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Change in Knowledge and Awareness in Teacher Education on Satoyama Environmental Learning: Through a Blend of Learning Spaces, Methods and Media

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Abstract: Lessons on Satoyama environmental education were held for undergraduate students who are training to be educators. The lessons blend inquiry-based learning through research using ICT tools and experiential learning in a complementary manner. Students learn about the underlying concepts about the environment from a global perspective through inquiry-based learning; experiential learning can encourage students to get involved with the environment at the local level and also develop abilities and skills to conduct classes in environmental education. This paper investigated how the lessons influenced the students in these areas: knowledge of technical terms related to Satoyama environmental education, students' confidence and desire to engage in environmental education, and how awareness of their own abilities were improved through the lessons. To understand the impact of the lessons quantitatively, survey contents of the subjective awareness etc. were printed on A4 paper medium and were distributed. The medium were collected after filling them during class. The data are analyzed using Wilcoxon signed-rank test, Wilcoxon rank sum test, and cluster analysis. As a result, overall recognition of technical terms increases on post-survey. There is an increase in the mean score for all items on confidence and desire to engage in environmental education. For the awareness on abilities, students feel that their abilities increased overall across all items.

Keywords: *Trainee teacher, environmental education, blended learning, inquiry-based learning, experiential learning.*

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Introduction

The ever-changing and abundant landscape, unique to Satoyama, has provided much to human society. Satoyama are sites rich in biodiversity (Natural Environment Bureau, 2012). However, with the changes in society and economy in recent years, it is becoming difficult to maintain and manage Satoyama and Satochi—the mountains and the lands at the interface of nature and human settlement. This was a finding reported in a survey of organizations which promote the preservation of Satoyama. There have been attempts to improve the situation through educational programs with a heavy focus on experiential learning. E.g. In collaboration with an elementary school, the students were taught about the origins of Satoyama and the health of the forests within it. They made continuous observations of the forest and spent time immersing in the forest environment. After which, the students then made recommendations to renegotiate the relationship between forests and humans for modern society (Forestry Research Institute Kansai Branch, 2009).

To cultivate leaders for a sustainable society through education, UNESCO has been promoting Education on Sustainable Development (ESD) (Japanese National Commission for UNESCO, 2016). ESD aims to encourage students to ownership of global problems and act at the community level to tackle the issues at hand. While this philosophy is widely known, the implementation of ESD currently is far from ideal. An example will be Nakaguchi and Asada's (2016) recommendation on experiential learning of Satoyama and Satoumi: the part of the ocean environment where humans and nature interact. The dilemma faced was that: Studying the earth's environment requires a deep understanding of science and hence, exploration of this topic may end up being a paper exercise on theory and concepts; however, fieldwork can cause one to be myopic and focus too much on the activities at hand, with the risk of losing sight of the bigger picture.

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Finding a balance between intellectual exploration and experiential learning is difficult. Most cases tend to focus on one at the expense of the other. René Dubos advocated the ideal of "Think globally, act locally" at the UN Conference on the Human Environment in 1972. The philosophy of ESD that UNESCO is promoting is based on this maxim. Environmental education resonates with the model which refers to the environment in a holistic, human-oriented approach as interacting biophysical, social, economic and political dimensions (Goldman et al., 2013). Uyanik (2016) reported that considering nature walking activity's positive effect on study group's emotions towards environment, nature-based activities will be very beneficial for environmental education applications. Additionally, self-evaluation activities let students make assessment about themselves. Such a kind of activities can be used in order to let students develop awareness themselves. Edsand and Broich (2020) found some statistical evidence that environmental education can promote a higher level of environmental awareness. El-Batri et al. (2019) reported that extracurricular environmental activities in Moroccan middle schools promoted effective environmental education.

A survey conducted previously shed light on how children interact with nature during daycare. This survey also collated suggestions from daycare centers on the competencies trainee daycare teachers need to be trained in on in order to be effective, among other barriers in environmental education (Maesako, 2006). In another example, Ida, et al. conducted a survey on trainee teachers in universities about their views of nature they see in their surroundings and how that affects their views in education on nature (Ida & Aoki, 2006). The survey found a decreasing trend in the interactions teachers have with nature (Nozaki, 2012). It is thus vital to include interactions with nature as part of the curriculum for students training to be teacher. To further promote environmental education, concrete evidence on the effectiveness environmental education is essential. Unfortunately, there are almost no attempts to collect and evaluate data in this area. Trainee teachers hold the key to the education of young children who will become our future leaders. Getting trainee teachers to understand the importance of evaluations is thus critical. Currently, there are no theses by trainee teachers who have tried to measure and analyze the effectiveness of education programs on the natural environment.

