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Effects of Environmental Education on Young Children's Water-Saving Behaviors in Japan

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Abstract: While environmental education in early childhood can raise children's environmental awareness and shape environmental attitudes, little is known about the effects of environmental education programs on pro-environmental behaviors in children. This paper analyzes the impact of the Eco Experience Education Program for Early Childhood (EEEPEC), an educational program featuring lectures on global warming and water- and energy-saving, as well as visual prompts, on young children's water-saving behaviors in Fukuoka Prefecture, Japan. Through observations, interviews, and survey data, this study found that the EEEPEC was associated with increased water-saving behaviors. The results suggest that the behavioral changes were driven by the program's visual prompts (e.g., water coils placed next to water taps) that provide children with immediate feedback and enhance pro-environmental communication among teachers, parents, and children. Early childhood environmental education programs such as the EEEPEC have the potential to foster long-term pro-environmental behaviors in young children.

Keywords: early childhood; environmental education; water-saving; pro-environmental behaviors; Japan

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1. Introduction

In 2012, the Japanese government partially amended a law related to environmental education, entitled "Act on the Promotion of Environmental Conservation Activities through Environmental Education." The amendment extended the period of environmental education to include "early childhood". Furthermore, the National Institute for Educational Policy Research (NIER) published a guide text about environmental education for kindergarten and elementary school teachers [1]. The text strongly emphasized the fostering of three desirable components of early childhood environmental education (ECEE): (i) cultivate sensitivity to nature, (ii) encourage curiosity and interest for the environment, and (iii) develop skills to be actively involved with the environment through their lifestyle and play.

Although environmental education is becoming increasing central to early childhood education in Japan, it is important to note that the numbers of both practical cases and research articles targeting ECEE have not been sufficiently reported. For example, by the year of 2003, Inoue [2] searched articles related to ECEE edited by the Japanese Society for Environmental Education and found that only nine papers focused on the field. Furthermore, most of the papers covered "education in the environment", which aims to cultivate sensitivity to nature by going into the field and teaching about the relationships between humans and nature through direct experience [3]. According to Lucas [4], environmental educational programs can be divided into several categories: in, about, and for the environment, or a combination of these categories. Abe [5] emphasized that early childhood education should prioritize "education in the environment". Such experiential environmental learning, which helps young children respect and care for their environment [6], is fundamental to successful early childhood education. Regular and sustained contact

with natural environments is already in place in many ECEE programs [7]. Educational programs such as nature-based early childhood programs can support multiple functions including physical, cognitive, and social-emotional benefits [8]. As a matter of fact, the majority of articles published in international journals related to environmental education or early childhood consider education programs about and in the environment [9,10]. In other words, very few studies have examined education programs for the environment in early childhood.

To shed light on early childhood education for the environment in Japan, this paper presents a case of an Eco Experience Education Program for Early Childhood (EEEPEC) in Fukuoka prefecture of Japan. EEEPEC targets education for the environment with the goal of reducing CO_2 emissions resulting from electricity and conserving water resources as well as saving money due to resource consumption in school facilities. The remainder of this paper is structured as follows. The next section clarifies research questions to be addressed by reviewing relevant literature on ECEE with a high emphasis of education for the environment. Then, the article provides an overview of the EEEPEC. Following this overview, a discussion of this study's methodology is presented. The program's impacts are subsequently analyzed before turning to a discussion of the factors that lead to positive behavioral change in program participants. Finally, the implications of these results are presented in the conclusion.

2. Literature Review and Research Questions

Ardoin and Bowers [8] screened 1629 citation records of ECEE during the period from 1998 and 2018, and used 66 studies that represented a variety of research designs that produced qualitative and quantitative data. The majority of the studies (64%) were published between 2013 and 2018. The most frequently studied ECEE programs involved children in the four- and five-year old age ranges participating in on-going, educator-facilitated programs that occurred in a formal setting such as preschools. The meta analysis showed strongly positive environmental education outcomes in terms of their knowledge, attitudes, and skills. Out of the studies, 11 (17%) described programs where action-taking was an important pedagogical practice, largely corresponding to the type of education for the environment or education for sustainability.

Education for the environment moves beyond education in and about the environment approaches with its focus on participation and action to improve the environment [11]. The programs empower, providing learners with skills to take positive actions [12]. Taking age- and situationally-appropriate action is included as an important part of ECEE approaches [6,8]. Ideally, it is suggested that programs targeting "for" are implemented on the basis of those targeting "in" as well as those targeting "about" [13]. This means that it may be too early to incorporate ECEE due to immature language competence, cognition, and judgment. Samuelsson and Katz [14] also reported that many teachers saw discussion about sustainability as "doom and gloom", in that the issues were too big, too awesome to do anything about and should not to be dumped onto young children. Knowledge of environmental issues in isolation may increase the risk of raising children's anxiety levels and a sense of helplessness [15]. Indeed, a large research project on sustainability conducted within the World Organization for Early Childhood Education (OMEP) during 2009–2014 showed that adults tend to underestimate the competencies of young children [16]. Even in Japan, there is a lack of views of children as having agency according to the national curriculum and the teacher's handbook of environmental education [17]. However, the images of young children have changed and they are viewed as capable and competent learners with an active role in their own learning and the learning of others [18–20]. In other words, young children are able to critically respond to environmental issues [15,21–25], contributing to environmental conservation. Davis [22], for example, presented an ECEE program called *Sustainable Planet Project* in Brisbane's Campus Kindergarten. With the presence of passionate and committed teachers, young children were capable of engaging in education for the environment in their day-to-day practices, such as recycling and

