

The comparative study of environmental awareness on a local basis among elementary school students both in Japan and the U.S. –Taken from the cases in Choshi and Findlay–

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In this research, we evaluated the quantitative environmental awareness of the 6th grade elementary school students in Choshi, Japan, and Findlay, in the US by means of a questionnaire comprised of the relevant question items, and to attribute the difference of awareness to the difference in social systems or public services.

The results of the questionnaires show the Findlay students are more concerned with environmental problems, and seem to know how to protect nature. However, they feel that nothing will change no matter what they do. On the other hand, the Choshi students are more interested in addressing environmental problems on a daily basis, and their self-efficacy is highly maintained.

The purpose of this research is to compare the results of the questionnaire to the differences in social system on public services between Choshi and Findlay. The garbage disposal system in Findlay, contracting with private agencies, bury all garbage without separation. Under this system, it is expected that the students become less interested in addressing environmental problems, resulting in less self-efficacy of pro-environmental behavior. On the other hand, Choshi enforces separation of eleven types of garbage, and adults there are highly aware of environmental problems. This implies that the students in Choshi become more interested in addressing the environmental problems, and feel more self-efficacy of pro-environmental behavior because they are ethically influenced by those who are ready to address the environmental problems there.

The outcome of multiple-regression analysis tells us that “*Environmental Conservation Attitude*” is the most important variable to explain “*Pro-environmental Behavior*”, regardless of a student’s nationality. Therefore, a stable and effective way to improve students’ “*Pro-environmental Behavior*” is to teach students the inherent value in all methods of cultivating the sense of regret concerning waste.

Introduction

One of the authors in this study, *Ando*, joined a scholar exchange program in Chiba Institute of Science to be dispatched to the U.S., and stayed at the University of Findlay for three months, from February 7th to May 8th in 2015, as a visiting scholar. This paper presents a

comparative study of 6th grade elementary students’ environmental awareness in Choshi and Findlay during a time period prior to, and in the middle of, the scholar exchange program.

The purpose of this research is to evaluate quantitatively environmental awareness of the 6th grade students by means of questionnaire comprised of _ relevant question items, and to attribute the difference of the awareness to the difference of social systems or public services. Essentially, our hypothesis is that the degree of environmental awareness of the students is greatly influenced by the awareness or behavior of the adults around them, and by the social systems and public

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services peculiar to the regions, such as a different garbage disposal system. Finally, we propose a more effective way of environmental education is to adapt it to each local region.

Methodology

2-1. Survey Area

2-1-1. Survey in Japan

Choshi city is located on the Choshi peninsula in the north-eastern part of Chiba prefecture. The city is surrounded by the Pacific Ocean, and is well recognized for fisheries, agriculture, tourism, and its soy sauce industry. The total population is approximately 70,000 people, and 12 municipal elementary schools are located in the area. The Japanese portion of the survey took place at *Shimizu* elementary school (30 students in 6th grade) and Takagami elementary school (40 students in 6th grade) during November, 2014.

2-1-2. Survey in the U.S.

Findlay stands in the north-western part of Ohio in the U.S., the population of which is approximately 42,000 people. Van Buren Local School, which is the site for this research project, is located in the northern outskirts of Findlay. Approximately 2,000 students from K to 12 study here, and 70 students in 6th grade were sampled out of them.

2-2. Questionnaire

The precedent research assumes that the definitive factors in a students' eco-friendliness are "*Environmental Perception*", "*Behavioral Assessment*", "*Environmental Conservation Attitude*", "*Pro-environmental Behavior*", and "*Environmental Conservation Awareness*", estimated by means of 25 four-scale question items. Moreover, the validity and reliability of the items are carefully investigated and verified¹⁾. Our research is established on this precedent, and restructures the questionnaire by taking 6 items relevant to "*Sense of Environmental Catastrophes*", "*Responsibility for Environments*", and "*Efficacy of Environmental Behaviors*" in the category of "*Environmental Perception*", 6 items to "*Sense of Ability*", "*Sense of Burden*", and "*Sense of Morality*" in "*Behavioral Assessment*", 3 items in "*Environmental Conservation Attitude*", 8 items in "*Pro-environmental Behavior*", and 2 items in "*Environmental Conservation Awareness*". The original Japanese questionnaire is shown in the appendix, and the English version was

carefully translated from it.

