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Contributing to Sustainability Education of East Asian University Students through a Field Trip Experience: A Social-Ecological Perspective

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Academic Editor: Richard C. Smardon
Received: 11 August 2016; Accepted: 18 October 2016; Published: 21 October 2016

Abstract: This study reports the effects of a field trip environmental education program with a social-ecological perspective on the experience and learning of university students from China, Japan, South Korea and Vietnam. The students visited Jeju Island, the Saemangeum Sea Dike, the Demilitarized Zone and Seoul, South Korea. Their experiences and learning about social-ecological interactions were analyzed using the new environmental paradigm test, an evaluation questionnaire, group presentations and individual reports. Across demographic characteristics, the participants believed the program fairly presented the concept of social-ecological systems. Some developed new ideas of social-ecological systems through interpreting, transforming and contextualizing their field trip experience based on prior knowledge bases; others compared the sites to case studies. They preferred the sites where social-ecological issues were clearly presented by well-preserved landscapes, successful environmental management or environmental conflict. The results show the need for an advanced multi-dimensional methodology to evaluate students' learning through constructive processes. The program design of this study from planning to field trip and evaluation, the field site design in which regional site resources were organized in a social-ecological context and the analysis of participants' learning and experiences could contribute to attempts to couple the social-ecological perspective with the practice of sustainability and environmental education in field trip design.

Keywords: constructive learning; corporate social responsibility (CSR); environmental education; new environmental paradigm (NEP); resilience

1. Introduction

Resilience in social-ecological systems, which is one of the recent striking perspectives in transdisciplinary studies on society, coherently links and binds the social system and ecosystem and allows those systems to be dynamic, complex, nonlinear, multidimensional, adaptable and transformable [1–4]. In the perspective of social-ecological systems, resilience describes not only the "capacity to absorb shocks and still maintain function", but also the "capacity for renewal, re-organization, and development" [3] (p. 253). Sustainability studies have aimed to be interdisciplinary across nature and social sciences. Here, the social-ecological perspective responds to the aim; the perspective allows us to think about sustainability by comprehensively integrating complex and resilient processes in the social-ecological system.

Social-ecological system resilience can be devoted to building a novel framework for sustainability and environmental education because the environmental problems that sustainability and environmental education aims to solve deal with dilemmas and contradictions among diverse sociocultural interests and perspectives with a lack of a single stable state of the solution [5,6]. Consequently, environmental educators have sought the possibility of teaching about resilience and the social-ecological perspective in environmental education. For example, Schultz and Lundholm [7] suggested the potential values of biosphere reserves for resilience education. Sriskandarajah et al. [8] introduced case studies that promote resilience learning for university students. Sterling [9] discussed resilient learners "who are able to develop resilient social-ecological systems" (p. 512) by integrating instrumental and intrinsic perspectives in education for sustainable development. Therefore, the perspective of resilience in social-ecological systems is expected to provide new insights in sustainability and environmental education.

The field of sustainability and resilience education practices are expanding from within the boundary of academia [10,11] to informal and non-formal types of education, such as field trips [12,13], citizen science [14,15] and civic ecology [16,17]. These informal education types can expose society to easy learning of sustainability and could consequently contribute to social resilience. Environmental education has feasibly utilized field trips because they supplement the aims of environmental education that the classroom environment does not satisfy. Environmental education needs to integrate various cognitive dimensions, such as the ontological (i.e., realities), epistemological (i.e., values) and axiological (i.e., ways of knowing) [8], in addition to satisfying numerous educational purposes such as conveying information, building understanding, improving skills and enabling sustainable action [18]. The complex framework of environmental education corresponds to the following several strengths of field trip education: subject- or topic-oriented focus, strong group interaction, direct nature experience and affection for the environment [19–21]. Therefore, field trips have been welcomed by environmental educators, not only for youths, but also in higher education [8,22].

The East Asian region is concerned about various environmental problems, such as the growth of resource use and CO_2 emissions, land use change, desertification and dust sandstorms, radioactive exposure, rising sea levels, and so on, within and across countries [23–25], resulting in potential international conflicts in contrast to the rapid growth of economies, populations and well-being. Environmental education may have a large potential in leading toward the sustainability of East Asian environments, alongside the various efforts to foster sustainable societies in science and technology, business and economics and policy and management practices. Nevertheless, international reports on environmental education in the East Asian region are rare [26].

The current study aims to report on the experience and knowledge gained from a field trip environmental education program for East Asian university students organized by a private foundation's corporate social responsibility (CSR) program (see Section 2, Materials and Methods, for details). Specifically, we question (1) the learning processes that foster the social-ecological perspective of the participants; (2) the effective design of the field trip program; and (3) the direction of environmental educators in the context of a CSR-funded field trip program (see Section 4, Discussion). To achieve this, we conducted a quantitative analysis to test the effect of the field trip program on participants' learning and to evaluate the program (see Section 3, Results). In addition, we analyzed qualitative statements from participants regarding their experience of the field trip program from the social-ecological perspective (see Section 3, Results). Finally, it is anticipated that this study will contribute to excellence in sustainability education through the use of field trip programs.

2. Materials and Methods

2.1. Description of the Field Trip Environmental Education Program

The field trip environmental education program aimed to provide opportunities to East Asian university students to go on field trips, to learn about current environmental problems in the region and

to envision future sustainability in the region. For approximately one week, participants visited field sites nationwide, listened to lectures and performed group and individual assignments. The program was launched in 2012 with a Chinese, Japanese and South Korean university (anonymous) and was held successively in those countries on an annual basis. It was organized and funded by a private foundation (anonymous). The Office of International Affairs and a few professors from the departments of environmental, educational and/or international studies at each university participated in the field trip design, planning and management in cooperation with the funding foundation. In addition, the professors played the role of instructors, providing lectures, reading materials and evaluations. Meanwhile, professional staff from a tour agency managed the field trip program.

In August 2013, the second program was held in South Korea, and a Vietnamese university was newly included. Approximately 20 participants were selected in each university by the professors and university managers. The details of the selection standards for the voluntary applicants differed across the universities. However, three guidelines were shared: (1) the students were interested in environmental problems; (2) the students were able to communicate with students from other countries using English; and (3) the students had diverse demographic and academic backgrounds. As a result, the demographic characteristics of the participants were diverse (Table A1). For example, the gender ratio (M:F) was 3.8:6.2; academic years were broadly distributed from undergraduate freshman to graduate; and nearly half of participants were majoring in environmental-related study (24%) and business/economics (23%), while the other half were majoring in various other subjects, including arts, education, engineering/technology, law, literature/language, medical/natural science, social science, and so on.

