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Design and Development of a Micro-Curriculum for Environmental Character Education in Early Childhood Education

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Abstract: Design and Development of a Micro-Curriculum for Environmental Character Education in Early Childhood Education. Objective: This study aims to design a micro curriculum for environmental character education at the early childhood education (ECE) level that aligns with the Sustainable Development Goals (SDGs). The curriculum is designed to instill environmental awareness values in children from an early age, laying a foundation for preparing future generations. **Methods:** The research adopts the Design and Development (D&D) method. A needs analysis was conducted using Likert-scale questionnaires administered to 18 principals and 85 teachers from public kindergartens in Banten Province. The goal was to identify the actual conditions of environmental character education implementation and determine the essential competencies required for designing the micro curriculum. **Findings:** The analysis results showed no significant differences between the factual conditions in highland and lowland areas. Additionally, quantitative analysis using SPSS indicated that teachers' perceptions regarding the necessary competencies were relatively homogeneous. Based on these findings, three main topics were selected as core content for the curriculum: sustainable lifestyle, animals, and plants. The curriculum content was designed, including learning objectives, instructional materials, teaching media, learning strategies, and assessment methods. The developed micro curriculum for environmental character education was subsequently evaluated by experts in early childhood education, kindergarten principals, and kindergarten teachers to assess its feasibility. The validation results demonstrated that the curriculum was considered feasible and appropriate for implementation. **Conclusion:** The study concludes that public kindergartens in Banten Province require a systematic and structured curriculum for environmental character education. Moreover, the designed curriculum aligns well with the identified competency needs and has been validated as feasible based on expert and practitioner evaluations in the field of early childhood education.

Keywords: curriculum development, character education, environmental awareness, early childhood education.

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INTRODUCTION

Environmental education has become a key element in the global development agenda, especially after the adoption of the Sustainable Development Goals (SDGs) by the United Nations. SDG 4, on quality education, and SDG 13, on climate action, encourage the transformation of education from an early age to foster care and responsibility for the environment. Reflecting on environmental conditions around the world, according to WHO data from 2020, major cities globally produce approximately 1.3 billion tons of waste each year, and this is expected to increase to 2.2 billion tons by 2025. (Akbar,

Mauliyana, & Dode, 2024). The current condition of the environment in Indonesia is also not in good enough condition, and shows a high urgency for strengthening the character education of environmental care. Data from BPS and KLHK show that water and air pollution, forest degradation, and the volume of plastic waste in Indonesia are at an alarming level. According to data from KLHK, "Indonesia produces about 6.8 million tons of plastic waste per year, and more than 60% of it is not recycled" (Muhammad Nizar Arvila Putra et al., 2024). Furthermore, Indonesia is listed among the countries with the highest consumption of microplastics in the world, which not only pollutes the environment but also enters the food chain of people, including children. "An effective solution to the environment al awareness problem is the existence of individuals with environmental awareness, which is indispensable in creating a liveable and sustainable environment" (UÇAR ÇABUK & ÝÞAL, 2023).

Education is the most important part of efforts to shape human character, and schools play a major role can utilizing various learning resources available to carry out the character education process optimally. "Character education is one of the soft skills. In addition, the Directorate General of the Ministry of Education and Culture explains that character is a way of thinking and behaving that is unique to each individual to live and work together in families, communities, nations, and countries"(Putra, Syifak, Huda, Guntoro, & Fahira, 2023). Through character education, children will be able to apply their knowledge and internalize the expected character values, which will be reflected in their daily behavior. In order to realize the expected character, a supportive environment is needed, one of which is structured formal education, with a character education curriculum. Character education, one of which is intended as a process of instilling good values and personality (Fajriati & Prastiani, 2022). The existence of early childhood education institutions, which also collaborate with parents and the community in the educational process for children, is important in developing the personality and character of children. "Children are the future generation of the nation who need to have character, one of which is caring for the environment, so that they can know all kinds of natural resources and their biodiversity to be utilized in meeting the needs of society in a sustainable manner" (Ashuri et al., 2021). Besides that, "Children not only will inherit the responsibility of looking after the Earth, but in many developing countries, they comprise nearly half the population" (Engdahl, 2015).

Environmental education at a young age encourages curiosity and exploration, helping children form a direct and meaningful relationship with nature" (Roussou, Argyrakou, & Milakis, 2025). Planting the character of environmental awareness is one of the efforts in achieving the SDGs goals, especially in the environmental aspect. "Early childhood education is an important period for promoting environmental literacy"(Ramulumo & Shabalala, 2024). This was also conveyed by Masykuroh, Yetti, Nurani, & Rahmawati (2024), who stated that "Environmental education in children is essential, and motivation for eco-friendly formation in childhood may have a lifelong effect." "Conservation has an important role in achieving these goals by protecting and maintaining the natural resources needed for sustainable development" (Dian Pramesti & Trimurtini, 2024). So, to be able to instill the character of environmental education in children, it is necessary to develop a curriculum design for environmental awareness character education at the early childhood education level. "Education for Sustainable Development should be integrated at all educational levels, starting from early childhood" (Güler Yýldýz et al., 2021). In line with the opinion of Lestari et al. (2024) that

"socialization of SDGs in the school environment is the right step to teach students about the importance of a sustainable environment."

In the realm of early childhood education, although the Merdeka Curriculum has been introduced, the integration of environmental care values is still very limited. Regarding the development of the character of environmental care, based on the results of observations made, Hasan (2019) found that "in one PAUD in Polewali Mandar Regency, it was found that there were still many children who had not been able to apply to throw garbage in its place." This needs attention, because if it is not corrected, the character of children who are accustomed to littering will continue to be attached to adulthood. So that they can know all kinds of natural resources and their biodiversity to be utilized in meeting the needs of society in a sustainable manner" (Ashuri et al., 2021). Beside that, "Children not only will inherit the responsibility of looking after the Earth, but in many developing countries, they comprise nearly half the population" (Engdahl, 2015). Regarding the development of environmental awareness character in kindergarten, based on observations made by Masykuroh & Fajriah (2023), "in reality, learning to develop environmental awareness character is only as a decoration. Educators only teach theory without applying it."

That is the description of the real conditions in the field; character education does not address the affective aspects and tends to focus only on cognitive aspects. Students are only given knowledge about good character values, which must be owned, but are not given real examples of what the implementation of character or virtue values looks like. The role of the teacher is limited to transferring information, whereas it should also be a role model for students in the implementation of character education, especially environmental education. There are many simple things that teachers can model in everyday life, especially to increase children's concern for the environment.

At the micro level, the challenges in implementing environmental awareness character education in early childhood education are increasingly complex. "Not all early childhood teachers are able to integrate environmental values into their teaching materials" (Elmanora et al., 2023). The practices carried out are still superficial, such as inviting children to pick up trash or water plants, without any conceptual and reflective understanding that accompanies them. In addition, the involvement of parents and communities in supporting environmental programs in early childhood education remains low. "Sustainability education is currently not addressed systematically due to knowledge gaps among staff and organizational challenges" (Furu & Heilala, 2022). These conditions indicate a gap between the urgency of environmental issues and the capacity of early childhood education institutions to address them. There is a need for a curriculum approach that can bridge this need through a micro-curriculum design that is contextual, applicable, and based on needs research. With a hands-on experience-based approach, such as nature exploration activities, creative recycling, and environmental-themed storytelling, children can learn to understand environmental issues in a more meaningful way.

