

Effective Environmental Education Program to Solve Social Dilemma

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People may be aware of environmental problems but still not behave in ways that will solve them. What kind of educational program promotes environmentally responsible behavior? Since we have already found that the most influential factor promoting environmentally responsible behavior is cost consciousness, we hypothesized that the most effective educational program would be one fostering an understanding of social dilemmas. Testing this hypothesis in an experiment comparing a social dilemma program and an enlightenment program, we found that only the social dilemma education program increased cost consciousness and elicited environmentally responsible behavior. We therefore think that a social dilemma education program would promote environmentally responsible behavior better than an enlightenment education program would.

Keywords: environmental education, environmentally responsible behavior, questionnaire survey, cost consciousness, social dilemma

1. Introduction

If we are to create a sustainable society, we need to deal effectively with such environmental problems as air and water pollution, the destruction of the ozone layer, the over-harvesting of renewable resources, and the exhaustion of nonrenewable resources. Some governmental solutions to these problems are the promotion of technical developments that will result in the widespread use of hybrid cars and other energy-saving products (METI, 2004), recycling laws (MOE, 2004a), and the regulation of vehicle categories in specified areas (MOE, 2005). Here we would like to focus on environmentally responsible behavior (Hirose, 1995, Sugiura, 1998).

Environmentally responsible behavior is not widely practiced because it prioritizes long-term social advantage over short-term individual advantages like convenience and economic efficiency. A questionnaire survey by the Ministry of the Environment, Japan (MOE, 2004b) found that environmentally responsible behaviors that are not required by law (such as trash separation) and that do not affect the consumer's budget directly (such as saving electricity or water) are practiced by less than 50% of the population. These results indicate the need for an environmental education program encouraging environmentally responsible behavior (MOE, 2004c, 2005).

The environmental education of Japan, begun as an action program for the pollution issue of the 1970's, has prevailed in various fields such as school education, lifelong learning, and corporate education. A representative environmental education program is the "Team-6%" project (T6P) provided by the Ministry of the Environment (see <http://www.team-6.jp/>). This project, part of Japan's efforts to cut its volume of greenhouse gas emission by 6% as promised in the Kyoto Protocol, explains how people can act individually to prevent global warming and suggests six concrete actions: how to set thermostats, how to choose eco-friendly items when shopping, how to use water, how to use cars, how to use electricity, and how to dispose of garbage. It also provides information about the Kyoto Protocol, Japan's emission of CO₂, and the ecological and economic effects of reducing this emission. Even if people do not join as a member of the project by registering on its home page, by browsing the site they can learn about many of the problems caused by global warming and can learn what

they can do to help prevent global warming.

2. Social dilemma in cost consciousness

Suwa et al. (2005) used questionnaire surveys investigating environmental perception and environmentally responsible behavior, and they developed an environmental behavior model. Using their model and applying path analysis to the survey results, they found that cost consciousness is the most influential factor promoting environmentally responsible behavior. From this we inferred that people who are more aware of the costs of their behavior are more likely to behave in ways that are environmentally responsible. So we hypothesized that environmentally responsible behavior would be encouraged by an education program that helped people understand social dilemmas.

Social dilemmas have been discussed by many researchers—see, for example, Olson's (1965) "The Logic of Collective Action," Hardin's (1968) "Tragedy of Commons," and Platt's (1973) "Social Traps"—and were defined by Dawes (1980). Fujii (2003) expanded Dawes's definition by considering the time lag that is a part of actual social dilemmas. He defined a social dilemma as follows;

Social dilemma is "the social situation in which one must be selected cooperative behavior that decreased short-term individual profit and increased long-term social profit, or defective behavior that increased short-term individual profit and decreased long-term social profit."

There have been many studies applying the concept of the social dilemma to environmental issues. For example, Yamagishi (1990) claimed that garbage-related problems, environmental disruption, and resource exhaustion are the results of acting in ways intended to benefit only oneself. Umino (1991) argued that the rational pursuit of individual benefit by using spray cans with Freon propellant leads to the destruction of the ozone layer and plunges our society into an irrational situation. Hasegawa (1991) discussed the "tragedy of commons" effect with regard to resource management and environment pollution on a global scale.

