Learning Activity

Energy Crunch

Facilitating Students' Understanding of Eco-Efficiency

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Abstract

Recreation administrators have had to evolve their approach to managing areas and facilities as both financial and environmental resources have become more limited. One way that administrators have attempted to meet such challenges is through strategies that are more environmentally sustainable. The following article addresses the importance of making eco-efficient decisions regarding the sustainable management of recreation areas and facilities and provides a learning activity that can help educators illustrate this point in a more practical and meaningful way. As part of a recreational areas and facilities course, students conducted a basic energy audit on the "lighting" for their place of residence. After a 2-week period of observation and data collection, students compared the energy consumption and costs of their current lighting with more energy efficient alternatives. That comparison allowed students to then calculate the payback period on potential lighting changes and ultimately develop a decision-making rationale for the most eco-efficient course of action.

Keywords: *assessment; competencies; entry-level professional; accreditation; self-perceptions*

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Introduction

Decreasing revenue, rising expenditure, and limited growth opportunities are just a few of the recent and incessant challenges that face many small and big businesses alike. The current economic and environmental landscape has forced many businesses to take a hard look at the way in which they carry out their day-to-day operations (Young & Tilley, 2006). The parks and recreation industry and the many agencies and organizations within that industry are no stranger to this reality (Mowen, Kyle, Borrie, & Graefe, 2006). Public parks and recreation agencies have had to cope with increased fiscal constraints as revenue shortfalls have mounted from a depressed housing market, a rise in unemployment, and a greater competition for tax supported funding (Mulvaney, 2010). In order to overcome these types of challenges, parks and recreation agencies and other businesses have had to seek out strategies that enable them to be more operationally efficient.

One way in which organizations have tried to improve their overall efficiency is through strategies that are more environmentally sustainable (Fowler & Hope, 2007). Sustainability, as a concept, refers to a pattern of resource use that works to fulfill the environmental, economic, and social needs of the present generation, without compromising the needs of the future generation (Elmualim, Shockley, Valle, Ludlow, & Shah, 2010; Larson, Teisberg, & Johnson, 2000; WCED, 1987). As a business strategy, sustainability has come to reflect an approach in management that not only can lead to a healthier and cleaner world, but also greater profitability (Nidumolu, Prahalad, & Rangaswami, 2009). For that reason, many organizations have adopted sustainable business practices in order to create value and gain a competitive edge (Sneirson, 2009; Penny, 2007).

To achieve these objectives, organizations must often first carry out a systematic review of their current operations so as to better discern where cost-savings may exist (Ehrenfeld, 2000). One area that has shown to be effective in reducing facilities' operational costs is energy use (Penny, 2007). When evaluating strategies for reducing energy use, many organization will look for those approaches that are the most eco-efficient. Eco-efficiency reflects an approach in management by which an organization aims to enhance the efficacy of business practices while at the same time reduce their impacts on the environment (Sinkin, Wright, & Burnett, 2008). That is, businesses seek to identify opportunities that allow for the achievement of both environmental and financial objectives. Such an approach could be especially useful to recreational facilities and areas given that they are often energy intensive. Recreational facilities, such as pools, ice rinks, and even the more common recreation centers, consume a great deal of energy in heating, chilling, or lighting. Through careful examination of the inputs (i.e., energy sources), a recreation organization can determine ways to conserve energy, generate less waste, and thus become more eco-efficient.

The Learning Activity

As part of a recreational areas and facilities course, students were required to complete a major course assignment entitled *Energy Crunch*. The assignment required students to take on the role of an energy auditor. In that role, students carried out a basic energy audit. An energy audit is a systematic review of the energy trends and costs for a given facility or area. Reviews of this type have become an important evaluative tool for organizations that are looking to reduce their energy consumption, and achieve a certain level of cost-savings. With those ideals in mind, the learning activity intended to provide students with an additional source of information from which they could evaluate a facility or area as part of the needs assessment process. As well, the learning activity set out to heighten students' awareness of concepts and issues related to sustainability. The following article outlines each aspect of the *Energy Crunch* learning activity, identifies the activity's learning outcomes, presents activity recommendations, and concludes with a brief reflection on the importance of making eco-efficient decisions.

Step 1: Collecting Energy Consumption Data

The *Energy Crunch* learning activity was set up as an individual assignment that required students to carry out an energy audit. Although students could choose between their place of residence and place of employment, all students in the example presented here chose their place of residence. As part of this assignment, students focused explicitly on 'lighting' as this particular system often accounts for a major percentage of a building's total energy use (EPA, 2008). Students' initial efforts involved collecting energy consumption data for a period of two weeks. During that observational period, students recorded daily trends for lighting use in each of the rooms and areas associated with their selected facility. To assist them in this process, students received a data collection form that identified the precise kinds of information that they would need to collect in order to complete a basic energy and financial analysis for their residence. That data form comprised three main sections. Those sections included Building Profile, Facility Floor Plan, and Energy Usage.