Several countries have developed environmental education curricula that are systematically integrated into early childhood education. Recent studies confirm that environmental education, starting at an early age, contributes to the development of pro-environmental character and habits. For example, the Eco-Schools program implemented in more than 60 countries has increased environmentally friendly practices at the school community level, including ECD. Research by Chawla (2020) showed that children's involvement in environment-based activities significantly affects

their development of ecological empathy. As demonstrated by the Reef Guardians program in Australia, where students learn about the principles of ecologically sustainable development and adopt behaviors and practices that protect the Reef, the program is integrated into their national education curriculum (Great Barrier Reef Marine Park Authority, 2023). Besides Australia, another country that has also long prioritized environmental character education is Japan. The new curriculum in Japan, which was developed, contained the purpose, needs, and methods for environmental education. It was categorized into six core categories, considered important for solving environmental problems. These were: awareness, attitudes, skills, knowledge, ability, and participation (Laiphrakpam, Aroonsrimorak ot, & Rama Shanker, 2019). In addition, as mentioned by Inoue et al. (2019), "Japanese forest kindergarten numbers have expanded and some early childhood services have implemented Skogsmulle outdoor programs adapted from Sweden."

Finland is one of the countries that shows that most of its citizens have high environmental awareness based on the results of research that has been conducted. This condition is caused by many factors, including "Finnish primary school teaches students quite well about climate change and biodiversity, or that those who have attended primary school are quite environmentally conscious with information obtained elsewhere" (Ratinen & Linnanen, 2022). In Finland, Germany, and Denmark, the forest school model has been implemented. "Forest school is a form of outdoor learning that takes children into regular and repeated learning experiences in natural settings" (Sella, Bolognesi, Bergamini, Mason, & Pazzaglia, 2023), or in other words, this program introduces learning based on nature exploration, and based on the results of research has been shown to increase children's ecological awareness and social skills. In addition to these three countries, New Zealand has also integrated environmental character education into the learning curriculum. "In Aotearoa, a basic characteristic of Early Childhood outdoor education involves children and teachers regularly and repeatedly visiting a forest-bush-park-farm outdoor space" (Alcock & Ritchie, 2018). Meanwhile, in Australia and the United States, the garden-based learning approach has shown success in instilling ecological attitudes and sustainable living behaviors through gardening activities and direct observation in the surrounding environment. However, the effectiveness of these environmental education programs and learning models is highly influenced by teacher readiness, the availability of relevant micro-curricula, and consistent institutional support.

This research offers a micro-curriculum design for environmental character education based on the results of systematic D&D research, which began with a quantitative needs analysis of teachers in two different topographies (highlands and lowlands), which has not been widely done in the context of early childhood education curriculum development in Indonesia. The curriculum is organized thematically, tiered, and integrated with play while learning activities that are developmentally appropriate. The main innovation of this design lies in the integration of character pedagogy and environmental literacy approaches through micro-learning modules that are easily implemented by teachers. Additionally, the involvement of parents and communities is a crucial aspect of implementing this curriculum, which helps strengthen the internalization of environmental values in children's daily lives.

This micro-curriculum design is also equipped with a measurement tool for children's environmental care character development based on observation and authentic assessment, to facilitate teachers in monitoring and evaluating the learning process. Previous research by Seo et al. (2020) showed that project and portfolio-based

assessments are more effective in measuring children's understanding and attitudes toward the environment compared to conventional assessments. Therefore, the evaluation component in this curriculum is designed to capture children's development holistically, including cognitive, affective, and psychomotor dimensions related to the character of environmental care.

By integrating the values of character education and environmental literacy into the PAUD micro-curriculum, it is expected that children will not only acquire knowledge about the environment, but also develop the attitudes and skills to protect it. Furthermore, this approach is expected to shape future generations who are environmentally conscious and actively contribute to maintaining the sustainability of the planet. Based on this background, the formulation of the problem in this study is "How to design a micro-curriculum of environmental awareness character education for PAUD in Indonesia that is effective, contextualized, and in accordance with children's developmental needs and supports the achievement of sustainable development goals?" It is hoped that it can improve the character of environmental awareness in early childhood.

METHOD

Participants

The population of this study included heads of State Kindergartens in Banten Province and teachers of State Kindergartens in Banten Province. The research sample consisted of 18 heads of State Kindergartens in Banten Province, which were divided into nine schools in the highland area and nine other schools in the lowlands. The sample of public kindergarten teachers consisted of 80 people, who came from 9 schools in the highlands and nine schools in the lowlands. The following are the characteristics of respondents for the analysis of factual conditions, namely, the heads of public kindergartens, as follows.

Table 1. Characteristics of kindergarten head respondents

Aspect	Codes	Highland	Lowland
		F (n=9)	F (n=9)
Age of Teachers	<25 years old	0	0
	25-30 years old	0	0
	31-35 years old	1	0
	36-40 years old	1	0
	>40 years old	7	9
Educational Background	High School	0	0
	Diploma	0	0
	S1	9	8
	S2	0	1
Professional Experience	< 5 years	0	0
	5-10 years	0	0
	11-15 years	2	1
	>15 years	7	8

Based on the table, it is evident that, in both highland and lowland areas, most public kindergarten teachers are over 40 years old, hold an S1 educational background, and have more than 15 years of service. Based on these characteristics, respondents can be considered to have the necessary qualifications to participate in identifying the competencies required for

designing an environmental care character education curriculum in early childhood education units. Meanwhile, Table 2 presents the characteristics of 80 public kindergarten teachers who participated in identifying the competencies needed to design a micro-curriculum for environmental awareness character education in early childhood education units.

Table 2. Characteristics of teacher respondents

Aspects	Codes	Highland	Lowland
		F (n=51)	F (n=29)
Age of Teachers	<25 years old	0	1
	25-30 years old	2	2
	31-35 years old	1	1
	36-40 years old	1	0
	>40 years old	47	25
Educational Background	High School	3	1
	Diploma	1	0
	S1	43	27
	S2	4	1
Professional Experience	< 5 years	2	5
	5-10 years	7	3
	11-15 years	18	6
	>15 years	24	15

Based on the table, it is evident that, in both highland and lowland areas, most public kindergarten teachers are over 40 years old, hold an S1 educational background, and have more than 15 years of service. Based on these characteristics, respondents can be considered to have the necessary qualifications to participate in identifying the competencies required for designing an environmental care character education curriculum in early childhood education units.

This study applied the purposive sampling technique, which is a non-probability sampling technique in which respondents are purposively selected based on characteristics relevant to the research objectives. This technique was chosen because it emphasizes the selection of the most informative subjects, specifically the heads of public kindergartens and public kindergarten teachers in Banten Province, who come from both highland and lowland areas. Selection based on this consideration is effective when the population is geographically dispersed, allowing for time and resource efficiency and supporting comparisons between regions. In addition, purposive sampling enhances methodological reliability by ensuring a match between the sample and the research objectives, which has a positive impact on the credibility, transferability, and dependability of the data and research results (Campbell et al., 2020).