The specific objectives of the program in 2013 were defined as follows: (1) to understand the processes, characteristics and effects of the interactions between the environment and humans by studying various cases in Korea; (2) to share numerous thoughts of students from the four countries about the environment and humans; and (3) to learn the cooperative method to deal with environmental topics by sharing cases of environmental management. The idea of interaction between the environment and humans, which was the key concept of the program, is illustrated in Figure 1; humans manage the environment through adaptation, conservation, cultivation, development, exploitation, and so on, while the environment responds to this management through climate, culture, energy and resources, natural disasters, pollution, and so on. The participants were expected to learn, think and practice the multidimensionality of environmental problems by considering the complex interactions between humans and the environment beyond the linear continuum between anti- to pro-environment. This key concept was adopted from the social-ecological perspective and other analogous concepts, such as ecosystem service [27], human ecology [28] and human ecosystem [29].

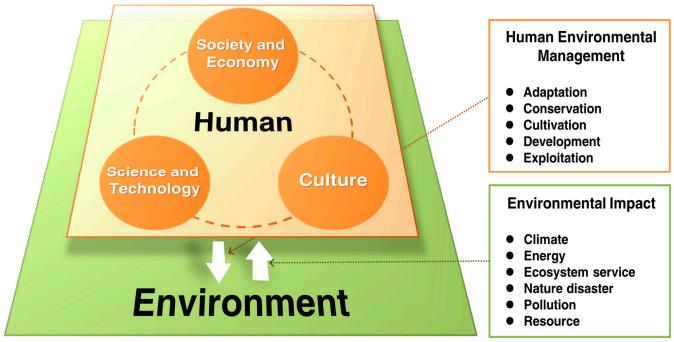

Figure 1. Concept of the interaction between humans and the environment in the field trip environmental education program for East Asian university students.

Figure 2 shows the framework of the field trip program. During the program planning, the key concept, field sites and activities were designed. Field sites that supported the key concept

were selected in consideration of their social-ecological characteristics, their novelty, which may be a source of astonishment to participants, and location and accessibility (see Section 2.2, Field Sites). Reading materials that describe the key concept of the program and the features of the field sites from the social-ecological perspective were provided to the participants before the field trip commenced. On the first day of the program (Day 1), instructors lectured on the social-ecological perspectives of environmental problems and outlined the program. In addition, instructors from four universities successively lectured on specific environmental issues in their representative countries every night during the field trip. The participants were asked to conduct group work during the field trip, give a group presentation at the end of the field trip (Day 7) and write an individual report a number of weeks after the program. The group presentation and individual reports were assigned for participants to describe their own understanding and findings regarding the key concept of the program. Quantitative tests were performed before (Day 1) and/or after (Day 7) the field trip to obtain participants' demographic backgrounds (demographic questionnaire) and environmental knowledge (environmental literacy questionnaire) and to evaluate the effects of the program on their environmental attitudes (new environmental paradigm) and experiences (evaluation questionnaire). Finally, the instructors analyzed the participants' group presentations, individual reports and experiences with the results of the quantitative tests to evaluate the success of the program with respect to environmental education (see Section 2.3, Analysis of the Field Trip Experience).

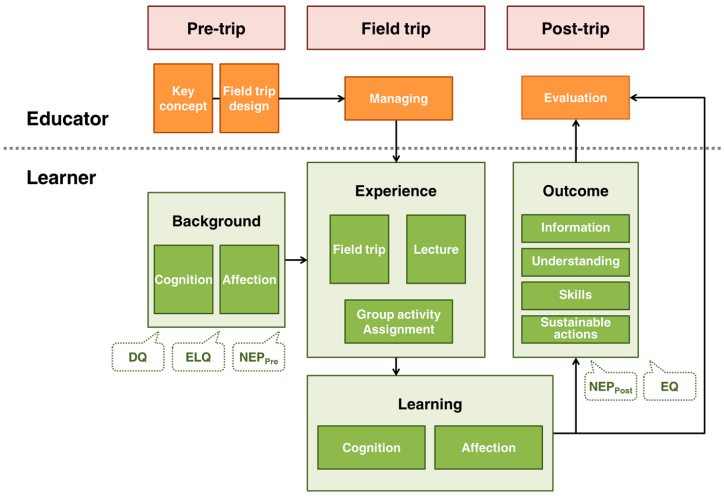

Figure 2. Framework of the field trip environmental education program for East Asian university students. Educators set the key concept (Figure 1) and field trip design (Figure 3) in the pre-trip stage, managed the field trip and evaluated the effects of the program on learners' cognition and affection. Learners integrate their background knowledge with the field trip experiences and cumulate knowledge during the field trip. The demographic questionnaire (DQ; Table A1), new environmental paradigm (NEP; Table S1) [30–32] in the pre-trip stage (NEP_{Pre}) and environmental literacy questionnaire (ELQ; Table S2) [33–36] were administered to determine the learners' background and baseline of their environmental attitude before the field trip. At the end of the field trip, the evaluation questionnaire (EQ; Table S3) and NEP at post-trip (NEP_{Post}) were given again to investigate the learners' learning and outcomes from the field trip program.

The learning achieved through the field trip is illustrated as a cognitive and affective process of knowledge building regarding environmental problem cases, their related social-ecological processes and possible solutions or further challenges through contextual interactions between a learner's background knowledge and field trip experiences (Figure 2). Here, the field trip experiences are contextualized by the learner's acting, thinking and feeling in physical, personal and sociocultural contexts [37]. For example, the participants experienced the physical environment of the field sites,

acquired environmental knowledge from lectures and communicated with group members or local people. As a consequence of learning in the field trip experiences, learners achieve educational outcomes, such as knowing information, understanding, skills for practice, performance and behavior and sustainable actions through building the transformative capacity to environmental problems [18]. This framework mainly inherits constructivist perspectives [9,38,39] focusing on the constructive processes of learning between learners and contexts, including participation in, adaptation to, interpretation of and transformation of knowledge. These perspectives are appropriate for interpreting the learning processes in informal and non-formal types of education, such as field trips [40].

2.2. Field Sites

On the field trip, the participants visited sites in four regions: Jeju Island, the Saemangeum Sea Dike, the Demilitarized Zone (DMZ) and Seoul. The selected sites represent various, unique patterns of social-ecological processes (Figure 3) among the available site resources in South Korea. Each field site is briefly described below.

