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Environmental Education Strategies for Building a Waste Management Culture in Elementary Schools

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ABSTRACT

The purpose of this study is to identify and describe environmental education strategies that have been implemented by elementary schools with a focus on waste management. The research method used was qualitative, employing a case study approach. Data were collected through interviews, observations, and documentation. The data analysis method used was based on the Miles & Huberman framework, which includes data collection, data reduction, data presentation, and drawing conclusions. Data validation was conducted using the triangulation technique. The research findings indicate that the environmental education strategies implemented by SDN Ngabean are carried out through school policies in the Adiwiyata program, curriculum integration, and various eco-pedagogy-based activities. These findings confirm that the environmental education strategies implemented by schools have a positive impact on increasing students' awareness and skills in waste management. However, the challenges involved in sorting and managing waste in a disciplined manner still require further attention.

Abstrak

Penelitian ini memiliki tujuan untuk mengidentifikasi dan mendeskripsikan startegi Pendidikan lingkungan hidup yang telah diterapkan oleh sekolah dasar dalam focus pengelolaan sampah. Metode penelitan yang digunakan ialah kualitatif dengan pendekatan studi kasus. Data dikumpulkan melalui wawancara, observasi, dan dokumentasi. Analisis data yang digunakan dari Miles & Huberman yang meliputi pengumpulan data, reduksi data, penyajian data, dan penarikan kesimpulan. Validasi data menggunakan Teknik triangulasi. Hasil penelitian menunjukkan bahwa strategi Pendidikan lingkungan hiudp yang dilakukan oleh SDN Ngabean diterapkan melalui kebijakan sekolah pada program adiwiyata, integrase kurikulum, serta berbagai program kegiatan berbasis ekopedagogi. Temuan ini menegaskan bahwa strategi Pendidikan lingkungan hidup yang diterapkan sekolah membawa dampak positif bagi peningkatan kesadaran dan keterampilan siswa dalam mengelola sampah. Kendati demikian, tantangan dalam memilah dan mengelola sampah secara disiplin masih memerlukan perhatian lebih lanjut.

1. INTRODUCTION

Waste management has become an increasingly alarming global issue. Various member countries of the Organization for Economic Co-operation and Development (OECD) are cited as the world's largest contributors to waste. According to data from the Ministry of Environment and Forestry, Indonesia's total waste accumulation reached 68.7 million metric tons in 2020.. The accumulation of various types of waste—including organic waste, plastic, paper, and other types of waste—has shown that this issue has evolved into a cross-sectoral problem that requires an integrated solution.

One region facing severe pressure due to waste management issues is the Special Region of Yogyakarta, particularly following the closure of the Piyungan Integrated Waste Disposal Site in 2023. According to data from the National Waste Management System, daily waste production in this region has exceeded 1,500 metric tons, causing many waste collection sites to experience unmanaged waste buildup. This situation has serious consequences, such as environmental pollution, the spread of disease, and aesthetic degradation of the area (Mulasari et al., 2016). This problem is exacerbated by the public's consumerist behavior and a lack of awareness of the economic value of waste itself (Sholihah, 2020). In this context, environmental education is viewed as a

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strategic approach to instilling understanding, values, and concrete actions in environmental management from an early age (Purnami et al., 2016).

Elementary schools play a crucial role in fostering ecological awareness, particularly through the incorporation of environmental education into classroom activities and students' daily habits. Approaches such as the 5R principles (Reduce, Reuse, Recycle, Replace, Replant) have been widely integrated into elementary school curricula as a form of ecological education. Several schools in Yogyakarta have implemented these principles and achieved Adiwiyata status—that is, schools that are environmentally conscious and promote an environmental culture (Handayani et al., 2015). SD N Ngabean is one of the elementary schools in Yogyakarta that received the city-level Adiwiyata award in 2022. The school implements a number of waste management programs, such as waste sorting, a waste bank, reducing the use of disposable tableware, and encouraging students to keep the school environment clean. However, a preliminary study conducted by researchers in July 2024 showed that plastic waste management is not yet optimal and that students' discipline in handling their own trash remains low.