The structure of a social dilemma is one in which the results of individual decisions made rationally are worse than the results of individual decisions made irrationally. This happens because a rational person chooses to behave selfishly because selfish behavior increases short-term individual profit. If all individuals in a society chose selfish behavior, however, long-term social profit decreases. As a result, the individual will suffer a loss greater than he would have if he had decided irrationally.

Environmentally responsible behavior is regarded as cooperative behavior, and the failure to act in an environmentally responsible way is regarded as selfish behavior. Environmentally responsible behavior causes a short-term loss for the individual because it requires the expenditure of effort, time, or money, but it improves the situation for the society by improving the environment in the long term. As a result, the individual will actually benefit. Conversely, inattention to environmental issues profits the individual in the short term but causes environmental deterioration that produces a bad situation for society in the long term. So the individual will not actually benefit.

The structure of social dilemmas implies that environmentally responsible behavior eventually promotes individual profit and that individuals should not shortsightedly pursue their private interests but instead take a long-term perspective of environmental issues. Yamagishi (1990) discussed how a social dilemma can be resolved by what he called altruistic egoism: seemingly acting for the benefit of other people while actually thinking of one's own long-term benefit. If people understand that environmental issues pose social dilemmas and require cost-consciousness actions, they will act in environmentally responsible ways. Thus we hypothesized that the desired behavior would be promoted by an education program that helps people

understand the structure of social dilemmas and the necessity for cost-conscious behavior (here called the SD education program).

3. Comparing the SD education program with the T6P education program

In what kind of process does an appropriate education change a person’s attitude or behavior? There are many models of human perception with regard to environmentally responsible behavior, three of which are Hirose’s (1994) factor-relational model of environmentally responsible behavior, Koike et al.’s (2003) structural model of the perception of environmental issues, and Misaka’s (2003) model of the perception of environmental issues and their behavior regarding those issues. Hirose (1994) proposed a factor-relational model of environmentally responsible behavior and discussed four factors influencing that behavior. He also verified the validity of his model by using surveys. Some experimental studies based on Hirose’s model (Nonami et al. 1997, Sugiura et al. 1998, Nonami et al. 2002, Yorifuji & Hirose 2002) demonstrated various factors influencing environmentally responsible behavior, and Koike et al. (2003) and Misaka (2003) developed a specific model based on Hirose’s general model.

To measure the effects of the SD education program and the T6P education program, we used a framework based on the results of Suwa’s (2005) survey. Focusing on what factors of motivation affect behavior, we developed the structural model of motivation and behavior shown in Figure 1. According to Suwa (2005), six factors have effects on deliberate environmentally responsible behavior. We used as detailed factors of motivation five of those six factors (all except awareness of waste reduction): abstract environmental consciousness, concrete environmental consciousness, awareness of social reform, awareness of movement, and awareness of the costs of their behavior. In accordance with some insights of Suwa (2005), we also used two variables as detailed factors of behavior: deliberate environmentally responsible behavior and routine environmentally responsible behavior.

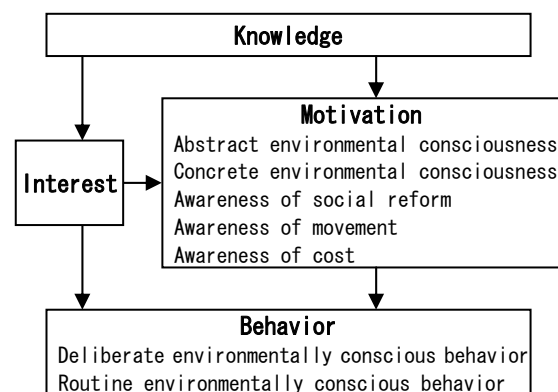


Figure 1: Structural model of environmental issue awareness.

We expected the SD education program to increase people’s knowledge of and interest in the environmental issues related to global warming, to increase their awareness of the costs of their behavior and of the role of these costs in social dilemmas, and to increase the frequency with which they behaved in deliberately environmentally responsible ways.

We expected the T6P education program, on the other hand, to similarly increase people’s knowledge of and interest in the environmental issues related to global warming, to increase their awareness of movement as a factor enlightening people about how they can prevent global warming, and consequently to increase their concrete environmental consciousness with regard to the six suggested concrete actions. We did not, however, expect it to increase the frequency with which they showed deliberate environmentally responsible behavior. Or if it did, we expected the increase to be less than that due to the SD education program.

