

TECHNICAL NOTE

Can an Education Program alter Students' Perceptions of the Causes of and Solutions to Climate Change? – A Case in South Korea

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Abstract

This study investigated whether an educational program could alter students' perceptions of the causes of and solutions to climate change. On October 23, 2020, a 3-hour climate change educational program was provided to 400 high school students in Suncheon City, (Jeonnam Province, South Korea). According to the program, climate change represents a social dilemma, or tragedy of the commons; it also asserts that collective action aimed at strengthening government policy is the optimal solution to climate change, and concludes that motivated citizens should convey their opinions directly to the government through political action. After the program, the students made and shared placards calling for policy-based responses to climate change. Questionnaires completed by the students before and after the program revealed that their perceptions of the causes of and solutions to climate change changed significantly. This case study indicates that education programs have the potential to alter students' perspectives and promote actions aimed at mitigating and adapting to climate change.

Key words : Tragedy of the commons, Social dilemma, Political action, Placards, Government policy

1. Introduction

In recent years, experts have increasingly emphasized the role of education for preventing catastrophes associated with climate change (Pierrehumbert, 2005). At the opening of the United Nations Framework Convention on Climate Change (UNFCCC), all parties to the United Nations(1992) asserted their commitment to “promote and cooperate in education, training and public awareness related to climate change.” In the Paris Agreement, the United Nations(2015) reaffirmed the importance of education and recently asserted that “Education is key to addressing climate change”. The “Climate without

Borders” education network has a daily reach of approximately 375,000,000 people (United Nations, 2022).

The purpose of climate change education is to ensure a safe and prosperous future by mitigating the negative impacts of climate change. Citizens must understand the necessity of, and participate in, targeted action (UNESCO and UNFCCC, 2016). Regarding the kinds of action that climate change education should encourage, some insist that consumption patterns must be changed in line with increased use of renewable energy (e.g., Anderson, 2012). However, while renewable energy is important, it may not be sufficient to address the problem

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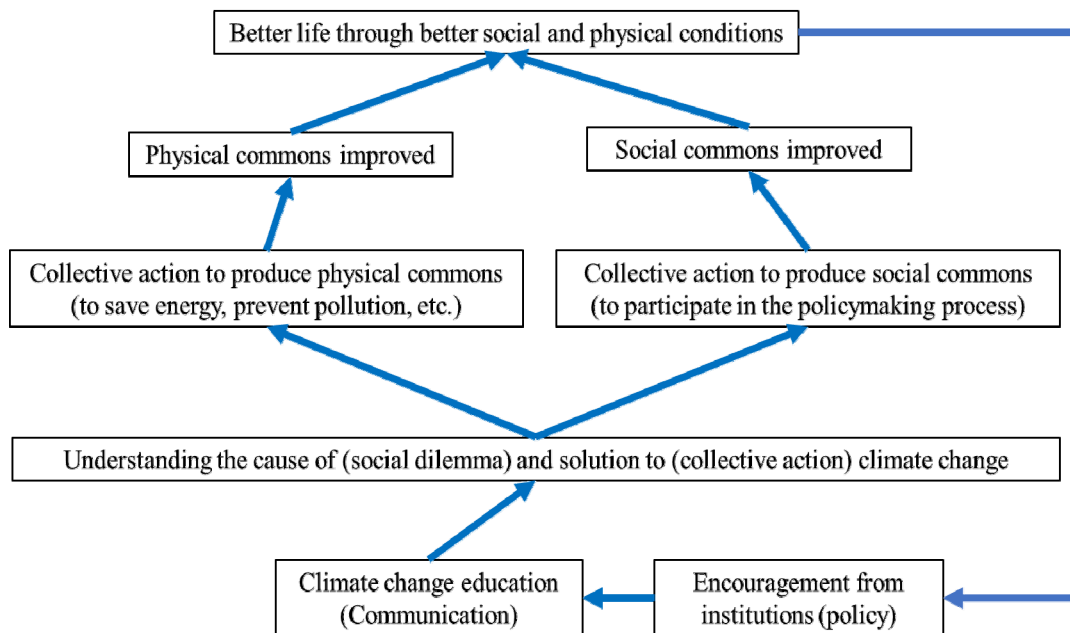


Fig. 1. Causal chain of climate change education.

of climate change.

From the perspective of institutionalism that studies the choice within constraints (Ostrom, 2010a; Paavola, 2011; Bisaro and Hinkel, 2016), this paper seeks to determine the actions that should be encouraged through climate change education. Identified political actions include demonstrating and picketing to encourage changes in government policy on climate change. An education program implemented in South Korea in 2020 to encourage 400 high school students to engage in such actions is described, along with the results of questionnaires completed by the students both before and after the program. The results illustrate that such programs can alter students' perspectives regarding the causes of and solutions to climate change.