water conservation. The work further reported that their water conservation habits also transferred to home. Duhn and Ritchie [23] also found that caring for the environment by infants and toddlers rippled out into the home. Likewise, Mackey [24] and Vaealike [25] showed that young children could advocate for environmental issues as a catalyst for change. They were competent to transfer their actions beyond the preschool setting and make their voices heard in the family and community. Hence, young children's active participation in everyday educational practices is highly prioritized in the field of early childhood education for sustainability (ECEfS) [26].

From the viewpoint of educational materials, Mattsson and Laike [27] implemented interventions promoting turning-lights-off behaviors in a preschool in Sweden, using board games as well as visual prompts. The games and visual prompts could convey information about energy-saving behavior and influence the actual behaviors, reducing around 40% of energy used for lighting in the toilets. In addition to board games, visual prompts, especially pictures, which are commonly used in early childhood education, could be a possible tool to draw attention to a specific behavior in a given situation [28]. As for the EEEPEC, this program uses visual prompts—water-saving coils placed adjacent to tap water faucets—to further enhance awareness of water issues and water-saving behaviors.

Despite there having been a slightly increasing trend in the proportion of international papers related to early ECEE or ECEfS, especially in the 2010s [8,10], these tended to document studies with a qualitative focus. As mentioned the above, there are several studies presenting that young children have the capacity to understand environmental issues and the willingness to care for the environment within their preschools, at home, and in their communities. Yet, little is known about empirical evidence on impacts of education for the environment on preschool children's actual behaviors. Out of 121 empirical studies that measured environmental education outcomes with K-12 (approximate ages 5 through 18), Ardoin et al. [29] found that only two articles (2%) described programs for ages 5–6. There is an urgent need for further empirical research [30]. Regarding the EEEPEC, it provides young children with opportunities for learning about global warming and the necessity of energy- and water-saving behaviors. During the program, water-saving coils as visual prompts were installed in a preschool setting. Therefore, learners' pro-environmental behaviors, particularly water-saving behaviors, were expected to be more promoted after the program in preschools compared to a home setting without the visual prompts. Within these recognitions, the research questions of this study are as follows:

RQ1: Has the program increased the proportion of water-saving behavior by young children in both preschools and homes?

RQ2: What factors led to the adoption of such a behavior by program participants in the different settings?

Since there have been few studies that have evaluated the ECEE programs, this paper expands contemporary knowledge regarding the effects of for programs on pro-environmental behaviors. It is important to note that there is a large quantity of literature and research pertaining to participatory research on young children's perspectives on their daily lives, such as the Mosaic approach [31], which combines the traditional methodology of observation and interviews with the introduction of participatory tools. In Japan, the Mosaic approach has been recently applied in the field of play spaces [32–34], but it has seldom been applied to specific behaviors, especially in the field of pro-environmental behaviors. Although this research did not sufficiently meet the participatory framework for listening to young children's perspectives on their water-saving behaviors, the study used participant observation and interviews with children and teachers as well as questionnaires for teachers in order to gain a deeper understanding of children's perspectives, which are largely linked to evaluations on the effects of the EEEPEC.

3. Methodology

This paper evaluates the effects of the EEEPEC, an early childhood education program for the environment, by examining young children's water-saving behaviors in both preschool and home settings. There are three reasons why this study focused on changes in water-saving behaviors rather than energy-saving actions. First, hand-washing is a more common daily activity of children in early childhood education compared to electricity use practices, in which "turning lights on and off" in the preschools is often managed by teachers for security reasons. Young children thus have more control over changes to their water-saving behaviors in preschools. Second, water-saving is a major challenge in Fukuoka Prefecture, taking into account the geographical factors affecting water storage. Those living in Fukuoka Prefecture have faced serious water shortages in the past; hence, teaching water-saving behaviors at an early age is increasingly important in this area. Third, the use of visual prompts, which is a part of the EEEPEC, is expected to directly lead to more water-saving behaviors in preschools, compared to in a home setting without the visual prompts.

3.1. The Eco Experience Education Program for Early Childhood

The Eco Experience Education Program for Early Childhood (EEEPEC) was initiated by a consortium on CO_2 reduction during early childhood in the fiscal years of 2014 and 2015 in Fukuoka Prefecture, Japan. Kindergartens, pre-schools, and certified children's centers (hereinafter schools) were targeted for the program. This consortium consists of various stakeholders, including the Fukuoka Center for Climate Change Actions (FCCCA, project secretariat), non-profit organizations and Climate Change Actions Promoters working on environmental education in early childhood, a kindergarten principal, the Department of Environmental Conservation, Fukuoka Prefecture, and several universities. The program was supported by a grant, "CO_2 Emission Control and Others Project", provided by the Ministry of the Environment, Japan. The program aims to raise environmental awareness from early childhood and promote pro-environmental behaviors, particularly water-saving behaviors.