For the building profile section of the form students provided descriptive details for their selected facility. The type of information required for this section included minutiae such as building type (i.e., personal residence, rental property, commercial), building age, gross square footage, number of occupants, number of rooms, as well as the total number of light fixtures. Information of this sort not only played a critical role in the audit process, but also provided some perspective from which the instructor could further assess students' recommendations at the conclusion of the assignment. Having provided background information on their selected facility, students then had to obtain or create a facility floor plan. The presented floor plan needed to include dimensions for each space so that square footage for the space could be determined. Knowing the square footage of a given space is an important variable in determining the lighting efficiency index for a particular area (total watts consumed in an area divided by total square footage of the area). A lighting index that is greater than 1.3 watts/ft^2 often indicates that there are potential opportunities for cost savings.

In the final section of the data collection form, students completed three energy usage tables. Table 1 (The Energy Log) served as a template for students to use in their recording of daily lighting trends. The arrangement of that table consisted of 3 columns that represented the categories of location (i.e., kitchen), date, and light usage (i.e., # of minutes or hours used). Following the two-week observational period, students could then use the data that they had recorded each day in their Energy Log to determine the average number of hours the lights were in use for a given space. By knowing approximately how long the lights were in use, students could then begin to complete Table 2, referred to as the Energy Consumption Table. That table consisted of 6 columns representing the categories of location, # of light units (A), # of watts consumed per light unit (B), total watts consumed per hour (C), average use per day (D), and total watts used per day. Completing the table required students to multiply Column A with Column B to determine the total watts consumed per hour. Students then had to multiply Column C with Column D in order to determine the total watts consumed per day for that particular space. At the bottom of the provided table, students tallied the total watts consumed per day for each space to obtain an overall average of watts consumed by their facility for lighting.

In Table 3 (Energy Conservation Measures), students repeated the process performed in Table 2 using more energy efficient lighting alternatives. In most cases, students were able to identify alternative lighting sources that used dramatically less energy or watts than their current lighting. Once completed, the tables offered students a means of easily comparing the differences in energy consumption for each lighting system. An examination of the lighting efficiency index for each room under both conditions further demonstrated those differences. In addition, that assessment indicated which rooms offered the most promise in terms of cost-savings. To gain a better understanding for the economic benefits that they would gain from making such changes in lighting, the students then had to calculate the payback period on their initial investment.

Step 2: Calculating the Payback Period

The feasibility of replacing current lighting with more efficient lighting is contingent on the cost of replacement versus the cost savings one would derive from making the proposed changes. To determine whether such changes would make financial sense, students performed a series of basic calculations that appeared immediately after the energy usage section of the data collection form. The first of those calculations involved converting the total watts consumed per day into kilowatts consumed per day. Most utility companies charge by the kilowatt hour (KWh). To convert watts into kilowatts, students simply divided the total number of watts consumed for lighting by 1,000. Having converted watts into a more useable unit of energy, students could then multiply their average day's kilowatt expenditure by thirty. This in turn established the average amount of power consumed by a student's lighting system for a period of one month. Multiplying that figure by the cost per KWh enabled students to see approximately how much they were spending on lighting during a given month.

Having established a baseline for their monthly lighting expense, students then performed the same basic calculations on the lighting system that they had proposed in the Energy Conservation Measures Table. With knowledge of the monthly costs required for each lighting system, students could now begin to make a judgment about the likely cost savings gained from having more energy-efficient lighting. Students obtained the cost-savings amount by computing the difference between the monthly expenditures for each lighting system. Although important, the monthly cost savings figure did not account for the financial investment needed to purchase replacement light units. As a result, students had to add up the total amount of money they would spend on replacing their current lighting with more energy-efficient light units. By dividing that amount by the monthly cost savings, students were able to determine approximately how many months would pass before they would see a return on their financial investment. With all of the data gathered and analyzed, students had the important task of developing a rationale for what course of action they would implement and why.

Stage 3: Developing a Decision Rationale

For the final portion of the learning activity, students had to create a rationale for the most appropriate and eco-efficient course of action. Aimed at promoting critical thinking, this aspect of the learning activity forced students to consider a number of factors as they prepared their proposed recommendations. Those factors included not only the costs and payback, but also matters such as illumination, color quality, area applicability, and maintenance. An examination of these types of factors in combination with the others would help to create a compelling argument around the proposed decision. The rationale itself was limited to one page single-spaced. If students desired, they could use an additional page to present any charts or graphs that they had created to support their case. Documents such as the student's Energy Log, Data Collection Form, and Energy Calculations were included as appendices to the rationale. Ultimately, the decision rationale portion of the activity served as a culmination to the efforts and inquiry of the student.

