on-campus dormitories — over 150 of these competitions have taken place in the last few years, with median energy reductions of 22 percent (Johnson et al, 2011). This paper is a case study of one of those competitions: the Kukui Cup at Hawai'i Pacific University (HPU). In the three-week-long competition, students living on campus played an online game and participated

in associated educational activities using resources from the Collaborative Software Design Laboratory at the University of Hawaii at Mānoa. The Kukui Cup was an attempt to use gamification techniques, competition and technology to encourage changes in environmental behaviors, attitudes, concerns and knowledge of on-campus residents, with hopes of improving their overall levels of energy and environmental literacy. This study aims to answer the questions: What is the level of environmental literacy of dorm residents at HPU, and how is it affected by participation in an on-campus energy-saving competition?

Keywords: environmental literacy, environmental education, Kukui Cup, New Environmental Paradigm (NEP), Dominant Social Paradigm (DSP)

Encouraging Environmental Literacy on Campus

Many ecological problems and increasing environmental degradation come from our society's prevalent values, attitudes and beliefs, such as unlimited growth, technophilia, and commitment to a free-market economy (Dunlap & Van Liere, 1978). The coming decades will bring many environmental challenges and complex changes: an additional 2 billion people, increasing global needs for fuel, water and clean air, and an unprecedented human impact on natural systems (Hollweg et al., 2011). Ignorance and indifference to environmental problems can do massive and irreversible harm to the environment (United Nations Conference on Human Environment, 1972). A remedy for apathy and illiteracy concerning environmental issues is environmental education and environmental literacy, which are crucial for all generations in order to improve their levels of knowledge and protection of the environment (Venkatamaran, 2008). Environmental literacy enables people to be able to address environmental issues and find practical solutions (Hollweg et.al, 2011).

Human behaviors that negatively impact ecosystems are not usually harmful on purpose: they often stem from apathy and ignorance. This notion has been around for four decades: the 1972 UN Conference on Human Environment (Teksoz, Sahin & Tekkaya-Ostekin, 2011) recognized that disinterest in environmental problems and a lack of momentum toward solving them can affect the environment, and that disregarding these problems can contribute to irreversible damages on a large scale. Environmental education is crucial for building a sustainable society and

educating an environment-conscious population who balance the interests of nature and humanity in decision-making (Roth, 1992).

As environmental problems become more pressing and the window of time to act on major global environmental problems such as climate change is shortened (Zelman & Gerken, 2012), it becomes increasingly essential for people to make appropriate actions on both local and global scales. These individual and societal actions can be encouraged through environmental education. The outcome of successful environmental education is environmental literacy (Teksoz et al., 2011), which is an amalgamation of deep understanding of environmental issues and a proficiency of skills that help mitigate environmental damage and promote environmental sustainability.

A thorough understanding of environmental literacy and ways in which it can become more widespread is essential for developing a more environmentally conscious society. Environmental education in institutions of higher learning is particularly important, as university campuses tend to be breeding grounds for new thought and shape future leaders. As Chalkley (2006) observed, higher education has a crucial and unique role in its ability and responsibility to "graduate large numbers of students who understand environmental issues, have the skills to act sustainably if they choose to do so, and nurture the personal and emotional values that compel them to behave sustainably" (Shephard, 2006).

Environmental Literacy

Literacy is traditionally defined as the ability to read and write (Merriam-Webster, 2012). The term has evolved from this definition; it can also signify a

citizen's capability and demonstrable skills in a specific field. Literacy can include the ability to research information from multiple sources, understand it, and synthesize it into knowledge (Pischetola, 2011). It can also refer to a person's motivation and desire to use information in the best way and improve his or her skills. Other fields have adapted and applied the term as well: Digital literacy, media literacy and information literacy are examples.

Charles E. Roth first coined the term environmental literacy in 1968 in response to the public apathy and blindness toward emerging pollution problems that gave birth to the modern environmental movement in the 1970s. He then reworked his initial definition in the early 1990s to include other researchers' additions (McBeth & Volk, 2010). According to Roth (1992), society tends to view literacy in binary terms: Either a person is literate or illiterate. The term literate usually refers to functional literacy, or the basic math and reading skills, such as balancing a checkbook and reading a menu, that enable a citizen to function in society and fit in existing social structures (King, 2000). This is where a major distinction of environmental literacy and traditional literacy appears, which Roth (1992) demarcated. Achieving functional literacy allows a person to successfully assimilate into present social structures, but it does not necessarily encourage him or her to reflect on or challenge the legitimacy and morality of those structures. Environmental literacy requires challenging current societal practices that negatively impact the environment, and questioning the very paradigms that guide society (King, 2000). By definition, an environmentally literate person is active and progressive; a traditionally literate person can survive and thrive in the modern

world without having to make complex judgments or actions or challenge the system's validity.

Someone who has achieved environmental literacy not only has a deep understanding of environmental issues, but can also demonstrate those skills and apply them in the real world (Coyle, 2006). Environmental literacy is also interdisciplinary and draws from many sources, including energy management and use, science, economics, sociology and politics (Hollweg et al., 2011). Roth views environmental literacy as a continuum, measured in degrees of proficiency from inability to advanced aptitude. There are three specific degrees of literacy: nominal, functional and operational, with nominal being on the low end of the continuum and operational being the highest stage. An operationally environmentally literate person has achieved the final phase of environmental literacy. Each of these three degrees contains four stages: awareness, concern, understanding and action (Roth, 1992).

A nominally environmentally literate person can recognize basic terms and provide rough definitions. This person also respects natural systems and is concerned about the effects of human systems upon them. A functionally environmentally literate person has a broader understanding of systems interactions, particularly the negative effects of human systems on the ecosystem, and analyzes and evaluates information with his or her own personal values and morals. Furthermore, this person goes a step beyond nominal literacy by sharing information with others. An operationally environmentally literate person has even further depth and breadth of understanding, is engaged, feels a sense of

responsibility and acts both locally and globally. Table 1 below details the characteristics of each stage of the continuum, as described by Roth (1992).

Table 1. Environmental Literacy Continuum, adapted from Roth (1992).

Degree of environmental literacy	Nominal	Functional	Operational
Characteristics	Recognizes basic terms	Broader knowledge and understanding of human-natural systems interactions	Broader, deeper scope of understanding and skills
	Provides rough definitions of environmental terms	Aware of and concerned about above interactions	Routinely evaluates the impacts and consequences of actions
	Develops awareness and sensitivity toward environment	Analyzes, synthesizes and evaluates information about environmental issues using primary and secondary sources	Advocates environmentally sound action positions after choosing among alternatives
	Respects natural systems	Evaluates problems based on evidence and personal values	Ongoing personal investment and responsibility to prevent and remediate environmental problems as an individual and collectively, at local and global scales
	Concerned for nature and impact of human systems	Communicates their findings and feelings to others	Ingrained habits
	Rudimentary knowledge of how human and natural systems interact	Motivated to make changes based on knowledge	Routinely engaged with world at large

True environmental literacy, as defined by Roth (1992), is only attained when all three stages are present and the person has moved from understanding to communication to action. The environmentally literate citizen is active: This person recognizes problems, thinks before acting, rejects short-term gains in favor of long-term benefits, alters consumer practices in favor of environmentally friendly ones, participates and initiates group action, supports appropriate organizations with time and money, and continues to read (Roth, 1992). The higher one is on the environmental literacy scale, the greater positive effect he or she has on the environment (Coyle, 2006).

Another common definition of environmental literacy is the one provided by the 1977 Tbilisi Declaration, the global framework for environmental education. The declaration defined an environmentally literate person as one who is aware and sensitive to the total environment, understands environmentally associated problems, acquires values and concerns for the environment and participates in environmental protection, acquires skills for solving environmental problems and works for the solution of environmental problems (Teksoz et al., 2011). The Tbilisi Declaration defined the components of environmental literacy that the public should achieve as: awareness, knowledge, attitudes, skills and participation (Hollweg et al., 2011).

Environmental Literacy in the United States

Environmental education has become more widespread in secondary schools and higher education institutions since the late 1970s (Coyle, 2006; Daudi, 2008; Dunlap, 2008; Venkatamaran, 2008) but only a small percentage (1-2) of American

adults are considered environmentally literate (Coyle, 2006). Furthermore, there is a distinct gap in ecological and scientific knowledge among adults in the United States. This knowledge gap, in the latest nationwide adult environmental literacy survey, is the same across the board for blue-collar workers and community leaders and high-level decision makers, regardless of age, income and education levels (Coyle, 2006). While fostering environmental literacy is arguably important for all members of society, it seems especially crucial for decision makers in high-level positions in public and private sectors whose decisions do have a significant impact on the environment (Coyle, 2006). A contributing factor to the overall lack of environmental literacy could be that as a society we chastise those who fail to grasp basic civic or historical knowledge, but the same ignorance of ecological tenets is often overlooked (King, 2000) and not considered nearly as unacceptable.