To realize Dubos' vision, this paper focuses on "blended learning" (BL), a teaching method that accommodates both inquiry-based learning and experiential learning. BL combines traditional classroom-based instruction, in which students go through similar learning experiences in the same time and space, with e-learning done on an individual basis. It is hoped that the two learning methods can complement each other to raise the overall learning effectiveness (Miyaji, 2009). In one example, Fujimoto and Miyaji (2008) observed that critical communication skills were fostered in elementary school students when they share their observations on flowering plants on electronic bulletin boards. In another case, junior high school students learn were tasked to publish a newsletter by actively using digital contents as part of a geology lesson (Fujimoto et al., 2005). The students also went through classroom-based instruction, along with group learning and individual learning. A class which combines e-learning and other media with a lecture is at present called a blended class (Thorne, 2003; Bonk & Graham, 2006). It is possible to support many and various student learning styles and to deepen understanding by using more than one medium (Bersin, 2004; Miyaji, 2009). In this example, the increase in the consciousness of issues is significant through the BL method. Blended learning enhanced students' perception of the educational environment in medical education (Facharzt et al., 2013). The blended learning environment presented rich content, easy accessibility, effective guidance and motivation (Uz & Uzun, 2018). Beyond elementary and junior high schools, BL has proven to be effective in different contexts including early discovery of poor performers in class (Hasegawa et al., 2016), acquisition of techniques in nursing school (Okamoto et al., 2015), IT-related classes in higher education (Miyaji & Yoshida, 2005), student guidance, special education etc.

There are no precedent studies on the effect of conducting classes on environmental education about Satoyama on trainee teachers using the BL method. In order to better fulfill Dubos' vision, BL which combines inquiry-based learning and experiential learning, will be the teaching methodology adopted in this study on the effect of environmental education on Satoyama. Data on the effectiveness of this class is gathered through four survey questionnaires on knowledge of technical terms, desire and confidence in delivering lessons on environmental education, awareness in own abilities and activities that were effective in enhancing abilities. These data would then be evaluated to see the effectiveness of the class, i.e. the BL-style lessons designed, for this study.

Methodology

Goal of study

In the class, the space, method and media for conducting environmental education were modified to suit the contents to be covered in the BL-style environmental education on Satoyama. It is hoped that the BL method helps to increase knowledge, cultivate practical skills and to increase the desire to do more for environmental education in the students. As part of the lessons, student research on the earth's natural environment using ICT tools. The knowledge gained and the critical thinking and decision-making skills fostered would help them develop a global perspective. On the other hand, efforts were also made to cultivate interest and desire in the students to interact with their surrounding environment, and to gain practical skills to protect the environment. This process would develop the local perspective in students.

Data collection tools

To find out if learning effectiveness is increased through a blend of learning spaces, methods and media, four types of survey questionnaires were designed. Survey contents were printed on A4 paper medium and were distributed. The medium were collected after filling them after the class. Because their responses are subjective by students, obtained scores absolutely are consciousness, awareness or feeling.

Pre-surveys were held on November 2015 and they consisted of the following parts: (1) Recognition of technical terms associated with Satoyama environmental education, (2) Confidence and desire to engage in environmental education; and (3) Awareness of own abilities and improvement (if any) due to the class. The post-survey held on December 14 consisted of the above 3 parts and an additional part on (4) activities that were perceived to be effective in improving abilities. A total of 22 students took this module. All of them were present for the surveys (response rate 100%) and all responses were used in the analysis.

(1) Recognition of technical terms associated with Satoyama environmental education

Respondents were asked if they know the 50 technical terms in Table 2 and to provide their responses on a 5-point scale: "5. I know this term; “4. I have some knowledge about this term”; “3. I do not know much about it in detail but I have heard about it.”; “2. I know almost nothing about this term.”; “1. I don’t know this term at all.”

(2) Confidence and desire to engage in environmental education

Respondents were asked to answer to the 20 questions as listed in Table 3 on a 5-point scale with the following responses: "5. Yes, I do.”; “4. Yes, I do to some extent.”; “3. I neither agree nor disagree.”; “2. No, I do not really think so.”; and “1. No, I do not.”

(3) Awareness of own abilities and improvement due to the class

Respondents were asked to evaluate their abilities across 30 items in Table 4 on a 9-point scale:“9. I have a lot of ability.”; “7. I have quite a bit of ability.”; “5. I have some ability.”; “3. I have a little ability.”; "1. I do not have this ability at all.”

Study group and teaching process

The subject for the BL-style class is third-year trainee elementary school teachers who are taking the elective module “Science II”. The total number of trainees who took part in this module is 22. They consist of 12 men and 10 women. This module covers the theories on the various aspects of science education and the foundation of safety instruction in science. Six lessons of this module are dedicated to fieldwork on outdoor activities and environmental education. One lesson is 90 minutes. The six lessons are usually done through experiential learning in the university learning forest. Details for these lessons are in Table 1. The numbers (1)-(6) refer to the number of lessons held. For the class, all students learn about the theories of environmental education simultaneously through a lecture in lesson (1). In lessons (2), (3) and (4), basic skills on ensuring safety in outdoor activities and conducting vegetation survey are taught in groups. In lesson (2), students make charcoal in Satoyama by group learning. In lesson (3), students do bamboo work and cook using charcoal fire by group learning. In lesson (4), students investigate vegetation into forest by group learning. In lesson (5), students conduct their own research on environmental problems, an inquiry-based individual learning approach by individual learning. Students then present their findings to each other in lesson (6) in their own groups, thus group learning occurs in this lesson. To investigate the effects of the class, pre- and post-surveys are conducted with the trainee teachers outside class time.

Table 1. Contents for the Lessons on Environmental Education on Satoyama through BL

Class contents	Learning type
(1) Lecture about the theories of environmental education and ESD	Ensemble learning
(2) Charcoal making training in Satoyama	Group learning
(3) A bamboo work and charcoal fire cooking training	Group learning
(4) Vegetation investigation into forest	Group learning
(5) Investigation learning about the environmental concern	Individual learning
(6) Presentation about the environmental education	Group learning

Data analysis

The following five types of analysis were conducted from the survey data.