4. Method

We excluded possible effects of differences in teaching effectiveness due to different instructors and teaching

techniques by having all the experimental subjects read one of two education documents, one prepared for the T6P education program and the other prepared for the SD education program. We prepared projection slides explaining environmental issues, a document about social dilemmas and a document for "Team-6%" project, and three sets of questionnaires with the same content. The projection slides introduced current environmental issues, explained the damage due to global warming over the past 100 years, and explained the damage global warming is expected to cause in the next 100 years. The two documents were made in such a way that the time needed to read either of them would be about the same, and the questionnaires examined the following four factors.

Knowledge: Five questions about knowledge of environmental issues and environmentally responsible behavior (e.g., "Do you know what are contemporary environmental issues?" and "Do you know what environmentally responsible behavior is?"). Subjects evaluated their knowledge on a scale from 1 ("completely unknown") to 4 ("well known").

Interest: Six questions about interest in environmental issues (e.g., "Are you interested in global warming?" and "Are you interested in the issue of energy sources being used up?"). Subjects evaluated their interest on a scale from 1 ("completely unconcerned") to 4 ("highly interested").

Motivation: Fifteen questions (three for each of the five factors) about the motivation for environmentally responsible behavior. The five factors were abstract environmental consciousness, concrete environmental consciousness, awareness of social reform, awareness of movement, and awareness of cost. These subjects evaluate their motivation on a scale from 1 ("irrelevant") to 4 ("extremely important").

Behavior: Twelve questions about environmentally responsible behaviors and how often the subject behaves in environmentally responsible ways. These subjects evaluated their behaviors on a scale from 1 ("never") to 4 ("always"). Half the questions were about deliberate environmentally responsible behavior and half were about routine environmentally responsible behavior.

The subjects were 53 university students randomly separated into two groups: 25 reading the document prepared for the SD education program and 28 reading the document prepared for the T6P education program. On 25 July 2005 all of the subjects filled out the questionnaire, watched the projection slides for 10 minutes, read their group's document for 10 minutes, and then filled out the questionnaire again. One week later they filled out the questionnaire a final time.

5. Results

We considered the SD education program group and T6P education program group two groups to originally be similar because unpaired t-testing found no significant differences between the first questionnaires filled out by the two groups (except for one question about routine environmentally responsible behavior). We excluded this question from consideration and also excluded another question (about deliberate environmentally responsible behavior) because many of the subjects did not answer it.

Analytical procedure

Knowledge: Factor analyses (principle component analysis using varimax rotation) revealed that the five questions about knowledge factors could be considered to measure a single latent variable, so we used the simple average of these five items as a score for knowledge about environmental issues and environmentally responsible behavior. Cronbach's α for these test items was 0.85.

Interest: Factor analyses (principle component analysis using varimax rotation) revealed that the six questions about interest factors items could be considered to measure a single latent variable, so we used the simple average of five of these six items (except one for which the factor loading was less than 0.4) as a score for interest about environmental issues. Cronbach's α for these test items was 0.79.

Motivation: Factor analyses (principle component analysis using varimax rotation) revealed that the fifteen questions about motivation factors measured six latent variables. Only one question was about awareness of cost, so we expected this. We make factor analyses again, and identify that those are five factor solutions. We used the simple average of the three items about each of the five factors (abstract environmental consciousness, concrete environmental consciousness, awareness of social reform, awareness of movement, and awareness of cost) as the score for that factor's motivation of environmentally responsible behavior. Cronbach's α for those test items were 0.83, 0.72, 0.66, 0.82, and 0.59.

Behavior: Factor analyses (principle component analysis using varimax rotation) revealed that ten of the twelve questions about behavior factors measured two latent variables (deliberate and routine environmentally responsible behavior), so we used the simple average of the five items about each of these factors as two scores for environmentally responsible behavior. Cronbach's α for these test items were 0.77 and 0.85.

Comparison with education effect

We used one-way analysis of variance to evaluate each group's about knowledge, interest, and motivation (Table 1), and we used unpaired t-testing to evaluate differences between behavior before reading the educational documents and behavior one week after reading the documents (Table 2).

Knowledge: One-way analysis of variance found significant knowledge differences in both groups: $F(2,72)=7.22, p<0.01$; $F(2,81)=9.32, p<0.001$.

Interest: One-way analysis of variance also found significant interest differences in both groups: $F(2,72)=3.28, p<0.05$; $F(2,81)=5.28, p<0.01$.