2-3. Analysis

2-3-1. t-test

Each of the mean scores and sample standard deviations of the four-scale question items are computed. This allows us to conduct independent t-test by setting up the regional difference as an independent variable, and the mean scores as a dependent variable. Furthermore, the investigation of the absolute value of the effect sizes also tells us the virtual gap of the scores. Plus, each of the scores is integrated into each of the five factors — "*Environmental Perception*", "*Behavioral Assessment*", "*Environmental Conservation Attitude*", "*Pro-environmental Behavior*", and "*Environmental Conservation Awareness*" —. This also allows us to conduct a independent t-test. In the same way, we investigate the absolute value of the effect size as well.

2-3-2. Multiple-regression Analysis

In order to identify how "*Pro-environmental Behavior*" is affected by the rest of the factors, multiple-regression analysis takes place by setting up the scores of "*Environmental Perception*", "*Behavioral Assessment*", "*Environmental Conservation Attitude*", and "*Environmental Conservation Awareness*" as predictors.

3. Result and Discussion

Table 1 indicates each of the question items, the categories of the items, and the standardized mean differences. Each of the items are categorized into "*Environmental Perception*" (Q1~Q6), "*Behavioral Assessment*" (Q7~Q12), "*Environmental Conservation Attitude*" (Q13~Q15), "*Pro-environmental Behavior*" (Q16~Q23), and "*Environmental Conservation Awareness*" (Q24~Q25). Moreover, **Fig. 1** indicates the bar plots of the mean scores in each factor separated by region.

Following this section, the research divides into two parts; one is the list of five factors to explain their distinction, the other is a summary of multiple-regression analysis to identify how "*Pro-environmental Behavior*" is affected by the rest of the factors.

3-1. Definitive five factors

3-1-1. "*Environmental Perception*"

The mean scores of Q1, Q2, and Q4 are statistically significant. The mean score of Q1 among the American

Table.1 The question items, the categories of the items, and the standardized mean differences

*	No.	Question	**	$\Delta_p(\text{US-JP})$
EP	Q1	Do you think that if the environment was seriously damaged, your everyday life wouldn't be affected until the future? (R: Reverse question)	C	0.52
	Q2	Do you think that doing good for the environment gives you a driving force for environmental protection?	E	-0.98
	Q3	Do you think that not only adults but also children should protect the environment?	R	n.d.
	Q4	Do you think that doing good for the environment doesn't give you a driving force for environmental protection? (R)	E	-0.34
	Q5	Do you think that you do not need to worry about the ongoing damage to the environment because someone is already taking care of the problem? (R)	C	n.d.
	Q6	Do you think that adults should be blamed for all of the damage to the environment? (R)	R	n.d.
**Class symbol C: a sense of Crisis, E: a sense of Effective, R: a sense of Responsibility				
BA	Q7	Do you think you are unable to protect the environment because you do not know how to?	P	-0.64
	Q8	Do you think that you cannot be bothered to work with others to protect the environment? (R)	N	-0.34
	Q9	Do you think that your family, people in your neighborhood, and your teachers want you to protect the environment?	B	0.45
	Q10	Do you think that you couldn't protect the environment even if you knew how to protect it? (R)	P	n.d.
	Q11	Do you think that it is understandable to try to protect the environment, even if you try to do so alone?	N	n.d.
	Q12	Do you think that your family, people in your neighborhood, and your teachers try to protect the environment?	B	-0.64
**Class symbol P: a sense of Practicable act, B: a sense of Burden of act, N: a sense of Normative act				
AT	Q13	Do you think that you want to reduce the total amount of garbage by reducing as much household garbage as possible?		-0.94
	Q14	Do you think that you want to do as much as possible to protect the environment?		n.d.
	Q15	Do you want to value all things?		-1.62
PB	Q16	Do you think that you value water? .		n.d.
	Q17	Do you think that you value all living things, such as dogs, cats, and insects?		-0.67
	Q18	Do you replace your old notebook with a nice, new one, even though your old one still has some available pages? (R)		-0.47
	Q19	Do you think that you make it a rule to produce as little garbage as possible?		-1.18
	Q20	Do you think that you make it a rule to separate burnable from non-burnable trash?		-1.62
	Q21	Do you think that you value all plants such as flowers, weeds and trees?		-1.00
	Q22	Do you think that you are saving electricity, for example, by switching off the lights in a room that you are not using?		n.d.
	Q23	Do you make it a rule to buy things made of recycled materials, such as a notebook made with recycled paper?		-0.47
AW	Q24	Do you think you know a better way to protect the environment?		0.41
	Q25	Do you think you know a better way of recycling?		n.d.