The Inclusion criteria included principals or teachers of public kindergartens who were currently actively teaching or leading, had at least two years of service in the school, were willing to participate voluntarily with informed consent, and were able to communicate well in Bahasa Indonesia. The exclusion criteria included respondents who were on sabbatical (such as maternity leave, sickness, or study assignment), those who had been on duty for less than two years, those who refused to participate, and those

with severe health conditions or limitations that prevented full engagement in the data collection process. The application of these criteria explicitly supports transparency and reliability in the sampling process.

Research Design and Procedures

This study employed the Design and Development research design proposed by Peffers et al. (2007), which comprises six systematic steps: Problem Identification, Defining Objectives, Design and Development, Testing the Artifact, Evaluating Testing Results, and Communication. However, the procedures carried out in this study only included the problem identification stage, the define objectives stage, and the design and development stage. The research was conducted during the period January-May 2025, with the following stages:

The first stage, namely problem identification and define objectives was passed by conducting a Needs Analysis which included several activities, including literature study on environmental competence for early childhood education, analysis of factual conditions related to the implementation of environmental character education in early childhood education units through questionnaires to 18 heads of public kindergartens in Banten Province, analysis of the competencies needed in the design of the micro curriculum for environmental character education in early childhood education units through a questionnaire given to 80 public kindergarten teachers in Banten Province.

The second stage, namely design and development, includes several activities, including the formulation of competencies, objectives, and materials, the preparation of the first draft of the curriculum prototype, and feasibility testing by ECD experts, kindergarten principals, and kindergarten teachers, for initial validation of curriculum content, through a Likert scale questionnaire.

Instrument

Initial data collection was conducted through a needs analysis. The data obtained from the needs analysis is quantitative, with the data collection instrument being a questionnaire. The questionnaire in this study consisted of two questionnaires. First, a questionnaire was used to analyze the factual conditions provided to 18 heads of public kindergartens in Banten Province, aiming to determine the implementation of environmental care character education in early childhood education units across Banten Province, including both highland and lowland areas. Two options can be selected in the question naire, namely Yes and No. The questionnaire was distributed offline and online. The questionnaire was distributed offline and online using Google Forms. The second questionnaire was used to collect data on the opinions of public kindergarten teachers, particularly in Banten Province, regarding the competencies required in the curriculum design of environmental care character education in early childhood education units. There are four answer options that teachers can choose from in the questionnaire given, namely Strongly Disagree, Disagree, Agree, and Strongly Agree. The questionnaire was distributed offline and online using Google Forms.

The statements in the questionnaire were compiled based on topics that align with the character of environmental care at the early childhood education level, and are associated with the themes of early childhood learning listed in the independent curriculum, also guided by the NEP-R Scale. "The NEP-R Scale is one of the most widely used instruments to measure ecological awareness and the degree of environmental concern" (Fernández, Gómez-Gonçalves, González, & Rodríguez, 2025). The statement items that will appear in the competency identification questionnaire filled in by respondents of public kindergarten teachers in Banten Province are presented in Table 3.

Table 3. Competency identification questionnaire grid

No.	Variable	Indicator
1.	Disposing of garbage in its place	1. Obtaining data on students' understanding of the right way to dispose of garbage.
		2. Obtaining data on students' understanding of different types of waste.
		3. Obtain data on students' knowledge of waste management.
2.	Watering plants	4. Obtain data on students' knowledge of equipment for watering plants.
		5. Obtain data on how students apply the right way to water plants.
		6. Obtain data on students' habits of watering plants.
3.	Helping to care for plants	7. Obtain data on students' knowledge of the types of plants.
		8. Obtain data on students' knowledge of equipment to care for plants.
		9. Obtained data on students' habits of recycling waste to care for plants.
		10. Obtain data on students' knowledge about applying fertilizer to plants.
4.	Helping to take care of pets	11. Obtain data on students' knowledge about the types of animals that can be kept.
		12. Obtaining data on students' initiative in helping to feed pets.
		13. Obtain data on students' skills in helping to clean pet cages.

From the data, information related to the environmental care character competencies needed by students at the early childhood education level was obtained based on the opinions of kindergarten teachers in Banten Province, from both highland and lowland areas.

The instruments were tested for validity and reliability. The validity test was conducted using an empirical validity test. Each instrument was tested on 30 kindergarten teachers with characteristics with the respondents. Based on the results of the empirical validity test conducted on 30 teachers, for the factual condition analysis instrument with 35 questionnaire statement items, the results showed that 27 statement items were declared valid, and eight other statement items were invalid, so the statement items used in the needs analysis questionnaire were 27 statement items. The competency identification questionnaire consisted of 60 statement items; the results showed that 52 statement items were deemed valid, while eight other statement items were invalid. Therefore, the statement items used in the competency identification questionnaire were 52 statement items. The instrument reliability test was conducted using Cronbach's Alpha. The factual condition analysis instrument yielded a Cronbach's Alpha score of 0.80, and the competency identification instrument obtained a Cronbach's Alpha score of 0.84, indicating that both instruments were reliable.

Data Analysis

The quantitative data obtained from the analysis of factual conditions instruments were analyzed using *SPSS* to obtain descriptive statistical results, including the mean, Standard Deviation, and the average difference between groups of respondents in the highlands and lowlands. Then, SPSS was also utilized to obtain the results of the Independent Sample T-Test, comparing teacher perceptions related to the competencies needed to design the micro-curriculum for environmental awareness character education in the highlands and lowlands.

RESULT AND DISCUSSION

At the preliminary study stage, researchers analyzed the factual conditions with respondents, specifically 18 principals from 18 public kindergartens in Banten Province, who were selected as the research sample. The results of the factual condition analysis are presented in Table 4.

Table 4. Results of factual condition analysis

Respondents	Region	
	Highlands	Lowland
Respondent 1	17	12
Respondent 2	18	12
Respondent 3	22	20
Respondent 4	23	14
Respondent 5	16	3
Respondent 6	25	26
Respondent 7	26	26
Respondent 8	25	26
Respondent 9	22	19

Based on the table, it can be seen that most schools have not implemented environmental care character education thoroughly. Environmental care character education is applied as a habit and is not included in the lesson plan, so teachers cannot measure the success of its implementation. Revitalizing learning facilities for children is necessary because they play a critical role in character education within early childhood education units. The available facilities are still limited, one of which is the availability of trash bins with various categories of waste types (organic and inorganic), as well as facilities for watering and caring for plants. In line with Suwandi et al. (2023), who stated that "Revitalizing learning facilities in children needs to be done because learning facilities play a crucial role in determining the quality of children's education."