Motivation: One-way analysis of variance found marginally significant differences in the SD education program group with regard to motivation and awareness of cost ($F(2,72)=2.71, p<0.10$) but

Table 1 : ANOVA testing of each program's effect on knowledge, interest, and motivation.

		SD education program			T6P education program		
		Degree of freedom	F value	Significance probability	Degree of freedom	F value	Significance probability
Knowledge		2	7.224	0.001	2	9.319	<0.001
Interest		2	3.282	0.043	2	5.280	0.007
Motivation	Abstract environmental consciousness	2	0.959	0.388	2	0.901	0.410
	Concrete environmental consciousness	2	0.932	0.399	2	1.003	0.371
	Awareness of social reform	2	0.062	0.940	2	0.340	0.713
	Awareness of movement	2	0.763	0.470	2	2.562	0.083
	Awareness of cost	2	2.707	0.074	2	1.086	0.342

Table 2: T-testing of each program's effect on behavior.

	SD education program			T6P education program		
	t value	Degree of freedom	Significance probability	t value	Degree of freedom	Significance probability
Deliberate environmentally responsible behavior	-2.03	48	0.048	-1.42	54	0.162
Routine environmentally responsible behavior	-0.95	48	0.349	-1.65	54	0.104

found no significant differences with regard to abstract environmental consciousness, concrete environmental consciousness, awareness of social reform, and awareness of movement ($F(2,72)=0.96$, n.s.; $F(2,72)=0.93$, n.s.; $F(2,72)=0.06$, n.s.; $F(2,72)=0.76$, n.s.).

In the T6P education program group, awareness of movement showed marginally significant differences ($F(2,81)=2.56$, $p<.10$) but the other factors (abstract environmental consciousness, concrete environmental consciousness, awareness of social reform, and awareness of cost) showed no significant differences ($F(2,81)=0.90$, n.s.; $F(2,81)=1.00$, n.s.; $F(2,81)=0.34$, n.s.; $F(2,81)=1.09$, n.s.).

Behavior: Unpaired t-testing showed that the SD education program group's deliberate environmentally responsible behavior one week after reading differed significantly from its behavior before reading ($t(48)=2.03$, $p<0.05$) but that its routine environmentally responsible behavior did not ($t(48)=1.03$, n.s.). In the T6P education program group, both parameters are showed no significant difference ($t(54)=1.39$, n.s., $t(54)=1.42$, n.s.).

6. Comparison between the SD education program and the T6P education program

Comparison of the two education programs supports our hypothesis that the SD education program makes people awareness of the costs of their behavior and promotes environmentally responsible behavior. Cost consciousness and deliberate environmentally responsible behavior seem to be taught by only the SD education program, and awareness of movement seems to be taught by only the T6P education program. The SD education program seems not only to instill cost consciousness but also to stimulate deliberate environmentally responsible behavior. The T6P education program, however, makes people awareness of movement but does not significantly influence their deliberate environmentally responsible behavior. In other words, the cost consciousness instilled by the SD education program is effective in getting people to behave in environmentally responsible ways.

We cannot, however, be certain that the SD education program document produced cost consciousness; the statistical result is only marginally significant. We need to examine educational methods and content. For example, we expect methods such as game-playing and simulated experiences to be effective in helping people understand social dilemmas. Understanding the necessity of considering costs would be encouraged by having each individual reconsider the costs of their actions by participating in group discussions or by role-playing. Horsley (1977) found that students asked to persuade their friends or family to behave in environmentally responsible ways began to behave that way themselves.

7. A future environmental education

We have found that environmentally responsible behavior is promoted by education that helps people

understand the structure of social dilemmas and recognize necessity of cost consciousness in resolving these dilemmas. Our results, however, do not mean that the existing environmental education is ineffective. They show that environmental education is effective in changing people's attitude toward environmental issues. Imamura (1997) writes that the purpose of environmental education is to solve environmental problems, and we suggest that adding the SD education program to the existing environmental education will further this purpose. We think that the SD education program will act synergistically with the existing environmental education and promote environmentally responsible behavior more effectively. A study in cooperation with an environmental education leader will be an issue in the future.

It will also be necessary to conduct a long-term investigation examining changes in the effects of various kinds of education. Moreover, we cannot claim that our results are generally applicable because our experimental subjects were university students. We need to conduct a broader investigation and compare its results with those of the present study.

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