



An Environmental Education Learning Model for Early Childhood: Achieving Sustainable Development

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Abstract

Purpose – Educational institutions play a crucial role in addressing environmental problems through Education for Sustainable Development (ESD) for early childhood. This research aims to identify effective methods for implementing sustainable education goals in environmental learning for young children by developing an environmental learning model.

Design/methods/approach – This research and development study utilized Borg & Gall's development model, simplified for efficiency in terms of energy, time, and cost. The study focused on the validation stage, with testing and dissemination planned for subsequent research. The product was designed based on an initial needs analysis. Currently, environmental learning is limited to cognitive abilities only, lacking additional skills or habits imparted to the children. The product was validated through a Forum Discussion Group with Jakarta Bisa School and Gaharu Nature School in Bandung.

Findings – Validation results indicate that environmental education can begin with character development in children. Jakarta Bisa School can implement the Green Attitude, which embodies values such as Life, Love, Responsibility, the Universe, and Sustainability. Additionally, learning should involve more direct experiences, allowing children to observe the natural life cycle, environmental care, and the sustainability of natural resources.

Research implications/limitations – This research requires an extended period for designing and implementing the environmental learning model. By involving multiple stakeholders, it has the potential to change teachers' and parents' perceptions in educating early childhood.

Practical implications – Environmental learning is essential for fostering future change. Children will grow with a strong understanding of the importance of love and care for the universe and a sense of responsibility for life within it. This approach helps cultivate environmentally conscious individuals who are equipped to address global challenges and contribute to a sustainable future.

Originality/value – This research contributes to the field of education by promoting a better future through learning aligned with ESD goals. It provides innovative teaching methods and materials that foster environmental awareness and sustainability from an early age.

Keywords Environmental learning, Early childhood education, Sustainable development education

Paper type Research Paper

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1. Introduction

The United Nations has designated the year 2030 as a pivotal time to ensure access to high-quality education for early childhood (Seidel et al., 2019). This initiative is part of the Sustainable Development Goals (SDGs), specifically through one of its key instruments: Education for Sustainable Development (ESD). UNESCO defines ESD as an effort to empower students to make responsible decisions and take actions to preserve environmental integrity for present and future generations (Bergman et al., 2018). This initiative responds to various issues that negatively impact global life, such as environmental changes, overpopulation, and social inequality (Taing & Mahadeo, 2020).

One of the pressing issues that requires immediate attention and resolution is the environmental problem. Environmental issues are the responsibility of all parties as they are directly related to the sustainability and well-being of human life (Jabbar et al., 2021; Liu et al., 2021; Muhammad & Kura, 2017). Current environmental problems include global warming, food waste, loss of biodiversity, deforestation, plastic pollution, air pollution, and rising sea levels (Ahmad et al., 2022; Kartodihardjo et al., 2020). These issues are the result of changes in human lifestyles and the increasing needs of human life, leading to high levels of industrialization and consumption that contribute to increased waste.

Educational institutions play a strategic role in addressing environmental issues. One of the primary goals of education is to help individuals develop positive behaviors towards the environment and their communities (Berchin et al., 2021; Pan et al., 2022). Environmental education for early childhood can be effectively taught through age-appropriate methods such as storytelling, games, and hands-on activities. This type of education helps cultivate a sense of care, knowledge, and practical skills necessary to protect the planet. The experiences received by children in early childhood will have a lifelong impact (Ardoin & Bowers, 2020; DeVille et al., 2021). Sustainable education provides periodic content to guide children in understanding the environment, requiring appropriate educational planning and strong connections between families, schools, and communities.

Several countries have developed environmental curricula for school children, but teaching the concepts of Education for Sustainable Development (ESD), which requires interdisciplinary thinking, is considered a challenging task (MacDonald, 2015). ESD has become a key component in school curricula in many regions, including Europe, North America, and Australia (Castellanos et al., 2022; Kalla et al., 2022; Larri & Colliver, 2020). The educational goals of ESD aim to encourage children to understand environmental phenomena (S.-Y. Chen & Liu, 2020; Tian et al., 2024), develop awareness of the interdependence of natural and social phenomena, and provide them with opportunities to acquire knowledge, values, personal perspectives, and specific skills related to pressing environmental issues such as climate change and sustainability (Güler Yıldız et al., 2021).