2. Materials and Methods

2.1. Theoretical backgrounds

2.1.1. Causes of and solutions to climate change

The aim of climate change education is to encourage action to mitigate and adapt to the adverse effects of climate change (Stevenson et al., 2017). To identify the activities that should be encouraged, it is imperative that the causes of and solutions to climate change be fully understood.

Climate change exemplifies the tragedy of the commons (Hardin, 1968) and represents a social dilemma (Beckenkamp, 2011). Under the social dilemma model, when an individual tries to maximize their own utility or benefit, the utility of the society is minimized (Dawes, 1980). Social dilemmas arise because of differential features of goods or resources (Ostrom, 2010b). Typical private goods traded under the market system are excludable and subject to rivalry (McNutt, 1999)-that is, owners of goods can exclude others from using (excludable) and once the owners are consuming the goods, the other people

Table 1. Types of activities related to climate change education

| Activity types | Examples | Implications |
|---|---|---|
| A-type: private actions to increase personal utility | To increase personal benefit and decrease personal cost | Without education, most people will only engage in A-type activities |
| B-type: collective action to improve physical commons | To save energy, reduce waste, and protect natural ecology | Most current climate change education encourages B-type activities. However, such activities alone are not sufficient to solve the problems caused by climate change. |
| C-type: collective action to improve social commons | Participation in activities influencing policymaking (e.g., picketing to encourage better policy on climate change) | Future climate change education should encourage C-type activities which are critical to resolve climate change. |

cannot consume the goods at the same time (rivalry). However, common or public goods, such as the ocean, are not excludable, i.e., people cannot be excluded from using them. Such goods are also not subject to rivalry, because its consumption of an individual does not limit its consumption of other people (Ostrom, 2010b). As the commons are neither excludable nor subject to rivalry, nobody is willing to produce them because they cannot be sold on the market (Adams and McCormick, 1993). The atmosphere and ecosystem, i.e., the global climate system, is a typical example of the commons (Li et al., 2021). People “using” the atmosphere by emitting greenhouse gases into it may be unwilling to protect the climate system if they cannot derive any profit from doing so.

Assuming that climate change is an example of the tragedy of the commons, preventing the tragedy should be the goal, rather than simply waiting for the collapse of human civilization, as has happened several times in the past (Diamond, 2010). Based on historical examples, Ostrom(1990) demonstrated how tragedy may be prevented through “collective management of the commons” (McGinnis and Walker, 2010). Collaborative creation and implementation of rules governing the sustainable use of resources (and preventing pollution thereof) was common to communities who successfully prevented such

tragedies (Ostrom, 1990). However, a question arises as to why members of these communities participated in the rule-making process despite the fact that such participation exemplifies the dilemma of collective action (Olson, 1965). That is, if an individual is attempting to maximize their utility (or profit) only, why would they participate in the rule-making process if doing so would derive no profit? Ostrom et al.(1992) answers this question by evoking the logic of repeated games—that is, if a game (or trade) designed to allocate resources is conducted repeatedly, the players will take action even though it will not be profitable in the short term, because it will be profitable in the long term.

2.1.2. Role of education in solving the problem of climate change

The role that education played in addressing the problem of climate change may be better illustrated by reference to the prisoner’s dilemma (Rapoport et al., 1965). Suppose that two criminals are questioned by the police: if the criminals communicate and cooperate to deny their crimes, their common profit will be maximized because they will be freed. However, if each of them attempts to maximize their own profit by betraying the other without communicating or cooperating, the benefit they derive will paradoxically be minimized because



Fig. 2. Two scenes from the education program on climate change held in 2020. All 400 students made their own campaign placards calling for government action on climate change (left), and some discussed their placards in front of the other students (right). The placard on the right-hand side reads, “Dear national congressman! Please change the law to promote recycling, public transport, and the use of environmentally friendly products.” (pictures by Kyung-suk Park)

they will be punished. The climate change problem resembles the prisoner’s dilemma (Soroos, 1994; Wood, 2011) in that individual humans, companies, and countries emit abundant greenhouse gases into the atmosphere while in pursuit of their own profit, and thus all contribute to society’s collapse.

This situation highlights the urgent need for communication and cooperation to make rules governing acceptable energy usage and greenhouse gas emission levels (Rashidi-Sabet et al., 2022). Fortunately, abundant evidence suggests that it is possible to resolve this issue. For example, research has demonstrated that social learning promotes the establishment of institutions (rules or agreements) for governing the commons (Sigmund et al., 2010). Agreements among players can be reached through iterations of the prisoner’s dilemma (Miller, 1996). In particular, when the goal of overcoming the social dilemma is established, people are better positioned to resolve it (Seijts and Latham, 2000)

because they can learn from (and trust) one another by sharing information (Ostrom, 2010B).