Additionally, 80 kindergarten teachers had completed a questionnaire to identify the competencies needed in designing the environmental care character education curriculum. Based on a review of various literatur e related to environmental care materials at the early childhood education level, the questionnaire developed by researchers to conduct a needs analysis is referenced in the study's results. It is formulated into several topics, which are then elaborated upon in terms of several competencies. Based on these competencies, the researcher made the statement items listed in the competency identification questionnaire. The descriptive statistical analysis of teachers' competencies is presented in Table 5. The follow ing is a comparis on graph of the average score of competencies needed based on the perceptions of kindergarten teachers in highland and lowland areas.

Table 5. Descriptive statistical analysis of competencies required by students

Competency Aspect	Competencies	Mean		Std Dev	
		DT	DR	DT	DR
Disposing of garbage by yourself	Understand the right way to dispose of waste	3.43	3.12	0.29	0.05
	Distinguishing the types of waste.	2.56	2.44	0.13	0.19
	Managing waste.	2.78	2.58	0.07	0.10
Watering plants	Using equipment to water the plants.	2.59	2.59	0.03	0.04
	Applying the right way to water the plants.	2.90	2.72	0.11	0.09
	Make a habit of watering plants.	2.84	2.76	0.14	0.12
Taking care of plants	Knowing the types of plants in the neighborhood.	2.96	2.65	0.10	0.13
	Using various tools to care for plants.	2.87	2.86	0.07	0.07
	Recycle waste to care for your plants.	2.59	2.75	0.11	0.09
	Apply fertilizer to plants.	2.73	2.65	0.11	0.05
Caring for pets	Knowing the types of animals that can be kept.	3.08	2.69	0.17	0.12
	Help feed the pets.	2.82	2.82	0.17	0.09
	Cleaning the pet's cage.	2.77	2.78	0.09	0.15

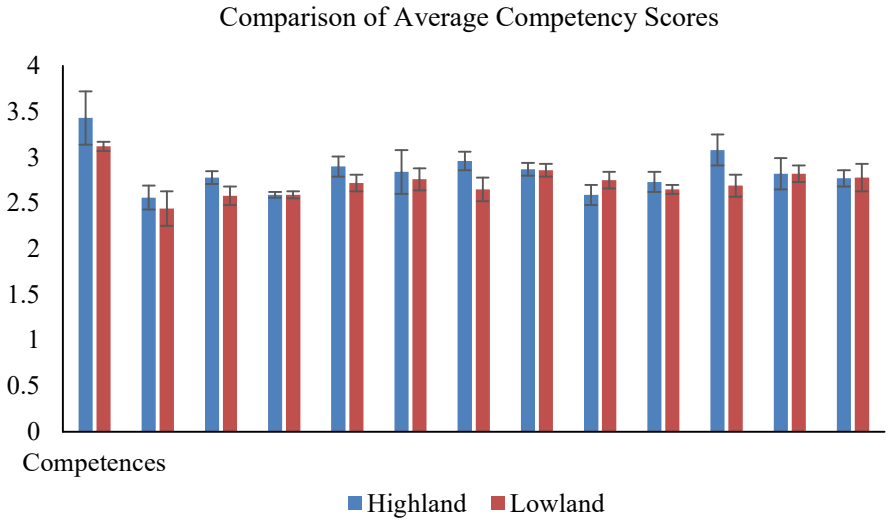

Figure 1. Comparison chart of average competency scores for highland and lowland areas

Based on the graph, it is evident that the highland region has a higher average score in most aspects of competence. Examining the error bars reveals that the highland region exhibits higher data variability compared to the lowland region.

Key Competencies for Environmental Character Education

Analysis of the identification of competencies obtained from the teacher questionnaire confirmed four central

competencies, including disposing of one's own garbage, watering plants, caring for plants, and caring for pets. The four competencies can be elaborated as follows:

Disposing of Own Trash

In this topic, three competencies were assessed: 1) understanding the right way to dispose of waste, 2) distinguishing between types of waste, and 3) managing waste. The mean scores on this topic were 3.43, 2.56, and 2.78 for highland areas, and 3.12, 2.44, and 2.58 for lowland areas. The standard deviation of each competency item for both highland and lowland areas is less than 0.5, which means that teachers' views are relatively homogeneous. Teachers perceived this topic as important, and each competency in this topic was also considered important to be included in the curriculum design for environmental awareness character education at the early childhood education level. Of the three competencies in the aspect of disposing of one's own waste, the competency of understanding how to dispose of waste properly (mean DT = 3.43, mean DR = 3.12) received the highest score, based on the researcher's analysis, this can occur because disposing of waste properly is the most basic practice and is most often emphasized in students' daily lives at school, because it is part of habituation. Meanwhile, the competency of distinguishing the types of waste (mean DT=2.56, mean DR=2.44) received the lowest score; this could occur because, to improve this competency, more complex knowledge and more adequate segregated waste bin facilities are needed, while the availability of facilities and infrastructure to distinguish the types of waste is generally not yet available in schools.

Watering Plants

In this topic, three competencies were assessed: 1) using equipment to water plants, 2) applying the right way to water plants, and 3) getting used to watering plants. The mean scores on this topic were 2.59, 2.90, and 2.84 for highland areas, and 2.59, 2.72, and 2.76 for lowland areas. The standard deviation of each competency item for both highland and lowland areas is less than 0.5, which means that teachers' views are relatively homogeneous. Teachers perceived this topic as important, and each competency in this topic was also considered important to be included in the curriculum design for environmental awareness character education at the early childhood education level. Of the three competencies in the aspect of watering plants, the competency of applying the right way to water plants (mean DT = 2.90, mean DR = 2.72) received the highest score, based on the researcher's analysis. This is because teachers consider watering plants to be one of the most important competencies to emphasize. Although watering plants is a common activity among students, it is often done incorrectly, such as using the wrong amount of water for the plants. In this case, teachers can teach students to save water, in accordance with the environmental pillar of the Sustainable Development Goals. While the competency in using equipment to water plants (mean DT=2.59, mean DR=2.59) received the lowest score, this may be because students already possess this competency, making it less crucial in learning practices.

Taking Care of Plants

In this topic, there are four competencies assessed: 1) knowing the types of plants in the surrounding environment, 2) using various tools to care for plants, 3) recycling waste to care for plants, and 4) applying fertilizer to plants. The average scores on these topics were 2.96, 2.87, 2.59, and 2.73 for highland areas, and 2.65, 2.86, 2.75, and 2.65 for lowland areas. The standard deviation of each competency item for both highland and lowland areas is less than 0.5, which

means that teachers' views are relatively homogeneous. Teachers perceived this topic as important, and each competency in this topic was also considered important to be included in the curriculum design for environmental awareness character education at the early childhood education level. Of the four competencies in the aspect of caring for plants, the competency of knowing the types of plants (mean DT = 2.96, mean DR = 2.65) received the highest score, based on the researcher's analysis, this is because introducing the types of plants, especially those in the surrounding environment is the first and most important thing that needs to be taught and mastered by students, so that later students can take care of plants in the right way, because each type of plant requires different ways of care, for example related to its water needs. In comparison, the competency to recycle waste to care for plants (mean DT = 2.59, mean DR = 2.75) receives the lowest score, which may be due to the need for adequate facilities and infrastructure to facilitate learning about recycling waste. At the same time, not all schools have the ability to meet their learning resource needs, for example, in the area of waste recycling education.