An awareness of environmental problems, an acceptance of responsibility for them, and a desire to help solve them can be viewed as basic civic duties (Rillo, 1974). In this way, environmental literacy will become increasingly important in the future. Environmental literacy may not only become a basic duty of being a functional member of society, such as voting and paying taxes, but also a survival skill: It may be necessary to navigate a world of climate change, dwindling energy resources and degraded ecosystems (Davies, 2010).

Environmental literacy is one of the major goals and outcomes of environmental education (Daudi, 2008), but education is not the only step toward literacy. True environmental literacy goes beyond awareness and understanding of terms and theories. Understanding problems is only the first step: addressing them

and working to solve them is another. Environmental literacy involves actual changes in human behavior that lead to more sustainable and eco-friendly lifestyles, and for an individual to make these changes, he or she must be able to understand and assess environmental information and put it to use in a hands-on way (Chepesiuk, 2007). However, the relationship between attitude and behavior tends to be weak: a person is not guaranteed to act on an issue just because he or she is aware its existence (Dunlap, 2008). A seminal study in 2010 gauging the environmental literacy of middle school students in the United States found that students, as with adults in previous studies, have strong verbal commitment and feelings toward environmental issues, but their actual reported behaviors are not consistent with their spoken passion (McBeth & Volk, 2010). A 2010 study of high school students in Turkey found that students scored higher on their passion toward the environment than in actual behavioral changes (Negev et al.., 2010).

The nation's overall progress on environmental literacy is not well-known because so far there has been no regular and systematic measurement of it (McBeth & Volk, 2010) and the status on environmental literacy is not yet understood (McBeth et. al, 2008). There is not yet a standardized tool to evaluate environmental literacy, but many variables have been used to study its different components, including knowledge, beliefs, opinion, values, perceptions, sensitivity and actions (Wright, 2008). The assessments of the components of environmental literacy have been standardized and have existed for a while, but the assessment of literacy as a whole and how the components are interrelated is still forthcoming (Hollweg et.al, 2011). While the need for the assessment of environmental literacy on a national

scale was identified in the early 1990s, only a handful of studies have been conducted since then (McBeth et al., 2008). These include the National Environmental Literacy Assessment Project (McBeth et al., 2008) and a 2006 study conducted with the help of funding from the Environmental Protection Agency's National Environmental Education Advisory Council (McBeth & Volk, 2010). Only one international study, the OECD report titled "Green at 15: How 15-Year-Olds Perform in Environmental Science and Geoscience in PISA" has ever been conducted (Hollweg et al., 2011). A gap in the research exists in the state of the nation's environmental literacy and its evolution over time.

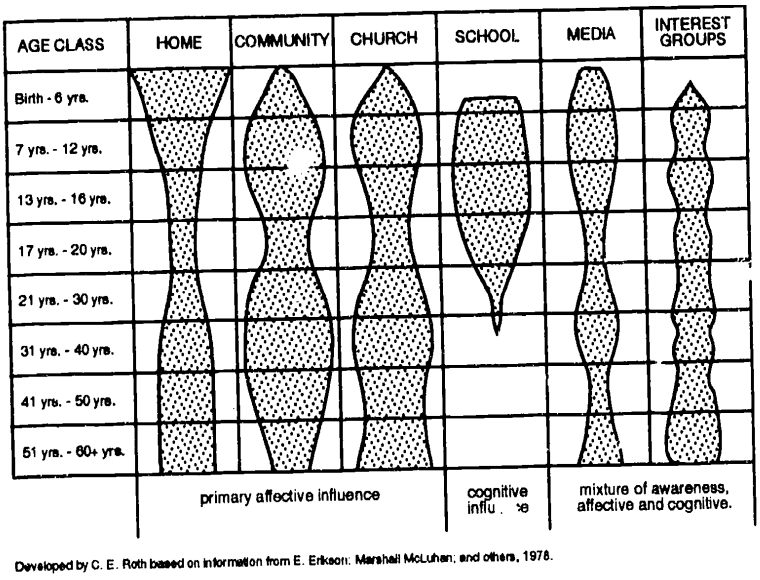
Though the relationships between aspects of environmental literacy are not yet fully understood, progress has been made on understanding how several of the components influence each other and what characteristics determine whether a person is or becomes environmentally literate. Traditionally, positive environmental behavior is viewed as a combination of knowledge and awareness. Environmental literacy components, however, are interrelated and also include attitudes and concerns for the environment. While there is not yet a model for the relationships between these components, several studies have been done as an attempt to do so. Teksoz et al. (2011) found in a study of middle school students in Turkey that high levels of environmental knowledge can inspire the other three environmental literacy components: concern, understanding and action. Attitudes also were found to have a direct effect on a person's responsibility toward caring for the environment. Therefore, one who has a more favorable attitude and personal interest in environmental issues will more likely invest more resources into it and

learn more. While previous life experiences may predispose an individual to develop pro-environmental concerns and attitudes, literacy can also be fostered in anyone by additional experiences, reflection and learning (Hollweg et al., 2011).

The type of education that can contribute to environmental literacy is accumulated over a lifetime and comes not only from school, but also the media, books, family and friends, entertainment, and many other life experiences (Coyle, 2006; Roth, 1992 [see Figure 1]). For some, this can add up to true literacy, but others accumulate scattered factual knowledge without gaining a real complex understanding of environmental issues. Only 12 percent of Americans in a nationwide Roper survey could pass a basic test comprised of questions on energy, and research has shown that many American adults think they have a higher level of ecological understanding than they really possess (Coyle, 2006). Research has also shown that even students in environmental affiliated disciplines do not have the high level of knowledge expected of secondary school graduates (Pe'er, Goldman & Yavetz, 2007).

A person's environmental knowledge is accumulated over time from a variety of sources: formal schooling, the media, personal reading, family members and friends, outdoor experiences, entertainment and more (Coyle, 2006). Figure 1 illustrates the primary affective, cognitive and behavioral influences on environmental literacy over a lifetime.

Figure 1. Influences on environmental literacy (Roth, 1992).



A seminal nationwide survey on environmental literacy conducted over a decade beginning in 1996 found that the demographic that knew the most about the environment was adults ages 38-54 (Coyle, 2006). Because this age group did not have the formal environmental education that younger generations are receiving now and were growing up during the early environmentalism movement of the 1960s and 1970s, this suggests that environmental knowledge is accumulated over a lifetime (Coyle, 2006). This finding is also in line with Roth's theory that environmental literacy is an ongoing process and takes time (Roth, 1992). However, environmental literacy can be achieved by all levels of society (Teksoz et al., 2011).

For the majority of American adults, television and newspapers are their primary sources of environmental information (Coyle, 2006). However, environmental issues are often complex and multi-faceted, and the depth of media coverage can be inadequate. The news media also tend to provide isolated facts without underlying context (Coyle, 2006), which produces a superficial rather than

deep understanding in consumers. Media can bring a community together by building its collective knowledge, but also isolate because it does not require consumers to truly participate. The word itself, *medium*, means that something stands between the consumer and the issue at hand (Wiebe, 1973). Some adults may feel the need to learn about environmental issues on their own, but it is arguable that formal environmental education could be more effective, as one is less pressured to learn and absorb information on their own without an authority figure present (Wiebe, 2001), in which environmental education has the advantage of tangible teacher-student roles. In addition, while environmental information may raise a person's level of knowledge, he or she may not feel able to do anything about the issues. Wiebe (1973) referred to this feeling of educated helplessness as "well-informed futility": the public understands problems and can articulate them, but they do not know how to solve them or what steps to take.

The public also fails to grasp many of the underlying contexts associated with environmental-themed content (Coyle, 2006). More complex issues tend to be less understood (Teksoz et al.., 2011). The major gaps in environmental knowledge do not concern understanding what basic environmental terms mean; it is primarily cause-and-effect relationships that are unclear. This deeper understanding of the interactions between human and ecological systems requires continuous education (Coyle, 2006), as environmental problems tend to be complex and draw from many disciplines.

The public also tends to perceive environmental problems as worse when they are closest to them and most threatening. Studies have found that people who

believe they are undergoing environmental risks read environmental news reports more closely and will seek out that type of coverage (Riffe & Hrach, 2009). Environmental literacy, then, too may be limited to what a person needs to know most about his or her area and nothing more. This "information sufficiency" (Griffin et al.., 2004) can limit a person to the level of information he or she needs to cope with environmental risk in his or her own daily life. A person's desire to seek information can be limited by his or her degree of confidence that they have processed enough information to reach his or her own goals (Griffin, Neuwirth, Dunwoody & Giese, 2004). Societal norms can influence how much information a person seeks: one who feels less information sufficient will seek out more knowledge, while one who feels he or she has the appropriate amount of knowledge will not seek out any more.