[Analysis I] Wilcoxon signed-rank test for (1) the recognition of technical terms on pre- and post-survey: Respondents were asked about their knowledge of 50 technical terms associated with the lessons twice, once before the survey and once after.

[Analysis II] Wilcoxon signed-rank test for (2) the confidence and desire to engage in environmental education on pre- and post- survey: Wilcoxon signed-rank test was performed for the mean scores of all 20 items that asked about students' confidence and desire to engage in environmental education, pre- (at the first lesson) and post-survey (after the sixth lesson).

[Analysis III] Cluster analysis for (2) confidence and desire to engage in environmental education: Cluster analysis was conducted on the 20 items on confidence and desire using pre-survey data.

[Analysis IV] Comparison between the mean scores of the two clusters as identified in III

[Analysis V] Wilcoxon signed-rank test of mean score of (3) awareness in abilities on pre- and post- survey: Respondents were asked to answer a survey questionnaire on awareness of their abilities for 30 items twice, pre- (at the first lesson) and post-survey (after the sixth lesson). The scores of all 30 items for pre- and post-survey were compared using Wilcoxon signed-rank test to see if the lessons caused the overall awareness of one's abilities to improve.

Results

For significance testing, the significance level of 5% is adopted. The symbols, m, SD, Z, p, and r stand for mean, standard deviation, test statistic, p value (significance probability), and effect size respectively. Significance levels of 0.1%, 1%, and 5% are represented by ***, **, and * respectively.

Significance Testing for Recognition of Technical Terms

Respondents were asked about their knowledge of 50 technical terms associated with the lessons twice, once before the survey and once after. The number of respondents who completed both the pre- and post-surveys is 22. The mean score on pre- and post-survey are 2.7 and 3.2 respectively. Table 2 shows the results of Wilcoxon signed-rank test for overall recognition of the 50 terms. At a significance level of 0.1%, there is a significant difference between pre- and post-survey. Effect size is 0.80 and means large. As recognition of technical terms was higher on the post-survey, students' knowledge has increased overall.

Wilcoxon signed-rank test were performed for each technical term. As shown in Table 2, there is a significant difference in the recognition before and after the survey for 33 technical terms at significance levels of 5% and below. These effect sizes are between 0.44 and 0.84 and mean large.

The following 10 terms here indicated no significant difference in as shown in Table 2: 2 Kyoto Protocol, 10 pollution, 11 global warming, 12 heat island, 13 greenhouse gases, 14 acid rain, 18 solar battery, 19 light emitting diode, 20 biomass generation, 30 deforestation, 48 food education.

Table 2. Wilcoxon Signed-rank Test of Technical Terms Associated with Environmental Education

No.	Technical term	Before		After		Test		r
		m	SD	m	SD	Z	p	
1	ESD	2.8	1.1	3.3	1.1	2.8	**	0.60
2	Kyoto Protocol	3.3	0.9	3.5	0.7	0.7		0.15
3	COP20	1.7	1.0	3.0	1.0	3.6	***	0.77
4	Child environment summit	1.9	1.1	2.7	1.0	2.6	**	0.55
5	Sustainable development	2.5	1.1	3.1	1.0	2.3	*	0.48
6	Biodiversity	2.4	0.9	3.3	1.0	3.1	**	0.66
7	Environmental conservation	3.1	0.9	3.6	0.8	3.2	***	0.68
8	North-South problems	3.0	1.0	3.3	0.9	1.7		0.36
9	Carrying capacity	1.4	0.6	2.6	1.1	3.1	**	0.67
10	Pollution	4.2	0.8	4.1	0.7	0.8		0.17
11	Global warming	4.5	0.5	4.4	0.6	0.6		0.13
12	Heat island	3.8	0.8	3.8	0.8	0.0		0.00
13	Greenhouse gas	4.0	0.7	4.0	0.7	0.0		0.00
14	Acid rain	4.3	0.5	4.1	0.7	1.4		0.30
15	PM2.5	3.6	0.7	3.9	0.7	1.9		0.40
16	Methane hydrate	2.4	1.4	2.8	1.3	1.8		0.39
17	Shale gas	1.7	1.1	2.2	1.0	1.8		0.39
18	Solar battery	3.6	0.9	3.6	0.7	0.4		0.08

