
Lights Off. Game On. The Kukui Cup: A Dorm Energy Competition

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Abstract

Our research seeks to investigate the relationships among energy literacy, sustained energy conservation, and information technology support of behavior change through an advanced dorm energy competition to take place in fall 2011. Game design techniques are used to attract competition participants, keep them engaged, and have a lasting impact in their energy use behavior through retained knowledge of energy obtained via the game environment.

Keywords

Sustainability, Energy, Behavior Change, Games, Gamification

ACM Classification Keywords

K.4.m [Computers and Society]: Miscellaneous, K.8.0 [Personal Computing]: General — Games

General Terms

Human Factors, Experimentation, Measurement

Introduction

The world is in the grip of an energy crisis. Fossil fuel consumption severely impacts our environment. One way fossil fuel use can be decreased is by decreasing the total amount of energy consumed. Changing people's behavior with respect to energy offers significant promise in reducing energy use. Darby's survey of energy consumption research finds that identical homes could differ in energy use by a factor of two or more [2]. Our research investigates how best to foster sustained positive energy use behaviors through information technology.

Changing people's behavior is difficult, and to achieve meaningful energy conservation, behavior changes must be sustained. Two strategies that have proven effective are providing direct feedback on energy usage through real-time displays [2], and a toolbox of techniques such as making public commitments and setting goals [6]. Another strategy we hypothesize will

help change behavior (when combined with the previous two strategies) is increased *energy literacy* (knowledge, attitudes, and behaviors with respect to energy). We have devised a research program to investigate the effectiveness of these strategies, which we call the Kukui Cup.

The Kukui Cup

The Kukui Cup is a three-year series of dorm energy competitions to be held on the University of Hawai`i at Mānoa campus (and later in more general residential settings). The competitions are named after the kukui nut, or candlenut, which was burned as an early source of energy by Native Hawaiians. A more complete description of the design and motivation of the competition can be found in [1]. The competition will take place over a three-week period, structured as two individual rounds and one final overall round. Prizes will be awarded to the winners of each round of the competition, and to overall competition winners. Two parallel competitions will take place: an energy reduction competition and a Kukui Nut points competition.

Energy reduction competition

In this competition, each dorm floor competes to use the least amount of electricity (measured in kWh). For reasons of infrastructure, privacy, and cost, energy can only be monitored at the floor level.

Kukui Nut points competition

In this competition, each participant performs activities described on the competition website. The activities include watching a short educational video on energy, attending an energy-themed event, performing an energy-related action such as switching an

incandescent light bulb with a CFL bulb, or making a public commitment to some energy-positive behavior. Each activity is worth a certain number of points based on complexity and the effort required to complete. To receive points, participants must verify their completion of the activity on the website with such actions as answering a question or submitting a digital photo. Points are earned by individuals, but can also be aggregated at the floor or dorm level.

The competition brings together activities in the actual world, such as turning off lights when leaving a room, and virtual activities mediated by the competition website. Conserving energy requires participants to take action in the actual world, but energy use is largely invisible so the competition website must be consulted for near-realtime energy usage data and floor standings. The actual world activities of the point competition are described and verified using the virtual world of the website.

We will collect a wide variety of data during the competition including: fine-grained energy usage (before, during, and after the competition), assessments of energy literacy (before and after the competition), and detailed logs of the competition website.

The inaugural Kukui Cup is scheduled to take place in October 2011, in 3 residence halls with approximately 780 first-year students in total.

Challenges

Both actual and virtual aspects of the competition face unusual challenges. Most energy conservation campaigns operate in contexts where the participants

have some feedback on their energy usage, and they have a financial incentive to reduce their energy usage in the form of a utility bill. University dormitory residents typically have no information about how much energy they consume, and usually pay a fixed rate regardless of how much energy they use. Our use of a point competition to increase energy literacy also provides motivation for participants in the absence of standard educational motivations, such as grades and class credit.

Since participation in the Kukui Cup is optional, the biggest risk to the success of the research is failure of the residents to participate. For this reason, much of our current work is focused on making the competition and website as exciting and engaging as possible.

Gamification

One of the main ways we hope to ensure engagement is by making the competition as game-like as possible. Obviously, as a two-sided competition with points and prizes, the overall structure of the Kukui Cup is a type of game, combining both actual and virtual world participation. However, based on discussion with other researchers who have run dorm energy competitions, this may not be enough to keep participants engaged and make them frequent visitors of the website.

The Kukui Cup follows in the footsteps of McGonigal's pioneering efforts to develop games such as "World without Oil" and "EVOKE" that address social and environmental problems [5]. In the Kukui Cup, we are attempting to avoid the mere creation of a "virtual social world" which generally lacks structured, mission-oriented tasks, defined character roles, and explicit goals [9]. Furthermore, as our game does not involve a

single narrative, we are applying concepts such as Lazarro's "four keys to fun" to see if we can heighten the emotional content of the activities [4]. Finally, our design must combine and rationalize game elements traditionally considered "male" (mastery, competition, destruction, spatial puzzles, trial and error) with game elements traditionally considered "female" (emotion, real world, nurturing, dialogue, learning by example) [10, 3]. We have incorporated the following game design elements.

Round structure

Some dorm energy competitions are structured over a single time period, with the winner declared at the end of the competition [8]. We will structure the Kukui Cup over three weeks, with a round one, round two, and final round, as is done in some sporting events. The energy consumption score and points are reset at the beginning of round two, while the score for the final round is the sum of the scores of all three rounds. We chose this structure because early participants may gain an insurmountable lead, which could discourage new participants from joining as the competition becomes more widely known. This structure allows a participant who joins in round two the chance to win round two, while still rewarding early joiners since the final round includes scores from rounds one and two.

Levels

The activities available through the website are organized into different levels to make them challenging but feasible. Early levels include simpler tasks and build foundational knowledge to enable participants to understand more complicated activities in later levels. To guide participants, the higher levels

of activities are locked until the participants complete a certain percentage of the lower level activities.

Raffle

We provide prizes for the most energy efficient floor and for the highest scoring individuals in each round. However, with 780 potential participants, most participants would have very little chance of winning a prize. Inspired by Balaji Prabhakar's work with innovative incentive schemes [7], we added a raffle to the competition. Participants earn one raffle ticket for every 25 points they earn. They can allocate their raffle tickets among a variety of prizes, depending on their interests. The system dynamically calculates their odds of winning each of the prizes to which they have allocated tickets, and participants can change how their tickets are allocated up until the end of the round. We hope that the chance of winning such prizes will motivate participants who have realized that they are not going to be one of the winners of the main competitions.

Future Opportunities

The Kukui Cup research project is funded for three years, which will allow us to continue to explore ways to bring more game design elements into the competition. We expect to refine both actual and virtual world components of the competition and website based on the results of the first run, making it a rich test bed for additional gamification techniques.

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