The development of an environmental education model for early childhood in Indonesia requires a robust theoretical and practical foundation, supported by recent literature emphasizing the integration of Education for Sustainable Development (ESD) principles into early childhood education. UNESCO (2021) highlights the critical role of ESD in fostering sustainable development through education, particularly in shaping young children's environmental consciousness and behaviors.

Additionally, studies by Motevalli et al. (2022) and Zguir et al. (2021) underscore the importance of integrating ESD into early childhood education to cultivate pro-environmental attitudes and behaviors from an early age. This integration helps instill a sense of responsibility and care for the environment in young children, laying the groundwork for a more sustainable future. Furthermore, research by Dzurenda (2022) and Algurén (2021) emphasizes the significance of experiential learning approaches in ESD, suggesting that hands-on activities and real-life experiences can effectively enhance young children's understanding of environmental concepts and sustainability principles. Additionally, the work of Parry & Metzger (2023) and Aiyetoro et al. (2024) highlights the role of teachers as facilitators in guiding children's exploration of environmental issues and fostering critical thinking skills related to sustainability.

Drawing from these recent literature reviews, this study aims to develop a comprehensive environmental education model that incorporates ESD principles into early childhood learning. By adopting innovative teaching methods and experiential learning activities, the proposed model seeks to empower young children to become environmentally conscious individuals capable of contributing to sustainable development initiatives in their communities. This approach not only educates but also inspires children to take active roles in preserving their environment, thereby fostering a generation of informed and responsible citizens.

2. Methods

This research employs the Research and Development (R&D) approach, following the procedures of the Borg et al. model (2014), which includes: (a) conducting a preliminary study, (b) making a plan, (c) designing an initial product, (d) conducting validation testing, (e) revising the product, (f) conducting field testing, (g) revising the operational product, (h) conducting operational field testing, (i) revising the final product, and (j) disseminating the final product. The development stages are simplified into three phases (Mardapi, 2018): a) Preliminary Stage. This includes two activities: needs analysis and field survey; b) Development Stage. This involves drafting the initial product and product validation; c) Implementation Stage: This includes conducting trials, revising the product, and its dissemination; d) Due to limitations in time and funding, the research was conducted up to the second stage only. Follow-up trials and dissemination can be conducted in subsequent research.

The first stage of the research begins with analyzing user needs through a literature review. The literature review gathers information related to environmental education learning models in early childhood education. This review is further reinforced by field surveys to validate assumptions based on field facts. Survey results serve as the basis for researchers to develop environmental education learning models for early childhood. The field survey is conducted by distributing questionnaires to all early childhood education institutions in the city of Malang. This aims to gather further information regarding the implementation of environmental education teaching models that have been practiced thus far.

The learning model is designed through two products: teaching modules and learning media. The products designed in the second stage are then validated by involving experts in group discussion forums to examine feedback and suggestions. The research outcome is an environmental education model developed through the creation of a teaching module and learning media. This product can be used by teachers as a guide in implementing environmental education models for early childhood. The third stage of this research involves implementing the developed products into early childhood institutions, which will be continued in subsequent research.

3. Result

This research aims to develop an environmental education model for early childhood through the creation of a teaching module equipped with learning strategies, activity designs, and media. To create a tool that meets the needs, the researcher conducted a preliminary study by analyzing the availability of environmental education learning in Early Childhood Education (PAUD/TK/RA) institutions.

The first step was a needs analysis, which involved collecting data related to environmental education conducted in schools through questionnaires given to PAUD/TK/RA teachers in Malang City. Next, the data generated was described and discussed with the IGRA Chairman and the IGTK East Java Chairman to gain an overview of the implementation of environmental education thus far. The results of this discussion will then serve as a reference in developing the product to be designed in this study. The designed product undergoes validation stages until it produces a product that can be used by educational institutions.

3.1. The Initial Stages of Research

The first stage of the research involves a needs analysis by collecting data related to environmental education for early childhood in Indonesia. This step consists of two stages: a literature review and a field survey.