While the home and family provide the most education and influence people the most from the early to end stages of life, school and the media can also significantly affect a person's awareness and cognizance throughout his or her entire life. The good news is that any awareness of environmental issues is beneficial (Coyle, 2006). Favorable attitudes toward the environment can prompt a person to want to make choices to protect the environment (Teksoz et al.., 2011). Widespread awareness of issues can support and urge governmental action (Coyle, 2006). People who have an understanding of basic environmental problems such as energy and water shortages or waste disposal problems (Coyle, 2006) are up to 50 percent more likely to change their personal, simple everyday behaviors, such as conserving gas or water or recycling. Even the smallest of changes, if adopted by

many, can save billions of dollars annually and conserve resources (Coyle, 2006). Contemporary environmental literacy studies demonstrate that passion for helping the environment is high (Coyle 2006; McBeth & Volk 2010; Negev, Garb, Biller, Sagy & Tal, 2010; Teksoz et al.., 2010), so the desire is there, but the learning environment needs to be transformed to better encourage environmental literacy.

The responsibility for providing environmental education should be shared by both formal schools and learning sources outside of school. As Roth (1992) emphasized, environmental literacy takes time and must be actively sought out. One's level of any type of literacy depends on many factors: the family's prioritization of reading, language spoken at home, pedagogies at home and at school, culture and social systems (Pischetola, 2011).

The New Environmental Paradigm

It is arguable a new worldview regarding humanity's relationship to and within the natural environment began to take shape in the 1970s, and has since extended from outside the scientific community and academic circles into the mainstream. In the late 1970s, in the midst of that movement, Dunlap and Van Liere named this change in thinking the New Environmental Paradigm (NEP), which represented a shift away from full faith in progress and economic growth to a new worldview that encompasses sustainability principles such as limits to growth, a steady-state economy, balance of nature and a rejection of anthropocentrism (Dunlap & Van Liere, 1978). These concepts, which were at first limited to academia, began to spread to the general public. The United Nations Conference on Environment and Development in 1992 produced Agenda 21, a document that

called for sustainable development-focused education and public participation in decision-making (Speth & Haas, 2006). Environmentalism began to be seen as about more than just reducing air pollution, as evidenced by the many studies that measured this mass change in perception and awareness using the NEP scale, a measurement tool that Dunlap and Van Liere developed in 1978 and which Dunlap redeveloped in 2000.

In studies performed using the NEP scale, environmentalists tended to score higher on each of the survey's 12 items than the general public (Dunlap & Van Liere, 1978). In consistency with the unequal relationship between attitude and behavior previously mentioned, those who agree with the new paradigm and have adopted it may still behave in ways that do not align with it (Dunlap & Van Liere, 1978).

Environmental Education

Environmental education is an important factor in the spread of the NEP and the proliferation of societal environmental literacy, as education is an inextricable part of environmental knowledge, action, protection and improvement (Venkatamaran, 2008). It is also a way to grow environmentally literate populace (Teksoz et al., 2011), as the ultimate goal of environmental education is to promote environmental literacy in all citizens (Toddt, 1995).

Environmental education emerged in the 1960s (McBeth & Volk, 2010), but like the concept environmental literacy, it became more well-defined in the following decades, with both national and international organizations recognizing its importance and pushing for its adoption. The 1975 United Nations Conference in Belgrade, Yugoslavia defined environmental education as "a process of developing a

world population that is aware of and concerned about the local environment and its associated problems, and which has the knowledge, skill, attitudes, motivation and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones" (Daudi, 2008). The United Nations Conference on Environment and Development in 1977 produced the Tbilisi Declaration, a milestone for global environmental education that defined awareness, knowledge, attitude, skills, and participation of respondents as five tenets of environmental education with the goal of developing environmentally literate citizens. This declaration called attention to the importance of attaining environmental knowledge, and further, the importance of understanding the causes and solutions of both local and global environmental problems (Negev et al.., 2010). Signed by President Richard Nixon in 1970, The National Environmental Policy Act later gave birth to the National Environmental Education Act of 1990. In that same year, the Environmental Protection Agency created the Office of Environmental Education to develop and sustain a national environmental education strategy (Wright, 2008). The Taillores Declaration in 1990 encouraged leaders from over 320 higher education institutions in 47 countries to include environmental sustainability as a goal of higher education (Teksoz et al., 2011). The United Nations Conference on Environment and Development in 1992 in Rio de Janeiro helped accelerate education for sustainable development around the world.

On the national level, environmental education has grown immensely in the past decades (Venkatamaran, 2008). Schools from the elementary to tertiary levels are incorporating and embracing environmental education in their curricula, and

the number of environmental-themed and focused programs has blossomed, as has community support for environmental action (Venkatamaran, 2008). National Environmental Education Week, celebrated annually in April across the nation, educates millions of children (Chepesiuk, 2007). This is good news not only for environmental literacy levels: Research has shown that students who receive environmental education have higher test scores and receive quality character education, and exposure to environmental education can even contribute to children's later career successes (Coyle, 2006).

Though supported by major organizations and widespread, environmental education has not yet become an integral part of the primary, secondary or tertiary school curriculum (Wright, 2008). Unfortunately, some of what is considered environmental education in the U.S. is often environmental information that does not promote real, complex understanding of environmental issues (Coyle, 2006). Thirty-five years after the Tbilisi Declaration, environmental education is yet to become a core subject in schools. This is not due to lack of interest, however: 95 percent of American adults favor making it one (Coyle, 2006). Maryland recently became the first state to require students to achieve environmental literacy before graduating from high school (The Baynet, 2012).

In order to foster environmental literacy, environmental education must provide hands-on learning activities as well as knowledge attained in the classroom (Venkatamaran, 2008). Students who apply classroom environmental knowledge to the real world do so because they have gained ownership and empowerment throughout their education (Hungerford & Volk, 1990). This personal investment in

the learning develops into personal commitments and learned skills applied into action in the real world. A major criticism of contemporary environmental education is that it does not help students develop real-world problem solving skills (Chepesiuk, 2007). The goals and principles of environmental education have been well discussed, but now the challenge is reshaping the educational system so that institutions have the means to help students achieve those goals and become environmentally literate (King, 2000). Though the adoption rate of environmental education may have been relatively slow, the potential for change is high (Wright, 2008), so it is important to continue to pursue these goals that have been set in place over the past few decades.

Environmental Higher Education

Universities have a unique role as a curricular tool to help teach future generations the knowledge required to solve complex problems and champion sustainable development (Brylinsky & Allen-Gil, 2009). At the university level, sustainability initiatives that have been accomplished in recent years around the world are "remarkable," (Shephard, 2006). However, much of the momentum and focus so far has been on prescriptive operational fixes rather than major changes to the curriculum (Shephard, 2006; Sherman, 2008; 2011).

A problem with sustainability in higher education today is that it is too often viewed as a "should," or a list of prescribed practices on campus that should be adopted or should lead to feelings of shame if ignored (Sherman, 2011). This viewpoint has led to behavioral changes on campus, but it is not the final step, and it de-emphasizes the more complex and relationships between humans and their

effects on the environment (Sherman, 2008). Though behavioral changes are important and can have a major impact, these prescriptive fixes do not easily translate into the overall educational mission of an institution. The challenge is to transform sustainability to include not only the actions taken on campus, but also how members of a university think (Sherman, 2008).

The full educational power of sustainability as a concept lies in the way it can be used to critically examine the contemporary world, because it can supplement, enrich and strengthen other educational disciplines as well as encourage social and environmental changes on campus (Sherman, 2011). Wiggins and McTighe (2005) refer to this as "uncoverage," an educational tool based on inquiry, discovery, depth of understanding and prudent prioritization of learning material (Sherman, 2008). This “uncoverage” can strengthen all aspects of students' education, as it requires them to consider, propose, test, question, investigate, criticize, verify and substantiate big ideas as they become better problem solvers and critical thinkers. Returning to the concept of environmental literacy, this way of examining the world will be important for citizens and future leaders alike.

One reason environmental education has not infiltrated higher education is that is political, ethical, and based on values. Educators may fear they are indoctrinating students or trying too hard to change their beliefs (Shephard, 2006). Perhaps when it comes to sustainability, affective learning, which is on the emotional side and includes values, attitudes and behaviors, should be treated separately from cognitive learning, which is more related to knowledge and how that knowledge is applied (Shephard, 2006). The difference between these two

types of scholarship is the difference between what is being learned versus what one learns to value (Shephard, 2006).

A criticism of the contemporary higher educational system is that it focuses on the cognitive domain while avoiding the affective one. Because of this, students can learn and recite their subjects, but do not have to change their behaviors or attitudes (Shephard, 2006). After all, it is easier to "green" the campus than to make major changes to the curriculum (Teksoz et al., 2011). A challenge, and also an opportunity, for universities is that sustainability is an interdisciplinary concept that requires an interdisciplinary approach and collaboration (Brylinsky & Allen-Gil, 2009). The integration of campus initiatives with academics of many disciplines is essential for the success of sustainability education, and sustainability should not be viewed as a niche interest, but as a universal goal for everyone (Brylinsky & Allen-Gil, 2009).