* EP: Environmental Perception, BA: Behavioral Assessment, AT: Environmental Conservation Attitude, PB: Pro-environmental Behavior, AW: Environmental conservation Awareness, $\Delta_p(\text{US-JP})$: standardized mean differences, n.d.: none deference

students is higher than the Japanese students'. This suggests that the American students feel less anxious of the environmental damage, and more optimistic about the influence. The mean scores of Q2 and Q4 among the Japanese students are higher than the American students'. This suggests that the Japanese students are more confident in contributing to the protection of environments.

3-1-2. "Behavioral Assessment"

The mean scores of Q7, Q8, Q9, and Q12 are statistically significant. The mean score of Q9 among the American students is higher than the Japanese students. This suggests that the American students feel they are expected by the people around them to protect nature. The mean scores of Q7, Q8, and Q12 among the Japanese students are higher than the American students. This suggests that the Japanese students believe that the adults around them understand how to protect nature, and this encourages the students to work together with the adults.

3-1-3. "Environmental Conservation Attitude"

The mean scores of Q13 and Q15 are statistically significant. Both of the mean scores among the Japanese students are higher than the American students. This suggests that the Japanese students are more ready to reduce the amount of garbage, and appreciate the value everything.

3-1-4. "Pro-environmental Behavior"

All of the mean scores except Q16 and Q22 are statistically significant. All of these mean scores among the Japanese students are higher than the American students. This suggests that the Japanese students are more ethically aware of the value of everything.

3-1-5. "Environmental Conservation Awareness"

The mean score of Q24 is statistically significant. The mean score of Q24 among the American students is higher than the Japanese students. This suggests that there are more of those who know how to protect nature in the U.S.

3-1-6. Summary

From the mean scores of Q1 and Q21, the American students feel more anxious about the environmental problems and know how to protect nature. However, they seem to feel that nothing will change no matter what they do. By associating it with the awareness of garbage disposal (Q13, Q19, Q20, and Q25), the students in Findlay potentially become less interested in addressing environmental problems and feel less self-efficacy in their pro-environmental behavior. This is because the garbage disposal system in Findlay, established through private agencies, sets a quota for garbage disposal. Plus, all of the garbage collected across the city is buried without separation. From a different perspective, the

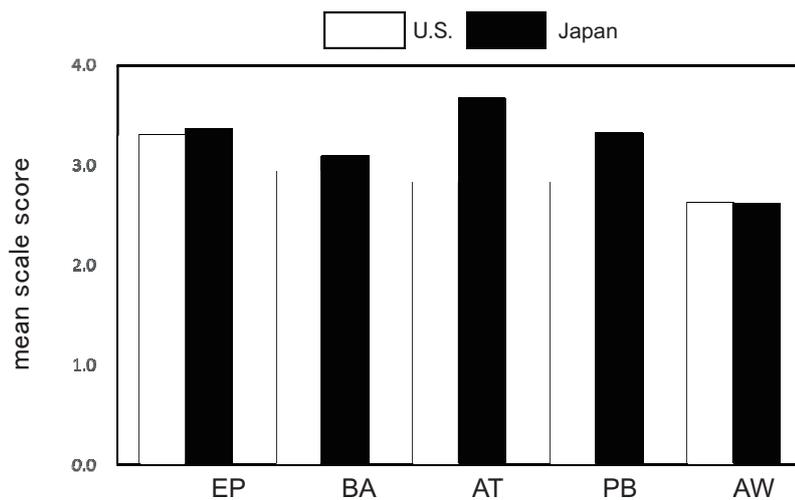


Fig.1 Comparison of the environmental consideration between the U.S. and Japanese children.

Black bar show Japan and white bar shown U.S.

EP: Environmental Perception, BA: Behavioral Assessment, AT: Environmental Conservation

Attitude, PB: Pro-environmental Behavior, AW: Environmental conservation Awareness

students might be able to be more aware of what they've done to local environments, and to feel more self-efficacy of their pro-environmental behavior, if they were educated to figure out the location of abandoned garbage and the effect of the buried garbage on local environments. On the other hand, from the mean scores of Q13, Q15, Q17, Q18, Q19, Q20, and Q21, the Japanese students are assumed to become more interested in reducing garbage and of the value of everything around them. Moreover, they feel more self-efficacy of pro-environmental behavior. By associating it with the garbage disposal system in the same way as the case of the U.S., it turns out that Choshi enforces separation of eleven types of garbage, and adults there are highly aware of the environment. This implies that the students in Choshi are more aware of environmental problems, and feel more self-efficacy in pro-environmental behavior because they are ethically influenced by those who are ready to address the environmental problems there.