- Jeju Island (Days 2 and 3): Jeju Island is the most famous tourism area in Korea with various volcanic landscapes, beautiful scenery and a distinct cultural heritage. The following four sites in Jeju Island illustrate the diverse patterns of interaction between the valuable environments, cultural heritage and development of tourism. Jeju Island has 368 Oreums, which means "parasitic volcanos" in the Jeju dialect. The participants hiked along a trail in Geomun Oreum, which was designated as a UNESCO World Heritage Site in 2007, and experienced the well-preserved environment. Visiting a managed forest (Hannam Experimental Forest) provided a case of sustainable forest management and an opportunity to walk, breathe and relax in a cedar forest (i.e., forest bathing [41]). The participants learned about the traditional culture of Jeju, which adapted to the inadequate island environment and resources, by visiting Jeju Folklore & Natural History Museum and Jeju Folk Village. The Olle Trail is a series of walking trails along Jeju's coastline, where visitors see beautiful nature and have contact with the locals. It suggests an alternative way of sustainable tourism beyond the usual mass tourism. The participants took a short walk on the Olle Trail. All visits were guided by local experts.
- Saemangeum Sea Dike (Day 4): Saemangeum, which is an estuarine tidal flat on the coast of the Yellow Sea, represents a case of intensive environmental management through dike construction and landfill. The Saemangeum Sea Dike Project from 1993–2010 dammed Saemangeum with a 33.9 km-long dike and remade the estuarine tidal flat into 28.3 km^2 of land. The project caused a large environmental conflict among the government, local people, NGOs, religious communities, politicians and scholars because of the potential impacts on habitats, biodiversity and water quality. Now, infrastructures on the reclaimed land are under construction depending on their agricultural, industrial, residential, research and recreational uses. The participants visited the dike and listened to lectures from the project office and a local NGO, who had opposing perspectives on the sea dike and its environmental impact. Finally, the participants conducted a tree-planting activity on the reclaimed land for both educational, as well as ceremonial purposes.
- Demilitarized Zone (DMZ) (Day 5): The DMZ, which is a strip of land running across the border between North and South Korea since the end of the Korean War, 1953, represents a novel environment with interaction between diplomacy and the environment. The DMZ is an approximately 4 km-wide buffer zone out of which the militaries in the two countries face each other. Because military and civilian activities are extremely controlled within and around the DMZ, environment and biodiversity in the DMZ area is significantly protected [42]. The participants visited migratory bird habitats and observatories to watch the landscape of the controlled DMZ area, as guided by a local NGO activist.
- Seoul (Day 6): Seoul, the capital city of South Korea, is a highly urbanized environment with a population of about 10 million. Since the 1960s, the landscape of Seoul has rapidly shifted

to an urban system alongside the increase of population, infrastructure, land cover and urban sprawl. Two sites, Nanji Park and the Cheonggyecheon Stream, demonstrated the history of environmental problems resulting from modernization and successful cases of restoration from a degraded environment. Nanji area was a past landfill site where 90 million m^3 of garbage were dumped from Seoul from 1978–1993. The landfill during the 15 years left two garbage hills 100 m high with contaminated soil, leachates and gases, in addition to degraded habitats. The restoration project aimed at land stabilization, leachate and gas treatment, and park creation was carried out after the landfill site closed in 1993. Finally, Nanji Park was opened to the public in 2002. The Cheonggyecheon Stream, which crosses downtown Seoul, was covered up with concrete for a road and elevated highway during the 1960s–1990s. The concrete infrastructures on the Cheonggyecheon Stream promoted the functions for industrialization and modernization in Seoul, such as traffic and sewage discharge. However, as time passed and the concrete aged, the stream needed to be renovated with the new sociocultural values instead of the former values of industrialization and modernization. It was placed under a restoration project from 2003–2005; the concrete was removed, and stream flow and green spaces were established. The restoration project improved the landscape of the Cheonggyecheon Stream and downtown Seoul. However, the project's aims and processes were a source of significant conflicts between the Seoul Metropolitan Government and NGOs, who held different perspectives on the environment and politics [43]. For example, environmentalists argued that there was a lack of naturalness in the water flow, which was artificially pumped from the Han River. Nowadays, the two sites are visited by many people for numerous purposes, such as recreation, tourism and education, and they symbolize environmental restoration in Seoul. The participants visited the sites and management offices, attended lectures given by the managers and talked with citizens about the environmental problems in Korea. We encouraged them to incorporate ideas they learned from the talks with citizens at the Cheonggyecheon Stream into the group presentation.

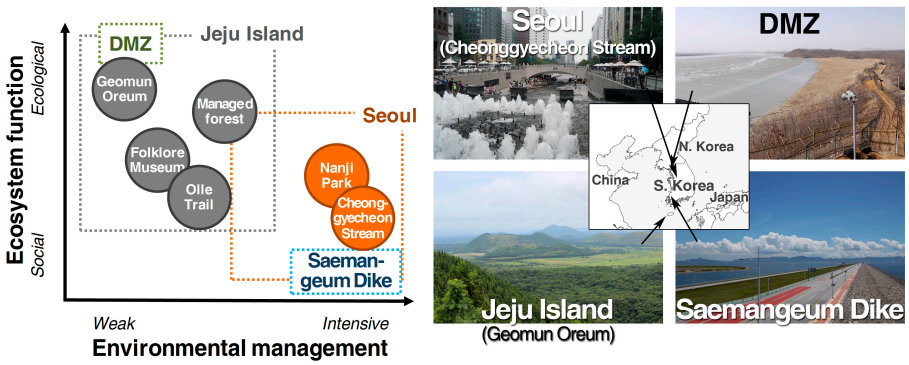

Figure 3. Schematic grid showing the field sites of the field trip environmental education program for East Asian university students.

The field sites each demonstrate a pattern of the social-ecological system on a multi-dimensional scale (Figure 3). The first dimension is the degree of environmental management, which ranges from no management to intensive intervention. The ecosystem of the DMZ has been almost isolated from human activities during the last 60 years following the confrontation between North and South Korea. On the other hand, the Saemangeum Sea Dike has undergone the most intensive environmental management, which changed the ocean and the tidal wetland to the land by the landfill. Jeju Island and Seoul are making an effort toward appropriate management in their contexts of (1) society and economy; (2) science and technology; and (3) culture.

The second dimension represents the ecosystem function along the continuum from supporting society to supporting ecosystem. For example, Geomun Oreum supports the volcanic landscape,

habitat and biodiversity, while Nanji Park provides leachate and sewage treatment for the urban environment and recreational places for citizens.

2.3. Analysis of the Field Trip Experience

Participants' experiences during the field trip were analyzed using questionnaires, group presentations and individual reports. In addition, demographic backgrounds of the participants were surveyed at the beginning of the field trip (Table A1).