Fukuoka Prefecture, situated on the northern tip of Kyushu Island, has faced difficulties in securing water resources due to topographical constraints such as few high mountains, low proportions of forest area, and low water volumes from rivers, as well as social constraints, such as population growth, urbanization, and changes in lifestyle (for example, the spread of flushing toilets). Addressing these difficulties requires large-scale changes to everyday life across all sectors of society. Under these circumstances, the EEEPEC was developed to raise environmental awareness from early childhood and promote water- and energy-saving behaviors. Participating schools are required to apply to the Fukuoka Center for Climate Change Actions, which is in charge of program coordination between each school and the external lecturers belonging to Climate Change Action Promoters. The external lecturers contact participating schools and discuss the program contents with the teachers in advance. On the program day, the external lecturers visit the schools and implement the EEEPEC, which can be divided into four parts and usually takes approximately one hour to complete:

Global warming education. First, the external lecturers explain the mechanism of global warming by using a picture-story show, entitled "*Chikyu Ondanka tte Naani*?" (What is global warming?), and a model globe. The picture-story show uses Japanese-style bedding as an analogy for CO_2 and then narrates the globe being painfully surrounded by the materials that look like thick bedding. This demonstration aims to encourage the young children to develop a better understanding of the need for CO_2 emissions reduction. In order to cope with this challenge, the program aims to introduce energy- and water-saving behaviors that the children can implement.

Energy-saving education. Second, the program encourages both young children and teachers to experience the difference between two types of electricity generation, LED bulbs and normal light bulbs, using hand generators. After this demonstration, the external

lecturers emphasize the significance of electricity generation and energy consumption using various resources, including non-renewable resources. The external lecturers then provide the young children with specific advice on how to use electricity efficiently and effectively, including advice regarding turning lights off in empty rooms and turning televisions off when not in use.

Water-saving education. Third, the young children are encouraged to build water towers using empty milk containers that represent actual water consumption. There are five different company designs, or colored empty milk containers, that represent various types of daily household water use (e.g., the toilet, bathroom, kitchen, laundry, and other uses such as hand-washing). The young children collect and sort the milk containers into these categories and build five water towers. When the towers are built, they are able to visualize how much water is consumed over the course of a day. Having visualized the water use that takes place over the course of a day, children are encouraged to be mindful of their own use and ways to save water. Then, the program moves to encourage the young children to handcraft water-saving coils by winding wire around a pen. The external lecturers further provide the young children with advice on how to save water using the water-saving coils, with tap water use projected to be less than the size of the pen. To promote water-saving behaviors, the coils were placed adjacent to tap water faucets as visual prompts in the schools, although the external lectures did not suggest the placement of water-saving coils in the children's homes.

True-and-false game. Finally, the program moves to a true-or-false game, which stimulates a review of the lessons learned. The external lecturers ask the young children several questions related to the program to review their learning. At the end of the program, the external lecturers request that the participants, including the young children and their teachers, save energy and water in their schools and homes.

EEEPEC participants. Young children between the ages of 4 and 6 years, as well as their teachers, participated in the program. Students in the middle were aged 4 and 5, and older students included those aged 5 and 6.

3.2. Data Collection

The EEEPEC was implemented in 33 schools, including a variety of pre-schools and certified children's centers. In total, 10 programs were implemented in schools in 2014 and 23 programs were implemented in 2015.

Our research method included participant observation and interviews with children and teachers as well as questionnaires for teachers in order to gain a deeper understanding of children's perspectives. Participant observation and interviews were conducted in three schools that agreed to these surveys in the midst of the EEEPEC application in the 2015 fiscal year. An undergraduate student researcher from the Laboratory of Environmental Life Science at Fukuoka Women's University visited these schools before the program started in order to develop a rapport with the targeted young children as well as to explain about the contents of these surveys. The three schools allowed the researcher to conduct these surveys, but the study was faced with time constraints related to the school activity schedule. Due to this, the study could not conduct these surveys one month after the EEEPEC in one school (A school). The three targeted schools received parents' consent for the surveys, and the observations and interviews were conducted in October and November of 2015. During the survey period, the participating schools did not experience any significant changes such as new educational stimulus.

Observational surveys were conducted in specific hand-washing sites. In this study, water-saving behaviors were defined as tap water use that amounts to less than the measure of water-saving coils (or the size of a pen), as shown in Figure 1. The surveys were conducted before (A school—boys: n = 11, girls: n = 7; B school—boys: n = 13, girls: n = 9; C school—boys: n = 13, girls: n = 8), immediately after (A school—boys: n = 11, girls: n = 9; B school—boys: n = 13, girls: n = 9; C school—boys: n = 9, girls: n = 7), one week after (A school—boys: n = 6, girls: n = 10; B school—boys: n = 9, girls: n = 9; C school—boys:

n = 9, girls: n = 8), and one month after (A school—no survey; B school—boys: n = 8, girls: n = 6; C school—boys: n = 11, girls: n = 9) the EEEPEC was implemented. Ultimately, 213 instances of hand-washing behavior were observed (boys: n = 119, girls: n = 94). Age-wise sample data could not be collected due to the shared washing places, making it difficult to count the sub-group sample by grade. The researcher made efforts to not only count the number of water-saving behaviors by children but also to listen to dialogue involving children and teachers.