The Learning Outcomes

There were several desired outcomes for the *Energy Crunch* learning activity. One of the primary learning outcomes was to provide students with an additional source of information from which they could evaluate a facility or area. Following their involvement in the activity, many student groups incorporated an energy audit into the needs assessment project required for the course. The data garnered from those efforts served students well in preparing recommendations for the report that they presented to their local partner organization and facility. The process of carrying out an energy audit also allowed students the chance to experience firsthand each phase of the evaluation process. Through research, data collection, data analysis, and data interpretation, students achieved a greater sense for how each phase could help inform the decisions made in operating a facility.

Finally, the *Energy Crunch* learning activity created a unique opportunity for students to reflect on their own energy use habits. Embedded within the decision rationales for the *Energy Crunch* learning activity, there were an abundance of comments made by students that highlighted some of their personal insights. For example, in reference to energy usage one student had commented, "After performing my initial data collection, I was amazed that I never noticed that the light in the bathroom uses five 75-watt light bulbs. That is a tremendous amount of energy being used for a bathroom." Although identifying energy consumption was an important part of the activity, the learning activity also aimed to promote students' application of key concepts. When weighing the costs and benefits of switching to new lights, one student stated, "As for cost, a traditional light bulb costs on average $0.37 per bulb, whereas an energy efficient bulb costs around $1.06. Although replacing the bulbs will cost extra money upfront, making the switch is a great way to help save money on the electric bill, and also a great way to help out the environment." Drawing on these types of remarks, it was clear that students took notice of how seemingly small changes in their energy consumption could lead to a positive return not only on their investment in new lighting, but also on their surrounding environment.

Recommendations

The students' introduction to the *Energy Crunch* learning activity coincided with a brief class lecture on the concept of eco-efficiency. As part of that lecture, the class also reviewed ways in which the parks and recreation industry has begun to adopt various eco-efficient practices. The presentation of this type of information helped to lay the foundation from which students could better understand the role that eco-efficiency plays in managing recreation areas and facilities. One addition to the learning activity that might enhance the learning experience could involve having students calculate the greenhouse gas emissions for the energy consumed under each lighting condition presented. Depending on the energy source (i.e., coal, nuclear, hydropower), the greenhouse gases generated from electricity can range from 1.4lbs to 2.8lbs per KWh. The inclusion of this aspect to the learning activity offers students another benchmark within their evaluation; a benchmark that more centrally examines the impacts that students' current or proposed lighting system has on the environment.

One other addition to consider may include having students calculate the energy consumption of a major home appliance (i.e., stove, refrigerator) or a structural piece of equipment (i.e., furnace, water heater). This sort of opportunity may reveal scenarios where energy-efficient upgrades do not warrant change because the cost of upgrading far exceeds the amount that a person would obtain in energy savings during the life of the appliance or equipment. With the prospect of such circumstances arising, students can further apply the concept eco-efficiency; a concept that emphasizes the importance of making decisions that are both environmentally and economically beneficial.

Conclusion

There is a widely held belief that the more environmentally conscious an organization becomes, the less likely it is that organization will remain competitive in the market (Nidumolu et al., 2009). From this standpoint, one might say that the costs do not justify the benefits. Current research, however, has shown that a number of companies have gained significant value by intentionally pursuing and implementing certain environmentally sustainable practices (Larson, Teisberg, & Johnson, 2000; Sneirson, 2009). Within today's society, "doing more with less" is an inescapable reality of the time. By adopting eco-efficient strategies, parks and recreation organizations have the potential to enhance the value of the services and experiences they offer to their patrons. That value is not simply a factor of savings, but in knowing that the services and experiences provided are accounting for the environment, and the people in that environment.

The Energy Crunch Learning Activity provided students with a unique opportunity to learn about and authentically apply concepts related to sustainability. Through students' involvement, they not only became more conscious of their own energy consumption, but also more knowledgeable about what actions they could take to be more eco-efficient. With both financial and environmental resources becoming increasingly limited, understanding the importance and utility of sustainability is essential for all future professionals. To that end, we as educators have a responsibility to identify ways in which we can seamlessly integrate sustainability education and training into our curricula. By doing so, we will better equip our students to meet tomorrow's challenges head on, and become leaders in sustainable practice.