Three questionnaires were administered at the beginning and/or end of the field trip for a quantitative analysis (see the items of all questionnaires in the Supplementary Materials). First, the new environment paradigm (NEP) test was administered twice, at the beginning (NEP_{Pre}) and end (NEP_{Post}) of the field trip, to test for the effect on the participants' environmental attitude. The NEP test consisted of 15 standard statements regarding the relationship between humans and the environment (see Table S1). Respondents were asked to check the degree to which they agreed with each statement using a Likert-scale; the scores of each statement were then added together. The NEP test, first invented by Dunlap and Van Liere [30] in 1978 and revised in 2000 [44], has become the most widely-used measure of environmental concern worldwide and has been employed in hundreds of studies [31]. For example, Hawcroft and Milfont [32] conducted a meta-analysis of 69 studies from 36 countries using the NEP test and evaluated the effects of respondent types (e.g., white-color, student, environmentalist, etc.) and number of questionnaire items (from 5–15 items) on NEP scores. Therefore, we believe the NEP can represent the epistemological aspects of participants' learning on the degree of a standardized measure. The meta-analysis by Hawcroft and Milfont [32] reported 0.68 ± 0.11 ($N = 78$) of mean Cronbach's α values, which are an indicator of internal reliability, across case studies. Some questions and words on the questionnaire may have been difficult for the participants, who were non-native English speakers (e.g., "Human ingenuity will ensure that we do NOT make the Earth unlivable"). However, we used the standard NEP (2000 revised edition [44]) questionnaire without any modification because we respect its standardization. To understand the meaning of the questions, participants were allowed to use dictionaries, search the Internet and ask their colleagues for help.

Second, the environmental literacy questionnaire (ELQ) was administered only at the beginning of the field trip. It comprised 15 questions that tested respondents' knowledge of environmental issues, such as human influences on the environment, biodiversity and ecosystem and environmental resources. The total number of correct answers was then counted. The ELQ was invented by the National Environmental Education & Training Foundation of the United States in 1997 [34] and has been modified by several studies for late secondary school and university students in Chile, England, Switzerland, South Korea and the United States [33,35,36]. Limited results of validity tests for ELQ are available; Jin [33] reported a 0.55 mean Cronbach's α value from three sub-categories of the ELQ. The ELQ is not as popular as the NEP, but it is the only available published questionnaire for testing environmental knowledge. We disagreed with some of the questions on the original [34] due to their lack of generalizability and United States-oriented background. For these reasons, questions from modified tests [33,35,36] were selected and modified (see Table S2).

Third, a program evaluation questionnaire (EQ; see Table S3) was provided to the participants at the end of the program. The questionnaire was developed by the authors based on the details of the program and topics. Both the NEP and evaluation questionnaire used a 5-point Likert scale from 1 "strongly disagree" to 5 "strongly agree". Because participants favored the field trip program, the responses may have been biased toward the positive. Nevertheless, the potential bias of even a state-of-the-art evaluation questionnaire would be unavoidable.

The pre-test and post-test NEP scores and environmental literacy scores were tested for differences according to nationality, gender, academic major, age and past environment-related activity experience using the Wilcoxon rank-sum test using the NPAR1WAY procedure of SAS [45]. The net change of NEP scores between the pre-test and post-test was tested using a paired Wilcoxon rank-sum test (H_0: $NEP_{Pre} = NEP_{Post}$). Correlation tests were run to determine the relationships between

participants' demographic backgrounds, NEP scores, environmental literacy and program evaluation. The Cronbach's α values for the pre-test NEP, post-test NEP, environmental literacy and program evaluation questionnaires were 0.53, 0.50, 0.73 and 0.88, respectively. All statistical analyses except the Wilcoxson rank-sum test were conducted in *R* [46].

The participants' group presentations, individual reports and comments were reviewed for a qualitative analysis according to the constructivist perspectives of learning [9,38–40]. At the end of the field trip, the participant groups, which consisted of two participants from each of the four universities, gave 5-minute oral presentations about the experience and findings from the field trip (N = 10). The presentations were video-recorded and noted. The individual reports that were allowed for the participants' research use were collected (N = 16). The participants' comments about the program were gathered in the evaluation questionnaire at the end of the field trip.

In the analysis, two of the authors individually reviewed all of the qualitative materials, mainly the group presentations and individual reports, and then discussed them together. We categorized the participants' statements based on the keywords and ideas pointed out in each qualitative material. During the analysis of participants' statements, we were interested in several questions, such as the following: What were the participants' thoughts about the topic of the social-ecological system? How did the participants develop the idea? How did the participants' demographic backgrounds affect the idea? To which sites did the participants frequently refer? Which factors contributed to their satisfaction or dissatisfaction? These questions guided our in-depth analysis of the participants' experiences and responses. The potential favorable bias in the participants' statements, as well as that in the evaluation questionnaire could not be fully removed, which was a limitation of the analysis. In addition, these analyses were limited by not tracing the long-term responses of the participants.

3. Results

3.1. Questionnaire Analysis on Participants' Learning from an Evaluation of the Field Trip Program

Overall, the evaluation questionnaire, group presentations and individual reports indicated positive effects of the field trip program on the participants' learning; however, the NEP scores did not.

The responses to the evaluation test showed that the students were highly satisfied with the field trip environmental education program (Table 1). They generally agreed that the field trip program was worthwhile in understanding various interactions in the social-ecological system (EQ-43 mean score: 4.74), dealing with local environmental issues in participants' countries of origin (EQ-42: 4.37) and being motivated to engage in environment-related activities in the future (EQ-41: 4.63). Most of the responses fairly corresponded among demographic characteristics, such as nationality and gender groups.

Table 1. Selected participants' evaluations of the field trip environmental education program for East Asian university students using a 5-point Likert scale (1: strongly disagree; 2: mildly disagree; 3: unsure; 4: mildly disagree; 5: strongly agree). An asterisk (*) and dagger (†) indicates a significant difference of means among the participants' nationalities and genders, respectively ($p < 0.05$). Numbers in parentheses indicate the standard deviation. The overall results of the evaluation questionnaire (EQ) are listed in Table S3.

Questionnaire Item	Total	Nationality				Gender	
		China	Japan	South Korea	Vietnam	Female	Male
The program successfully taught the main topic about the interactions between humans and the environment (EQ-43). *,†	4.43 (0.76)	4.35 (0.99)	4.55 (0.52)	4.11 (0.76)	4.74 (0.45)	4.59 (0.54)	4.13 (0.99)
My experience during the program will be helpful for dealing with environmental issues in my country or local community (EQ-42).	4.32 (0.76)	4.25 (1.02)	4.45 (0.69)	4.28 (0.67)	4.37 (0.60)	4.34 (0.61)	4.29 (1.00)
My experience during the program has motivated me to be involved in environment-related activity in the future (EQ-41).	4.44 (0.74)	4.25 (1.02)	4.45 (0.69)	4.44 (0.62)	4.63 (0.50)	4.57 (0.55)	4.21 (0.98)
The group activity with participants from other countries was effective for understanding diverse and different thoughts on the environment (EQ-39).	4.51 (0.61)	4.50 (0.61)	4.55 (0.52)	4.39 (0.78)	4.63 (0.50)	4.59 (0.50)	4.38 (0.77)

The NEP scores did not differ by gender or nationality in either the pre- or post-test ($p > 0.05$). The participants' mean NEP score (3.55) were slightly lower than that in the meta-analysis of 69 studies (3.75) by Hawcroft and Milfont [32]. Even though the participants shared general interests in the environment, their mean NEP score showed that their environmental attitude was not strongly pro-environment. The mean NEP scores for China, Japan, South Korea and Vietnam, respectively, were 3.55, 3.66, 3.59 and 3.48 on the pre-test and 3.46, 3.71, 3.72 and 3.47 on the post-test (Figure 4a). The NEP scores on the pre- and post-tests were 3.60 and 3.58, respectively, for the female participants, and 3.52 and 3.48 for the male participants (Figure 4b). The environmental literacy scores significantly differed among nationalities in the order of China (11.0), South Korea (10.8), Vietnam (9.6) and Japan (9.2) (Figure 4c); however, they did not by gender (10.0 and 10.6 for the female and male participants, respectively; Figure 4d).