Taking Care of Pets

In this topic, three competencies were assessed: 1) knowing the types of animals that can be kept, 2) helping to feed pets, and 3) cleaning pet cages. The mean scores on this topic were 3.08, 2.82, and 2.77 for highland areas, and 2.69, 2.82, and 2.78 for lowland areas. The standard deviation of each competency item for both highland and lowland areas is less than 0.5, which means that teachers' views are relatively homogeneous. Teachers perceived this topic as important, and each competency in this topic was also considered important to be included in the curriculum design for environmental awareness character education at the early childhood education level. Of the three competencies in the aspect of caring for pets, the competency of knowing the types of pets (mean DT = 3.08, mean DR = 2.69) received the highest score, based on the researcher's analysis, this is because introducing the types of pets is the first and most important thing that needs to be taught and mastered by students, so that later students can take care of pets in the right way, because each type of pet requires different ways of care. In addition, introducing types of pets can be done in various ways, such as through pictures, videos, or by presenting the original animals directly in the classroom, if possible. While the competency of cleaning pet cages (mean DT = 2.77, mean DR = 2.78) received the lowest score, this can occur because cleaning pet cages is not the primary task for early childhood, and the practice still needs to be supervised by adults, so it is not the primary competency to be mastered by students.

Comparison of Highland and Lowland Teachers' Perceptions

The comparative analysis of competency identification scores in DT (highland) and DR (lowland) presented in Table 5 shows a mixed pattern. Many items averaged higher in the highlands, but some practical items, such as "recycling waste to care for plants," scored higher in the lowlands (mean DT = 2.59, mean DR = 2.75). The following are the results of the independent sample t-test calculations for each competency aspect:

Competency Aspects of Disposing of Waste Independently

Based on the results of the independent sample t-test statistical test on the aspect of competence in disposing of waste independently, it was found that there was a significant difference between highlands and lowlands, because the sig-2 tailed value was less than 0.05.

Table 6. Independent sample T-Test on the aspect of competence in disposing of waste independently

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Competency Score	Equal variances assumed	2.20	.14	4.92	78	.00	3.23	.65	1.92	4.53

Table 7. Independent sample T-Test on the aspect of competence in watering plants

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Competency Score	Equal variances assumed	.32	.57	1.45	78	.15	.60	.41	-.22	1.42

Competency Aspect of Watering Plant

Based on the results of the independent sample t-test statistical test on the aspect of plant watering competence, it was found that there was no significant difference between highlands and lowlands, as indicated by the 2-tailed p-value. Value was greater than 0.05.

Competency Aspect of Plant Care

Based on the results of the independent sample t-test statistical test on the aspect of competence in plant care, it was found that there was a significant difference between highlands and lowlands, because the sig-2 tailed value was less than 0.05.

Competency Aspect of Pet Care

Based on the results of the independent sample t-test statistical test on the aspect of competence in pet care, it was found that there was a significant difference between highlands and lowlands, because the sig-2 tailed value was less than 0.05. Some possible explanations for this pattern:

Table 8. Independent sample T-Test on the aspect of competence in plant care

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Competency Score	Equal variances assumed	7.79	.01	2.04	78	.04	1.51	.74	.34	1.99

Table 9. Independent sample T-Test on the aspect of competence in pet care

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Competency Score	Equal variances assumed	9.35	.00	2.32	78	.02	1.63	.70	.23	3.02

Access to Waste Management Programs

Communities in lowland urban areas tend to have easier access to various waste management programs, so schools in lowland areas are more familiar with them than schools in highland areas. Research on waste banks in Indonesia indicates that the implementation of waste management programs at the local level can significantly enhance community participation in waste management, thereby increasing recycling capacity. This program can be effectively replicated in schools (Budiyarto, Clarke, & Ross, 2025). Researchers also found that one public kindergarten in the lowland area has waste sorting bins, but with unique shapes. For example, for inorganic waste, the bins are shaped like bottles, while for organic waste, the bins are shaped like fruit. This certainly makes it easier for students to differentiate between waste types and subsequently manage or recycle them.

Differences in Waste Composition and Local Interpretation

In schools in highland areas, the waste circulating may consist more of organic waste or leaves, leading teachers to mistake it for natural waste (rather than "recycled" materials for crafts or pots). Meanwhile, in lowland areas, packaging waste is more prevalent, leading to a more common practice of recycling inorganic waste into valuable items. Further surveys on waste composition in highland and lowland areas, as well as local waste management practices, are needed to confirm this hypothesis.

Availability of Facilities and Gardening/ Composting Programs

Field data indicate that limited facilities are a common obstacle, consistent with the analysis of actual conditions. One finding suggests that implementing environmental character education in schools is challenging due to limited facilities and infrastructure, as well as the lack of clear implementation guidelines. Schools with gardens, composters, or regular gardening schedules score higher on recycling and plant care practices, and vice versa. Therefore, differences in scores likely result from a combination of constraints related to accessibility to various external programs, facilities, and local community practices.

Differences in Teacher Training Exposure

Not every region has equal access to various types of seminars or training, especially those related to environmental awareness education for early childhood. This has led to differences in perception between teachers in highland areas and those in lowland areas. In addition, seminars and training are believed to improve teachers' ability to implement environmental awareness education.

Proposed Micro Curriculum as a Solution

After identifying competencies through a questionnaire instrument given to kindergarten teachers, researchers also conducted interviews with structured interview guidelines with expert resource persons in the field of early childhood education who had been obtained at the needs analysis stage, including Mrs. Dr. Isti Rusdiyani, M.Pd (Lecturer in the Department of Early Childhood Education, Sultan Ageng Tirtayasa University) and Mrs. Eti (Head of the Early Childhood Education Division, Lebak Regency Education Office), input from the resource persons focused on developing learning components based on the formulated competenci es. From the results of the interviews, explanations were obtained regarding learning objectives, learning materials, learning media, learning methods or strategies, and learning evaluation techniques that can be used to implement the environmental care character education curriculum in early childhood education units.

Based on the results of the questionnaires and interviews, the researchers then formulated the content of the environmental care character education curriculum, which is divided into several aspects, as presented in the following table:

Table 10. Curriculum content for environmental care character education

No.	Topic	Material	Method	Evaluation
1.	Sustainable lifestyle	God's Creature	Lecture Play Singing Storytelling Practice Role Play	Anecdotes Checklist Exhibition of Work
		How to Keep Clean		
		Types of Garbage		
		Sorting Garbage		
		Managing Waste		
2.	Plants	Types of Plants		
		How to Take Care of Plants		

3.	Animals	Types of Pets How to Take Care of Pets	Experimental

The quantitative results obtained from Table 5 served as the primary basis for formulating the curriculum content presented in Table 10. Each competency was analyzed based on the mean score given by the teacher respondents, taking into account the standard deviation to see the homogeneity of perceptions. Competencies that have a high average score indicate a relatively good level of mastery in the field, or are considered important to be mastered by students, so that, in curriculum design, a proportional portion of learning is given to maintain and strengthen these achievements. Conversely, competencies with a lower average score are identified as areas that require strengthening through more applicable and in-depth learning methods, also taking into account the availability of facilities and infrastructure in education units.