The Need for a New Environmental Paradigm

Perhaps the influential factor that is missing in the spread of environmental education and literacy is the mass adoption of the New Environmental Paradigm that Dunlap and Van Liere first noticed in the late 1970s. As Dunlap (1978) noted, a society cannot longer survive when the dominant social paradigm (DSP) that is its foundation no longer offers valid guidance. A developing challenge to the spread of the NEP to the general public is the anti-environmental message that has taken shape in the last few years and spread by conservative elites, and the skepticism it has generated has spread to the public, contributing to a "paradigm war" between the NEP and DSP (Dunlap, 2008). According to Dunlap (2008), the DSP appears to be

weighing heavily in instance of U.S. institutional policies that do not reflect the magnitude of biodiversity loss, population growth, peak oil and climate change.

As environmental awareness and interest grows, so too does a counter-trend, a backlash against scientific evidence for threatening environmental problems, particularly climate change. While the percentage of Americans who believe there is sound evidence of global warming has risen slightly in the past two years, this number is down from what it was between 2006 and 2008. Only 28 percent of adults see it as a serious problem. The threat of climate change as perceived by the general public also seems to be divided along party lines: More than two-thirds of Democrats see it as a threat, while less than half of Republicans feel the same way (Pew Research Center, 2011). The two paradigms are at odds with each other and entrenched in conflict, but the necessary actions required by policy makers are at a standstill. For the first time in over 20 years, climate change was not mentioned in any of the presidential debates in 2012 (Zeller & Zelman, 2012). The backlash against environmental crises and scientific evidence can hurt environmental educators too: Environmental education itself is in danger of coming under scrutiny and being seen as too political (Kerkham & Comber, 2007).

An October 2012 Pew Research study found that 67 percent of Americans now believe there is solid evidence of climate change, but only 42 percent think it is mostly caused by human activity (Gerken, 2012). There is a stark contrast between the scientific community, in which 97 percent of the most prominent science academies and climate scientists agree that anthropogenic climate change is occurring, versus a little more than half of the general population that feel the same

way (Gerken, 2012). As NASA's James Hansen stated, "There's a huge gap between what is understood by the scientific community and what is known by the public" (Zelman & Gerken, 2012).

As mentioned earlier, environmental literacy's major distinction from the traditional definition of literacy is that it assumes similar beliefs about the goals of a human society and the value of nature (Coyle, 2006). Sustainability is a value-laden concept: It opens up ethical and philosophical questions about what is important and how behavior should be influenced (Sherman, 2011), and is fundamentally a moral and political question that must inevitably be addressed for a shift to be successful (Egan, Gray, Kaufman & Montrie, 2004).

The NEP, which challenges contemporary moral and political views, is an essential part of the foundation of environmental education. Environmental literacy requires a personal and global redefinition of the relationship between humans and nature (King, 2000). This paradigm shift may seem idealistic, but the progress in environmental education and the interest measured in environmental literacy studies is encouraging. Conversely, environmental literacy may help quicken the rate of the paradigm shift when learners become inspired to share their education with others.

The Kukui Cup

The Kukui Cup began at the University of Hawaii at Mānoa (UH) in 2010 as a research project of the Collaborative Software Development Laboratory (CSDL) with funding from the National Science Foundation (Kukui Cup, 2012). The goal of the project was to improve energy literacy through educational activities and

engagement through competition, and to investigate the relationships among energy literacy, sustained energy conservation, and information technology, and how they support behavioral changes (Brewer, Lee & Johnson, 2011). The competition, facilitated by an online game, was intended to be a way to use "meaningful play" to encourage sustainable behavior and improve energy literacy (Johnson et al., 2012).

The game was created by CSDL using two open-source systems: WattDepot, which analyzes, stores and displays energy data in near real-time, and Makahiki, a framework that can support a complex competition (Brewer et al., 2011). The design of the game was also influenced by Community Based Social Marketing (CBSM) processes, a group of proven effective behavioral change techniques (Johnson et al., 2012).

The aspects of the game included in Makahiki are feedback, commitments, goal setting, knowledge and incentives. The Kukui Cup creators found in their research that these aspects are all important aspects of creating sustained behavior change (Johnson et al., 2012).The game includes commitments because, as McKenzie-Mohr noted (2009), information about sustainable behavior alone does not often lead to behavioral change, but actually making commitments can encourage individuals to change their behaviors, from small to large scales (Brewer et al., 2011). Students are also able to view the progress of other dorms and can broadcast their commitments via social media. Cialdini et al. (1990) found that people's behavior is often dictated by social norms, so making commitments public can be a powerful incentive to act on them (Brewer et al., 2011).

Students were rewarded for logging into the game, engaging their friends and neighbors in the game, attending events and field trips, using social media to broadcast their accomplishments in the game, and for answering questions related to educational videos covering energy and sustainability topics. The behaviors the Kukui Cup aims to improve range from "light green" behaviors, or nominal on the environmental literacy scale, such as turning off the lights when leaving a room, to more complex behaviors, or operational on the environmental literacy scale, such as voting for candidates who support good environmental policies. The Kukui Cup primarily focuses on energy and the energy problems unique to the state of Hawaii now and in the future. However, the broader goal of the game is to support a transition toward sustainability as a whole.

The first competition took place at the Hale Aloha residence hall at UH from October 17 to November 6, 2011. Participation rate as a whole for the residence halls was 40 percent. 418 out of 1,000 students tried the game at least once. The highest energy reduction in any of the dorm lounges was 16 percent. A statistically significant improvement of $p<0.06$ was observed in knowledge about energy for students who participated in the game, while attitudes and behaviors did not significantly change throughout the course of the competition (The Kukui Cup, 2012).

The 2012 HPU Kukui Cup game was modeled after the UH competition and used the same software. Students in six residence halls on campus were given access to the online game beginning the night of September 17, 2012, until the competition closed on the night of October 8, three weeks later. The game contained three levels

of play where students can earn points for watching energy and sustainability-themed educational videos. If students could correctly answer questions relating to these short three-to-five-minute YouTube videos, they received additional points. Students also received points by making commitments, which ranged from simpler behaviors in Level 1, such as using a lamp or natural lighting instead of overhead lighting, or turning off the lights when leaving a room, to more demanding behaviors in Level 3, such as abstaining from eating meat.

The Kukui Cup is part of a trend of dorm energy competitions, which have become popular in recent years, with more than 150 competitions taking place on university campuses nationwide (Johnson et al., 2012). This "play" has been meaningful to the universities themselves, outside of their research benefits: The competitions have been found to dramatically reduce energy use on campus (median 22 percent) and save tens of thousands of dollars in energy costs (Johnson et al., 2012).

The Kukui Cup relates to all three levels of environmental literacy, as it teaches participants environmental knowledge and encourages behavior change from nominal to operational. It starts off as small as installing CFL light bulbs to becoming more politically active or taking environmental-themed classes (Johnson et al., 2012). Goals for participants are to not only increase their energy literacy, but to think critically about their own behaviors and commit to improving them in the long-term, as well as building community with others (Johnson et al., 2012).

On a larger scale, the Kukui Cup's goal is to help students understand how energy is generated and consumed so they can make better decisions in the wake of

a future energy crisis (Brewer et al., 2011). Johnson et al. (2012) argue that energy will be one of the most important energy issues of the 21st century, but it is not frequently taught and often misunderstood.

Method

Overview

This research project attempts to answer the questions: What is the level of environmental literacy of HPU students? Will participation in a three-week-long energy-saving competition influence their levels of environmental literacy and its four parts: attitudes, behaviors, knowledge and concerns?

As I learned in my literature review, there is a sufficient gap in environmental knowledge of U.S. citizens across the board. There have also been difficulties in making environmental education classes a core part of the curriculum at the university level, and in moving sustainability beyond campus operations and into the classroom. Levels of environmental information and benevolent attitudes toward the environment, even if they are high, do not necessarily translate to behavioral changes. This study aims to learn more about these relationships in the context of students living on campus in the dorms at Hawai'i Pacific University who participated in the inaugural Kukui Cup energy-saving competition.

The Kukui Cup competition was three weeks long and took place from September 17 to October 8, 2012. A survey was administered to HPU on-campus residents participating in the game. Participants were able to compete both individually and as teams with their residence halls. Six residence halls participated in the competition: Ilima, Kukui, Lehua, Lokelani, Melia, and Mokihana. Both the

survey and the competition itself were modeled after and done in collaboration with UH, where the first-ever Kukui Cup competition took place in the fall of 2011. Data collection was a mixed methods approach that included both quantitative and qualitative methods, including the survey with multiple-choice, true or false and open-ended questions and data collected from the Kukui Cup online game site.

Setting and Research Site

The Kukui Cup took place at the HPU Hawaii Loa Campus (HLC), a 135-acre site at the base of the Ko'olau Mountains near Kaneohe, Hawaii, on the lush, windward side of the island of Oahu. The dorms at HLC are home to approximately 190 students, both graduates and undergraduates who come from Hawaii, the mainland United States, and all over the world.

HPU has made a culture of campus sustainability a core goal (Hawaii Pacific University, 2012), and has been building on it for several years. Recent accomplishments include the addition of a full-time campus Sustainability Coordinator and membership in AASHE, or the Association for the Advancement of Sustainability in Higher Education (Hawaii Pacific University, 2012). Both HLC and the school's main campus in downtown Honolulu together recently earned a bronze award from the AASHE Sustainability Tracking, Assessment & Rating System (STARS), which measures an institution's sustainability related education, curriculum, research, operations, energy, transportation, waste and more (AASHE, 2012).