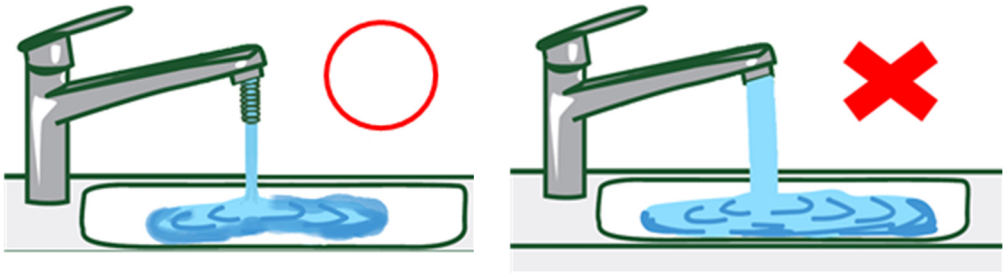


Figure 1. Visual assessment of water-saving actions. Revised from FCCCA [35].

Interviews with the young children were randomly conducted immediately after, one week after, and one month after the EEEPEC was implemented, with 48 children interviewed in total (see Table 1). Twenty-two respondents were boys (four- to five-year old group n = 9, five- to six-year old group n = 13) and twenty-six were girls (four- to five-year old group n = 11, five- to six-year old group n = 15). The interview survey aimed to capture children's impression of water-saving coils, the presence of water-saving behaviors in their schools and homes, and the factors contributing to water-saving behaviors. The interviews were structured in light of techniques that have been used in interviews with children in Europe and the United States. According to Tanaka [36], there are eight techniques commonly used in interviews with children: (i) building rapport, (ii) informing them of the interview objective, (iii) understanding ground rules, (iv) collecting personal information, (v) seeking free narrative responses, (vi) asking questions, (vii) using assistive materials (water-saving coils), and (viii) informing them of the end of the interview [36]. These techniques were applied in the present study, in order to enhance the validity of the interviews. In each period (immediately after the program, after one week, and after one month of the program), the researcher obtained consent from the respondents and then asked the students the following questions (see Appendix A in detail):

a. Do you know what these are (showing the water-saving coils)?
b. How are the coils used (showing the water-saving coils)?
c. Have you engaged in any water-saving behaviors in school? Why or why not?
d. Have you engaged in any water-saving behaviors at home? Why or why not?

Interviews targeting teachers were also implemented after the program finished, in order to interpret changes in water-saving behaviors by children.

In addition to participant observation and interviews, questionnaires were conducted in 33 participating schools. The study collected answers from 31 schools (i.e., one participating teacher from each school) with a response rate of 93.9%. The survey included a free response from the teachers about their impressions of children's environmental attitudes and behaviors after the EEEPEC was implemented. In addition, the questionnaire asked the teachers questions regarding (i) satisfaction with the program (using a four-point Likert scale); (ii) changes in children's pro-environmental communication and behaviors after the program (using a three-point Likert scale and a free response); and (iii) changes in teachers' pro-environmental behaviors after the program (three-point scale). Appendix B reports the contents of questions.

Table 1. Sample data of interviews.

School	Grade *	Gender	Immediately after	One Week after	One Month after
A	Third Class	Male	3	2	No survey
		Female	4	2	
	Second Class	Male	2	1	
		Female	1	3	
B	Third Class	Male	2	2	1
		Female	2	2	1
	Second Class	Male	1	1	1
		Female	1	2	1
C	Third Class	Male	1	1	1
		Female	2	1	1
	Second Class	Male	1	1	1
		Female	1	1	1

* Third class: 5- to 6-year old age group, second class: 4- to 5-year old age group.

The above data, which were collected from three surveys (observational survey, interviews and questionnaire), were analyzed in IBM SPSS Statistics 27 and R version 4.0.3 (10 October 2020). The graphics used in the figures were processed in Microsoft Excel 2016.

4. Results

4.1. Participant Observation Results

Findings revealed that the average percentage of water-saving behaviors before the program was 15%. This drastically increased immediately after the program (see Figure 2). The statistical analysis using a Chi-squared test showed significant differences among the four periods ($\chi^2(3) = 96.4$, $p < 0.001$, $\varphi = 0.673$). Residual analysis revealed that water-saving behaviors significantly increased immediately, one week and one month after the program. Likewise, results of the chi-squared test showed significant gender-based differences (girls: $\chi^2(3) = 40.1$, $p < 0.001$, $\varphi = 0.633$; boys: $\chi^2(3) = 58.3$, $p < 0.001$, $\varphi = 0.718$) in terms of the actions among the four periods. The pre-schooler girls significantly increased water-saving behaviors immediately after and one month after the program, while no significant differences of the actions during the periods of one week and one month after the program were confirmed among the pre-schooler boys. By school, the difference of the behaviors among the four periods were statistically significant (A school: $\chi^2(2) = 36.2$, $p < 0.001$, $\varphi = 0.819$; B school: $p < 0.001$, Fisher's exact test; C school: $\chi^2(3) = 33.1$, $p < 0.001$, $\varphi = 0.711$). According to the residual analysis, the significant differences of the behaviors before and immediately after the program were commonly confirmed in the three schools. Additionally, water-saving behaviors significantly increased one month after the program in the C school.