For example, the competencies of distinguishing between types of waste and managing waste received lower mean scores than other competencies in both highland and lowland areas. One indication is that children's understanding and skills related to these two competencies are not optimal. Therefore, in the curriculum content (Table 10), this material receives a larger portion, incorporating a practical learning approach, such as the application of the Practice, Experimental, and Role-Play methods. The Practice method allows children to directly sort and manage waste according to its category, and the Experimental method encourages children to try the process of processing organic waste into compost. In contrast, the Role Play method provides space for children to play the roles of "janitors" or "waste bank managers," making learning contextual and fun.

With this strategy, the transformation of quantitative data to curriculum content involves an in-depth analysis of learning needs. The result is a curriculum design that is able to answer competency weaknesses in the field with learning interventions that are concrete, participatory, and in accordance with the characteristics of early childhood.

Based on an in-depth analysis of the competency identification results, the topics used in designing the environmental awareness character education curriculum for early childhood education include sustainable lifestyles, animals, and plants. These three topics were chosen because they align with the competencies required for developing environmental care character from an early age. In the context of sustainable lifestyles, UNESCO's Education for Sustainable Development (ESD) framework emphasizes the integration of knowledge, skills, values, and attitudes that support the three pillars of sustainability-economic, social, and environmental-through contextualized and participatory learning. The competencies identified in this study, such as throwing garbage in its place, managing organic waste, and caring for plants, are in line with the ESD dimensions that demand critical thinking skills, active participation, and ecological awareness. In line with that, Güler Yýldýz et al. (2021) mentioned that "education is seen as a crucial tool for the provision of SD with its environmental, economic, and socio-cultural pillars."

From these three topics, relevant materials were derived and organized, as shown in Table 6. For example, for the topic of sustainable lifestyles, waste management materials are provided with practice-based learning methods, such as composting from organic waste. "Education for the environment emphasizes active participation in solving environmental problems or making socially just and sustainable choices" (Hedefalk, Almqvist, & Östman, 2015).

Additionally, topics such as sustainable lifestyles, plant care, and pet care are also explored. These two topics are also very important to increase students' concern for the environment, and not only limited to acquiring knowledge, but also experiencing firsthand how to interact with nature and the creatures in it. "As a learning environment, the outdoors can also positively influence children's personal and social growth, healthy development, wellbeing, and learning abilities" (Kiviranta, Lindfors, Rönkkö, & Luukka, 2024). As Born (2018) states, "It is essential to give young children lots of hands-on opportunities in nature, and to guide them in safe, sensitive handling or physical contact with other species." The learning methods chosen vary, tailored to the material and the level of early childhood developm ent in the cognitive, affective, and psychomotor aspects. "Through activities such as role-playing, storytelling, and hands-on projects, learners engage deeply with ecological concepts, developing critical thinking, empathy, creativity, and collaboration skills" (Roussou et al., 2025).

Learning media also adjust the method used. In the composting activity, the media required include organic waste such as leaves, soil, and composting containers. "We value project-based learning environments because the natural complexity of a project gives children multiple entry points and many opportunities to deepen their understanding and thinking" (MacDonald, 2015). In addition, the environmental dimension now includes not only animals and plants, but also extends to waste management, compost, soil, and daily food, making the ecological cycle more real to children (Engdahl, Samuelsson, & Ärlemalm-Hagsér, 2021). To ensure that learning related to environmental care character education runs optimally, and children's concern for the environment increases. This can also be one of the efforts to achieve the SDG goals. "In addition to spending time in the environment, young children also need exposure to and education about sustainable lifestyle practices that will foster their capacities for actions for the environment" (Ginsburg & Audley, 2020).

Then, evaluation of learning is done using approaches common in early childhood education, such as anecdotal records, checklists, rubrics, and exhibitions of work. For example, an exhibition of plastic waste processing results can be a means to assess children's skills and understanding authentically.

Practical Implications

The curriculum content designed can serve as a guide for kindergarten teachers in implementing environmental awareness character education as part of learning and character education at the early childhood education level. The following are the practical implications of the micro-curriculum for environmental character education for three key parties: teachers, school managers/principals, and policymakers.

For Teachers

This environmentally conscious character education curriculum not only serves as a guide for teachers in designing learning materials but also includes learning methods that teachers can use in implementing the curriculum. However, various seminars and specific training for teachers related to the use of these learning methods are certainly needed to provide optimal benefits in learning. Some types of training that can be provided to teachers include:

Workshop: Short 1-2 day training on various practical learning methods that focus on simulations of these learning methods, for example: *Storytelling Learning Method:* Teachers are taught how to tell environmental-themed stories with appropriate intonation, expression, and learning media. *Experimental Learning:* Teachers conduct simple experiments related to various environmentally conscious character education materials, such as practicing composting, explaining the necessary tools and

materials, and demonstrating their application with students at school.

Role Play: Teachers practice role-playing with environmentally conscious character education materials. During the training, teachers engage in role-playing in groups with other trainees, for example, playing the role of a gardener whose job is to water and care for plants. Teachers are taught how to condition students to implement the role-play learning method at school.

Utilizing Online Platforms: In addition to offline workshops or seminars, workshops or seminars can also be conducted online using various learning media, such as training modules and video examples of implementation accessible on educational YouTube channels or LMSs, allowing teachers to learn independently at a more flexible time and place.

For School Managers/Principals

The results of the analysis of the actual conditions for implementing environmentally conscious character education indicate that the availability of facilities is a barrier to its implementation. Therefore, to address this, schools need to provide adequate facilities that are within their capabilities to optimally implement the environmentally conscious character education curriculum:

Suggestions for necessary facilities: Organic and inorganic waste bins with individual characteristics that students can easily recognize, for example, by distinguishing the colors of each type of trash bin. Place them in several locations, such as in each classroom and the play area or schoolyard.

A small green area/garden for watering and caring for plants. Educational play equipment and books relevant to environmentally conscious character education materials. Simple equipment for practical activities, such as watering cans, small brooms, and compost bins.

Supporting Infrastructure: An open area (it does not have to be large; even a small space, such as plant pots on the school terrace, is sufficient) for gardening practices. A water container for learning how to conserve water when watering plants. Some facilities that can also be provided using easily found used items include: Using plastic bottles to make plant pots. Encouraging the school committee/parents to contribute to providing plant seeds or growing media. Scheduling a monthly "environmental awareness day" as part of the school routine.

For Policy Makers

This micro-curriculum can be integrated directly with Merdeka Curriculum, both in learning themes and as a Pancasila Learner Profile Strengthening Project (P5) with the theme of Sustainable Lifestyle. The Sustainable Lifestyle theme in P5 is in line with the competencies in this curriculum (throwing garbage in its place, watering plants, caring for plants, caring for pets).

This micro-curriculum can be a ready-to-use P5 project module, complete with learning outcomes, activity flow, and assessment. Benefits for policy include reducing the burden on teachers in designing their own P5 projects, because field data-based guidelines are available, encouraging uniformity in the quality of environmental care learning throughout PAUD, without reducing school flexibility in contextualizing activities.