Sample and Participants

Surveys were administered to and filled out by 67 students at the end of the Kukui Cup Kickoff Party, held at the HLC dining commons right before the beginning of the competition on September 17. The second surveys were taken at the close of the competition on October 8. 13 students filled out the final survey. Students were awarded 10 bonus points in the game and free prizes for their participation in the first survey, which took them approximately five to 10 minutes to complete. Because the second survey was given after the competition had ended, participation was voluntary and no prizes or points were awarded, which may have contributed to the lower participation rates for the second survey. Participants in both survey rounds were self-selected and could choose to take the survey or abstain.

The survey was modeled after one devised by Philip Johnson and Robert Brewer at UH. The survey contained three parts. The first section comprised 12 statements, which students could either "agree" or "disagree" with. This section of the survey contained both value-laden statements intended to gauge a student's environmental attitudes and environmental concerns, as well as statements about behaviors, such as whether they planned to volunteer in the school garden during the semester or if they had been to a farmer's market recently.

The second section of the survey contained eight multiple choice questions, with five choices each: a) Always, b) Quite frequently, c) Sometimes, d) Not very often, and e) Never or hardly ever. These eight questions related to pro-environmental behaviors only and included actions such as turning off lights, recycling, and using reusable shopping bags. This section was included in the environmental literacy survey because research has shown that even small amounts

of environmental education can help to encourage "simple" behavior changes such as recycling as turning off the lights (Coyle, 2006). Students were encouraged to be honest, as there was no "right" or "wrong" answer.

The third section of the survey included 10 multiple-choice questions intended to gauge students' levels of environmental factual knowledge. The questions specifically addressed environmental issues unique to the state of Hawaii. The answers in this section would be covered in the educational tutorials in the Kukui Cup game, so this section was also included to help determine whether students improved their environmental knowledge during the course of the competition. Students were directed to rely on their current knowledge only for this section and were instructed to avoid consulting books, computers or cellular phones.

In addition to the three-section survey adopted from Johnson and Brewer, we also included one last open-ended question: "What is the first thought that comes to mind when you see or hear the word sustainability"? This section was included to determine how sustainability as a concept has infiltrated the university. I found in my research that for many higher institutions, sustainability has not yet become a core, interdisciplinary concept, but is often seen as an action term only that relates to operational changes such as recycling or conserving energy.

The word association exercise was modeled after one conducted by Daniel Sherman at the University of Puget Sound. Sherman's research was conducted with both faculty and undergraduates who were asked to do word association with the word "sustainability." The studies found that nearly 90 percent of both faculty and

students associated sustainability with a prescribed practice, also known as a "light green" action, such as recycling, and only the remaining 10 percent associated it with "big" or more complex ideas like systems thinking or conservation (Sherman, 2011). A study of students in eight environmental studies classes at the same university found that five percent related sustainability to an environmental problem like global warming or biodiversity loss, and only five percent included "big ideas" such as environment, future generations or balance (Sherman, 2008). Of faculty surveyed, 86 percent associated with sustainability with recycling or other prescribed practices, and eight percent related it to the larger ideas. In general, most answers reflected "shoulds" or environmentally friendly practices (Sherman, 2008). This final question was included in our survey as an attempt to gauge how the concept of sustainability is reaching students on campus at HPU.

Students were asked to give their names their answers could be correlated with their participation rates and points earned in the online game. In addition to their names and survey answers, students were asked their ages, classes and their home states or countries, to see if any correlations were found to their answers. Hines et al. (1986) found that educational levels could also have a direct relationship with behavior. Participants ranged in age from 17 to 25 and from freshmen to graduate students. Students from 19 states and six countries filled out the survey.

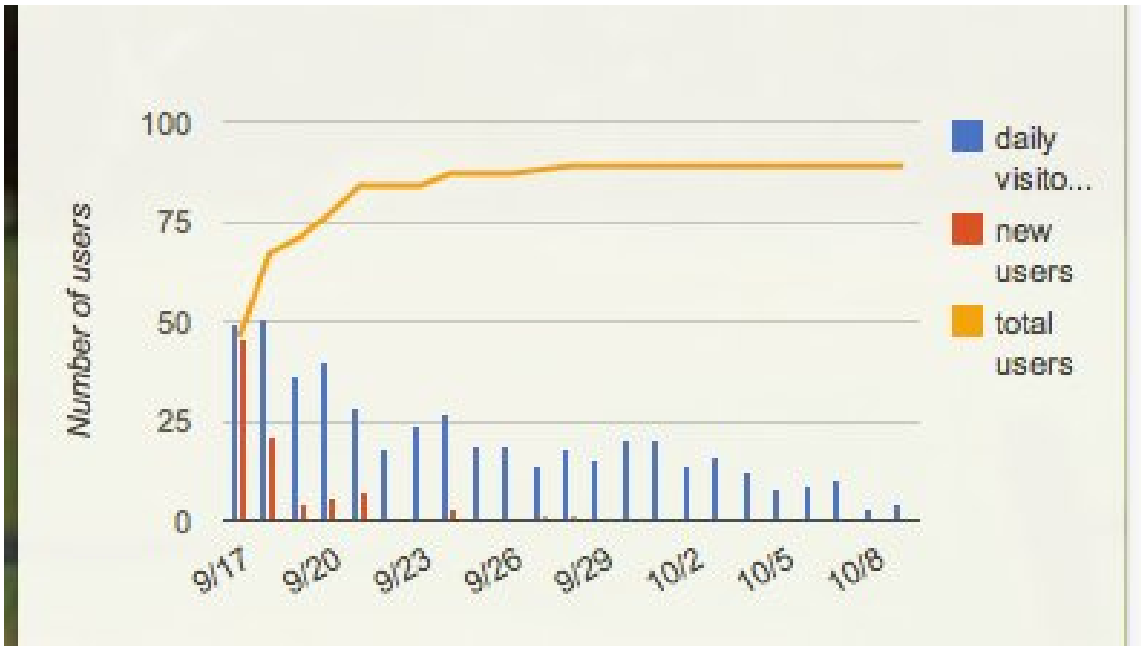
Results

Kukui Cup Results

Participation

A total of 89 students played the Kukui Cup game, meaning that approximately 48.6 percent of the 190 total potential participants in the residence halls logged in to the game at least once. Participation rates were high at the beginning of the Kukui Cup, then dropped dramatically several days into the first week. The number of daily visitors to the site peaked at 50 on the third day of the competition, and fell to below 10 on the final day. There were no new users after September 25, eight days into the competition. The game was designed so participants could enter as late as the third week without being at a disadvantage, but no new participants played in the third week. These trends are illustrated in the graph below.

Figure 2. Kukui Cup game players.



There were dramatically different participation rates between the six residence halls. Lokelani had the highest participation at 100 percent, while Melia,

on the low end, had only 8 percent participation. Mokihana had 64 percent participation, Lehua 25 percent, and Ilima and Kukui 9 percent, respectively.

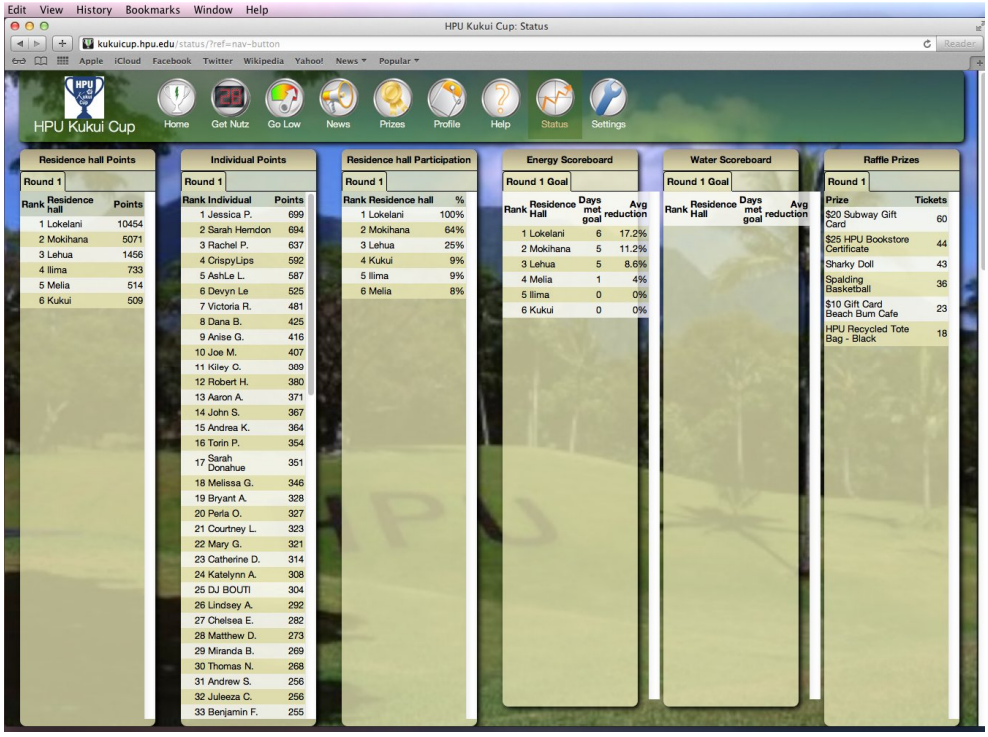
Energy

Participation rates by residence hall correlated with the amount of energy saved throughout the competition. Lokelani and Mokihana, the halls with the highest participation, also used by far saw the highest reductions in energy. Lokelani also had the highest number of points of any of the residence halls at the end of the competition, earning 10,454 points. Lokelani met its energy goals on 14 days during the competition, with an average reduction in energy use of 11.3 percent. Mokihana met its goals on 9 days, with an average of 7.4 percent reduction in energy use. Lehua met its goals on 10 days, with a 5.8 percent average reduction. Kukui met its goals on 3 days with an average of 4 percent reduction. Melia met its goals on two days, and reduced its energy usage by an average of 2.5 percent. Ilima met its goals on 1 day, but did not significantly reduce its use of energy.