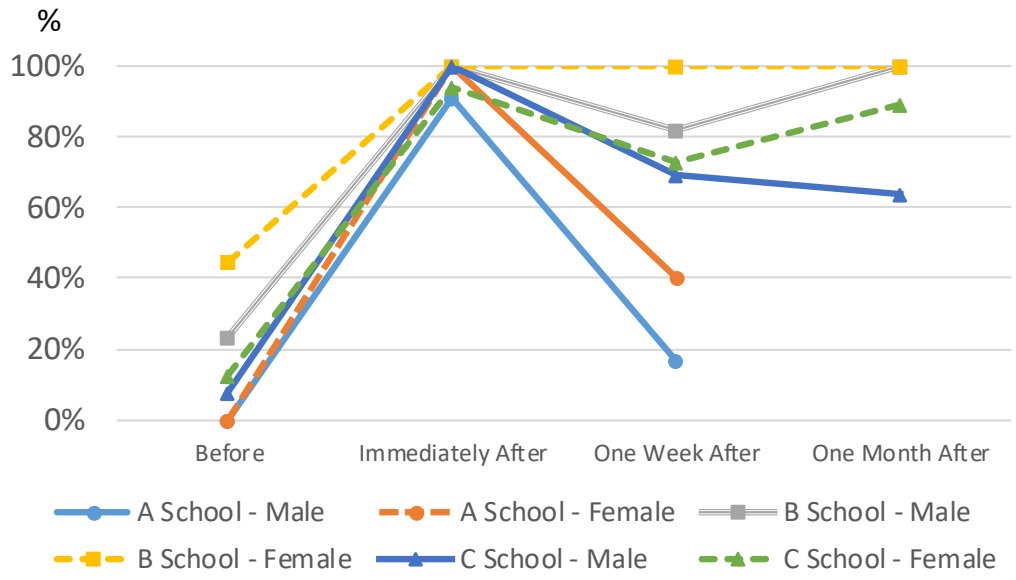


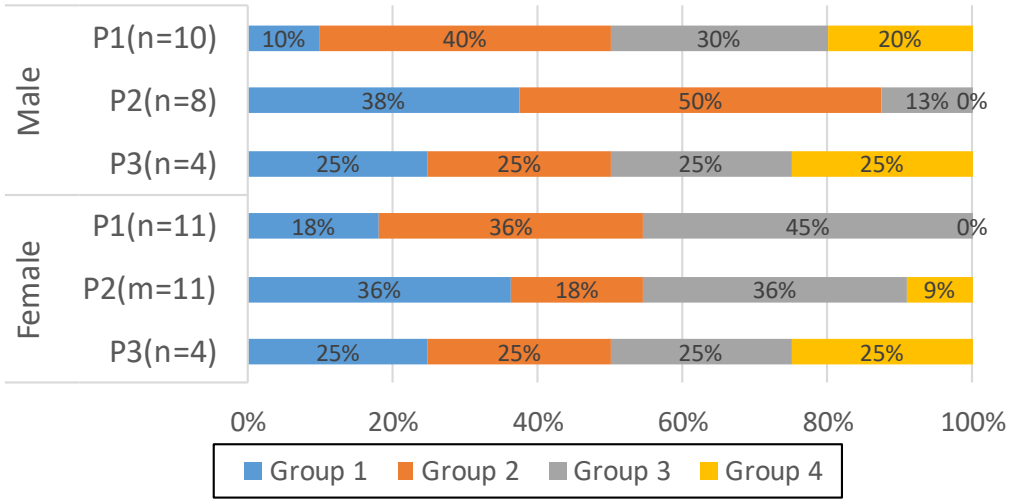
Figure 2. Rates of changes in water-saving behaviors before and after EEEPEC.

4.2. Interview Results

When the researcher showed the students the water-saving coils while asking the prompt, all young children remembered the water-saving coils, but some of them stumbled slightly over the first question regarding identifying the water-saving coils immediately after the program (14%) and one week after the program (26%). When the researcher used a gesture showing hand-washing, these children who struggled with this question were able to recall the visual prompt accordingly. After one month of the program, however, all respondents knew what the coils were without any assisting gestures, resulting from habits acquired in their daily life.

With regard to how to use the coils, answers to this question can be divided into four categories. The first group of answers revolved around the use of water, with children reporting that "*there are the coils in hand-washing sites*" and "*the coils are placed adjacent to tap water*". The answers of the first group cannot be interpreted regarding how the coils work. The second group centered around the impact of water coils on water use. The young children in this group reported that "*the coils can shorten the size of water volume*" and that "*the coils can reduce water use*". Group 2′s answers did not consider how the coils contribute to water-saving, but these children indicated an awareness of their effects on water use. For example, most of the respondents in this group (71%) mistakenly believed that placing the coils adjacent to tap water itself could automatically reduce water use. The third group consisted of such comments as "*it is a shame to consume much water*" and "*the coils are needed because keeping water running is bad*". The children in this group understood the role and objective of the coils in promoting water saving through visual prompting. Finally, the fourth group was made up of the children who linked their answers to their learning experience and their commitment to the environment. Children in Group 4 made comments such as "*I made a promise to use the coils*" and "*we learned the coils*".