Table 2. Continued

No.	Technical term	Before		After		Test		r
19	Light emitting diode	3.3	0.9	3.3	0.8	0.6		0.13
20	Biomass generation	3.0	1.0	3.0	1.1	0.0		0.00
21	Renewable energy	3.3	0.7	3.7	0.8	2.5	*	0.54
22	Carbon offset	1.4	0.6	2.4	1.1	3.5	***	0.75
23	Symbiosis	2.0	0.9	3.1	0.5	3.5	***	0.75
24	Recycling society	3.0	1.1	3.5	0.8	1.7		0.36
25	LOHAS	1.4	0.8	2.3	1.1	3.3	***	0.69
26	Reducing	4.0	0.7	4.4	0.7	2.3	*	0.50
27	Reuse	4.1	0.7	4.5	0.7	2.5	*	0.54
28	Recycling	4.3	0.6	4.5	0.6	1.9		0.40
29	Satoyama	2.5	0.9	3.9	0.7	3.9	***	0.84
30	Deforestation	4.0	0.9	4.1	0.7	0.9		0.19
31	Vegetation	2.5	1.1	3.3	1.2	3.1	**	0.66
32	Transition	1.5	0.9	2.3	0.9	2.6	**	0.55
33	Pioneer plant	1.5	1.0	2.1	1.0	2.3	*	0.48
34	A male tree, shade tree	1.9	1.2	2.6	1.3	2.7	**	0.58
35	Miscellaneous trees	2.3	1.2	2.7	0.9	1.7		0.36
36	Evergreen broad-leaved forest	2.1	1.1	2.6	1.3	2.1	*	0.44
37	Climax	1.1	0.5	1.8	0.8	2.9	**	0.62
38	Equilibrium	1.1	0.3	1.9	0.9	3.0	**	0.64
39	Thinning	2.1	1.4	3.0	1.3	2.6	**	0.56
40	Wood miles	1.0	0.2	2.2	1.0	3.3	***	0.71
41	Charcoal	3.6	1.0	4.0	0.8	2.2	*	0.47
42	Bamboo charcoal	3.6	1.0	4.5	0.6	3.3	***	0.71
43	Artificial plantation and natural forest	2.8	1.2	3.4	1.0	2.3	*	0.49
44	Green dam	2.0	1.1	3.0	1.1	2.8	**	0.61
45	Watershed protection	1.1	0.3	2.0	1.0	3.1	**	0.67
46	Environmental learning	3.0	0.6	3.9	0.6	3.5	***	0.74
47	Comprehensive learning	3.4	0.9	3.8	0.8	2.3	*	0.49
48	Food education	3.8	0.6	3.9	0.6	1.1		0.24
49	Biotope	1.9	1.2	2.5	1.2	2.8	**	0.60
50	Kindergarten in a forest	2.0	1.2	3.0	1.4	3.2	***	0.69
	Mean	2.7	1.4	3.2	1.2	3.8	***	0.80

*** p<.001, ** p<.01, * p<.05

Significance Testing on Confidence and Desire to Engage in Environmental Education

Wilcoxon signed-rank test was performed for the mean scores of all 20 items that asked about students' confidence and desire to engage in environmental education, pre- (at the first lesson) and post-survey (after the sixth lesson). As shown in the last row of Table 3, there is indeed a significant difference. Effect size is 0.82 and means large. The results demonstrate that the mean scores did increase the overall confidence and the desire of the trainee teachers to engage in environmental education.

Wilcoxon signed-rank test was performed for each item to see if there is any significant increase in the score after the survey. The results are also shown in Table 3. Out of 20 items, 16 items showed a significant increase after the survey. These effect sizes are between 0.44 and 0.77 and mean large as shown in Table 3. We find that the scores of the following 16 items increased: item 1, 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20. The activities conducted as part of the lesson were effective in raising the participants' confidence and desire, especially for these items.

There was no significant increase in the scores for the following item on post-survey: item 3 "Do you want to instruct on the theme of 'international understanding' for the period of integrated study?", item 7 "Do you think experiencing nature in the fields is a good instructional activity?", item 15 "Do you want to do more woodwork experience using bamboo and wood in future?" and item 16 "Do you want to make charcoal?".

Table 3. Results of Wilcoxon Signed-rank Test on Confidence and Desire to Engage in Environmental Education

No.	Contents of confidence and desire	Before		*After*		Test		r
		m	SD	m	SD	Z	p	
1	Do you know the contents for the period for integrated study?	2.9	0.7	3.5	0.7	3.3	***	0.70
2	Do you have the confidence to instruct a class for the period on integrated study?	2.3	0.9	3.1	0.9	3.3	***	0.70
3	Do you want to instruct on the theme of 'international understanding' for the period of integrated study?	3.6	1.1	3.7	0.9	0.3		0.06
4	Do you want to try instructing on the theme of 'information' during the period of integrated study?	3.0	0.9	3.4	0.8	2.1	*	0.45
5	Do you want to try instructing on the theme of 'welfare and health' during the period of integrated study?	3.2	0.9	3.7	1.0	2.7	**	0.57
6	Do you want to try instructing on the theme of 'environment' during integrated study?	4.0	0.6	4.5	0.6	3.4	***	0.72
7	Do you think experiencing nature in the fields is a good instructional activity?	4.8	0.4	4.9	0.3	1.7		0.37
8	Do you think that environmental education on forest is a good instructional activity?	4.5	0.6	5.0	0.2	2.9	**	0.62
9	Do you think activities that involve handling fire and sharp objects are good instructional activities?	4.2	0.6	4.7	0.6	2.7	**	0.57
10	Do you think that doing woodwork with bamboo and wood is effective in environmental education about the forest and experiential-based learning in nature?	4.2	0.8	4.8	0.4	3.0	***	0.63
11	Do you think that making charcoal is effective in environmental education about the forest and experiential-based learning in nature?	3.8	0.8	4.5	0.7	2.7	**	0.58
12	Do you think that cooking experience using charcoal is effective in environmental education about the forest and experiential-based learning in nature?	4.0	0.9	4.5	0.7	2.6	**	0.55
13	Do you think that doing vegetation survey is effective in environmental education about the forest and experiential-based learning in nature?	3.8	0.9	4.4	0.8	2.1	**	0.45
14	Do you want to do more nature-based activities in satoyama in future?	4.0	0.9	4.5	0.7	2.1	*	0.44
15	Do you want to do more woodwork experiences using bamboo and wood in future?	4.1	0.8	4.5	0.7	1.5		0.31
16	Do you want to make charcoal?	4.2	0.7	4.4	0.6	0.9		0.20
17	Do you want to use more charcoal in future?	3.6	0.9	4.1	0.8	2.3	*	0.49
18	Do you want the next generation to be able to also go through environmental education about the forest and experiential-based learning in nature?	4.0	0.7	4.6	0.5	2.8	**	0.60
19	Do you have confidence in the instruction of environmental education about t he forest and experiential-based learning in nature?	2.4	0.7	3.5	0.8	3.6	***	0.77
20	Do you have the confidence in instructing activities that involve handling fire and sharp objects?	2.4	0.9	3.4	0.9	3.5	***	0.75
	Mean	3.7	1.1	4.2	0.9	3.8	***	0.82

