

Teaching Energy Efficiency at OJC

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大阪女学院でエネルギー効率を教える

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Abstract

This paper focuses on the importance of and techniques for teaching about energy efficiency. Energy efficiency is important for Japan, a nation with few fossil fuel energy reserves. Energy efficiency education is important because it is related to caring for God's creation, it is good for the environment, it can save consumers money, it can reduce military tensions, and it is a suitable topic for EFL study. Techniques for teaching energy efficiency are: Energy Awareness Activity, Home Energy Use Comparison, Efficiency Presentation, Energy Efficiency Project, and Solar Power System Design Project. The paper closes with further encouragement to focus on this topic.

Key words : Energy efficiency, energy education, energy awareness

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抄 録

本稿はエネルギー効率についての授業の重要性とテクニックについて取り扱う。化石燃料の乏しい日本においてこのトピックは重要である。エネルギー効率の教育は、神の創造に関心をもつこととの関連性や、環境に良いこと、消費者の出費削減、軍事的緊張緩和の可能、そしてEFL教育に対する適合性という点で重要である。エネルギー効率を教える際のテクニックは「エネルギー意識のためのアクティビティー」、「家庭でのエネルギー使用量の比較」、「エネルギー効率についてのプレゼンテーション」、「エネルギー効率に関するプロジェクト」、「太陽エネルギーシステムに関するデザインプロジェクト」である。本稿は最後にエネルギー効率のトピックを積極的に取り扱うことを奨励する。

キーワード：エネルギー効率、エネルギー教育、エネルギー意識

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Introduction

Many schools and programs in Japan are using global issues as teaching material for English language instruction. Numerous textbooks have sections or themes related to global issues. This can be seen in topics related to human rights, indigenous cultures, and particularly, the environment. The environment is a broad topic itself, ranging from the protection of endangered species, to rainforests, to global warming and acid rain. From my experience as a teacher, it was difficult to keep abreast of the whole range of environmental issues when I was trying to advise and support my students while they wrote research papers. I found it was helpful to focus on one area of the environment and I chose the area of energy for my class. Within the area of energy and the environment, I particularly took an interest in teaching about energy efficiency. I became interested in teaching energy efficiency after experiencing how it benefited my own family. When we first came to Japan, we used a large refrigerator and our minimum payments to Kansai Electric were at least ¥4,000 a month. As that refrigerator showed signs of wearing out, I chose a large sized energy saving replacement. With the new refrigerator, we found that our electricity cost dropped by ¥2,000 a month. That is equal to ¥24,000 a year. The new refrigerator paid for itself in energy savings within five years and we continued to have ¥2,000 each month that was available for other uses. During a one-term course, my students do not have the opportunity to experience similar benefits themselves but they are able to see how they can get such benefits.

Energy efficiency is environmentally and financially important. According to one estimate, if every home in Japan would use the most energy efficient refrigerator, washing machine, microwave oven, and air conditioner, the savings in energy costs would equal ¥1 trillion. In other words, it would be like a ¥1 trillion tax cut in economic benefits for the nation (Asaba 1998). Fortune magazine recently called for a US energy policy including requiring energy efficiency and conservation (Bookman, 2004). This is especially relevant for Japan, an island nation with few of its own energy resources. Consumer education can help energy efficiency to increase in Japan. Appliance makers are continuously working to improve energy efficiency resulting in electric appliances being sold with lower and lower energy requirements each year. Consumers in homes are responsible for a great deal of Japan's energy consumption. However, without education and understanding of energy efficiency, consumers may fail to make the best choices for their own long-term benefits, both financially and environmentally. Thus, we can see why educating present and future consumers about energy efficiency is important.

Teaching energy efficiency in Japan is worthwhile for several reasons. First, as stewards of God's creation, wise use of resources is commendable (Cobb 1994; Nash

1991). All of creation has value which should be protected rather than squandered through wasteful use. Second, from an environmental viewpoint, energy efficiency reduces consumption of fossil fuels. Less use of fossil fuels lessens the effects of global warming and acid rain. Third, consumers who reduce energy use can save money when paying utility bills. Money saved from utility payments can be used for other purposes. Fourth, reducing energy use increases global stability since a rising world population is dependent on common fossil fuel reserves. Much of the turmoil in the Middle East can be traced to a struggle over the supply of oil. Reducing energy demand through efficiency lessens the demand for oil and the military tension related to securing it. Fifth, energy efficiency is a good topic for content-based language instruction. It is related to environmental issues which many students already have general knowledge about. It can also be taught in a very practical and student friendly manner suitable for second language learners.

For about ten years, through 2003, I taught a second year, content-based Topic Studies I course at Osaka Jogakuin Junior College called Energy and the Environment. The course requires student discussion, presentations, reading, and a research paper. I would like to share some of the teaching methods which I developed and adapted for this course which are related to energy efficiency education. I encourage teachers to adapt or adopt these methods for their own environmental education courses. As much as possible, these activities are based on the actual lives of students and their families as energy consumers. Educating students about energy efficiency with real and concrete activities related to their lives has proven to be quite effective.