Environmental education programs have been implemented, but most of their approaches are still limited to technical aspects without delving deeply into the social, cultural, and structural aspects associated with environmental issues. A narrow interpretation of environmental education, which is viewed merely as a means of conveying information. Therefore, it is important to adopt a transformative approach—one that fosters critical awareness, strengthens collective responsibility, and encourages active participation in protecting the environment (Sauvé, 1996). In this context, there is a research gap that has not been thoroughly explored: the lack of studies examining how environmental education strategies in elementary schools focus not only on technical behavioral changes but also on shaping students' ecological values and character.

The novelty of this study lies in environmental education that influences waste management and processing from the students' perspective, as implemented in both elementary schools and non-school settings. This differs from previous studies, which generally focused on the ecological awareness of school students (Purnami, 2020). In addition, other studies have also focused on Car Free Day activities as a subject in environmental education (Dewi et al., 2020).

This study aims to bridge that gap by focusing on environmental education strategies at SD N Ngabean. The uniqueness of this study lies in its holistic approach, which not only evaluates the technical implementation of waste management but also examines how the environmental education process fosters a sense of care, responsibility, and ecological awareness among students. This study is expected to make a theoretical contribution to the development of a transformative environmental education model at the elementary school level, while also offering practical implications for schools and policymakers in creating a sustainable, ecologically-oriented learning environment.

2. METHODS

This study employs a qualitative case study approach, which allows for an in-depth and comprehensive description of waste management methods within the context of elementary schools. (Suárez Sousa & Bradbury, 2025). This approach was chosen because it allows for a sustainable analysis of issues in waste management. This study was conducted at SD N Ngabean in Yogyakarta and involved one principal, six teachers, one school cafeteria attendant, and students in grades 1 through 6 as the primary data sources for the study. In addition, secondary data was collected from various documents related to ongoing environmental education activities at the school. SD N Ngabean Yogyakarta, located at Jl. K.H. Ahmad Dahlan No. 18, Notopeajan, Ngampilan, Yogyakarta City, was selected as the research site in light of its Adiwiyata designation in 2021.

Data collection methods included interviews, observation, and documentation. The data validity methods used included triangulation of sources and techniques (Lim, 2025). Data analysis was conducted using Miles and Huberman's interactive analysis model, which includes data collection, data reduction, data presentation, and drawing conclusions (Miles & Huberman, 1994). The research instruments were developed based on a framework that focuses on aspects of environmental education strategies, such as their implementation in the curriculum, eco-pedagogy-based activities, and the integration of the 5R values into students' daily lives at school. This research was conducted continuously from November 2024 through December 2024.

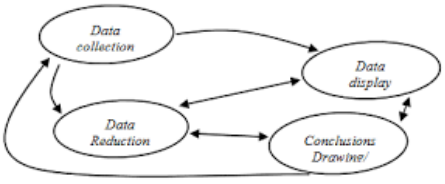


Figure 1. Miles and Huberman's Interactive Data Analysis Model.

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3. RESULTS AND DISCUSSION

RESULT

This study was conducted continuously over the course of a full month at SD N Ngabean in Yogyakarta. Its strategic location in the heart of Yogyakarta, combined with the fact that SD N Ngabean was awarded the "Adiwiyata" title in 2021, made the school a suitable subject for this study. This school has six classrooms, one ICT lab fully equipped with computers and Chromebooks, one library, one principal's office, one teachers' lounge, one kitchen, one storage room, one cafeteria, one student health room, and one prayer room. Instruction is conducted in an interactive and context-based manner, making use of the classrooms, school grounds, school playgrounds, and the surrounding area as venues for interscholastic, extracurricular, and Pancasila Student Profile project activities.

The environmental education strategy at Ngabean Public Elementary School has been designed in response to the urgent need to foster students' character so that they become caring and responsible toward environmental sustainability. Guided by the principles of eco-pedagogy and aligned with national educational goals, the school integrates a holistic approach through institutional policies, the curriculum, and the daily practices of the school community. The implementation of this strategy aims not only to equip students with ecological knowledge, but also to instill attitudes, skills, and active participation in protecting the school environment and its surroundings.