Table 2. Individual dorm results.

Dorm	Participation rate	Energy saved	Days goals met
Lokelani	100	11.3	14
Mokihana	64	7.4	9
Lehua	25	5.8	10
Ilima	9	0	1
Kukui	9	4	3
Melia	8	2.5	2

Figure 3. Individual and dorm results.



Commitments

The most popular of the volunteer commitments in the Kukui Cup game were turning off the lights, using sunlight instead of electrical lighting, and only washing full loads of laundry. The least popular commitments were abstaining from eating meat, taking the stairs, pulling the plug and turning off the sink. Figure 4 shows the commitments in order of most to least popular.

Figure 4. Kukui Cup game commitments.

Popular Commitment		
commitment	Submts	Cmpltd
Turn off lights	73	72
Use sunlight	72	69
Full load laundry	72	70
Task lighting	69	68
Reusable bag	65	64
Recycle cans	27	24
Limit TV	16	8
Use stairs	16	7
Pull the plug	16	8
Turn off sink	14	7
Go meatless	14	8
Turn Off Music	0	0
Walk < 1 mi	0	0
Car pool	0	0
Off b4 bed	0	0
Cold laundry	0	0
Shorter showers	0	0
Take bus	0	0
Turn off	0	0

Survey Responses

67 students took the first survey, and 13 students took the second survey. Participants ranged from ages 18 to 25, with the average age being 18.7. The students surveyed were from 19 U.S. states and six countries. It is unclear why participation rates were lower at the end of the competition, but responses mirrored a similar trend with participation in the game. Participation was high in the first few days: it peaked at 50 on the third day, and dropped dramatically after that, to only 10 daily users at the end of the game. There are two other plausible reasons why participation in the second survey was much lower. Surveys were passed out during dinnertime in the dining commons on a Monday evening, but there were more students in the dining hall, where the survey was taken, on the day the first survey was passed out because it was also the day of the kick-off party for the competition, while the day the second survey was distributed was a normal day

and not a special event. Students who participated in the first round of surveys also had the opportunity to win prizes, including T-shirts, coffee mugs and candy. There were no prizes given out for participation in the second survey, which could have hampered the effort to garner more responses.

Survey Results

The survey was divided into three sections. Table 3 shows how the points were distributed to each section, based on the number of questions in each.

Table 3. Survey point distribution.

Environmental attitudes and concerns	Environmental behaviors	Environmental Knowledge
40%	26.7%	33.3%

Survey #1

In Section 1 of the survey, the agree-or-disagree section, which measured commitments, concerns, behavior and attitudes, participants scored an average of 88 percent. 22 students earned a "perfect" score on all 12 questions of this subjective section, and this number was also the mode. The questions that were answered correctly most often were questions 1, 7 and 10: 98.5 percent of students answered these questions correctly. Question 1 stated: "It is important for Hawaiian residents to conserve more energy." Question 7 stated: "I would do more to save energy if I knew how." Question 10 stated: "I would try to lower my electrical use if HPU were to offer an electricity rebate on the decreased cost of electricity."

In Section 2, the first of the two multiple choice sections, which measured behaviors, attitudes and concerns by asking how frequently students acted and felt

in pro-environment ways, students answered the questions with "always" 54.85 percent of the time. "Always" was the most popular answer in this section; second was "quite frequently," which was chosen 19.6 percent of the time. 2.4 percent of the answers were "never or hardly ever." 4.5 percent of students earned a "perfect" score on this section and answered every question with "always." The questions answered with "always" most often were questions 7 and 8. Question 8 asked how often students took showers instead of baths. 86.6 percent of students answered "always." Question 8 asked how often students washed only full loads of laundry. 77.6 percent of students replied to this statement with "always."

In Section 3, the second multiple choice section of the survey which measured factual knowledge of local and global environmental issues, students answered the questions correctly 45.5 percent of the time. The questions that were correctly the most often were questions 8, 9 and 10, at 67.2, 74.6 and 65.7 percent, respectively. These questions dealt with the greenhouse effect, greenhouse gases, and the cause and effects of climate change. The questions that were most often answered incorrectly were questions 1 and 3, at 23.9 percent. These questions both concerned energy in Hawaii: Question 1 concerned the Hawaii Clean Energy Initiative mandates. Question 2 asked how Hawaii ranks in electricity costs is in comparison to the rest of the country.

Survey #2

In Section 1, the average score was 83 percent, five points lower than in the first survey. Only 12 percent of participants earned a "perfect" score on this section, down from 32 percent. The mode was a tie between 9 and 11 questions answered

correctly, at 30.7 percent. 100 percent of participants agreed that they wanted to save more energy, that climate change is real, and that they would do more to conserve energy if they knew how. Only 61.5 percent of students agreed they would volunteer at the school garden on campus, and this was the question that was answered "correctly" least often.

In the first multiple-choice section, "always" was selected 60.6 percent of the time. "Not very often" and "Never or hardly ever" were chosen least often, at 2.9 percent each. 23.1 percent of students earned a "perfect" score on this section by answering all eight questions with "always." The question that was answered with "always" most often was question 7, at 100 percent. This question asked how often participants washed only full loads of laundry. Questions 2 and 8 were answered correctly 84.6 percent of the time. Question 2 asked how often participants turned off lights when leaving a room, and Question 8 asked how often participants took showers instead of baths. Interestingly, these answers also coincided with the most popular commitments in the Kukui Cup game.

In the knowledge-based multiple-choice section, the average score was 43.8 percent, down slightly less than two percentage points from the first round. Like the first round, the questions correctly often were questions 8, 9, and 10, at 53.8, 61.5 and 53.8 percent. However, unlike the first survey, the question answered correctly most often was question 4, with 69 percent of students choosing the right answer. Question 4 asked for the unit in which electrical power is measured. The questions that students did not perform well on average concerned more complex

energy issues and water use. No one received a perfect score on this section in either round of the survey.

Comparison of Surveys

Due to a lower participation rate in the second round, only seven students who took the first survey also took the second. Of these seven students, two improved their scores. One participant's score improved by 3.33 percent and another by 10 percent. Two students' scores were unchanged. The other two students scored worse on the second round, by 3.33 and 6.67 percent.

There was not a significant improvement in the knowledge multiple-choice section or the agree/disagree section. Surprisingly, there were instances of students performing worse on the second round than they did on the first in all sections. There were a few improvements in self-reported behaviors, such as moving from "sometimes" to "quite frequently" or "quite frequently" to "always."

On both surveys, students scored overwhelmingly better on the agree/disagree section than the knowledge or behavior sections, supporting previous research that showed individuals' environmental attitudes and concerns were high even if their levels of knowledge and related behaviors were not (Coyle, 2006; McBeth & Volk 2010; Negev et al.., 2010; Teksoz et al.., 2011). Table 4 below conveys the mean scores for both surveys by section.

Table 4. Mean survey scores by section.

	Section 1	Section 2	Section 3
Survey 1	88%	54.85%	45.5%
Survey 2	83%	60.6%	43.8%

Overall Results

The mean scores were 65.1 percent for the first survey and 64.6 percent for the second. The scores did not rise after the competition as expected, but instead went down, though by a small margin at less than one percent (0.7). The total mean score for both rounds was 65 percent. The student with the highest score on either of the surveys answered 27 questions correct for a total score of 90 percent.

In comparison to the first Kukui Cup at UH, HPU students fared slightly better in some aspects of the competition and worse in others. At HPU, 89 out of 190 residents played the game at least once, for a participation rate of 46.8 percent, compared to 40 percent at UH. The average energy reduction in the dorm lounges was 16 percent at UH, while the highest reduction observed at HPU was 11.3 percent. A slight change in knowledge was observed in the UH competition, while attitudes and behaviors did not significantly change. In the HPU competition, there were no significant changes in environmental literacy observed by the results from our survey.