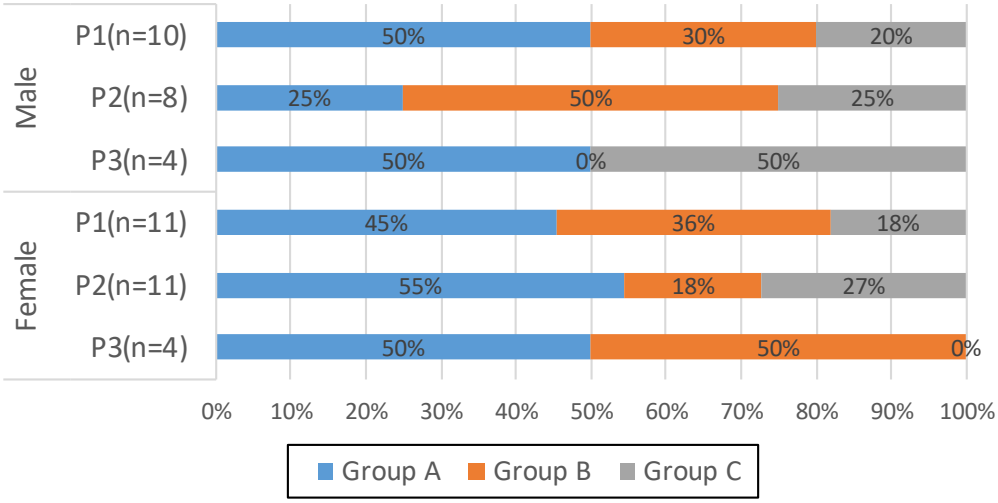
Results of Fisher's exact test showed no significant differences in terms of the group distribution among the three periods (Figure 3). Irrespective of gender, however, the percentage of children in the second and third groups were higher immediately after the program. Answers related to the third group fell one week after the program, while the percentage of the first group, who thought of their answers in a more abstract fashion, increased. One month after the program, the percentage of the fourth group increased, with all answers stating, "*I made a commitment by using the coils*".



P1=Immediately after the program, P2=One week after the program, P3=One month after the program
Group 1=Place of coils, Group 2= Effects of coils, Group 3=Roles of coils, Group 4=Promise

Figure 3. Impression of water-saving coils over time.

Finally, when the researcher asked about water-saving behaviors in the schools, all of the respondents answered "*I did the behaviors*" in every period in which interviews were conducted. The researcher also asked the respondents for the reasons for their answer. These reasons can be divided into three groups. Group A gave reasons related to environmental consciousness, such as "*for the earth*" and "*water will be depleted*". These answers can be interpreted as reflecting positive attitudes toward environmental conservation. Group B encapsulates answers related to injunctive norms, such as "*I do the behaviors because the lecturers told us wasting water is bad*". Finally, Group C's answers reflected their commitment to water-saving behaviors, such as "*I made a promise to the lecturers*". Results of Fisher's exact test showed no significant differences in terms of the group distribution among the three periods, but the majority of the answers concerning the reasons underlying water-saving behaviors were Group A in every period (see Figure 4).



P1=Immediately after the program, P2=One week after the program, P3=One month after the program
Group A=Enviomental consciousness, Group B=Injunctive norms, Group C=Commitment

Figure 4. Factors influencing children's attitudes toward water-saving behaviors in school.

By contrast, regarding the question on water-saving behaviors in their homes, 84% of respondents said "*I did the behaviors*" one week after. This percentage dropped to 62.5% one month after the program. The major barrier to water-saving behaviors was the lack of

visual prompts in their homes. Figure 5 shows the factors influencing their attitudes toward water-saving behaviors in their homes, using the same classifications (Groups A, B, and C) as above. Similar to the results in the school setting, no significant differences of the group distribution among the two periods were found in their homes. Irrespective of gender, however, Group A and Group B constituted the majority of the answers one week after the program, but their rate dropped one month after the program. The reasons in Group C constituted the most reported reasons for water-saving behavior one month after the program.

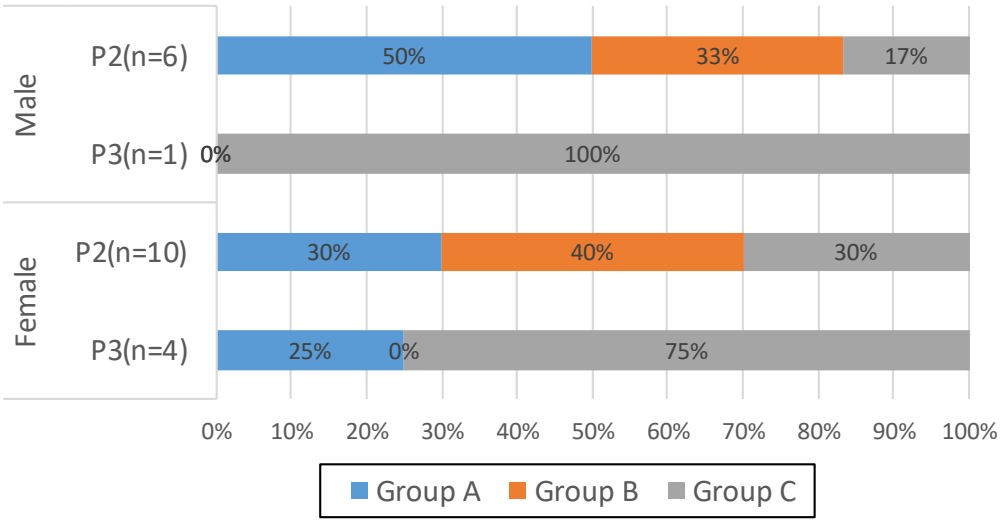


Figure 5. Factors influencing attitudes toward water-saving behavior in homes.