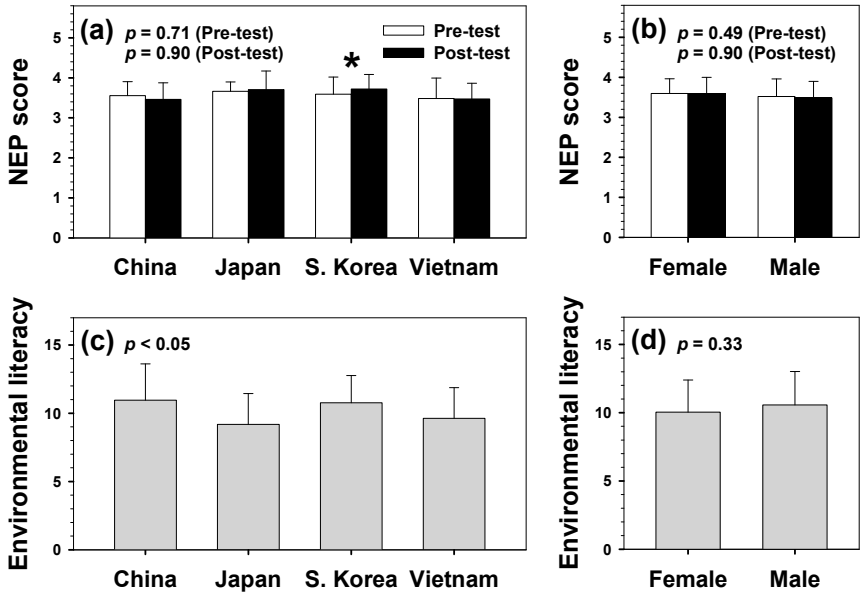

Figure 4. New environmental paradigm (NEP) scores of the East Asian university students before and after the field trip environmental education program using a five-point Likert scale (1: strongly disagree; 2: mildly disagree; 3: unsure; 4: mildly disagree; 5: strongly agree) (**a**,**b**) and their environmental literacy score (**c**,**d**). The *p*-values indicate the significant differences among groups (nationality or gender). An asterisk (*) indicates a significant difference between the pre- and post-tests, tested by the paired Wilcoxon rank-sum test (H_0: $NEP_{Pre} = NEP_{Post}$; $p < 0.05$). Bars indicate the standard deviation.

A change in the mean NEP score between the pre- and post-tests was significantly observed only for the South Korean participants (from 3.59 on the pre-test to 3.72 on the post-test; a change of 0.13), not for the participants of other nationalities or the two genders (Figure 4). The NEP score change was negatively related to the NEP pre-test score; the lower NEP pre-test score, the greater the NEP score increase (Figure 5a). In other words, the NEP score increased for participants who had a lower pro-environment attitude, whereas it remained unchanged or slightly decreased for those who already had a higher NEP score. On the other hand, the NEP score change was not related to the environmental literacy score (Figure 5b). The influences of demographic properties on NEP score change were mostly not observed. Participants' past experiences of environmental programs might be negatively related to the NEP score change; however, this tendency was insignificant (Figure 5c). The NEP score increased for participants with no experience (0.11 ± 0.45), changed little for those with some experience (0.05 ± 0.40) and decreased for those with frequent experience (-0.10 ± 0.23).

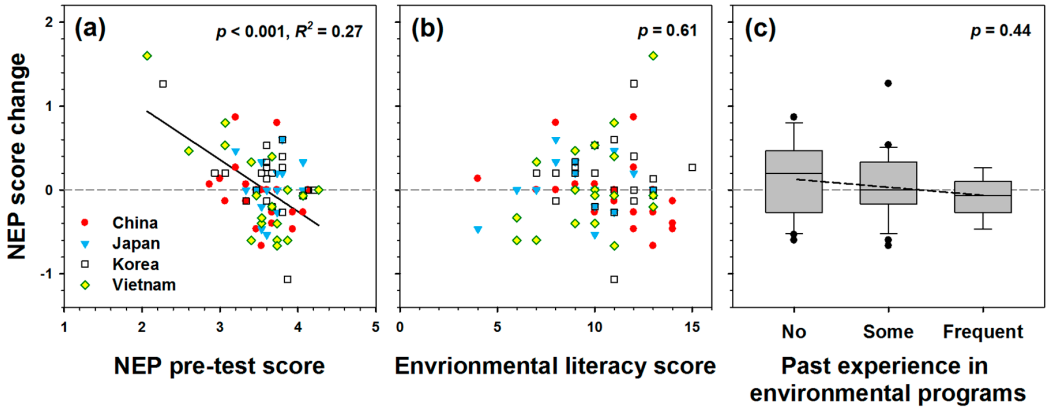

Figure 5. Relationship between new environmental paradigm (NEP) pre-test scores (**a**) and environmental literacy scores (**b**); past experience in environmental programs (DQ-10) (**c**) and NEP score change (post-test score–pre-test score). The first two relationships and the other were tested using the linear regression and the Wilcoxon rank-sum test, respectively.

3.2. *Qualitative Analysis of Participants' Statements on the Experience of the Field Trip Program*

From the participants' group presentations and individual reports, five types of interesting responses were observed: constructive learning, comparison with the environment in the country of origin, importance of education, importance of friendship and suggestion for the future (Table 2). First, several participants applied their prior knowledge to the field trip experience, then built a new idea through processes of constructive learning (Table 2). One participant studying business law interpreted the interaction between humans and the environment as a contract and environmental problems as a failure of the contract. One group attained the concept of ecosystem service as follows: "[N]ature provides three values that humans can benefit from: mental, social, and economic benefits" (Table 2; Figure A1). Another group adopted the environment Kuznets curve hypothesis, which shows a reversed U-shape curve of environmental degradation along income per capita [47] and applied it to the field sites (Figure A1). Second, the participants compared the social-ecological systems at the field trip sites to those in their origin countries (Table 2). One participant addressed the resource limitation in his hometown and sustainable development, while another discussed potential green tourism practice in Ha Long Bay, Vietnam (Table 2). Yet another participant introduced the Satoyama Initiative [48] as a successful case of rebuilding the balance between humans and the environment in Japan. One group shared the cases of environmental degradation and restoration in each country.