*** p<.001, ** p<.01, * p<.05

Cluster Analysis of Confidence and Desire to Engage in Environmental Education

As there are only 22 participants for the module, the sample size N=22 is small. Cluster analysis was conducted on the 20 items on confidence and desire using pre-survey data. A cross-tabulation table was created with 20 confidence and desire as rows and 22 students as columns. The Ward method was used to perform cluster analysis on the table, using confidence and desire as cases and students as variables. The resulting dendrogram showed that confidence and desire could be clustered into two clusters, as shown in Figure 1. These clusters were named clusters I and II. The horizontal axis in Figure 1 is the degree of dissimilarity and the vertical axis is the confidence and desire.

Results are displayed in Figure 1 as dendrogram. When the degree of dissimilarity is about 15 in this figure, the confidence and desire at the pre-survey can be grouped into two clusters, I-II.

Consequently, cluster I consists of 15 items from the confidence and desire as shown in Figure 1. Among these 15 items, following items 7, 8, 9, 10 have higher scores: Item 7 “Do you think experiencing nature in the fields is a good instructional activity?”; Item 8 “Do you think that environmental education on forest is a good instructional activity?”; Item 9 “Do you think activities that involve handling fire and sharp objects are good instructional activities?”; Item 10 “Do you think that doing woodwork with bamboo and wood is effective in environmental education about the forest and experiential-based learning in nature?” and so on. As a result, cluster I is named as “Desire for experiences in nature and using bamboo and wood”.

Cluster II consists of 5 items as shown in Figure 1. Following items belong to the cluster II. Item 2 “Do you have the confidence to instruct a class for the period on integrated study?”; Item 20 “Do you have the confidence in instructing activities that involve handling fire and sharp objects?”; Item 19 “Do you have confidence in the instruction of

environmental education about the forest and experiential-based learning in nature?"; Item 1 "Do you know the contents for the period for integrated study?"; and Item 4 "Do you want to try instructing on the theme of 'information' during the period of integrated study?". Consequently, cluster II is named as "II. Confidence in the instruction of environmental education and integrated study".

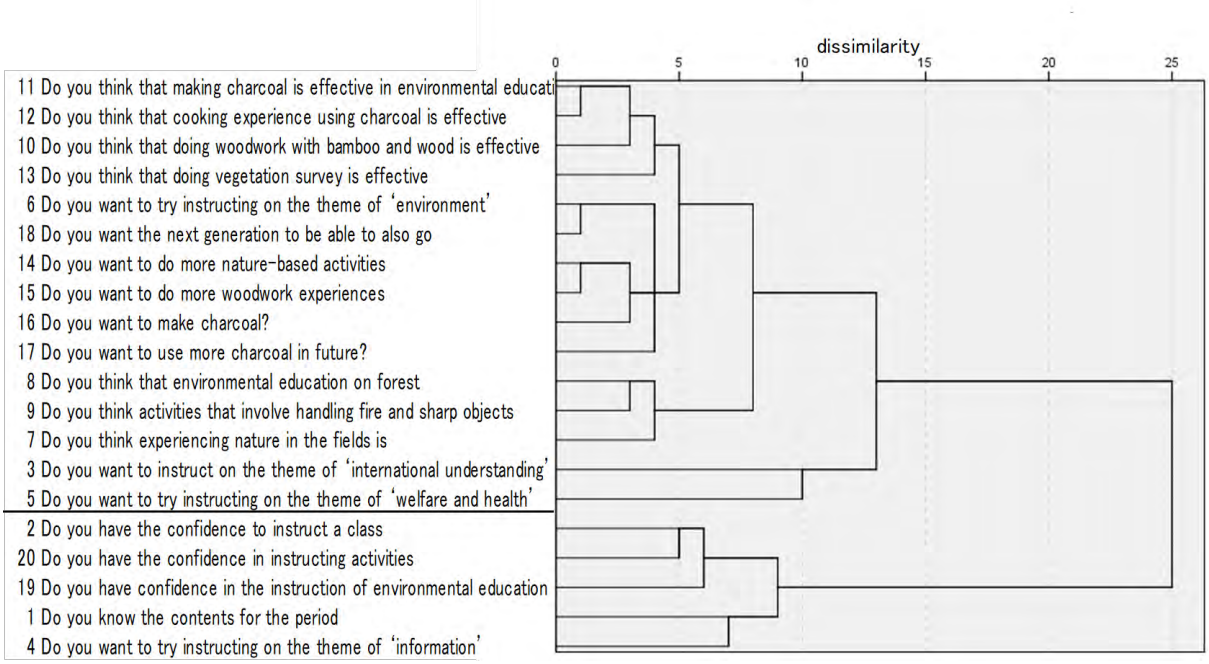

Figure 1. Dendrogram of Confidence and Desire Clusters Determined Using Cluster Analysis