3.1.1 Literature Review

Researchers gather information through reliable reading materials regarding the forms of environmental education teaching that have been implemented in early childhood education. If there are clear standards regarding environmental education in elementary schools, the researcher aims to further explore the standards for environmental education in early childhood education. Key topics such as effective teaching strategies, engaging activity designs, and suitable learning media are identified by the researcher. Subsequently, a synthesis is conducted to understand the trends and significant findings that have emerged in previous research. During this stage, the researcher did not find any standards for sustainable environmental education for early childhood. While institutions have introduced environmental learning to young children, there is no literature indicating a standardized form of learning that can be used as a reference for achieving sustainable education. To strengthen assumptions regarding the absence of standardized guidelines related to sustainable environmental education, the researcher conducts field surveys in PAUD/TK/RA institutions in Malang City.

3.1.2 The Field Survey

This step is executed through questionnaires distributed to early childhood educators in Malang City. Data collection in the initial step of the research involved several Early Childhood Education institutions (PAUD/TK/RA) in Malang City. Data were gathered using a research instrument in the form of a questionnaire. The questionnaire items were adopted from the guidelines for implementing the Adiwiyata program in elementary schools, which were then narrowed down to 8 questions. The questionnaire was distributed to PAUD/TK/RA schools in Malang City through Google Forms. Out of all the PAUD/TK/RA institutions in Malang City that received the questionnaire, only 44 institutions were willing to fill out the Google Form, representing PAUD/TK/RA schools from each district in Malang City. The data collected for the first question regarding the availability of a vision and mission related to environmental programs, as seen in Figure 1, indicates that 52% of institutions state they already have a vision and mission related to environmental education.

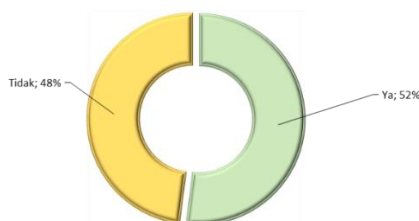


Figure 1. The Availability of a Vision and Mission Related to the Environment

This is evident from respondents' answers that articulate visions and missions related to the environment, such as "creating a clean and comfortable learning environment for school residents" or "realizing a generation skilled in life and sensitive to the surrounding environment." Such written visions and missions are considered by the schools to already support the realization of environmentally oriented learning.

The figure 2 shows results related to institutions that already have school programs related to environmental education. A total of 90% of institutions have programs such as waste management familiarization programs, junior scouts, and outing classes. These designed learning programs are implemented by teachers in the classroom.

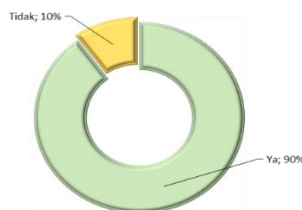


Figure 2. The Availability of Institutional Programs Related to the Environment

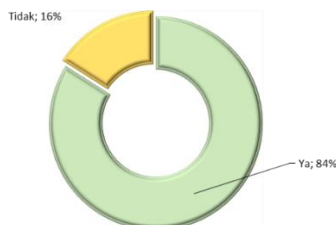


Figure 3. Availability of Environmental Education

During the implementation stage of learning, Figure 3 shows that approximately 84% of the learning introduces the environment to children. However, all learning activities still seem to be at the stage of introducing the environment cognitively, such as distinguishing organic and inorganic waste and showing videos illustrating the dangers of waste. There are still few schools that involve children directly in maintaining and caring for their environment, and no school focuses on instilling a love for the environment through daily habits.

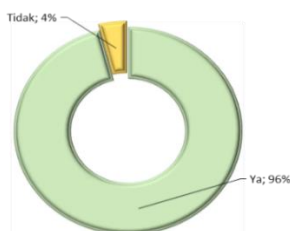


Figure 4. Introducing Global Issues to Children in Education

The topic of global issues is considered to have been introduced to children in learning, as seen in Figure 4. About 96% of schools provide examples of activities by inviting students to garden and take care of plants, helping children understand and address global warming in the future. Schools that do not have sufficient land maximize the introduction of global issues through classroom learning by displaying educational videos.

This aligns with data showing that around 84% of schools have utilized land for learning programs related to the surrounding environment. The activities carried out are similar across all schools, primarily involving planting and caring for plants. Some schools face limitations in using land for learning programs related to the environment, so the introduction to the environment is still primarily through pictures and videos in the classroom.