4.3. Questionnaire Results

Using the questionnaire, participating teachers from the 31 schools reported the degree of children's satisfaction for the program as "very good" (52%) and "good" (48%), with all answers related to program evaluation being positive. This means that the EEEPEC fulfilled the level required for early childhood education without difficulty, though it includes a wide variety of educational topics, including global warming and energy and water conservation. One teacher reported that "*It was easy for the children to listen to the talk, and the program including the hands-on learning was good*".

It is important to note that many respondents confirmed an increase in both environmental-friendly attitude (87%) and pro-environmental behaviors (81%), both of which were put into practice by the children in their schools. In other words, children's pro-environmental attitudes and actions were promoted in approximately 80% of schools that joined the program. One teacher reported, "*I saw children communicate with each other saying that the appropriate size of water volume is so-and-so*". In addition, another teacher realized the effects of the program, saying "*I think, adults' explanation using the word of Mottainai [having respect for the resources to not waste them] was too vague to make sense to the children, but they were able to develop environmental consciousness to some extent because of the lecture in detail*". After the program, pro-environmental behaviors by the teachers also increased (85% of schools). Thus, the program was able to promote positive environmental activities including water-saving behaviors, not only in the participating children but also their teachers.

5. Discussion

The EEEPEC was developed to enhance children's environmental awareness and increase water-saving behaviors. The program highlighted global warming and the significance of energy- and water-saving behaviors and installed visual prompts adjacent to tap

water faucets, which would encourage the participating children to engage in water-saving behaviors in the schools and their homes. In this section, this paper sets out to explore the two research questions (RQ1 and RQ2) in the different settings, respectively.

5.1. Water-Saving Behaviors at School and Factors Contributing to the Behaviors

Findings from the observational surveys showed that water-saving behaviors by young children had been encouraged after the program (RQ1). Young children reported the highest number of water-saving behaviors immediately after the program. One week after the program, the percentage of water-saving behaviors fell, but it was still significantly higher compared to before the program. This study further found that the average rate of water-saving behaviors increased between one week and one month after the program.

With regard to RQ2, the higher number of water-saving behaviors immediately after the program may be due to shorter time lapsing between the program's lessons and subsequent practicing of water-saving behaviors. It can be hypothesized that water-saving behaviors by young children would be reduced as the times passed. In this regard, however, the rate was increased again between one week and one month after the program. The alternative explanation can be rooted in pro-environmental communication between teachers and children, and among children. Compared to one week after the program, the researcher found more frequent pro-environmental communication one month after the program, including comments such as "*do not waste water*" during hand-washing time. This increased communication may have been triggered by teachers' commitment to the environment and the instalment of visual prompts. According to free responses from teachers in the questionnaire surveys, their environmental consciousness was inspired by the program. One teacher reported that "*It [the program] was very understandable . . . Taking part in the program, the teachers obtained more awareness to communicate with children for environmental conservation*". Accordingly, it is likely that teachers' commitment to pro-environmental communication was enhanced one month after the program, enabling the children to become accustomed to water-saving behavior. This suggests that there is a deep need for EEEPEC to work with the teachers, as Ardoin and Bowers [8] underscored the need for inclusion of ECEE content in teacher prepared programs. Given the fact that the EEEPEC is a one-time short lecture in each school, the involvement of the participating teachers who work with the children on the topic is crucial for promoting children' water-saving behaviors over a longer period of time.

In addition, the installation of visual prompts may have promoted pro-environmental communication and, by extension, water-saving. The water-saving coils provide immediate indications regarding the water saved through their use. This real-time feedback function of the coils can contribute to improvement of water-saving skills and the strengthening of pro-environmental communication. In the survey, one teacher reported, "*when children washed their hands, I heard them saying that the stream of water flowing from the tap should be pencil-thin*". Such social learning through the use of visual prompts took place during the action stage, thereby increasing the possibility of improved water-saving behaviors.

5.2. Water-Saving Behaviors at Home and Factors Contributing to the Behaviors

Interview data revealed that the young children reported water-saving behaviors not only in the schools but also in their homes (RQ1), as reported in earlier studies [15,22–25]. In contrast to the sustained water-saving behaviors in their schools, however, it is important to note that the proportion of water-saving behaviors in children's homes reduced over time.

With regard to RQ2, many young children identified the underlying causes of their failure to implement water-saving behaviors as the lack of water-saving coils next to their water faucets. It is likely that the visual prompts were powerful triggers reminding the children of the program as well as the need to adjust the water volume of a faucet. Without these visual prompts, it was difficult for them to recall their learning experience, contributing to them following their traditional hand-washing habits while at home. By contrast, in the schools, the children were able to realize the role, purpose, and necessity

of water-saving coils because they were placed adjacent to tap water for one month after the program.