Table 2. Examples of participants' statements from the evaluation questionnaire, group presentations and individual reports at the end of the field trip environmental education program for East Asian university students.

Statement
Constructive learning
"The agreement between humans and the environment includes purposes of contract, terms and conditions, as well as regulations related to torts and other concurred provisions. The intention is to create harmony between two parties so that they co-exist, and both parties have their own rights and obligations mentioned in the contract. When one party fails to fulfill its duty without reasonable cause or violates the terms of the agreement, it must compensate for the loss of the other party during the act of the breach."
"It could be said that nature provides three values that humans can benefit from: mental, social, and economic benefits. Nature provides resources and food that are needed for living. It can also be used to create business models such as tourism for economic benefit, and lastly, it has the power to provide mental relief, as I have experienced during this trip."
"Here is the Kuznets curve.... We have adopted, adapted, and modified it to measure the relationships between environmental damages and the nation's economic levels.... Once in a developing economy, nations tend to emphasize developing their well-being and put less effort into environmental protections."

Table 2. *Cont.*

Statement
Constructive learning
"I found no resource-depleted cities in South Korea. But my hometown Zaozhuang is a resource-depleted city. It was once famous for coal, but now the coal stores cannot sustain for another 20 years. So a transformation in development is urgent."
"Both Ha Long Bay and Jeju Island have received the goodwill of mother of nature, but they have some differences because the environmental management is different in each country.... Our time in Jeju taught me a lot of good ideas for my country about green tourism, especially for Ha Long Bay."
" . . . Creating an environment where there is a win-win relationship between the environment and human activity is important to consider when thinking about how to create a sustainable society for future generations. As promoted in the Satoyama Initiative, I believe that there are possibilities for modern technology, humans, and the environment to coexist in harmony."
"The biggest lesson that I learned is the method of education. People should have the chance to know both the positive and negative sides when learning about any problem."
"Education should be implemented as one of the main keys to solving environmental problems because it can change all the generations and then change the whole world."
"In order to improve the quality of an environmental management system, it is truly essential for a country to educate more and more generations of future leaders with a multidisciplinary approach."
"Field experiences are a more effective way to learn about the environment than lectures."
"Not only did I learn much knowledge, but I also participated in group work and formed good relationships with many outstanding students, and we became good friends."
"I realized that the communication between different countries and different cultures is very useful and important."
"It would be better to introduce to the students more details about environment-friendly technology."
"The program was very well organized. But the tight schedule was a little bit tiring."

Third, the participants learned the importance of education for managing environmental problems appropriately as they experienced the transdisciplinary perspective during the field trip (Table 2). They expected more opportunities of environmental education programs, like this field trip program, to be provided to many people. Fourth, the participants actively engaged in group work with other participants from different countries (EQ-39 mean score: 4.63; Tables 1 and 2). The differences of language and culture resulted in troubles in communication sometimes, especially during preparation for the group presentation with a limited time. Nevertheless, the participants practiced solving the problems that were due to the difficulty of communication among group members with diverse backgrounds. This experience will be useful to the participants for building human capital across countries in the East Asian regions. Finally, they left some suggestions for the future (Table 2). The participants who were interested in environmental-friendly technologies suggested visiting pollution control facilities. A considerable number of participants recommended adjusting the tight schedule of the field trip, which made the participants tired.

3.3. Site Evaluations for the Field Trip Program

Designing the field trips and selecting the field sites were important determinants of the success of the field trip environmental education. The participants reported having the highest satisfaction with Jeju and the lowest satisfaction with the DMZ as an appropriate site for field trip environmental education (Table 3). The key concept of the program was most successfully presented in Jeju (mean score: 4.54), followed by Saemangeum (4.24), Seoul (4.12) and the DMZ (3.68). In addition, Jeju (4.31) was evaluated as the most excellent place for environmental education, followed by Seoul (4.24), Saemangeum (3.81) and the DMZ (3.63).

Table 3. Site evaluations for the field trip environmental education program for East Asian university students using a 5-point Likert scale (1: strongly disagree; 2: mildly disagree; 3: unsure; 4: mildly disagree; 5: strongly agree). Asterisks (*) indicate a significant difference of means among the sites ($p < 0.05$). Numbers in parentheses indicate the standard deviation.

Questionnaire Item	Jeju	Saemangeum	DMZ	Seoul
I learned a lesson about the interactions between humans and the environment from the site. *	4.54 (0.58)	4.24 (0.81)	3.68 (1.00)	4.12 (0.87)
The site could be an excellent place for environmental education. *	4.31 (0.74)	3.81 (1.12)	3.63 (1.02)	4.24 (0.74)

4. Discussion

4.1. Constructive Learning and Education for Building a Social-Ecological System

Compiling all evidence of the participants' responses to the field trip program (Tables 1 and 2, Figure 2) especially in terms of constructive learning (Table 2), this program might present learning for resilience and develop the resilient learner, according to the terms of two different educational approaches to social-ecological systems [9]. The key concept of the program, complex interactions within social-ecological systems, was fairly understood by the participants (EQ-43; Table 1) in terms of instrumental learning. Moreover, the participants not only passively absorbed the concept of resilient social-ecological systems (i.e., learning for resilience), but also actively interpreted, transformed and contextualized the concept using their prior knowledge bases (i.e., resilient learner) (Figure 2). For example, they applied existing knowledge (e.g., the environmental Kuznets curve or the business law context) to the field trip experience (Table 2) and developed a new idea (e.g., concept of ecosystem service or placing the field sites on the environmental Kuznets curve; Figure A1). Here, the various demographic and academic backgrounds of the participants might be interpreted and communicated during the field trip experience, and this process facilitated the participants' resilient thinking and learning. This intrinsic learning process could build a learner's capacity for creating innovative solutions in dynamic, multi-dimensional and resilient social-ecological systems [9,49], which is the valuable art of environment management, in reality.