Energy Awareness Activity

One of the first activities I ask students to do is to share how they use energy in a typical day. This activity was originally found in Gore, Masoncup, Christensen, Heist, Johnson, Smith, & Smith (1980, pp. 61-62). I ask students to think through a day from morning to night and note which appliances they use, how they get to school and home, what energy is used at their part-time jobs, and any other ways that they use energy. In a following class, students share their observations. An entire chalkboard or whiteboard can easily be filled with the many items and ideas that students name. As I write their ideas on the board, I usually group them according to the type of energy they use, electrical, natural gas, or petroleum (see figure 1). After the board is filled with ideas I ask students to explain the groupings which they are usually able to do. Further discussion can be generated by asking students to choose which appliances or energy using items they would be willing to live without and why. When time allows, I have asked students to explain where the electricity comes from which powers the majority of the energy using items. I also ask where the natural gas and petroleum come from which supply hot water for baths

Figure1 Energy Awareness Example Chart

refrigerator washing machine train hair drier etc.	water heater gas fan heater cook stove etc.	car bus motorcycle etc.
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and power for those students who use cars, motorbikes or scooters. A number of other questions may arise concerning the environmental effects of these sources of energy. The point of the activity is to increase students' awareness of how they use energy in many aspects of their daily life and to point out that their use of energy is related to the environment.

Home Energy Use Comparison

A second energy awareness raising activity is to require each student to report to class the exact number of kilowatts their family used during a one-month period. I try to announce this assignment one month in advance so that students or families who may have thrown away the receipts from Kansai Electric will have time to receive a new receipt for class use. In order to relieve privacy concerns, I announce to students that if their parents do not want this information shared, the students can tell me and be excused however, no student has ever voiced such a parental concern. I also tell students that low energy use will not be rewarded with bonus points and high energy use will not be penalized. The point of the activity is to get information for us to analyze energy use. On the day that students report their family energy use, I write each student's number of kilowatts on the chalkboard and the number of members in the student's family. This factoring in of family members allows us to calculate the average energy use per person after all the information is posted. During the posting of information, I ask two students to add up the total amount of kilowatts reported and the total number of people. Then a calculation is made for the class average of kilowatts used per person per month. Next, we look for which students are above average, which students are below average, and which students are very close to average. We generally find some families which use a great deal of energy per person and some families that use much less energy than average. In one recent class, we collected information from 24 residences, housing 98 people. The average use of electricity was 85.5 kilowatts per month per person. The lowest use was 43 kilowatts per month while the highest use was 168 kilowatts per month per person. During discussion, students share ideas and information to explain why their family may be above or below average. Without being asked how to cut energy use, some students volunteer ideas for how their family could reduce their use of energy. I have not seen a similar

activity elsewhere and it may be that other teachers have not used such an activity because of privacy concerns for the students and their families. Certainly, sensitivity is called for. If teachers were to express strong disapproval for students whose families used a great deal of electricity, it would change the dynamics of the class. By keeping an inquiring and positive attitude of concerned interest while seeking to understand why energy use is high or low, students respond with similar interest and concern.

Efficiency Presentation

One of the course requirements is student presentations. Before students do their presentations, I make one model presentation on the subject of energy efficiency. I usually begin my presentation with a choice for the students. I hold up two light bulbs made by the same company and explain the following. The two light bulbs produce the same amount of light. One of them costs ¥125 and the other costs ¥1,280. Which one would you buy if you were shopping and needed to replace a light in your home? Year after year, almost all students have chosen the cheaper light bulb. I then proceed to explain and fill in the chart (figure 2) adapted from Schaeffer & the Real Good Staff (1994 p. 373), line by line. After filling in the complete chart, I give the students a choice once more between the two lights. Overwhelmingly, they switch to the higher priced light because they see that it saves them money and is more convenient, not needing to be replaced so often. They no longer want the cheaper light bulb which costs much more to operate. This activity alone indicates how more energy efficiency education could make a difference in consumer choice in Japan. Consumers might choose more energy saving items if they could see TV ads, posters and pamphlets explaining the savings and convenience of energy saving items. After watching my most recent presentation, students wrote comments on their required evaluation form like the following.

“I would like to use more efficient electric light bulb in my house to save energy. I’m going to tell people around me about the informations I learned in your class.”

Figure2 Presentation

	60 watt incandescent bulb	15 watt fluorescent bulb
bulbs needed for 8,000 hrs. use	10	1
bulb cost for 8,000 hrs. use	¥ 1,250 (¥125 × 10)	¥ 1,280
energy cost for 8,000 hrs. use*	¥ 8,870	¥ 2,210
total cost	¥ 10,120	¥ 3,498
savings in money		¥ 6,622
savings in energy		360 kilowatts
*¥ 18.48/kw for 1st 120kw/mo.		

“I want to review my life-style and choose goods that save energy and money.”