It is important to note that the factors influencing children's attitudes toward water-saving behaviors in their homes differed in each period of the study. Commitment to the program (Group C) was the most popular factor driving water-saving behaviors one month after the program. This popularity is linked to extrinsic motivation, which is taken as a means to an end, rather than intrinsic motivation, which is perceived as an end in itself. According to Deci and Ryan [37], there are four categories of behavioral regulation resulting from extrinsic motivation: integration, identification, introjection, and external regulation, from most to least self-determined regulation. Commitment to the group, such as "*I made a promise to the lecturers*", corresponds to introjection or external regulation, which reflects external reasons for pursuing an activity such as peer or regulatory pressure [38]. Lavergne et al. [38] found that autonomous motivation (intrinsic, integrated, and identified motivation) that is based on an activity's value predicted a higher frequency of pro-environmental behaviors, whereas controlled motivation (introjection and externally regulated motivation) did not predict it. As time passes, extrinsically-motivated behaviors in combination with external factors such as different types of tap water and users around young children may result in a loss of focus on water-saving techniques. On the contrary, intrinsically motivated behaviors are much more likely to be sustained over time [39]; thus, water-saving behaviors driven by extrinsic motivation may not be sustained in the long term. To stay conscious of the importance of water-saving behaviors in children's homes, their intrinsic motivation for water-saving must be further developed. This may occur by installing visual prompts to remind them of the program as well as by promoting pro-environmental communication with their families.

6. Conclusions

This study sought to assess the effects of the EEEPEC on the water-saving behaviors of young children in Japan. The EEEPEC was developed to promote pro-environmental behaviors, particularly water-saving behaviors. Three methods of data collection were used: participant observation, interviews, and questionnaires. Survey data indicated that the children's water-saving behaviors were promoted by the program, especially in the period immediately after it. The recent learning experience and the use of visual prompts enhanced their interest, with most children putting their knowledge of water-saving into practice. Although the rate of water-saving behaviors fell one week after the program, it is important to note that this average number increased again, possibly resulting from the habituation of water-saving behaviors combined with the use of visual prompts and increased pro-environmental communication between teachers and children.

Importantly, the water-saving coils, as visual prompts, served multiple functions in promoting water-saving behaviors. First, water-saving coils made the young children, to some extent, recall their memory of the program whenever they used taps adjacent to the prompts. Second, these devices give an immediate feedback regarding water-saving behaviors, motivating users to adjust the water volume to below the size of the coils. Finally, others, including teachers and fellow children, could easily monitor users' behaviors, thereby leading to pro-environmental communication between them.

These findings suggest that promoting water-saving behaviors in the long-term requires not only providing young children with educational programs for the environment, but also promoting teachers' commitment to pro-environmental communication and using visual prompts that both give immediate feedback and enhance pro-environmental communication among users. Visual prompts combined with active pro-environmental communication between young children, teachers, and parents are both crucial until the young children become accustomed to practicing water-saving on a regular basis.

Ultimately, this study showed that to a great extent, the EEEPEC led to the promotion of water-saving behaviors in the young participants. Early childhood is a period of life in which lifelong attitudes, values, and patterns of behaviors toward nature and the envi-

ronment are shaped [11,40–42]. ECEE has the potential to raise children's environmental awareness and shape environmental attitudes in the long term [43,44]. In Japan, however, teacher-training courses in schools do not provide sufficient time to learn environmental education due to time constraints on teachers to complete the courses [45]. Given these matters, developments are needed to create education programs for the environment in a way that involves external experts for environmental education such as EEEPEC and supports teachers who work with the children to increase pro-environmental communication.

The major limitation of this study is the small sample size and limited statistical representativeness; further research is necessary for generalizing our outcomes. Moreover, long-term monitoring of the program is needed to evaluate impacts on participants' behavior. Additionally, this research endeavored to examine young children's understanding and views on water-saving behaviors, but it was unable to sufficiently illustrate insights into children's views and experiences. Research involving children is not as simple as asking direct, structured questions; more care needs to be taken in this process. Hence, further empirical research using more participatory tools for listening to young children's perspectives about their water-saving behaviors is needed to develop education programs for the environment that are truly effective.

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Appendix A

Interview
Q1 Do you know what these are (showing the water-saving coils)?
☐Yes ☐No (→If the respondent answer "Yes", ask the question from Q3)
Q2 Did you recall these (using a gesture showing hand-washing)?
☐Yes ☐No
Q3 How are the coils used (showing the water-saving coils)?
free response
Q4 Have you undertaken any water-saving behaviors in school?
☐Yes ☐No
Q5 Why (if yes) or why not (if no)?
free response
Q6 Have you undertaken any water-saving behaviors at home?
☐Yes ☐No
Q7 Why (if yes) or why not (if no)?
free response

Appendix B

Questionnaire

This is an English translation of the questionnaire targeting the participating schools of EEEPEC.

Q1 What do you think about the EEEPEC?

☐Very good ☐Good ☐Not good ☐Very bad

Please fill in your remarks (free response)

Q2 Before and after the program, what do you think about children's pro-environmental communication?

☐Increased ☐No change ☐Decreased

Please fill in the information in detail

Q3 Before and after the program, what do you think about children's pro-environmental behaviors?

☐Increased ☐No change ☐Decreased

Please fill in the information in detail

Q4 Before and after the program, what do you think about teachers' pro-environmental behaviors?

☐Increased ☐No change ☐Decreased

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