Word Association

The open-ended question at the end of the survey, in which participants were asked what first came to mind when they thought of the word "sustainability," yielded mixed results. The response rate for this question was lower than other sections of the survey in both rounds. In the first round, 80.6 percent of participants answered the question, while the remainder left it blank. In the second round, only 61.5 percent of participants answered the question.

In the first round, almost half of participants associated with "sustainability" with answer's similar to Sherman's (2008; 2011) "big ideas." The remainder of the answers related to saving energy or recycling, what are commonly referred to as "light green" actions, as well as renewable resources. The "big ideas" included more complex sustainability concepts, such as conservation, maintenance, environmental impact, future generations, and long-term processes. The number of students who responded to the question with more complex ideas about humans and their relationship with the environment and future was higher than expected, at 38.3 percent. Almost 10 percent of answers related to recycling. Answers ranged from "climate" to "hippies" to "light bulb," and the majority mentioned either the words "green," "resources," "environment," "recycle," or "energy."

Like the other sections of the survey, the second round did not show much of an improvement in word association to larger ideas that might illustrate an increase in environmental literacy. However, all answers in this round did relate to sustainability and mentioned either renewable resources, efficient energy usage, or "reduce, reuse, recycle." The similarity of the answers in the second round may have been because there were fewer respondents and more students left this question blank than in the first round. The responses are indicated below in Figure 7, a word cloud made from the results. The size of the individual words corresponds to how often they were mentioned by respondents.

Figure 7.
Word cloud made from word association results.

Conclusion

Limitations

There are several factors that may have affected the response rates of the survey as well as participation in the competition itself. There may have also been variables that affected survey answers that can be addressed in future Kukui Cup competitions.

One factor is the age and lifestyle of participants. The average age of participants was 18.7; an overwhelming majority was out-of-state or international freshmen who were far from home. The competition began on September 17, only two weeks after the semester commenced. Students may have been still adjusting to a new semester, life in the dorms, and for some, the college experience as a whole. Students were also most likely loaded with school assignments, which may have been first priority over spending time on the Kukui Cup site. Initial momentum and

participation was high when the game kicked off, but fell after several days, which may have been partly due to other school and life priorities taking precedence.

Both rounds of surveys were filled out in the dining commons during the dinner hour, which is a social time for students. Participants may have been preoccupied with their meals and engaging with each other and may have not given the full attention to the survey that they might have in another setting. In the first round, there was a rush to get a limited number of prizes. In the second round, when no prizes were given, there seemed to be much less enthusiasm to participate as there was the first time. Several students mentioned they had taken the survey before and did not need to take it again. It was explained that the point of the survey was to compare before and after results from the Kukui Cup, but students seemed to feel that they had been through the process before and were not as eager to do it again.

The length of the competition could also have been a limitation to participation and better survey results in two ways. The first argument is that the competition was not nearly long enough to encourage any significant changes in behaviors or environmental literacy, both of which develop over the long term. Brewer and Johnson (2012) discovered this in the inaugural 2011 Kukui Cup, and this was part of the impetus for extending the length of the competition at UH Manoa so that changes could be more adequately monitored. Conversely, it can be argued that the competition was too long, which may explain the sharp drop-off in participation. Students may have tired of the game after the first few days or lost interest because of its length.

The sample size of the second round of the survey could have skewed data, which may explain in part why there was not a significant change in environmental literacy recorded at the close of the competition. A larger sample size in future surveys would be useful to compare results.

Value of Research

This study can be valuable for HPU to use if the Kukui Cup becomes an annual tradition on campus. The tools and dataset can also be beneficial for the university's assessment of sustainability on campus and to compare how participation in the competition may change over time.

A study with a larger sample size should be performed at the next opportunity. The study could also be conducted weeks or months after participation in the Kukui Cup to see if changes in environmental literacy appear more strongly over time. Environmental literacy is a powerful skill and mode of thinking that can benefit university students in many aspects of their lives and education. However, it is a skill that must be cultivated over time and comes from many sources, not just the classroom. Further research will be necessary to confirm the state of environmental literacy on campus at HPU, how it is changing over time, and how on-campus events and competitions like the Kukui Cup can influence changes in environmental knowledge, attitudes, behaviors and concerns. Future studies could also ask for students' majors as an attempt to see if there is any correlation between fields of study and environmental literacy in HPU students. Future research could also focus on participation in the game and why some dorms had higher participation and energy-saving rates than others, and whether higher and more

frequent participation in the game contributes to any changes in environmental literacy.

Conclusion

Similar to prior studies, our survey did not measure high levels of environmental literacy. However, as previously mentioned and as discerned from the high mean scores in the first section on both surveys, levels of environmental concern and attitudes are high. Students scored higher, at an average of 85.5 percent, on the agree/disagree section of the survey. The average scores on the knowledge and behavior sections were much lower. This data can support the conjecture that pro-environmental attitudes do not necessarily determine or correlate with behavior and knowledge related to environmental issues. Similar to other environmental literacy surveys, such as the National Environmental Literacy Assessment Project (McBeth et. al, 2008), the survey's knowledge section produced the lowest scores. As Hollweg et al. (2011) point out, however, this is to be expected: adults and young people alike cannot be fairly assumed to exhibit the full breadth and depth of environmental problems and issues and the interactions between human and natural systems. However, the rate at which students expressed concern in environmental issues and a want to change their habits and learn more is encouraging and could be the beginning of a paradigm change on campus at HPU that recognizes environmental problems, values and critiques the human-nature relationship, and encourages students to actively seek solutions in their community and world. The data gained by this study could be used as a baseline to measure

environmental literacy in HPU students in the future and see how it has changed over time.

References

Association for the Advancement of Sustainability in Higher Education. (2012). Hawaii Pacific University. Retrieved online from https://stars.aashe.org/institutions/hawaii-pacific-university-hi/report/2012-10-02/.

Brewer, S., Lee, G. & Johnson, P. (2011). The Kukui Cup: A dorm energy competition focused on sustainable behavior change and energy literacy. Retrieved online from http://csdl.ics.hawaii.edu/techreports/10-07/10-07.pdf.

Brylinksy, S. and Allen-Gill, S. (2009). Learning by doing: The university as a curricular tool for sustainability and environmental security. Springer Science and Business Media, 99-113.

Bybee, R. (1979). Science education for an ecological society. *American Biology Teacher 41*, 154-163.

Chepesiuk, R. (2007). Environmental literacy: Knowledge for a healthier public. *Environmental Health Perspectives 115*:10, 494-499.

Coyle, K. (2006). Environmental literacy in America. The National Environmental Education and Training Foundation. Retrieved online from www.neefusa.org/pdf/ELR2005.pdf.

Daudi, S.S. (2008). Environmental literacy: A system of best-fit for promoting environmental awareness in low literate communities. *Applied Environmental Education and Communication 7*:76-82.

Darby, S. (2006). The effectiveness of feedback on energy consumption (Tech. Rep.). Environmental Change Institute, University of Oxford.

Davies, K. (2010). Sustainable minds. *Alternatives Journal 36*:5, 8-11.

Dunlap, R. (2008). The New Environmental Paradigm: From marginality to worldwide use. *The Journal of Environmental Education 40*:1, 3-18.

Dunlap, R. & Van Liere, K.D. (1978). The 'New Environmental Paradigm.' *The Journal of Environmental Education 40*:1, 19-28.

Egan, D., Gray, V., Kaufman, w. & Montrie, C. (2004). Education for sustainable development: The role of the humanities and social sciences. *University Leaders for a Sustainable Future Publications: The Declaration* 7:1, 1-12. Retrieved online from www.ulsf.org/pub_Declaration_curvol71.htm.

Gerken, J. (2012, October 16). Pew Climate Change Poll reveals that less than half of Americans make anthropogenic connection. *The Huffington Post.* Retrieved

online from http://www.huffingtonpost.com/2012/10/16/pew-climate-change-poll_n_1970324.html#slide=1147367.

Griffin, R.J., Neuwirth, K., Dunwoody, S. & Giese, J. (2004). Information sufficiency and risk communication. *Media Psychology 6*, 23-61.

Hawai'i Pacific University. (2012). Sustainability at HPU. Retrieved online from http://www.hpu.edu/sustainability.

Hines, J., Hungerford, H., & Tomera, A. (1986/87). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *The Journal of Environmental Education 18*:2, 1-8.

Hollweg, K.S., Taylor, J.R., Bybee, R.W., Marcinkowski, T.J., McBeth, W.C. & Zoido, P. (2011). Developing a framework for assessing environmental literacy. North American Association for Environmental Education. Retrieved online from www.naeee.net.

Hungerford, H.R. & Volk, T.R. (1990). Changing learner behavior through environmental education. *Journal of Environmental Education 21*:3,: 8-21.

International Communication Association. n.d. Reducing hostile media perceptions. International Communication Association Conference Papers.