Comparison of the mean scores and the Elongations of the two clusters

Further analysis is done using each of the mean scores of the two clusters, desire and confidence. The results of performing Wilcoxon signed-rank test between scores in pre- and post-survey of each cluster are as shown in right of Table 4. The mean scores for both cluster I and cluster II were significant. The mean scores for "I. Desire for experiences in nature and using bamboo and wood" and "II. Confidence in the instruction of environmental education and integrated study" showed significant differences. Two effect sizes are 0.47 and 0.39 and mean largish. Hence, it can be concluded that the lessons to a certain extent increased both of participants' desire and confidence.

Wilcoxon rank sum test was performed as an unpaired test to see if there are any significant differences between the center locations of scores of cluster I and cluster II in pre-survey, post-survey and elongation. The results are as shown in the lower part of Table 4. A significant differences were recognized between the center locations of scores of two clusters in pre-survey, post-survey and elongation. Two effect sizes for two clusters in pre-survey and post-survey are 0.55 and 0.52 and mean large. But the effect size for elongation are 0.16 and mean small. As a result, the center locations of scores of cluster I in pre-survey and post-survey are different from that of cluster II and larger than it. In addition, it is revealed that cluster II on "Confidence in the instruction of environmental education and integrated study" increased to a larger extent than cluster I on "Desire for experiences in nature and using bamboo and wood".

Table 4. Results of Wilcoxon Signed-rank Test and Wilcoxon Rank Sum Test in Mean Scores for the Two Clusters, Desire and Confidence, to Engage in Environmental Education

Cluster	Before		After		Elongation		Test		r
	m	SD	m	SD	m	SD	Z	p	
I. Desire for experiences in nature and using bamboo and wood	4.0	0.9	4.4	0.8	0.5	0.8	8.6	***	0.47
II. Confidence in the instruction of environmental education and integrated study	2.6	0.9	3.4	0.8	0.8	0.8	7.1	***	0.39
Z	11.5		10.9		3.3				
P	***		***		**				
r	0.55		0.52		0.16				

**** p<.001, ** p<.01*

Change in Awareness of Abilities due to the Lessons

Respondents were asked to answer a survey questionnaire on awareness of their abilities for the various items as shown in Table 5 twice, pre- (at the first lesson) and post-survey (after the sixth lesson). The number of respondents is 22 for both surveys. The mean scores of all 30 items for pre- and post-survey were compared using Wilcoxon signed-rank test to see if the lessons caused the overall awareness of one's abilities to improve. At significance level of 0.1%, there was a significant difference between the two scores. Effect size is 0.79 and means large. It can be concluded that students' overall awareness of their own abilities increased due to the lessons.

Wilcoxon signed-rank tests were also performed for the scores for each of the items to see if there is any significant difference before and after the survey. Out of the 30 items, there were significant differences in 24 items. These effect sizes are between 0.48 and 0.82 and mean large. The respondents felt that most of their abilities had improved due to the lessons.

There are no significant differences for following 6 items: (1) "Interest and curiosity about computers", (6) "Ability to plan and do things in a planned manner", (17) "Ability to communicate", (21) "Ability to pursue and explore matters deeply", (22) "Ability to execute", and (23) "Ability to cooperate". The lessons were not able to improve the abilities in these areas.

Table 5. Results of Wilcoxon Signed-rank Test on Change in Awareness of Abilities Due to the Lessons