In supporting environmental learning programs, school facilities and infrastructure should also support learning. Figure 5 shows that about 94% of schools already have facilities and infrastructure that support learning. However, not all schools fully utilize these facilities and infrastructure in environmental learning.

Based on the data obtained, almost all schools have implemented environmental education, even though it is not fully realized in their vision and mission and is not always supported by adequate facilities and infrastructure. Upon closer examination, the activities and materials provided are still limited to the theme of "I Love the Earth." Environmental education activities and materials are not applied across all themes. Nevertheless, the efforts made by teachers already demonstrate commitment, although there are still aspects that need further attention. It is important to minimize the gap between what is desired and what happens in practice.

Therefore, greater efforts are needed to ensure that the vision and mission can be effectively implemented in environmental education

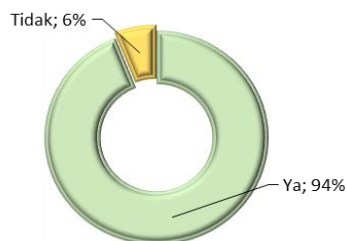


Figure 5. Utilization of School Facilities and Infrastructure for Learning

3.1.3 The Implementation of Follow-Up

In general, follow-up implementation is crucial in the context of planning and decision-making. This ensures that plans or decisions made not only remain in the planning stage but are also effectively carried out to achieve the set goals. Based on the previously obtained data, the next step for the researcher is to seek confirmation and further examine environmental education that has been conducted through Focus Group Discussion (FGD) activities. The FGD involved the chairpersons of the Indonesian Kindergarten Teacher Association (IGTK) and the Indonesian Raudatul Athfal Teacher Association (IGRA) in Malang City, held on July 20, 2023. The discussion addressed the implementation of environmental programs in Early Childhood Education (PAUD/TK/RA) institutions.

The speakers explained that PAUD/TK/RA institutions do not yet have an environmental program like the Adiwiyata program in elementary schools. However, children have been introduced to the environment and taught to care for it through interesting themes related to the surrounding environment. The hope is that children feel comfortable, understand, and have a positive impression. So far, there has been no specific attention from the government or education department regarding the environmental education program in these institutions. The schools implement lessons based on the overarching themes of the independent curriculum, one of which relates to the environment, namely the theme "I Love the Earth." It is only through this theme that institutions develop environmentally focused learning.

A learning environment that involves easily accessible facilities and infrastructure is needed so that environmental education can be well-organized and documented. The hope is that children gain direct experience and can further understand, enabling them to comprehend and apply it in the future. Therefore, the researcher intends to initiate the study by creating an environmental education learning module that can be utilized by schools to introduce the environment to early childhood.

3.1. The Stages of Product Development

The second phase is the development stage, which involves the activities of drafting the initial product and product validation. This research develops an environmental education model that begins with the development of learning tools, namely a teaching module and a learning video. The development phase involves several steps, including defining learning objectives, determining content, structuring learning activities, designing learning videos, and reviewing the learning tools with experts. The environmental education learning tools are designed considering the developmental stages of early childhood and the learning principles for early childhood.

3.1.1. Defining Learning Objectives

Before designing the learning tools, clear learning objectives are needed to effectively reflect the intended goals in line with the principles of Education for Sustainable Development (ESD), which aim to create individuals with a heightened awareness of environmental and social issues. The expected learning outcomes include children recognizing and exhibiting positive behaviors towards themselves and the environment, as well as fostering a sense of pride as Indonesian

children grounded in Pancasila. Based on these learning outcomes, the researcher divides them into several learning objectives, namely cultivating positive behaviors within the child and fostering positive behaviors towards the environment, especially in waste management in their surroundings. The designed learning objectives also encompass core values.

The designed learning objectives encompass values in various elements. In the realm of religious values, the intended learning objective is for children to appreciate nature by caring for it and showing affection towards living creatures, which are creations of Allah SWT. This is related to the principles of ESD that emphasize the importance of environmental ethics and spiritual responsibility towards nature and living beings. Through this understanding, children are encouraged to nurture nature and demonstrate affection towards living creatures, integrating religious values with environmental awareness.