Communication and cooperation are now clearly acknowledged as essential to overcoming the social dilemma of climate change (Brick et al., 2016). Social dilemmas can be overcome through education that promotes pro-social activities, such as cooperation (Ahmed, 2008). Climate change education should not be delivered through unidirectional teaching, but rather should encourage students to find solutions by sharing information and devising and implementing rules to regulate the use of resources (Stevenson et al., 2017).

2.1.3. Causal chain of climate change education and types of activities

With respect to climate change education, students must first understand that climate change is caused by a social dilemma, and that participation in the production of commons is necessary and beneficial for themselves in the

Table 2. Differences between the education program for this study and conventional climate change education

| Features | Conventional climate change education | Education conducted for this study |
|-----------------------|--|---|
| Main contents | Natural sciences focusing on the climate change phenomenon. | Social sciences relating to the cause of (social dilemma) and solution to (collective action) climate change. |
| Methods | The lecturer delivers a one-sided explanation to the students. | Socrates style: The lecturer poses questions to the students and the students discover the truth by answering the questions. |
| Activities encouraged | None. | (1) "Please write a sentence addressing the government, as though you were demonstrating." (2) "Please tell your friends about your sentence." |

long term. Moreover, when designing climate change education programs, it should be emphasized that there are various kinds of commons, including natural, knowledge, and social commons (Hess, 2008). Activities aimed at protecting or producing only natural commons (a term from Bazzul and Tolbert, 2017) or physical commons (a term from Tavani, 2005) are emphasized in conventional environmental education. Activities designed to protect or improve the social commons (a term from Byrne, 2009; Lees-Marshment et al., 2020), such as legislation, must be emphasized in climate change education because of their critical importance.

As Fig. 1 illustrates, climate change education is a form of communication among communities (Monroe et al., 2007). Through climate change education, students can understand the cause of (social dilemma) and solution to (collective action to protect the commons) climate change. The students may then engage in two kinds of collective action: the production of physical commons (e.g., saving energy and preventing pollution) and social commons (e.g., participating in the policymaking process). These activities improve both the physical and social commons, and thus enhance quality of life. This better quality of life will lead to the establishment of institutions for education, which will in turn encourage climate change education.

Three types of activity may take place, as shown in Table 1 (the terms in which are from Olson, 1965; Hansen et al., 2005; and Goodin, 2015). A-type activities are "private" actions taken to increase personal utility. Without education, in a society that teaches that the market accomplishes everything, most people will only engage in A-type activities. B-type activities are collective actions aimed at improving physical commons, and include activities aimed at saving energy or reducing waste. Most climate change educations seem to focus on B-type activities (e.g., Kim and Choi, 2010; National Research Council, 2011; Anderson, 2012), but these are insufficient to resolve climate change problems. C-type activities are collective activities undertaken to improve the social commons. Participation in policymaking processes and picketing to improve climate policies are examples of C-type activities. Future climate change education initiatives should encourage such activities, which are critical for addressing climate change.

2.2. Aims, contents, and methods of the education program

A 3-hour climate change education program was delivered to 400 high school students on October 23, 2020, in Suncheon City (Jeonnam Province, South Korea). The program's ultimate goal was to encourage students to engage in the

Table 3. Questionnaire responses of high school students in South Korea before and after the climate change education program conducted in October 2020

| Lefthand statements | | Agreement rate | | Righthand statements | |
|--|------------|-------------------------------------|------------|---|--|
| 1: Climate change is better explained by natural sciences. | 68% 44% | Before program After program (*) | 32% 56% | 1: Climate change is better explained by social sciences. | |
| 2: The problems caused by climate change can be more effectively resolved by developing science and technology. | 71% 32% | Before program After program (*) | 29% 68% | 2: The problems caused by climate change can be more effectively resolved democratically. | |
| 3: Climate change education should focus on natural sciences. | 60% 32% | Before program After program (*) | 40% 68% | 3: Climate change education should focus on social sciences. | |
| 4: The responsibility to protect the world against climate change rests with adults, including politicians and scientists. | 36% 29% | Before program After program | 64% 71% | 4: The responsibility to protect the world against climate change rests with everybody, including myself. | |
| 5: I am not willing to act to protect the world against climate change | 11% 7% | Before program After program | 89% 93% | 5: I am willing to act to protect the world against climate change. | |
| 6: Assembly and demonstration are undesirable activities because they threaten democracy and peace. | 19% 11% | Before program After program (*) | 81% 89% | 6: Assembly and demonstration are desirable activities because they strengthen democracy and peace. | |
| 7: The most desirable activity for adolescents to make the world safe from the climate change is school learning. | 51% 23% | Before program After program (*) | 49% 77% | 7: The most desirable activity for adolescents to make the world safe from the climate change is demonstration to request policy changes. | |
| 8: The government should formulate climate change policy based on the advice of experts, such as scientists. | 65% 32% | Before program After program (*) | 35% 68% | 8: The government should formulate climate policy based on the opinions of citizens. | |