Local education offices can issue circulars or internal policies to encourage the adoption of this micro-curriculum as part of P5, as well as daily learning activities, and allocate BOSP funds or other sources for the procurement of minimal supporting facilities.

Limitations and Future Research Directions

The limitations of this study lie in its limited scope, which only includes public kindergartens in Banten Province; therefore, the findings and recommendations may not be generalizable to all early childhood education units in different regions or contexts. Social conditions, culture, facilities, and education policies in other regions have the potential to significantly influence the

implementation of environmental awareness character education. This study relies on self-reported data from teachers, which may not always reflect actual classroom practices. In addition, the study is still in the prototype design stage and has not yet tested the effectiveness of the curriculum implementation.

Therefore, future researchers are advised to expand the scope of their research to various types of schools (public and private) and other regions in order to obtain a more comprehensive picture and produce a more adaptive curriculum that represents the diversity of field conditions. Additionally, it is hoped that future researchers will conduct D&D research with a more comprehensive approach, not only up to the design and development stage but also through to the effectiveness testing and dissemination of research results.

■ CONCLUSION

In general, it can be concluded that this research departs from the main problem of the suboptimal implementation of environmental care character education in most public kindergartens in Banten Province, which is caused by the absence of clear guidelines or lesson plans. Through a needs analysis based on empirical data from the field, this research identified four key competencies that need to be developed, namely throwing garbage in its place, watering plants, caring for plants, and caring for pets.

The main contribution of this research is the production of a contextually relevant environmental care character education micro-curriculum prototype, designed to bridge the gap between environmental education theory and the practical needs of ECD teachers. The curriculum design is specifically organized based on factual conditions in the field, combining the principles of early childhood pedagogy with the development of science and technology, so that the learning content can be applied directly in students' daily lives.

Thus, this research has succeeded in formulating a micro curriculum design that is ready to be tested, which is expected to be a reference for teachers and stakeholders in implementing environmental care character education optimally in early childhood education units. Theoretically, this research enriches the literature on ECD curriculum development in developing countries, especially in Indonesia. Practically, this research provides educators and school managers with concrete tools for implementing environmental awareness character education. The crucial next step is the implementation and evaluation of this curriculum prototype on a broader scale to measu re its real impact on improving environmental awareness character in early childhood. Investing in the development of an environmental character education curriculum is a fundamental step in preparing a generation that is not only academically smart but also ecologically responsible, in line with the ideals of the SDGs.

■ REFERENCES

Akbar, M. I., Mauliyana, A., & Dode, H. (2024). *Edukasi sampah rumah tangga berbasis kurma (kurangi, sortir dan manfaatkan) di desa besu* [Date-Based household waste education (reduce, sort, and utilize) in besu village]. *BERBAKTI/ : Jurnal Pengabdian Kepada Masyaraka t*, *2*(2), 182–187. https://doi.org/10.30822 /berbakti.v2i2.3659

Alcock, S., & Ritchie, J. (2018). Early childhood education in the outdoors in Aotearoa, New Zealand. *Journal of Outdoor and Environmental Education*, *21*(1), 77–88. https://doi.org/10.1007/s42322-017-0009-y

Ashuri, N. M., Sa'adah, N. N., Setiawan, E., Ermavitalini, D., Saputro, T. B., & Nurhayati, A. P. D. (2021). *Penanaman karakter peduli lingkungan melalui program edukasi konservasi keanekaragaman hayati sejak usia dini*

[Instilling environmental awareness through biodiversity conservation education programs from an early age]. *Sewagati*, *5*(3), 240–248. https://doi.org/10.12962/j26139960.v5i3.29

Born, P. (2018). Regarding Animals: A perspective on the importance of animals in early childhood environmental education. *International Journal of Early Childhood Environmental Education*, *5*(2), 46.

Budiyarto, A., Clarke, B., & Ross, K. (2025). Overview of waste bank application in Indonesian regencies. *Waste Managemen t and Research*, *43*(3), 306–321. https://doi.org/10.1177/0734242X241242697

Cahyaningrum, D., & Nugraheni, N. (2024). *Upaya membangun kualitas pendidikan di indonesia untuk mencapai sustainable development goals SDGs* [Efforts to improve the quality of education in indonesia to achieve the sustainable development goals (SDGs)]. *Jurnal Penelitian Pendidikan Indonesia*, *1*(3), 224–231.

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., … Walker, K. (2020). Purposive sampling: complex or simple? Research case examples. *Journal of Research in Nursing*, *25*(8), 652–661. https://doi.org/10.1177/1744987120927206

Chawla, L. (2020). Childhood nature connection and constructive hope: A review of research on connecting with nature and coping with environmental loss. *People and Nature*, *2*(3), 619–642. https://doi.org/10.1002/pan3.10128

Dian Pramesti, R., & Trimurtini. (2024). *Analisis peran konservasi nilai peduli lingkungan terhadap penerapan program* SDGS *nomor 4 pendidikan bermutu* [Analysis of the role of environmental conservation values in the implementation of SDG 4: Quality education]. *Jurnal Ilmiah Multidisiplin*, *2*(4), 457–462. Retrieved from https://doi.org/10.5281/zenodo.11221910

Elmanora, Oktaviani, M., Kabbaro, H., Ardhianissa, F., Ngulandari, P. R., Saputri, A. W., … Priambodo, E. G. (2023). *Pelatihan penyusunan perangkat pembelajaran berbasis karakter cinta lingkungan pada guru paud di kelurahan jatinegara kaum* [Training on the development of character-based environmental education tools for early childhood education teachers in jatinegara kaum village]. *Prosiding Seminar Nasional Pengabdian Pada Masyarakat* , *2023*(2020), 431–440. Retrieved from http://journal.unj.ac.id/unj/index.php/snppm

Engdahl, I. (2015). Early childhood education for sustainability: The OMEP world project. *International Journal of Early Childhood*, *47*(3), 347–366. https://doi.org/10.1007/s13158-015-0149-6

Engdahl, I., Samuelsson, I. P., & Ärlemalm-Hagsér, E. (2021). Swedish teachers in the process of implementing education for sustainability in early childhood education. *New Ideas in Child and Educational Psychology*, *1*(1), 3–23. https://doi.org/10.11621/nicep.2021.0101

Fajriati, R., & Prastiani, Y. (2022). *Implementasi nilai-nilai karakter anak usia dini melalui keteladanan dan pembiasaan* [Implementing character values in early childhood through role modeling and habituation]. *Al Abyadh*, *5*(1), 9–14. Retrieved from https://doi.org/10.46781/al-abyadh.v5i1.466

Fernández, D. C., Gómez-Gonçalves, A., González, S. S., & Rodríguez, J. M. M. (2025). Connectedness to nature: assessing the impact of garden-based learning on teacher education. *Journal of Outdoor and Environmental Education*. doi.org/10.1007/s42322-025-00201-y

Furu, A.-C., & Heilala, C. (2022). Sustainability education in progress: Practices and pedagogies in Finnish early childhood education and care teaching practice settings. *The International Journal of Early Childhood Environmental Education*, *8*(2), 16. Retrieved from https://naturalstart.org/research/ijecee/volume-8-number-2