Ngabean Elementary School has received the Adiwiyata School Award at the Yogyakarta City level. As a follow-up, the school participated in training and workshops organized by the Department of the Environment and implemented school environmental management standards based on the Adiwiyata assessment indicators. The Adiwiyata school program, organized by the government, also facilitates workshops for educators. The workshop served to support efforts to improve teacher quality in the teaching and learning of environmental education. As indicated by the researcher's interview with Mr. ICS, as follows:

> "Well, I once participated in a workshop that introduced all of this to the school community—what is it? Regarding the school environment, for example, are the plants being properly cared for or not? And is the trash already being sorted and separated, or not yet? It's more or less like that—part of the students' daily activities through the P5 program, right?". (ICS Interview, November 29, 2024).

Environmental education is integrated into the curriculum, particularly the School-Based Curriculum, which was designed by the government to foster a generation that is engaged, caring, and environmentally conscious. As a result, students do not learn solely through theory but also gain hands-on experience by engaging with their surrounding environment. Thus, the government has established policies on environmental education as part of its efforts to support sustainable development. The environmental education strategy at SD N Ngabean in Yogyakarta is implemented in accordance with government policy guidelines through two factors: 1) environmental education integrated into the School-Based Curriculum and the Merdeka Curriculum, and 2) environmental education tailored to teaching modules prepared by teachers and approved by the school principal.

Environmental education at SDN Ngabean in Yogyakarta is integrated with the Pancasila Student Profile Strengthening Project (P5), which is held every Friday. The environmental education activities have different focuses, beginning with group exercises on the first Friday of the month. On the second Friday of the month, the P5 activity consists of a group breakfast. The activity held on the third Friday of the month is a community service project. Then, on the fourth Friday of the month, environmental education takes the form of a group walk around the school. Students are involved in various eco-friendly practices, such as bringing their own utensils, sorting trash, making ecobricks, and turning used cooking oil into soap. SD N Ngabean in Yogyakarta utilizes four aspects of eco-pedagogy, one of which is the aspect of attitude as a strategy for environmental education. This aspect of attitude is emphasized through teachers' assessments of students as they observe their surroundings, remind their peers to care for the environment, and demonstrate environmentally friendly behavior—not only at school but also at home. Meanwhile, the second eco-pedagogical aspect—children's skills in environmental education activities—is implemented through the development of students' creativity, such as turning used bottle caps into keychains and transforming plastic waste and used bottles into ecobricks, which are used as fencing for the classroom's reading corner. Students' skills are developed by participating in a training session at the Piyungan Waste Management Facility and then using used cooking oil to make soap. Another highlight of the skills-building activities at SD N Ngabean was inviting one of the parents to serve as a guest speaker for a workshop on upcycling, such as making piggy banks from used bottles and painting used water jugs to turn them into trash cans.

Sometimes, craft projects made from recycled materials can actually increase waste in the school environment due to a lack of proper waste management. As a solution, Mrs. FKN (the first-grade homeroom teacher) can focus on reducing waste and creating crafts using recycled materials at the waste bank located near Ngabean Public Elementary School. The third eco-pedagogical aspect is student awareness. SD N Ngabean strives to raise student awareness through announcements during assemblies, reminding and reprimanding students who still litter. Awareness of littering at SD N Ngabean is also addressed in the cafeteria policy; the principal ensures

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that the snacks provided in the cafeteria are homemade. This policy aims to minimize plastic waste. According to the researchers' observations, the snacks offered in the cafeteria are prepared by the cafeteria staff and parents who contribute to the snack supply. In addition, snacks and processed foods are served in reusable bowls and cups rather than single-use containers.

SD N Ngabean implements the fourth aspect of eco-pedagogical objectives, namely participation. Participation-based environmental education activities at SD N Ngabean are held on the second Friday of each month as part of a walking tour around the school. Students and teachers walk from the school to the Malioboro Kilometer Zero marker, carrying trash bags. This activity serves as a reminder to students that there is still a lot of litter scattered throughout the environment outside of school; it is hoped that this will motivate students to care about the litter around them and remind them that, wherever they are, they must continue to keep their environment clean. Waste management at SD N Ngabean in Yogyakarta is an integral part of the environmental education strategy that is implemented on an ongoing basis. Schools not only instill environmental awareness in theory but also guide students to engage directly in educational and practical waste management activities. Through this approach, students are guided to understand the importance of reducing waste at the source, sorting waste, and reusing waste as a form of ecological responsibility. The implementation of waste management in schools reflects a systematic effort to foster a culture of clean, healthy, and environmentally friendly living.