Johnson, P.M., Xu, Y., Brewer, R.S., Lee, G.E., Katchuck, . & Moore, C.A. (2012). Beyond kWh: Myths and fixes for energy competition game design. Retrieved online from http://csdl.ics.hawaii.edu/techreports/12-08/12-08.pdf.

King, R. (2000). Defining literacy in a time of environmental crisis. *Journal of Social Philosophy 31*:1, 68-81.

McBeth, B., Hungerford, H., Marcinkowski, T., Volk, T. & Meyers, R. (2008). National Environmental Literacy Assessment Project: Year 1, national baseline study of middle grade students final research report. Retrieved online from http://www.epa.gov/education/pdf/MASTERNELA_Year1_Report_081208.pdf.

McBeth, W. & Volk, T. (2010). The National Environmental Literacy Project: A baseline study of middle grade students in the United States. *The Journal of Environmental Education 41*(1), 55-67.

Merriam-Webster. (2012). Literacy. Retrieved online from www.i-word.com/dictionary/literacy.

Negev, M., Garb, Y., Biller, R., Sagy, G. & Tal, A. (2010). Environmental problems, causes, and solutions: An open question. *The Journal of Environmental Education 41*(2), 101-115.

Pew Research Center for the People and Press. (2009). Press accuracy rating hits two decade low: Public evaluations of the news media 1985-2009. Retrieved online from http://people-press.org/report/543.

Pew Research Center for the People and Press. (2011). Modest rise in number saying there is 'solid evidence' of global warming: more moderate republicans see evidence of warming. Retrieved online from http://www.people-press.org/2011/12/01/modest-rise-in-number-saying-there-is-solid-evidence-of-global-warming/?src=prc-headline.

Pe'er, S., Goldman, D., and Yavetz, B. (2007). Environmental literacy in teacher training: Attitudes, knowledge and environmental behavior of beginning students. *Reports & Research 39*:1, 45-59.

Pischetola, M. (2011). Digital media and learning evolution: A research on sustainable local empowerment. *Global Media Journal 11*:18, 1-11.

Riffe, D. & Hrach, T. (2009). *Newspaper Research Journal 30*:3, 8-25.

Roth, C.E. (1992). Environmental literacy: Its roots, evolution and directions in the 1990s. Columbus, OH: Clearinghouse for Science, Mathematics and Environmental Education.

Shephard, K. (2006). Higher education for sustainability: Seeking affective learning outcomes. *International Journal of Sustainability in Higher Education 9*:1, 87-98.

Sherman, D. J. (2008). Sustainability: What's the big idea*? Sustainability 1*:3, 188- 195.

Sherman, D.J. (2011, January 10). Sustainability in the curriculum. AASHE Newsletter.

Speth, J.G. & Haas, P.M. (2006). *Global environmental governance*. Washington: Island Press.

Teksoz, G., Sahin, E. & Tekkaya-Ostekin, C. (2011). Modeling environmental literacy of university students. *Journal of Science*, *Education and Technology 21*, 157-166.

The Baynet.com. (2011, June 21). MD becomes first state to require environmental literacy. Retrieved online from www.thebaynet.com.

The Kukui Cup. (2012, September 20). Retrieved online from http://www.kukuicup.org/vision.

Trochim, W. K. (2006). Types of Surveys. Research Methods Knowledge Base. Retrieved online from http://www.socialresearchmethods.net/kb/survtype.php.

Wiebe, G.D. (2001). Two psychological factors in media audience behavior. *Journalism Quarterly 50*, 426-432.

Wright, M.J. (2008). Web-based versus in-class: An exploration of how instructional methods influence postsecondary students' environmental literacy. *Reports & Research 39*:2, 33-45.

Venkatamaran, B. (2008). Why environmental education? *Environment Magazine 50*:5, 8-10.

Zeller, T. & Zelman, J. (2012, October 23). Climate change not mentioned in presidential debates for first time in a generation. *The Huffington Post*. Retrieved online from http://www.huffingtonpost.com/2012/10/23/climate-change-presidential-debate_n_2004067.html.

Zelman, J. & Gerken, J. (2012, September 19). Arctic sea ice levels hit record low, scientists say we're 'running out of time.' *The Huffington Post*. Retrieved

online from http://www.huffingtonpost.com/2012/09/19/arctic-sea-ice-loss-record-low_n_1897602.html.

Appendix

Kukui Cup Survey

Please fill out the survey as thoroughly as possible and answer the questions below. All answers will be confidential. Thank you for your time and cooperation.

Name: _____ Class (freshman, junior, etc.): _____
Home state/country: _____ Age: _____

Please indicate if you *agree* or *disagree* with each of the following statements by checking your preferred box. There are no right or wrong answers.

	Agree	Disagree
1. It is important for Hawaiian residents to conserve more energy.		
2. Students don't need to worry about their electrical use in the residence halls, because the university pays for the electricity.		
3. Hawaii should produce more electricity from renewable resources.		
4. The way I personally use energy does not really make a difference in the big picture.		
5. Laws protecting the natural environment should be made less strict in order to allow more energy to be produced.		
6. Climate change is real.		
7. I would do more to save energy if I knew how.		
8. I have been to a farmer's market this year.		
9. I plan on volunteering at the Hawaii Loa Campus garden sometime this semester.		
10. I would try to lower my electrical use if HPU were to offer an electricity rebate on the decreased cost of electricity.		
11. If HPU used recycling money for resident activities such as pizza parties, I would recycle more often.		
12. I would be willing to pay a $5 sustainability fee on my tuition if it were used to create internships and other possibilities for HPU students.		

Please select the choice that best describes your behavior. Please be honest, as there are no right or wrong answers.

1. I use public transportation.
   a. Always
   b. Quite frequently
   c. Sometimes
   d. Not very often
   e. Never or hardly ever

2. I turn off the lights when I leave a room.
   a. Always
   b. Quite frequently
   c. Sometimes
   d. Not very often
   e. Never or hardly ever

3. I bring reusable bags when shopping.
   a. Always
   b. Quite frequently
   c. Sometimes
   d. Not very often
   e. Never or hardly ever

4. I use sunlight rather than electric lighting whenever possible.
   a. Always
   b. Quite frequently
   c. Sometimes
   d. Not very often
   e. Never or hardly ever

5. I recycle my cans and bottles.
   a. Always
   b. Quite frequently
   c. Sometimes
   d. Not very often
   e. Never or hardly ever

6. I buy locally produced food whenever possible.
   a. Always
   b. Quite frequently
   c. Sometimes
   d. Not very often
   e. Never or hardly ever
7. I wash only full loads of laundry.

a. Always
b. Quite frequently
c. Sometimes
d. Not very often
e. Never or hardly ever

8. I take showers instead of baths.
a. Always
b. Quite frequently
c. Sometimes
d. Not very often
e. Never or hardly ever

Please answer the following questions to the best of your ability without consulting any books or the Internet. We are interested in what you know right now.

1. Hawaii Clean Energy Initiative mandates that by 2030 Hawaii's energy production must be:
a. 30% from renewable sources, 20% from conservation, 10% from natural gas.
b. 50% from renewable sources, 10% from conservation.
c. 30% from energy conservation, 40% from renewable sources.
d. 30% from solar, 30% from wind, 10% from waves

2. Which of these daily routines averages the most water per person, per day?
a. Bathing.
b. Flushing the toilet.
c. Running the washing machine.
d. Running the dishwasher.

3. Where does Hawaii rank in cost of electricity in comparison to the rest of the United States? (With 1 being the highest in the nation and 50 being the lowest in the nation.)
a. 1
b. 3
c. 5
d. 10

4. Electrical power is commonly measured in units of:
a. joule (J)
b. volts (V)
c. watts (W)
d. watt-hours (Wh)

5. What is the approximate maximum power generated from a single standard rooftop solar panel?
   a. 25 W
   b. 200 W
   c. 800 W
   d.10 kW

6. On average, how much electricity does a home in Hawaii use per day?
   a. 4 kWh
   b. 20 kWh
   c. 87 kWh
   d. 328 kWh

7. What is currently the primary source of Hawaii's electricity?
   a. solar
   b. wind
   c. coal
   d. oil

8. What is the greenhouse effect?
   a. The natural rise and fall of global surface temperatures.
   b. When certain gases in the atmosphere trap heat that would otherwise escape to space, thereby warming the planet.
   c. Increased warming at the Earth's surface due to more ultraviolet radiation passing through the depleted ozone layer.
   d. There is no such thing as the greenhouse effect.

9. What greenhouse gas accounts for approximately three-quarters of the warming impact of the current human greenhouse-gas emissions.
   a. Carbon dioxide (CO2)
   b. Sulfur dioxide (SO2)
   c. Hydrogen dioxide (H2O2)
   d. Carbon monoxide (CO)

10. What are the expected long-term effects of current climate changes?
   a. Increasing sea water acidity.
   b. Global temperatures increasing by a few degrees on average.
   c. Changes in seasonal rainfall patterns (droughts, floods).
   d. All of the above.

Open-ended question:

11. What is the first thought that comes to mind when you see or hear the word 'sustainability'?

Thank You!

Figure 6. Individual and residence hall competition results.