In the realm of identity, the expected objectives are for children to recognize and exhibit positive behavior towards themselves and the environment (family, school, community, nation, and the world), as well as to take pride as Indonesian children grounded in Pancasila. This objective aligns with the principles of ESD that teach the importance of social responsibility and pride as members of a society based on sustainable values. Children are encouraged to develop positive behaviors towards themselves and the environment, as well as to feel proud as Indonesian children who respect Pancasila as the guiding values of the nation.

In the literacy element, children are expected to demonstrate curiosity through observation, exploration, and experimentation, using the surrounding environment and media as learning sources, to gain ideas about natural and social phenomena. This aligns with the principles of ESD that encourage active engagement in environmental learning through observing natural and social phenomena. Children are encouraged to use the surrounding environment and media as learning sources, enabling them to gain a deeper understanding of the interaction between humans and the natural and social environment. Children can develop an understanding of environmental ethics, social responsibility, and appreciation for sustainability, which are key components in sustainable development.

3.1.2. Determining the Learning Topic

In the early childhood learning process, understanding environmental concepts can commence with one of the materials playing a central role in accordance with ESD, namely the "Reducing Waste" material. In the initial stages of learning, it is crucial to introduce children to the condition of the Earth, which is becoming polluted due to the accumulation of waste, especially food and plastic waste. Ultimately, this topic aims to provide a foundation for children, emphasizing their significant role in environmental preservation efforts. Children are expected to be aware that their behavior directly impacts their surroundings, encouraging them to develop positive habits from an early age. Through the integration of practical elements and an enjoyable approach, this learning is anticipated to establish a solid foundation for children to become agents of change who care about environmental sustainability.

3.1.3. Developing Learning Designs for Early Childhood

Learning is designed to provide practical understanding to children about the importance of waste reduction, engaging them in a fun and interactive learning process. Through the design of these learning activities, it is expected that children will not only grasp the concept of waste reduction but also apply these skills in their daily lives, creating a generation that cares about the environment.



Figure 6. Learning Designs for Early Childhood

The overview of the learning activities to be conducted and the expected objectives can be seen in table 1.

Table 1. The learning design focuses on the topic of reducing waste in early childhood

Intended Objectives:	Basic Understanding: To comprehend the fundamental concept of the importance of waste reduction and engage children in environmentally friendly practices. To achieve this learning objective, learning materials will utilize videos depicting the current condition of the Earth and its causes.	Environmental Awareness Enhancement: To enhance children's awareness of the positive impact of waste reduction on the environment and sustainability. To achieve this learning objective, learning materials will employ illustrated storybooks, demonstrating that everyday activities they might do at home can harm the Earth.	Introduction to the Dangers of Waste: To educate children about the dangers of hazardous waste and the importance of handling waste properly. To achieve this learning objective, children will revisit videos and storybooks to understand the current degraded condition of the Earth and collaboratively explore ways to make the Earth smile
Cultivation and Application:	Practical Activities: Involving children in practical activities of waste reduction by providing real-life examples. Children are encouraged to use lunch boxes for wrapping food instead of plastic.	Educational Games: Utilizing entertaining educational games or activities to reinforce their understanding, such as assembling waste puzzles or engaging in waste reduction games.	
Introduction to Daily Actions:	Implementation at Home: Encouraging children to practice waste sorting at home by involving them in daily tasks like disposing of trash properly.	Parental Involvement: Involving parents in the learning process by providing them with information and encouraging cooperation in implementing waste reduction habits at home.	

The learning activities aim to instill positive habits from an early age, involving children in concrete actions and creating a strong understanding of the importance of environmental conservation. Through a fun and practical approach, children can easily internalize these environmental values as part of their daily lives. The expected personal characteristics to be developed through these learning activities include a sense of responsibility, empathy, and environmental awareness.

The sense of responsibility is evident when children are encouraged to take responsibility for their environmentally related actions, such as ensuring proper waste reduction. Environmental awareness in children is expected to become ingrained in their daily activities, such as saving water and energy. The hope is that children will understand that every small action, even seemingly insignificant ones, has an impact on the environment, teaching sensitivity to ecosystems.