The school applies the 5R principles (Reduce, Reuse, Recycle, Replace, Replant) in its daily activities. For example, students bring their own water bottles, use their own eating utensils, and sort organic and inorganic waste. One of the school's flagship programs involves collectively turning plastic waste into ecobricks and processing used cooking oil into soap. SD N Ngabean in Yogyakarta has implemented a comprehensive environmental education strategy; however, its implementation still faces several challenges that require serious attention. These obstacles indicate that the development of environmentally conscious behavior among students has not yet been fully optimized. A lack of discipline and a limited understanding of waste management indicate that the process of internalizing ecological values still needs to be strengthened through a more contextual and participatory approach involving the entire school community.

DISCUSSION

Based on the theory of eco-pedagogy, SDN Ngabean has implemented learning activities that foster students' knowledge, attitudes, skills, concern, and participation regarding environmental issues. The integration into the curriculum and P5 aligns with the principles of natural ecology, social ecology, and integrated ecology as outlined by Gadotti. Activities such as community service, thematic P5 sessions, and recycling projects are not merely theoretical but also foster critical awareness and active student engagement. Based on the results of a study on the implementation of government regulations in carrying out the Adiwiyata School Program at SD N Ngabean, there are two main elements: First, environmental education integrated into the curriculum; and Second, environmental education tailored to the teaching modules. These elements serve as a foundation for the school to develop environmental education in accordance with government policies and regulations.

The environmental education strategy at SD N Ngabean in Yogyakarta is implemented in accordance with government policy through the Adiwiyata program. This program encourages schools to meet the administrative requirements for earning the Adiwiyata designation, as demonstrated by SDN Ngabean, which successfully received the Adiwiyata award at the city level in Yogyakarta. The Adiwiyata program also provides workshops for educators, aimed at improving the quality of environmental education. As explained by the Ministry of the Environment in 2006, the Adiwiyata program is a program for the development of environmental education at the elementary and secondary levels. The Adiwiyata program serves as a catalyst for raising awareness and knowledge among the school community regarding environmental stewardship and conservation in their surrounding area.

Environmental education at SDN Ngabean is integrated into the current curriculum, such as the School-Level Curriculum and the Merdeka Curriculum. As a result, students not only understand the theory but also engage in hands-on activities, such as waste management and adopting a sustainable lifestyle. The goal of this integration is to support the government's policy of promoting the principles of sustainable development and fostering a generation that is caring and aware of the need to protect the environment. El Yunusi, (2022) argues that environmental education in the Adiwiyata program involves provincial government policies. The purpose of these policies is to improve the quality of students, particularly in managing environmental balance. SDN Ngabean has implemented the Adiwiyata program, which is part of its environmental education efforts. One of the policies being implemented is environmental education integrated into the local content curriculum, which is officially regulated by the Yogyakarta city government. This curriculum was originally included in the KTSP, but has now been adapted to the Merdeka Curriculum.

SD N Ngabean has also developed a special teaching module to support environmental education. This module was designed by teachers and approved by the principal. The content of the teaching module focuses on

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activities that engage students with environmental issues, as well as planned activities such as watching environmentally themed films and other related activities to raise students' awareness of waste management. According to Rizka Chaerunisa et al., (2023) the presentation of the material is organized into learning resources for the practical implementation of P5 (Project to Strengthen the Pancasila Student Profile), incorporating images, videos, and animations to support student learning. In addition, the e-module enables the delivery of a waste management topic that has been adapted to the "Merdeka" curriculum in terms of curriculum enhancement..

SDN Ngabean integrates environmental education into various subjects, such as Integrated Natural Sciences (IPAS), Indonesian, Javanese, and Civics, as well as through environment-themed extracurricular activities. This approach utilizes resources from the surrounding environment, both inside and outside the classroom, and is supported by digital teaching materials—such as educational videos on YouTube—to make the lessons more engaging and relevant. Nugraha et al., (2021) It is noted that environmental education in the 2004 curriculum encompasses subjects that are already taught in an integrated manner. Meanwhile, environmental education in the 2013 curriculum at the elementary school level employs an integrated thematic approach, characterized by the use of themes to bridge the boundaries between subjects, thereby ensuring that environmental education is integrated into every subject.