However, the NEP tests failed to determine the effects of the field trip program (Figures 4 and 5) in contrast to the participants' positive responses regarding the educational effects of the program and evidence of constructive learning in participants' statements (Tables 1 and 2). This may not be surprising; a meta-analysis by Stern et al. [50] found that 12 of 86 environmental education programs reported no difference between pre- and post-program scores for various reasons. Several explanations for the limited NEP score change could be speculated. First, the NEP tests may be insensitive to determining the instantaneous effect of the field trip program during a short period. The NEP determines environmental attitude, which is already developed in the internal conceptual framework, rather than enhanced knowledge and constructive learning. Moreover, the participants were university students who had already developed and fixed their conceptual frameworks like environmental attitude. Therefore, the effects of the field trip program may not be reflected in the NEP score change. Second, the linearity and the single-dimensionality of the NEP test [32] may not provide an appropriate measure of the complexity and multi-dimensionality of the social-ecological perspective, the key concept of the program. That is to say, participants' learning from the social-ecological perspective might be too complicated to be quantified on the linear continuum along the degree of pro-environmental attitude.

The multi-dimensionality of learning about the resilient social-ecological system might result in the paradox of evaluating the related education. How do we define the success or failure of learning about the invisible social-ecological system? Which measures can be applied to evaluating such education? Social-ecological system education aims to enlarge learners' in-depth ability to adapt to, interpret and

transform knowledge about the resilient system over their surface instrumental knowledge about the system; therefore, the available tools in both qualitative (e.g., participants' statements) and quantitative analyses (e.g., NEP test) are insufficient to describe learners' experiences. In other words, our analyses might be limited to comprehensively unveiling the participants' learning during and after the field trip program, which remains a limitation of this study. Less is known about methods to evaluate the learning provided by social-ecological system education [11]. Recently, Milfont and Duckitt [51] invented the Environmental Attitude Inventory (EAI) that can determine the multi-dimensional aspects of environmental attitudes; however, it is limitedly applied due to the complicated questionnaire. More alternative measures that can evaluate learning for resilience and the resilient learner need to be developed and validated. Fazey [52] adopted a questionnaire about personal epistemological belief [53] as a measure of the degree of resilience thinking. Personal epistemological belief underlies the cognitive process of knowing with the nature of multiple dimensions: certainty of knowledge, simplicity of knowledge, source of knowledge and justification for knowing [53]. The current questionnaire that tests general aspects of individuals' epistemological beliefs can be modified to include more specific items relevant to the social-ecological perspective.

On the other hand, the remarkable increase of the NEP score by the program was observed in the participants with low NEP pre-test scores who might have limited experiences with the environment (Figure 5a,c). Unsurprisingly, the significant change in the mean NEP score of the South Korean participants (Figure 4a) may imply that field trips in one's own local environment, which the participants are familiar with and have more sociocultural background information about, would be more effective. Because this program focused on social-ecological interactions, the participants might need much more background knowledge to understand the complexity of the situation at each site. DeWitt and Storksdieck [13] suggested that very strong or weak novelty of a field site could affect the participants' learning to be less effective, according to the literature synthesis. Here, preparatory education can be highlighted for mitigating the novelty of the site [13,54]. Therefore, educators can require more interest in practices to reduce the 'handicaps' of foreign participants within the limited schedule.

4.2. Field Trip Design for Environmental Education

Jeju was selected as the most appropriate place for environmental education. The participants were impressed by the well-preserved naturalness and various lives of local people adapting the environment in Jeju. They were interested in most of the sites on Jeju (EQ-5–EQ-8; Table S3) and were willing to revisit the island for tourism in the future (EQ-9 mean score: 4.49; Table S3). The Saemangeum Sea Dike and Seoul demonstrated cases of both positive and negative sides of strong environmental management by humans. Especially at the Saemangeum Sea Dike, two opposite lectures by the project institute and a local NGO activist provided different views of the effects of the Saemangeum Sea Dike projects; this allowed the participants to understand the complex and contradictory views about environmental management. The participants responded differently to the acceptance of the Saemangeum Sea Dike Project (EQ-13; Table S3). For instance, the score was the highest for the Chinese participants (3.50) and the lowest for the South Korean participants (2.06) and lower for female participants (2.68) than for male participants (3.42).

On the other hand, the DMZ was the least interesting and effective site in the program for several reasons. The program design might have failed to include an appropriate context of the DMZ for environmental education from the social-ecological perspective. As a result of complex social-ecological processes, the landscape in the DMZ area, which has been unintentionally well preserved due to the confrontation between North and South Korea, should be novel and impressing. However, previous literature (e.g., [42,55]) and educators in this program have not fully illustrated the social-ecological processes in the DMZ yet. Therefore, the novelty of the DMZ was not directly linked to the participants' learning. In addition, the guided field trip mainly focused on the ecology of migrant birds and flora in the DMZ area, rather than the social-ecological perspective, due to the specialty of the NGO naturalist

who guided the field trip. Regarding the need for understanding the resilient DMZ system, Grichting and Kim [56] recently attempted to contextualize the DMZ in terms of greening in the red zone, which refers to "community-based stewardship of nature," for recovering social-ecological resilience (i.e., greening) in the aftermath of a political, economic, social and environmental crisis (i.e., the red zone) [57] (p. 3). Environmental education on the DMZ ought to consider adopting this new approach. Some operational problems, such as heavy rainfall, a tight schedule, and the long-distance drive on the day of the DMZ trip, also contributed to the participants' dissatisfaction.

The successes and failures of this study stress the importance of field trip design and context to represent the complex interactions between humans and the environment, among the various factors that affect the success of field trip environmental education (e.g., field trip design, the social context and novelty of the site, prior knowledge of the participants [13]). In reality, the social-ecological processes are hidden in the landscape of the site. The invisibility of these processes challenges the learning acquired from field trips, which mostly derives from visible factors. The landscape does not tell its story by itself; rather, the story must be translated by an educator. Frankly speaking, we put less effort into sharing social-ecological perspectives with the field educators who took charge of the invisible knowledge. Here, several questions can be suggested: How can we discover excellent resources for field trip education in local, regional and nation-wide environments? How can the resources be described and interpreted from social-ecological perspectives? How can the resources be positioned within the social-ecological dimensions? What kind of lectures can effectively promote the participants' interest in and background knowledge of resilient systems? How can the invisible social-ecological processes be visualized? Suggestions for successful field trips from a review of DeWitt and Storksdieck [13] may provide answers to the above questions. More conceptual frameworks and empirical reports that improve the integration of field trip education and the social-ecological perspective are expected.

4.3. Environmental Education in the Context of Corporate Social Responsibility (CSR)

Recently, the number of field trip environmental education programs has been growing with the support of private foundations and corporations. Funding a private foundation for environmental education is a worthwhile strategy for fulfilling CSR for sustainable development [58,59], despite the fact that such measures are sometimes criticized as mere greenwashing for marketing purposes that instantly enhances the public perception of a corporation, rather than seeking permanent substantial effects on society and the environment [60,61]. Beyond the debates on the social and environmental justice of CSR, opportunities for environmental education programs are increasing in response to the social demand for CSR. In particular, a field trip program, whether short or long term, temporary or permanent and regional or international, might easily be considered to be a feasible environmental program to be run as part of CSR activities. Thus, the interest of corporations in CSR can be successfully allied with the opportunity for sustainability and environmental education.