Additionally, the development of empathy is also anticipated through an understanding of the feelings of other living beings and the ability to perceive the impact of human actions on their lives. Therefore, it is necessary to instill values of justice and sustainability for the future.

3.1.4. Reviewing Teaching Modules and Learning Media

Quality learning tools require a collaborative process with education experts. The collaborative review process of learning tools with experts ensures that the content, teaching methods, and resources used in learning meet high standards and align with students' needs. The products developed in this research are teaching modules and learning media.

Initially, a teaching module is designed and then discussed with experts to obtain further feedback and suggestions. These modules and environmental education learning media are reviewed by experts experienced in implementing environmental education. The experts assess the initial product developed and provide feedback based on the teachings conducted at their schools. Subsequently, the product is revised based on the experts' input.

The experts involved are the Head of "Sekolah Bisa" (SB) in Jakarta and the Head of "Sekolah Alam Gaharu" (SAG) in Bandung. Both schools have taught and implemented environmental education for early childhood. Some aspects evaluated by the validators include the alignment of learning objectives with the theme and topic of the research, learning materials, skills taught, learning activities, suitability of learning media used, implementation of environmental values, and innovative teaching in line with sustainable education. Here are the expert assessments and general comments provided.

Table 2. The Expert Assessment Results for the Teaching Module and Learning Media

No.	Assessment Aspect	S B	SAG	Comment
1	Suitability with learning objectives	4	4	The chosen theme is highly suitable for children's needs.
2	Relevance to learning materials	4	3	Most of the materials are relevant to the chosen theme. However, a more detailed explanation of the plant life cycle is needed for easier understanding by children.
3	Skills taught	3	2	Child involvement needs to be emphasized more. Experts suggest adding more practical activities in the module to reinforce understanding of the concepts.
4	Relevance of learning activities to children's lives	2	2	Activities need to be better aligned with daily life, incorporating environmental activities every day to make it a habit and necessity.
5	Use of learning media	3	3	The media used is engaging, but it could be more varied, such as adding illustrated storybooks.
6	Suitability with environmental values	2	3	Learning activities still lack in instilling environmental values that will shape children's characters.
7	Innovation in learning approach	3	3	Additional creativity is needed to make the module more engaging.

Validators from Sekolah Bisa teach environmental education through self-habituation, eventually shaping character. This character is expected to enable individuals to preserve and cultivate the environment in the future. An example of character application at Sekolah Bisa is

students embodying the Green Attitude, which encompasses the values of Life, Love, Responsibility, Universe, and Sustainability. The connection between the values of life and the goals of Education for Sustainable Development (ESD) is that these values can serve as a foundation for understanding, appreciating, and applying sustainability principles in daily life. Every member of Sekolah Bisa is expected to uphold these life values. These values are applicable to all living beings on Earth and the universe. Every member of Sekolah Bisa has the responsibility to implement them.

Secondly, the value of Love pertains to affection, empathy, and positive feelings towards fellow beings and the universe. This value encompasses love for nature, fellow humans, and other living beings. The value of love is the foundation of ESD, encouraging the development of empathy towards the environment and awareness of social responsibility towards the universe and the global community. In early childhood education, children can be taught about the importance of love for nature and fellow humans through stories, games, and activities that promote empathy, cooperation, and friendship. This approach will help children understand that love and care for others are valuable principles.

Thirdly, the value of Responsibility refers to the obligation and awareness of individuals towards their actions and decisions. It includes responsibility towards the environment, society, and future generations. Individuals are directed to take positive actions and contribute to the sustainability and well-being of the environment and society. Children are taught about responsibility through role-playing, light tasks, and small projects that teach them to care for the environment, respect rules, and feel accountable for their actions.

Fourthly, the value of Universe refers to the recognition of the complex and interdependent relationship between humans, nature, and the entire cosmos. It is crucial to understand that humans are part of the larger universe, and everyone should act with respect. Children are taught about the universe and the importance of preserving it through stories about the cosmos, stars, and planets. This helps them develop a sense of connection with the universe and respect for it.

Fifthly, the value of Sustainability refers to awareness of the importance of sustainability in actions and decisions. In this context, children need to understand that our current actions can impact the future. This value teaches the importance of thinking about the long-term impacts of our actions and maintaining ecological and social balance. Children are taught about sustainability through environmental projects that teach them how to save water, energy, and care for plants. This approach helps them understand that their actions can impact the sustainability of the environment.