Ginsburg, J. L., & Audley, S. (2020). "You do not wanna teach little kids about climate change": Beliefs and Barriers to Sustainability Education in Early Childhood. *International Journal of Early Childhood Environmental Education*, *7*(3), 42–61. Retrieved from https://naturalstart.org/sites/default/files/journal/ijecee_73_summer_2020_final_0.pdf

Great Barrier Reef Marine Park Authority. (2023). Reef guardian school program overview. In *Reef Authority* (Vol. 80). The Great Barrier Reef Marine Park Authority. https://doi.org/10.1097/00004032-200104000-00005

Güler Yýldýz, T., Öztürk, N., Ýlhan Ýyi, T., Aþkar, N., Banko Bal, Ç., Karabekmez, S., & Höl, Þ. (2021). Education for sustainability in early childhood education: a systematic review. *Environmental Education Research*, *27*(6), 796–820. https://doi.org/10.1080/13504622.2021.1896680

Hasan, H. (2019). *Penerapan metode permainan aktif menggunakan media daur ulang sampah untuk meningkatkan karakter peduli lingkungan pada anak di paud permata hati* [Application of active game methods using recycled waste media to improve environmental awareness in children at permata hati early childhood education center]. *Tumbuh Kembang: Kajian Teori Dan Pembelajaran PAUD*, *6*(2), 163–170. Retrieved from https://ejournal.unsri.ac.id/index.php/tumbuhkembang/index

Hedefalk, M., Almqvist, J., & Östman, L. (2015). Education for sustainable development in early childhood education: a review of the research literature. *Environmental Education Research*, *21*(7), 975–990. https://doi.org/10.1080/13504622. 2014.971716

Inoue, M., Elliott, S., Mitsuhashi, M., & Kido, H. (2019). Nature-based early childhood activities as environmental education?: A review of Japanese and Australian perspectives. *Japanese Journal of Environmental Education*, *28*(4), 4_21-28. https://doi.org/10.5647/jsoee.28.4_21

Kiviranta, L., Lindfors, E., Rönkkö, M. L., & Luukka, E. (2024). Outdoor learning in early childhood education: exploring benefits and challenges. *Educational Research*, *66*(1), 102–119. https://doi.org/10.1080/00131881.2023.2285762

Laiphrakpam, M., Aroonsrimorakot, S., & Rama Shanker, A. (2019). Environmental education and awareness among students in India, Japan and Thailand for sustainable development. *Journal of Thai Interdisciplinary Research*, *14*(2), 48–53. https://doi.org/10.14456/jtir.2019.18

Lestari, B. B., Nugraheni, N., Husain, F., Semarang, U. N., Tinggi, S., & Pati, T. (2024). *Penerapan Edukasi SDGS di lingkungan sekolah guna mendukung terwujudnya kesejahteraan pendidikan* [Implementation of SDGS education in schools to support the realization of educational welfare]. *Jurnal Penelitian Ilmu-Ilmu Sosial*, *1*(10), 67–72. Retrieved from https://doi.org/10.5281/zenodo.11128176

MacDonald, M. (2015). Early childhood education and sustainability: a living curriculum. *Childhood Education*, *91*(5), 332–341. https://doi.org/10.1080/00094056.2015.1090845

Masykuroh, K., & Fajriah, F. (2023). *Penanaman karakter peduli lingkungan*

anak usia dini di OISCA jakarta multicultural kindergarten [Instilling environmental awareness in young children at OISCA jakarta multicultural kindergarten]. *Jurnal Pelita PAUD*, *7*(2), 408–415. https://doi.org/10.33222/pelitapaud.v7i2.2672

Masykuroh, K., Yetti, E., Nurani, Y., & Rahmawati, Y. (2024). Teaching environmental literacy in early childhood education to improve the character of environmental care. *Educational Administration: Theory and Practice*, *30*(1), 84–99. https://doi.org/10.52152/kuey.v30i1.706

Putra, M. N. A., Zahrani, N. A., Zahra, T. A., Bella, B. C., Hariyadi, A. G., Fadhila, D. S., ... & Firmansyah, P. (2024). *Sampah plastik sebagai ancaman terhadap lingkungan.* Aktivisme: Jurnal Ilmu Pendidikan, Politik Dan Sosial Indonesia, 2 (1), 154–165.

Peffers, K., Tuunanen, T., Gengler, C. E., Rossi, M., Helsinki, Hui, W., … Bragge, J. (2007). A model for producing and presenting information systems research. *Computer Science Research*, 24. Retrieved from h

Putra, D. S., Syifak, R. R., Huda, F. S., Guntoro, Y. T., & Fahira, A. (2023). *Pengembangn karakter bangsa pada anak melalui budaya mendongeng guna mewujudkn sustainable development goals nomor 4* [Developing national character in children through storytelling culture to achieve sustainable development goal number 4]. *Jurnal Dharma Bhakti Ekuitas*, *7*(2), 131–139. https://doi.org/10.52250/p3m.v7i2.626

Ramulumo, M., & Shabalala, N. P. (2024). Comparing environmental literacy in stem and non-stem preschools: evaluating the impact on young children's understanding and attitudes. *International Journal of Early Childhood*, (0123456789). https://doi.org/10.1007/s13158-024-00405-1

Ratinen, I., & Linnanen, L. (2022). The connection of finns' environmental awareness to their anticipatory competen ce. *Frontiers in Education*, *7*(April), 1–8. doi.org/10.3389/feduc.2022. 838005

Roussou, A. M., Argyrakou, C. C., & Milakis, D. (2025). Integrating STEAM and theatrical methods in early childhood environmental: A framework for holistic learning. *International Journal of Geography, Geology, and Environment*, *7*(2), 19–42. https://doi.org/10.22271/27067483.2025.v7.i2a.336

Sella, E., Bolognesi, M., Bergamini, E., Mason, L., & Pazzaglia, F. (2023). Psychological benefits of attending forest school for preschool children: a systematic review. *Educational Psychology Review*, *35*(1), 1–29. https://doi.org/10.1007/s10648-023-09750-4

Seo, E., Ryu, J., & Hwang, S. (2020). Building key competencies into an environmental education curriculum using a modified Delphi approach in South Korea. *Environmental Education Research*, *26*(6), 890–914. https://doi.org/10.1080/13504622.2020.1733493

Suwandi, S., Kurniawati, N. I., Werdani, R. E., & Kholidin. (2023). *Revitalisasi fasilitas belajar anak usia dini dalam mendukun g tujuan SDG's sektor pendidikan di pendidikan anak usia dini. GOTAVA Jurnal Pengabdian Kepada Masyarakt*, *1*(1), 17–20. https://doi.org/10.59891/jpmgotava.v1i1.4

UÇAR ÇABUK, F., & ÝÞAL, S. (2023). The effect of environmental awareness education program on children's environmental awareness. *Ýnsan ve Sosyal Bilimler Dergisi*, *6*(Education Special Issue), 379–400. https://doi.org/10.53048/johass.1358178