“I want to change light bulb in my house soon. For saving money now, I often buy many cheap goods, but I have to think about energy and money for long-term.”

“Saving energy is great, because we can save money and I think it is good for our lives.”

These students are ready to invest more money in appliances and lights in order to save money in the long-term. Producers of energy saving appliances need to encourage such consumer awareness so that producers, consumers, and the environment can benefit. I have read that Amory Lovins, a noted expert on energy efficiency, carries a briefcase with energy saving light bulbs to demonstrate cost saving investments in efficiency (Kleiner 1992). That was one inspiration for me to develop an energy efficiency demonstration using a real comparison of light bulbs.

Energy Efficiency Project

Another requirement of the course is to do a project. I have two projects which I often alternate using so that students in one term are not so likely to share information with their classmates in a second term. The first of the projects compares energy use. Students use a form (figure 3) on which they write information on energy use for both three products in their house at present and three similar currently available products which use less energy. After completing the form and the required calculations of energy use, students see how many kilowatts of energy they can save in a week, a month, and a year if they exchange three items in their home for the three more energy efficient items. During discussion of this activity in last year's session, our class found that by changing three items in their homes, the average savings per home per month was 24.98 kilowatts. This is equal to about 10% of the electrical consumption for many families. Students were encouraged to talk with their family members about the project and to learn what parents or other family members thought about changing electrical items to save energy. A common response, either by the students or their family, was that the time to change electrical items is when they wear out. Then newer and more efficient items can be bought. On numerous project papers, students wrote that in the future, they would carefully check the energy consumption of appliances before buying any. This was something that they had not even thought about before taking the class. The following quote, by one of my recent students, is representative of many similar comments each year.

“From this project, I realized that our family uses a lot of energy in our daily life. Just changing each item, we can save energy and also reduce costs. So after these items (TV, VHS, oven) which are using now are broken, I'll buy new items that use less energy. So that it is good for costs and for environment. ... Specially my mom was

Figure3 Efficiency Project

Name of old item	watts × hrs. daily use × days of use/week ÷ 7 =	Avg.watts/day
	Total avg. watt hours per day from old items =	

Name of new item	watts × hrs. daily use × days of use/week ÷ 7 =	Avg.watts/day
	Total avg. watts per day from new items =	

Total average watts per day from OLD items	
Minus total average watts per day from NEW items	
Equals total amount of watts saved per day	
× 30.4 equals the amount of watts saved per month	
× 12 equals the amount of watts saved per year	

shocked to see this result. She didn't think that we use so much energy. Our family is trying to start saving energy from small things like turning off the light."

This activity was developed by using some elements from Gore et al., (1980, pp. 161-2), which is a simpler comparison. Students are required to go into stores and find three new electrical items and compare them with three items in their home to determine if the new items use more or less electricity. My activity also requires a careful analysis of energy use for the items based on a chart used to determine home energy needs (Schaeffer & The Real Goods Staff, 1994, p. 150). In addition, I require students to calculate energy savings for one month and one year.

Solar Power System Design Project

The second project was to design a solar system that would provide enough energy for the student's home. Again, a handout provided basic information and guidance to do this. To determine what size solar system would be required, students used the number of kilowatts from their Kansai Electric receipts for one month. This is the same information about electric use that was required for the energy awareness activity. They divide the number of watts used per month by the number of watts each solar panel can produce during an average day of Osaka sunlight. Real current costs and watt ratings of solar panels

were checked on the internet so that students could get an accurate idea of how expensive solar electricity is. Finally, students were required to draw a picture showing their home and how they would attach the solar system. Those living in mansions or apartments could draw a design with the solar energy system on top of the building and a wire running to their home. Those who lived in a house drew the solar system on the roof, however, some students whose families used a great deal of electricity often had trouble finding enough space on their home's roof for all of the solar panels needed. Students were encouraged to talk with their family about the project and write their family member's thoughts as well as their own thoughts about the size, the expense, the good points and the bad points of having a home solar electric system. These thoughts and opinions could then be shared in class as well as in their project papers. Some of the students whose families used large amounts of electricity realized that by reducing their electricity use, they could also reduce the size and expense of a solar energy system.

Conclusion

Certainly, there are many other ideas for teaching energy efficiency. The activities in this paper are ones that I adapted or developed to suit my students and my course. Each teacher will need to take into account their own students and their own course requirements when adapting and developing such teaching materials. Teachers might also benefit from trying these activities themselves and putting into practice what they learn. Another way to demonstrate these ideas would be a campus-wide effort to find ways to reduce energy use involving teachers and students.

Energy efficiency is not just a matter for dreamy environmental wishful thinking. It is a very practical, useful, and rewarding endeavor for individuals, families, communities, nations, and our worldwide environment. Teaching energy efficiency has been very rewarding because many students have decided to apply what they learned through their activities and research. Even graduates have reported making changes in their lifestyle because of what they learned in this course. Energy education can make a difference.

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