3-2. Multiple-regression analysis

Computed from each of the question items are the mean scores of each four factors – “*Environmental Perception*”, “*Behavioral Assessment*”, “*Environmental Conservation Attitude*”, “*Pro-environmental Behavior*”, and “*Environmental Conservation Awareness*” – . In order to identify how “*Pro-environmental Behavior*” is affected by the rest of the factors, multiple-regression analysis takes place.

3-2-1. Analysis in the U.S.

Stepwise variable selection returns the following model equation:

$$\text{“Pro-environmental Behavior”} = \alpha + \beta_1 \times \text{“Environmental Perception”} + \beta_2 \times \text{“Behavioral Assessment”} + \beta_3 \times \text{“Environmental Conservation Attitude”} + \beta_4 \times \text{“Environmental Conservation Awareness”}$$

Note: α is an intercept, and β_i is each partial regression coefficient ($i=1, 2, 3, 4$)

Table 2 shows the outcome of this multiple-regression analysis.

The adjusted coefficient of determination is approximately 35% ($p < .001$). This means that the stepwise algorithm works well to improve the model. Moreover, as of “*Environmental Conservation Attitude*” the partial regression coefficient is .321 ($p < .001$) and the standard partial regression coefficient .465 ($p < .001$). Judging from the fact that this coefficient is statistically

significant and the biggest among the others, it brings to the statement that “*Environmental Conservation Attitude*” is highly relevant to “*Pro-environmental Behavior*”.

3-2-2. Analysis in Japan

Stepwise variable selection returns the following model equation:

$$\text{“Pro-environmental Behavior”} = \alpha' + \beta_1' \times \text{“Environmental Perception”} + \beta_2' \times \text{“Environmental Conservation Attitude”}$$

Note: α' is an intercept, and β_i' is each partial regression coefficient ($i=1, 2$)

Table 3 shows the outcome of this multiple-regression analysis.

The adjusted coefficient of determination is approximately 47% ($p < .001$). This means that the stepwise algorithm works well to improve the model. Moreover, as of “*Environmental Conservation Attitude*” the partial regression coefficient is .453 ($p < .001$) and the standard partial regression coefficient .704 ($p < .001$). Judging from the fact that this coefficient is statistically significant and the biggest among the others, it brings to the statement that “*Environmental Conservation Attitude*” is highly relevant to “*Pro-environmental Behavior*”. Besides that, as of “*Environmental Perception*” the partial regression coefficient is .281 ($p < .01$) and the standard partial regression coefficient .437 ($p < .01$). Judging from that, “*Environmental Perception*” is highly relevant to “*Pro-environmental Behavior*”, as well.

3-2-3. Summary

The multiple-regression analysis reveals that “*Environmental Conservation Attitude*” is the most important variable to explain “*Pro-environmental Behavior*”, regardless of a student's nationality. Therefore, a stable and effective way to improve students' “*Pro-environmental Behavior*” is to teach students the inherent value in various things for cultivating a sense of “*Mottainai*”²⁾. Moreover, in the case of Japan “*Environmental Perception*” works well to explain students' “*Pro-environmental Behavior*”. Hence, it is also desirable to make students be more responsible for environmental problems.

4. Conclusion

In order to figure out a 6th-grade students environmental awareness both in Choshi and Findlay, a questionnaire comprised of four-scale question items took place. Twenty-five items in total are categorized

into each of five factors – “*Environmental Perception*”, “*Behavioral Assessment*”, “*Environmental Conservation Attitude*”, “*Pro-environmental Behavior*”, and “*Environmental Conservation Awareness*” –, and had the mean score of each calculated. The purpose of this research is to associate the outcome gained by the analyses with social systems or public services on a local basis. The investigated American students are more concerned with the environmental problems, and seem to know how to protect nature. However, they feel that nothing will change no matter what they do. On the other hand, the investigated Japanese students are more interested in addressing environmental problems on a daily basis, and their self-efficacy is highly maintained. This research attempts to attribute the difference of environmental awareness to the difference of garbage disposal systems. The garbage disposal system in Findlay, established through a contract with private

agencies, sets a quota for garbage disposal. Plus, all of the garbage collected across the city is buried without separation. Under this system, it is expected that the students become less interested in addressing environmental problems, resulting in less self-efficacy of pro-environmental behavior. On the other hand, Choshi enforces separation of eleven types of garbage, and adults there are highly aware of environmental problems. This implies that the students in Choshi become more interested in addressing the environmental problems, and feel more self-efficacy of pro-environmental behavior because they are ethically influenced by those who are ready to address the environmental problems there. The outcome of multiple-regression analysis tells us that “*Environmental Conservation Attitude*” is the most important variable to explain “*Pro-environmental Behavior*”, regardless of a student’s nationality. Therefore, a stable and effective way to improve