Note: The star marks () indicate that the support for the righthand statements increased significantly ($p < 0.01$) after the education program based on t-tests.

above activities—particularly C-type activities—with the aim of mitigating and adapting to the adverse effects of climate change. To this end, the lecturer sought to alter students' perspectives on the causes of and solutions to climate change. The program covered the causes of (i.e., a social dilemma) and solution to (collective action for the commons) climate change. The lecturer particularly sought to persuade students to engage in C-type actions (i.e., collective actions aimed at improving social commons).

Our education program differed from conventional climate change education in three respects (Table 2). The main content related to social sciences, i.e., the social dilemma and

collective action, rather than the natural sciences. In the style of Socrates (Woodruff, 1998), the lecturer continuously posed questions to the students, rather than simply lecturing, so that the students could arrive at the truth by themselves as they answered the questions.

For example, the lecturer asked the students the following question: "You all know that greenhouse gases are the cause of climate change. But greenhouse gases have existed throughout human history. Why has the ratio of greenhouse gases increased so sharply during the 20th and 21st centuries?" The students stated that factories and cars were the key causes of the increased ratio of greenhouse gases. The lecturer

then posed the following additional questions: "What about you? You are also using electricity, cars, and factory-made products, even though you know that they are the cause of climate change. Is there anybody who is not going to use them from now on? All people are the same. Why do people emit greenhouse gases into the air despite their knowledge that such activities contribute to climate change?" In response, the students stated that emitting greenhouse gases into the air is profitable to individuals. Then, the lecturer asked, "Do you think current campaigns are sufficient to persuade people to reduce greenhouse gas emissions?" The students indicated that they were not. Finally, the lecturer asked, "How can we encourage people to reduce greenhouse gas emissions?", in response to which some students stated that the law should be changed to persuade people to reduce emissions.

The lecturer then asked the students to engage in "learning by doing" (Smart and Csapo, 2007; Cavanagh, 2011), based on the following scenario: "Imagine that you are participating in a street demonstration in front of government offices or the national congress. What would you ask the government to do to resolve the problems caused by climate change? Please limit your answer to one sentence, suitable for a placard. After you have made your placard, please tell us about it" (Fig. 2). In this way, the lecturer tried to encourage the students to think independently about climate change.

3. Results and discussions

To assess changes in the students' perspectives, they were asked to indicate which of two opposing statements they agreed with, for eight pairs of statements. The pre-program questionnaire was completed by 304 (76%) students, while 282 (71%) students completed the

post-program questionnaire (from among 400 high school students aged 15-16 years). The results revealed that the education program changed the students' perceptions with respect to the causes of and solutions to climate change; the pre- and post-program responses differed for six of the eight items (Table 3).

After the program, 56% of the students agreed that the causes of climate change were better explained by social rather than natural sciences, compared with 32% prior to the education program. Furthermore, after the program, 68% of the students stated that the problems caused by climate change can be better resolved democratically than through the development of science and technology, compared with 29% before the program. Regarding political actions, the proportion of respondents who thought that demonstrations were the best activity for adolescents increased from 49% to 77% after the program.

However, willingness to take action to combat climate change did not increase significantly after the educational program (93%), because the rate was already high (89%). Moreover, students' sense of responsibility (statement No.4) did not increase significantly (from 64% to 71%), perhaps because many students feel their responsibility already strongly. Perhaps it means that the students are ready do something against the climate change, but they just do not know how to act.

4. Conclusion

The adverse effects of climate change are so urgent that climate change education should not be limited to a passive form; an action component is needed to address the problems facing humanity. For this reason, climate change education should be distinct from other types of environmental and sustainable development-related education. Given that climate change is a

social dilemma, institutions (agreements or rules) should be improved to encourage all social actors to do something to mitigate and adapt to climate change.

Herein, an education program that altered high school students' perspectives on the causes of and solutions to climate change was described. The students came to realize that political engagement with the aim of changing government policy on climate change is their responsibility, because climate change is a social dilemma.

As this study is limited to only one case, more education programs emphasizing students' action need to be implemented. Especially, if an exemplary education program shows that students' action can really change the government policy, it may encourage other teachers and schools to do such education programs more. As climate change continues to pose a threat to human life, targeted education and greater involvement of the populace in policymaking processes are needed.

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