SDN Ngabean Yogyakarta has incorporated environmental education into its co-curricular activities through the Pancasila Student Profile Strengthening (P5) project, which focuses on sustainable lifestyles and is held every Friday. These activities vary each week and include morning exercises, communal breakfasts, community service, and walks around the school. Additionally, the P5 program is designed based on learning modules, making it more structured and systematic. Mualifa et al., (2024) believes that the Pancasila Student Profile (P5) Program's "environmental detective" initiative is in line with the national curriculum. The program is implemented through comprehensive planning to determine both short- and long-term program objectives and to prepare the steps to be taken, as well as through teacher training and the development of instructional materials.

The strengthening of environmental education at SDN Ngabean is implemented through four aspects: 1) attitude, 2) awareness, 3) participation, and 4) skills. SDN Ngabean in Yogyakarta prioritizes the attitude aspect as the main strategy in environmental education, which not only focuses on students but also involves the entire school community as role models. The goal of environmental education is to foster a caring attitude toward the environment in every individual. This aspect of attitude can motivate each individual to acquire the values and skills needed to make sound choices and take appropriate action. In addition, an attitude of environmental concern can foster sensitivity to environmental conditions and encourage people to play an active role in protecting their surrounding environment (Adisendjaja, 2012).

Environmental awareness is part of developing good character, including a sense of responsibility, empathy, and cooperation. These values are essential for shaping ethical individuals who make positive contributions to society (Jayadinata et al., 2024). Meanwhile, (Ismail, 2021) explains that an environmentally conscious character has seven indicators in the learning process, namely: (1) developing habits to maintain cleanliness and care for the school environment; (2) providing adequate facilities for trash disposal and handwashing; (3) providing restroom facilities that meet acceptable maintenance standards; (4) developing habits to conserve energy; (5) building adequate wastewater drainage systems; (6) practicing the habit of sorting waste by type—namely, organic and inorganic; and (7) providing cleaning supplies. The students' environmental awareness at Ngabean Public Elementary School is reflected in various positive habits, such as disposing of trash in the proper bins, sorting organic and inorganic waste, keeping school facilities clean, and supporting the cafeteria's eco-friendly policies.

SD N Ngabean implements participatory environmental education by involving the entire school community—including students, teachers, and staff—in various environmental projects. One of its flagship programs is a field trip to Malioboro. In addition, other activities—such as cleaning sidewalks, watching environmental-themed films, creating posters for waste management campaigns, and composing songs about the environment—are carried out to raise students' awareness. This program not only instills a habit of caring for the environment, but also motivates students to be more active in keeping their surroundings clean. Aini et al., (2021) explains that the Adiwiyata program is a form of environmental education that emphasizes the active participation of the entire school community in protecting the environment. The program is based on two main principles: the principle of participation and the principle of sustainability. Through this approach, students are taught to care for the environment, both within the school and in the surrounding community.

Developing students' skills at SDN Ngabean through the use of recycled materials. As part of this program, students are taught to turn plastic waste into ecobricks, make keychains from bottle caps, and recycle used cooking oil into soap. In addition, the school also involves parents as guest speakers in workshops on repurposing used items as a creative and solution-oriented approach—such as making piggy banks from used bottles or painting water jugs to use as trash cans. However, these skill-building activities must be carefully planned so as not to increase the volume of trash on school grounds. Therefore, to optimize waste management at SDN Ngabean, the

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school has implemented a skills-training project at the nearest waste bank, thereby reducing the potential for new waste and teaching students to take responsibility for waste management.



Figure 2. Students making crafts from used bottles

Suaedi & Tantu, (2016) it states that students' skills are assessed in an effective and practical manner by observing their efforts to prevent and address various environmental issues. In addition to serving as a basis for teachers to evaluate students, these skills also reflect the students' enthusiasm and motivation in participating in environmental education activities.