Energy Crunch: Data Collection Form

Section 1.	**Building Profile**				
Building Type:		Building Age:		Gross Square Footage	
Number of Occupants:		Number of Rooms:		Number of Light Fixtures:	

Section 2.	**Facility Floor Plan**

Section 3.	**Energy Usage**

Table 1. **Daily Energy Log (Lighting)**

Location	Date	Minutes/Hours in Use Per Day
Example	**Example**	**Example**
Bedroom 1	**2/8/13**	**2.5 hours**

Table 2. **Daily Energy Consumption**

Location	# of Light Bulbs (A)	Watts/hr (B)	Total Watts/hr (A x B) = C	Average Use/Day (D)	Total Watts Used Per Day (C x D)
Example	**Example**	**Example**	**Example**	**Example**	**Example**
Bedroom 1	**5**	**100**	**500**	**4.5**	**2250**
				Overall Total	

Table 3.	Energy Conservation Measures				
Location	# of Light Bulbs (A)	Watts/hr (B)	Total Watts/hr (C)	Average Use/Day	Total Watts Used Per Day
Example	Example	Example	Example	Example	Example
Bedroom 1	5	12	60	4.5	270
				Overall Total	

1	Convert total watts consumed into total kilowatts consumed.

________ Total Watts Consumed/ Day ÷ 1000 = ________ KW Consumed/ Day

2	Calculate the total kilowatts consumed per month for lighting.

________ KW Consumed/Day x 30 days = ________ KW Consumed/Month

3	Calculate the total cost for lighting in a month.

________ KW Consumed/ Month x Cost/ KWH (___) price ________ Total Cost for Lights/Month

Repeat above calculations for Energy Conservation Measures Table.

4	Calculate the monthly savings gained from using more energy-efficient lighting.

________ Lighting Cost/Month (Current) _ ________ Lighting Cost/Month (Energy Efficient) = ________ Monthly Cost Savings

5	Calculate total replacement cost required for energy-efficient light units.

________ Watts Light Unit Type ________ # of light units x ________ Cost per Light Unit = ________ Replacement Cost

6	Calculate payback period.

________ Replacement Cost ÷ ________ Monthly Cost Savings = ________ Payback Period in Months

References

Ehrenfled, J. R. (2000). Colorless green ideas sleep furiously: Is the emergence of sustainable practices meaningful? *Reflections, 1*(4), 34–47.

Ekins, P. (2005). Eco-efficiency: Motives, drivers, and economics. *Journal of Industrial Ecology, 9*(4), 12–14.

Elmualim, A., Shockley, D., Valle, R., Ludlow, R., & Shah, S. (2010). Barriers and commitment of facilities management profession to the sustainability agenda. *Building and Environment, 1*(45), 58–64.

EPA (Ed.). (2008). *ENERGY STAR® Building Upgrade Manual*, Ch 6: Lighting. Retrieved from http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual

Fowler, S. J., & Hope, C. (2007). Incorporating sustainable practices into company strategy. *Business Strategy and the Environment*, *16*(1), 26–38. doi: 10.1002/bse.462

Larson, A. L., Teisberg, E. O., & Johnson, R. R. (2000). Sustainable business: Opportunity and value creation. *Sustainable Business*, *30*(3), 1–12.

Mowen, A. J., Kyle, G. T., Borrie, W. T., & Graefe, A. R. (2006). Public response to park and recreation funding and cost saving strategies: The role of organization trust and commitment. *Journal of Park and Recreation Administration, 24*(3), 72–95.

Mulvaney, M. A. (2010). *Economic Issues Affecting Parks and Recreation: A White Paper Summary of Two Special Sessions at the 2009 NRPA Congress.* National Recreation and Park Association, pp. 1–26.

Nidumolu, R., Prahalad, P. K., & Rangaswami, M. R. (2009). Why sustainability is now the key driver of innovation. *Harvard Business Review*, *87*(9), 56–64.

Penny, W. Y. K. (2007). The use of environmental management as a facilities management tool in the Macao hotel sector. *Facilities, 25*(7/8), 286–295.

Sneirson, J. F. (2009). Green is good: Sustainability, profitability, and new paradigm for corporate governance. *Iowa Law Review, 94*(3), 987–1022.

Sinkin, C., Wright, C. J., & Burnett, R. D. (2008). Eco-efficiency and firm value. *Journal of Accounting and Public Policy, 27*(2), 167–176.

World Business Council for Sustainable Development (WBCSD). (1996). *Eco-efficient Leadership.* Geneva: WBCSD.

World Commission on Environment and Development (WCED). (1987). Our Common Future. [Brundtland Report]. Oxford: Oxford University Press.

Young, W., & Tilley, F. (2006). Can businesses move beyond efficiency? The shift in effectiveness and equity in the corporate sustainability debate. *Business Strategy and the Environment, 15*(6), 402–415.