On the other hand, differences in the principles between business and environmental education may disorder the practice of providing field trip programs, apart from their educational purposes. Despite the easy accessibility of selecting a field trip program as a CSR activity, such an environmental program can easily face a lack of discipline, strategy and/or reflection in its planning, management and evaluation due to the inherently less-structured characteristics of field trips as an informal mode of education. Moreover, field trip programs can easily be biased as "too field trip" focused (i.e., underutilization due to not integrating the field trip experience into the educational orientation) or "too education" focused (i.e., overutilization due to a strong educational orientation using classroom-style instruction) [20] without professional knowledge and experience of environmental education.

Therefore, the role of environmental educators should be to elaborate the design of environmental programs, to enlarge the educational effects of programs and then to make good use of opportunities from CSR activities. Only a limited number of studies have been conducted on CSR participation in sustainability and environmental education in terms of the current status and its educational aspects. Further studies are thus recommended.

5. Conclusions

The resilient social-ecological perspective was practiced in the field trip environmental education program for university students from four East Asian countries. Participants built and expanded their knowledge of environmental problems through the contextual interactions between their own background knowledge and the field trip experiences, according to their qualitative responses. This case study supports that field trips can help develop resilient learners and, consequently, social resilience. On the other hand, the existing measures that are generally applied in environmental education could not adequately illustrate the effects of the field trip program on participants' learning; therefore, advanced measures that can evaluate the dynamics, trans-dimensionality and resilience of learning are needed. Educators in the field trip program need knowledge, experience and strategies to design the contexts of field sites in order to represent complex interactions between humans and the environment.

This exploratory study presents a case in which it was attempted to couple the social-ecological perspective with the practice of sustainability and environmental education in field trip design. This study does not report surprising results, such as a tangible change in participants or an excellent standard for a field trip program; nevertheless, it does contribute to program design from planning to field trip and evaluation (Figure 2), the field site design in which regional site resources were organized in the social-ecological context (Figure 3) and analysis of participants' learning and experience (Figures 4 and 5; Tables 2 and 3) for further progress in this field. Using the excellent practices of sustainability and environmental education through appropriate cooperation with CSR activities, it is expected that the sustainability of the East Asian region will be fostered by the opportunity to experience nature, to gain new perspectives on the social-ecological system and to interact with candidates for future international collaboration, as the next generation who will lead their respective societies.

Supplementary Materials: The following are available online at www.mdpi.com/2071-1050/8/10/1067/s1, Table S1: The questionnaire of the new environmental paradigm (NEP), Table S2: Environmental literacy questionnaire, Table S3: Questionnaires responses evaluating the field trip environmental education program.

Acknowledgments: We appreciate the anonymous private environmental foundation that organized and supported the field trip program. We also appreciate the passionate NGO directors and activists who devoted themselves to helping and guiding the field trip in Jeju, Saemangeum and the DMZ. This study was supported by research grants from the National Research Foundation of Korea (2015R1A6A3A01058445) and the Korea Forest Service (S211216L030120).

Author Contributions: Tae Kyung Yoon, Takako Takano and Yowhan Son conceived of and designed the study. Tae Kyung Yoon and Seongjun Kim performed the data collection. Tae Kyung Yoon, Seongjun Kim and Sun-Jin Yun analyzed the data and discussed the implications. Tae Kyung Yoon wrote the paper.

Conflicts of Interest: The authors declare no conflicts of interest. The funding sponsors had no role in the design of the study; in the collection, analyses or interpretation of data; in the writing of the manuscript; nor in the decision to publish the results.

Appendix A

Table A1. Demographics of the participants in the field trip environmental education program for East Asian university students (N = 78).

Characteristics	Frequency	Characteristics	Frequency
Gender		*Academic major*	
Female	48 (62%)	Arts	4 (5%)
Male	30 (38%)	Business and economics	18 (23%)
Nationality		Education	2 (3%)
China	22 (28%)	Engineering and technology	9 (12%)
Japan	16 (21%)	Environment-related study	19 (24%)
South Korea	21 (27%)	Law	4 (5%)
Vietnam	19 (24%)	Literature and language	6 (8%)
Age		Medical and natural science	9 (11%)
Under 20	9 (12%)	Social science	7 (9%)
20–22	49 (63%)	*Experience of participation in environmental programs*	
23–25	16 (21%)	Actively involved	13 (17%)
26–28	3 (4%)	A few times	40 (51%)
29 and over	1 (1%)	No	23 (29%)
Academic year		No response	2 (3%)
Freshman	6 (8%)	*Motivation for participating in the program*	
Sophomore	19 (24%)	Interest in environmental topics	46 (44%)
Junior	22 (28%)	International friendship and experience	30 (29%)
Senior	17 (22%)	Tourism in many places of Korea	17 (16%)
Graduate school	14 (18%)	Participation in and lessons about environmental practices	12 (11%)

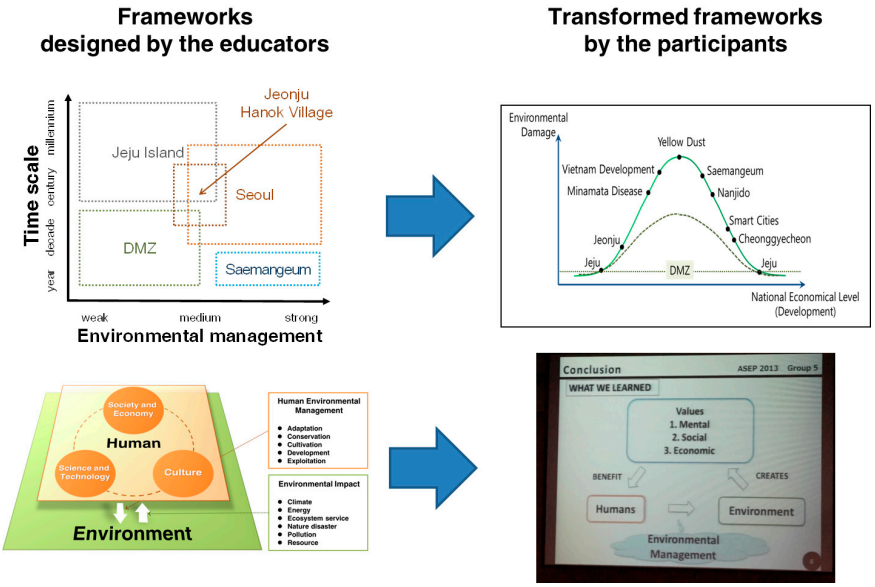

Figure A1. Cases for which the participants transformed the frameworks of the field trip program based on the contextual interactions between learner's background knowledge and the field trip experiences.

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