Evaluation Items	Before		After		Test		r
	m	SD	m	SD	Z	P	
(1) Interest and curiosity about computers	5.6	1.9	6.1	2,0	1.8		0.39
(2) Understanding of computers	3.6	1.4	4.6	1.4	2.9	**	0.62
(3) Computer operation skills	3.8	1.2	4.6	1.6	2.3	*	0.48
(4) Ability to broaden usage and situations of computers	3.7	1.2	4.9	1.5	2.7	**	0.57
(5) Ability to set challenges, ability to discover problems	3.5	1.1	5.4	1.6	3.4	***	0.73
(6) Ability to plan and do things in a planned manner	5.6	1.5	6,0	1.5	1.3		0.27
(7) Cultivation of understanding of knowledge learned	4.5	1.6	6.1	1.3	3.2	***	0.69
(8) Ability to study by oneself and to learn	5.5	1.5	6.4	1.4	2.4	*	0.51
(9) Ability to gather information and to consult	5.1	1.4	6.4	1.4	3.3	***	0.70
(10) Ability to ṣort through and consolidate relevant data and information	4.3	1.5	6,0	1.6	3.4	***	0.72
(11) Ability to analyse information	4.4	1.4	5.4	1.8	2.4	*	0.52
(12) Ability to express thoughts in writing	4.0	1.7	5.2	2.0	3.2	**	0.68
(13) Ability to express thoughts through media other than writing	4.1	2.0	5.6	2.2	3.2	**	0.67
(14) Ability to talk to and explain to others comprehensively	3.7	1.9	5.2	2.2	3,0	**	0.64
(15) Ability to give presentations	3.6	1.9	5.3	2.4	3.5	***	0.75
(16) Ability to listen and ask questions	5.1	1.7	5.9	1.7	2.4	*	0.52
(17) Ability to communicate	5.3	2,0	6,0	2.1	1.8		0.39
(18) Ability to appropriately self-evaluate one's thoughts	4.5	1.5	5.4	1.8	2.8	**	0.59
(19) Ability to appropriately evaluate thoughts of other people	4.9	1.7	5.6	1.7	2.4	*	0.51
(20) Ability to correct and improve on one's own thoughts	4.8	1.5	5.8	1.6	2.9	**	0.62
(21) Ability to pursue and explore matters deeply	5.5	2.1	6.1	1.8	1.8		0.38
(22) Ability to execute, to practice and to carry out	5.7	1.8	6.1	1.4	1.5		0.32
(23) Ability to cooperate and to learn through cooperation	6.4	1.7	6.9	1.2	1.6		0.33
(24) Sense of fulfilment and satisfaction	6.0	1.4	7.3	1.6	2.6	**	0.55
(25) Sense of accomplishment and achievement	5.8	1.5	7.1	1.6	3.1	**	0.66
(26) Ability to solve problems	5.1	1.2	6.1	1.2	3.3	***	0.69
(27) Ability to construct and create knowledge	4.0	1.5	5.9	1.5	3.5	***	0.74
(28) Ability to think, consider and come up with ideas by oneself	4.8	1.4	6.3	1.4	3.4	***	0.71
(29) Ability to create and creativity	4.6	1.6	6.4	1.3	3.3	***	0.70
(30) Interest and concern about environmental education	5.6	1.8	7.7	1.2	3.9	***	0.82
Mean	4.8	1.8	5.9	1.8	3.7	***	0.79

*** p<.001, ** p<.01, * p<.05

Discussion

On the Analysis of Recognition of Technical Terms

The mean scores of the recognition of all 50 technical terms increased. This result shows that the recognition of the technical terms increased as a whole. From the results for Wilcoxon signed-rank test performed for each technical term, recognition of 33 terms (66%) has increased. Terms that were used in the lessons on environmental education for the

students saw an increase in their recognition rates. It can be said that the lessons held on environmental education on Satoyama had helped the students gain more knowledge. This is an effect due to the lessons.

The recognition of 10 terms did not see a significant change on post-survey. While these terms are used often in environmental education, they were not used in these lessons. As a result, it can be inferred that their recognition rates did not improve.

On the Confidence and Desire to Engage in Environment Education

There is an overall increase in the mean score across the 20 items on "Confidence and desire to engage in environmental education" as shown by the results of the Wilcoxon signed-rank test. This shows that confidence and desire to engage in environmental education increased overall on post-survey. For the lesson, students learned about theories of environmental education through simultaneous classroom instruction. They also picked up the skills on conducting outdoor fieldwork safely and the vegetation survey through group work. Finally, the students did inquiry-based research on an individual basis and gave their presentations on environmental problems in groups. Through these series of activities in the lessons, the students are able to gain the required knowledge through the studying of theories and experiences in the lessons. As a result, they became more confident of their ability to instruct classes on environmental education. Their desire to instruct also rose.

From the Wilcoxon signed-rank tests performed for each of the 20 items, 16 items showed a significant increase on post-survey in their mean scores. The results demonstrate that the activities in the lessons were effective in raising the confidence and the desire of the students. Contents that can be incorporated into the period on integrated study in schools were included in these lessons and hence the confidence of the trainee teachers in delivering appropriate classes was raised. The scores of the items 1, 2, 4, 5, and 6 increased. With the introduction of various activities through environmental education, the trainee teachers probably felt that these activities were useful in their own classroom instruction when they enter the teaching service. Hence, their confidence increased and they want to repeat some of the useful activities themselves.

Through the experiences in the forest environmental education, the students get to understand the advantages and necessity for this form of education. This can be seen from the increase in the scores in the items 8, 10, 11, 12, 13, 18, and 19.

In the lessons, students are able to have many experiences with nature, which could explain why the scores for the items 9, 14, 17, and 20 become higher after the survey.

On the other hand, item 3 did not show a significant increase in the score on post-survey. As this theme is not touched on during the lessons, this result corresponds to the subjective assessment of the instructor and is reasonable. Item 15 did not show any significant increase in the mean score on post-survey. This could be because there is no need for woodwork and charcoal making in modern life.

On the Mean Scores of the Two Clusters on Confidence and Desire to Engage in Environmental Education

Cluster analysis divided the items on confidence and desire to engage in environmental education into two clusters. Wilcoxon signed-rank test was performed on the increase in the mean scores of cluster I and cluster II. The results showed that the increases were significant. It can thus be said that confidence and desire increased. This means that this environmental education on Satoyama is effective in increasing the desire for experiential activities and confidence in the instruction of environmental education.

Cluster II showed a bigger increase in its mean score on post-survey compared to cluster I. This means that this environmental education on Satoyama is more effective in confidence in the instruction of environmental education than in the desire for experiential activities. The students participated in the experiential learning enthusiastically and were thus able to increase their confidence in their own instruction of environmental education.