Table 2 The outcome of the U.S. multiple-regression analysis.

explanatory variable	partial regression coefficient	standard partial regression coefficient
intercept	0.554	0.000
Environmental Perception	0.177	0.256
Behavioral Assessment	0.169	0.244
Environmental Conservation Attitude	0.321*	0.465*
Environmental conservation Awareness	0.084	0.122
adjusted R ²		0.352*
multiple correlation coefficient		0.539*

* p<.001

Table 3 The outcome of Japan multiple-regression analysis.

explanatory variable	partial regression coefficient	standard partial regression coefficient
intercept	0.715*	0.000
Environmental Perception	0.281**	0.437**
Environmental conservation Awareness	0.435***	0.704***
adjusted R ²		0.437***
multiple correlation coefficient		0.688***

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

students' "*Pro-environmental Behavior*" is to teach students the inherent value in various methods for cultivating the sense of regret concerning waste. Besides that, for Japanese students "*Environmental Perception*" also works well to explain students' "*Pro-environmental Behavior*". Hence, it is desired to make students be more responsible for the environmental problems.

Acknowledgement

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環境への意識についてのアンケート Appendix The original Japanese questionnaire.

次の質問について、どの程度そう思うか あてはまる数字1つに、まる(○)をつけてください。

年	組	番	名前
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まったく思わない
 あまり思わない
 少し思う
 とても思う

1. 自然がこわされようとしても、自分の生活でこまるのは、ずっと未来のことだと思う。・・・1 — 2 — 3 — 4
2. 自分たちが環境にやさしいことをすると、自然を守る大きな力になると思う。・・・1 — 2 — 3 — 4
3. 大人だけでなく、自分たち子どもも自然を守らなければならないと思う。・・・1 — 2 — 3 — 4
4. 自分たちが環境にやさしいことをしても、自然を守る力にはならないと思う。・・・1 — 2 — 3 — 4
5. 自然がこわされようとしても、だれかが守ってくれるからだいじょうぶだと思う。・・・1 — 2 — 3 — 4
6. 自然がこわされようとしているのは、すべて大人のせいだと思う。・・・1 — 2 — 3 — 4

7. 自然を守れないのは、守る方法がわからないからからだと思う。・・・1 — 2 — 3 — 4
8. みんなで協力しあって自然を守ろうとするなんて、めんどろうだと思う。・・・1 — 2 — 3 — 4
9. 家族や地域、学校の先生たちは、あなたに自然を守ってほしいと思っているようだ。・・・1 — 2 — 3 — 4
10. 自然を守る方法がわかっても、自然を守ることはできないと思う。・・・1 — 2 — 3 — 4
11. 自分一人でも自然を守ろうとすることは、当たり前のことだと思う。・・・1 — 2 — 3 — 4
12. 家族や地域、学校の先生たちは、自然を守ろうとしていると思う。・・・1 — 2 — 3 — 4

13. 自分もできるだけゴミを出さず、ゴミをへらしたいと思う。・・・1 — 2 — 3 — 4
14. 自分もできるだけ自然を守るようにしたいと思う。・・・1 — 2 — 3 — 4
15. 生き物や物を大切にしたいと思う。・・・1 — 2 — 3 — 4

16. 水を大切に使っている。・・・1 — 2 — 3 — 4
17. 犬やねこ、昆虫など動物を大切にしている。・・・1 — 2 — 3 — 4
18. まだ使えるページがあっても、気に入ったノートがあると、新しいものを買っている。・・・1 — 2 — 3 — 4
19. ゴミをできるだけ出さないようにしている。・・・1 — 2 — 3 — 4
20. 燃えるゴミ（紙など）と燃えないゴミ（ビンやカン）を分けてすてるようにしている。・・・1 — 2 — 3 — 4
21. 花、草や木など植物を大切にしている。・・・1 — 2 — 3 — 4
22. 使わないところの電気を消すようにするなど、電気を大切に使っている。・・・1 — 2 — 3 — 4
23. ノートや紙などを買うとき、再生紙でできたものを買うようにしている。・・・1 — 2 — 3 — 4

24. 自分は、自然を守る方法を知っている方だと思う。・・・1 — 2 — 3 — 4
25. 自分はゴミのリサイクルの意味を知っている方だと思う。・・・1 — 2 — 3 — 4

以上です。