An evaluation of the implementation of environmental education at SDN Ngabean was conducted comprehensively by assessing various eco-pedagogical aspects, such as students' knowledge, attitudes, concern, skills, and participation. The evaluation process was carried out on an ongoing basis through observation, assignments, and reflection on the behavior of students and educators during daily school activities. In addition, various assessment methods are used, including cognitive assessments, spontaneous questioning, completing the evaluation checklists included in the teaching modules, and direct observation during the learning process, environmental education projects, and daily school activities. Mualifa et al., (2024) stated that the evaluation of environmental education activities based on the P5 program can be conducted using the CIPP framework (Context, Input, Process, Product). The context of the evaluation is assessed through observation of the environmental conditions around the school and the environmental issues that need to be addressed. The input for the evaluation is assessed based on the school's support, the availability of relevant materials, and student participation. Meanwhile, the evaluation process is carried out by monitoring the implementation of Pancasila projects based on environmental education. In addition, product evaluation may take the form of an assessment of the work produced or the success of the programs that have been implemented. By evaluating all aspects, SDN Ngabean can assess the extent of students' understanding and involvement in environmental conservation efforts, and provide feedback to improve the effectiveness of the environmental education program that has been implemented.

Waste management at SDN Ngabean in Yogyakarta is implemented based on the 5R principles (Reduce, Reuse, Recycle, Replace, Replant) as a way to reduce waste and raise environmental awareness among the school community. The school promotes waste reduction by encouraging students to bring their own non-disposable lunchboxes, teaching them to sort waste into organic and non-organic categories, and processing waste into more useful materials. In addition, the school has implemented a policy to reduce the number of separate trash bins and conducts outreach programs on waste sorting from an early age. These waste management efforts are further supported by a waste bank program operated at the school.

The 5R approach to waste management consists of Reduce (minimizing the use of items that generate waste), Reuse (reusing items), Recycle (recycling), Replace (replacing items with eco-friendly alternatives), and Replant (replanting). This concept can reduce waste generation in a given area. The 5R concept is aligned with the development of waste banks in managing waste sustainably. As a result, it can produce useful products with market value (Meiwinda et al., 2024).

The implications of this study point to the need for a holistic approach to environmental education that involves all stakeholders in the school, including the principal, teachers, and parents as key partners in fostering a culture of environmental stewardship. Furthermore, knowledge, attitudes, skills, and a sense of responsibility—all integrated with the values of Pancasila—will further strengthen students' character in a sustainable way, thereby shaping a generation that is not only concerned about the environment but also capable of taking concrete actions to preserve it. Although waste management in schools based on the 5R principles (Reduce, Reuse, Recycle, Replace, Replant) has had a positive impact on reducing waste, challenges related to students' still-insufficient awareness and parents' lack of involvement in supporting waste management policies still need to be addressed. Therefore, schools need to optimize their outreach efforts and involve parents more actively so that the policies implemented can be fully effective, thereby having a long-term impact on environmental conservation.

The limitations of this study can be divided into two factors. The researcher acknowledges that there were inaccuracies in explaining the questions to the informants. These limitations led to confusion among the informants in providing information relevant to the focus of the study. Although the researcher has made efforts to minimize this, differences in understanding sometimes arise between the researcher and the informants. This affects the depth of the data obtained and results in responses that do not align with the research context. One of the researcher's limitations is time, specifically the time available to the informants to participate in the interviews. The informants were busy with school activities and preparations for end-of-semester summative assessments, so the interviews were conducted within a limited time frame. These limitations may have resulted in shorter or less in-depth responses and affected the quality of the data collected by the researcher. In addition, the researchers also faced time constraints that may not always fully reflect environmental education activities both inside and outside the classroom. Given these limitations, it is hoped that future researchers will be able to explore in greater detail the environmental education practices implemented by schools in waste management and identify more in-depth aspects of environmental education that have not yet been explored by previous researchers.

4. CONCLUSION

This study aimed to identify environmental education strategies for building a waste management culture in elementary schools. The findings indicate that these strategies are implemented through the Adiwiyata Program, curriculum integration, eco-pedagogy activities, and the application of the 5R principles, which contribute to improving students' environmental awareness and waste management skills. However, this study has limitations in terms of data collection time, interview depth, and research scope, which was limited to a single school. Therefore, future research is recommended to involve more schools, extend the observation period, and explore the involvement of students, teachers, and parents to obtain a more comprehensive understanding of environmental education strategies.

5. CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to the research or publication of this article.

6. USE OF GENERATIVE AI

The authors declare that no generative artificial intelligence (Generative AI) tools were used in the preparation, analysis, or writing of this manuscript

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