On Scores of Awareness Related to Abilities

Wilcoxon signed-rank test was performed on the overall mean score of all 30 items on awareness related to abilities on both pre- and post-survey. The result of the test indicated that there is an increase in the overall mean score. In other words, the students felt that their abilities improved overall after taking the lessons.

Wilcoxon signed-rank tests were also performed on the mean score of each item on pre- and post-survey. Among the 30 items, 24 items had significant increases. This means that the lessons have made some impact in contributing to the students' awareness associated with their abilities in solving problems and impression.

The scores of items (2), (3), and (4) showed increases. The lessons had intended to help students gain knowledge about computers and there is evidence to suggest that this intention has been fulfilled.

Through the environmental education on Satoyama, those students had to do some research and showcase their findings by writing reports etc. cultivated the item (12) through the lesson. What students also had to use relevant graphics and photos to supplement their presentations cultivated the item (13). Students perceived that they have

improved upon various abilities in 24 items as shown in Table 5. This improvement in a variety of abilities is necessary in increasing problem-solving abilities.

The three items (6), (22), and (23) did not show any increase in mean scores on post-survey. Throughout the six lessons, students did not have much opportunity to do their own planning. This may explain why mean score for item (6) did not increase. The lessons consisted of a lecture session with use of textbook, instruction on skills by forestry experts in small groups, individual research sessions using computers, smartphones and other ICT equipment. As the activities for each lesson were already planned beforehand, students simply had to follow the plans. This is probably why the score for item (22) did not increase significantly. For item (23), the mean score on pre-survey was already largest. Thus, there was no room for it to increase further with the students cooperating with each other as they usually do.

From the results, the lessons have been successful in building a foundation for students to develop a global perspective with regards to environmental education. With the lessons, item (30) were increased, students also picked up know-how about computers. Students also perceived that they have improved upon their (9), (10), and (11). Overall, the students became more adept at turning data into useful information. In addition to a perceived increase in (28), students also felt that these abilities (26), (27), (29), and so on improved. The change in these awareness shows that foundation which cultivates a global perspective in environment education has been successfully built.

Many students felt the activities in experiential learning were good instructional activities or were effective in environment education and experiential-based learning in nature, as can be gleaned from the responses to the questions 8, 10, and 13.

These positive experiences are related to the subsequent responses on their desires to continue with some of these activities going forward and the desire to teach, as evident in the items 14, 17, and 18. These lead item 19.

From the survey results on awareness of abilities, it can be seen that the students felt that their computer skills have improved. Combined with the findings on the confidence and desire to engage in environmental education, we can tell that the students have started to develop an interest in and desire to interact with their surrounding environment. They have also picked up skills to protect the environment and increased their confidence in delivery instruction. Overall, the students have successfully developed a local perspective in environmental education.

On the Correlation between Recognition of Technical Terms, Confidence and Desire to Engage in Environmental Education, and Awareness Related to Abilities

The correlation coefficient for the mean scores of recognition of technical terms and the confidence and desire to engage in environmental education is -0.01. The correlation coefficient for the mean scores of recognition of technical terms and awareness related to abilities is 0.30. Lastly, the correlation coefficient for confidence and desire to engage in environmental education and awareness related to abilities is 0.31. All the correlations were not significant. Hence, there is no correlation between the mean scores of all three indexes. They each stand on their own. This means that the gain in knowledge, confidence and desire to engage in environmental education and changes in awareness related to abilities are not linked. We had inferred that there could be a correlation between confidence and desire to engage in environmental education and awareness related to abilities. However, the data showed that there was no such connection.

We also looked to see if there is correlation between mean scores in awareness in abilities and the two clusters obtained from "confidence and desire to engage in environmental education". The correlation coefficients of two clusters for the mean score of awareness in abilities are 0.12 and 0.22 respectively. The correlation coefficient between the two clusters I and II is -0.08. None of the correlations are statistically significant. We had thought there would be a correlation between the awareness related to abilities with either one of the two clusters. But the data had shown otherwise. This shows that these three kinds of scores are independent each other.

Conclusion

Overall recognition of technical terms increased on post-survey. There is overall an increase in the mean score on confidence and desire to engage in environmental education. For the awareness on abilities, students felt that their abilities increased overall. These findings show that the lesson has been successful in building a foundation for a global perspective and cultivating a local perspective in environmental education.

For this study, subjective data on how students perceive their own abilities are collected. Going forward, focus can be placed more on objective data that measures the increase in the competencies and abilities of the students. Tests on facts and comprehension can be conducted to collect objective data for analysis to complement the subjective data. Follow-up studies can also be done on the students to see their abilities in instruction as a teacher.

Suggestions

One of authors practiced BL classes in many classes and reported learning effects of each class (Miyaji, 2011, 2013, 2014). Those reports show that the BL is the splendid class form that is applicable to various classes. BL class was applied to environmental learning. When the blended learning was practiced with some learning methods using some types of media in some types of learning spaces, an effective and attractive class can be developed. In the case of suggesting a superior class method, it is necessary to explain learning effect clearly after measuring data related to a class by subjective awareness or an objective test.

Limitations

Because the data which we used for this study are 22 students, the application of a provided result is restrictive. It is necessary to collect the data of more students to generalize these results and to analyze them.

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