Based on the discussion with the validator from Sekolah Bisa, it was suggested that in teaching environmental awareness, it is important to start with the development of children's character through instilling five moral values as previously explained. Each stage of the activities should incorporate tasks aimed at continuous character formation. The hope is that there will be a change in the character of young children in the future regarding environmental care. This input will significantly impact the daily activity sheets used by teachers.

While Sekolah Bisa incorporates values and attitudes as the initial foundation for implementing sustainable learning, Sekolah Alam Gaharu tends to introduce children to life and environmental concepts through direct experiences. Sekolah Alam Gaharu teaches environmental education by instilling habits in students to care for and nurture their surroundings. Various learning activities for early childhood are designed in accordance with the goals of ESD. Sekolah Alam Gaharu extensively integrates sustainability concepts into learning through direct experiences, not only providing knowledge about the importance of environmental preservation but also shaping attitudes and habits that are sustainable throughout life.

True to its name, Sekolah Alam Gaharu has a spacious school environment, allowing the school to implement various out-of-school activities that involve direct experiences for students. The school has created a mini farm in the school garden called the farming area. Children are encouraged to plant and care for vegetables such as water spinach and Chinese cabbage. Additionally, they are also invited to feed the fish in the fishpond. This process not only provides direct experience with plant growth and animal development but also teaches them about the natural life cycle, environmental care, and the sustainability of natural resources. These activities

help children understand the importance of preserving and caring for nature, fostering an understanding that every living being requires shared protection.

In waste management, Sekolah Alam Gaharu encourages children to organize recycling activities in the classroom by decorating and using recycled items to create art or creative toys. Through these activities, children can grasp the concept of recycling and understand the importance of waste reduction. Besides offering practical insights into environmental preservation, these activities also stimulate the creativity of children in reusing items that were previously considered useless. Additionally, the school facilitates visits to waste processing sites. Children collect household and school waste, sort it together, and add it to the School Waste Bank. The recycled products from the Waste Bank are then transformed into fertilizer and sold. This initiative not only imparts understanding of the environmental impact of waste but also motivates children to take an active role in waste reduction efforts.

Sekolah Alam Gaharu facilitates children aged 2-4 years in observing nature around the school. On specific days, accompanied by guides and parents, children are invited to walk around the school to observe various bird and plant species. They are encouraged to recognize different animals and plants they encounter. If the plants are fruit-bearing, children are invited to taste the fruits, introducing them to the names and flavors of the fruits. This hands-on experience helps children develop curiosity about nature and the surrounding ecosystem, understand the relationship between humans and the environment, and enhance awareness of environmental sustainability from an early age.

In the learning activities, Sekolah Alam Gaharu utilizes storybooks and educational toys focused on sustainability values as an enjoyable approach. Teachers read stories or introduce toys that illustrate sustainability concepts. Children are also encouraged to engage in small projects, such as creating informational boards or posters about preserving clean water or the importance of protecting forests, as a collaborative activity. These projects provide opportunities for children to develop cooperation skills. They not only creatively learn about sustainability values but also form positive attitudes toward sustainable practices.

Based on the discussion with the school principal, feedback suggests that teaching environmental awareness to young children can be achieved through various activities. The initially designed teaching module has already adopted a theme related to plants. This theme can be further developed by encouraging each child to care for their own plants and engage in organic waste management. It's recommended that the institution incorporates environmental conservation activities into daily routines, ensuring that it becomes a sustainable learning process.

Feedback and suggestions based on informal discussions and tangible evidence from schools enable researchers to develop a more focused, relevant, and implementable development model within the context of quality education. Therefore, the researchers revised the teaching module according to the feedback provided and added learning media. Initially, they only created learning videos; however, they later incorporated an illustrated storybook that could stimulate children's thinking patterns in understanding the current and future conditions of the Earth. Below is the final product that has been revised based on feedback from experts in figure 7.

Figure 7 depicts the design of the teaching module that will be used by teachers for one week. The daily lesson plans are not presented in this document. Based on previous expert feedback suggesting the addition of other media besides instructional videos, researchers have developed an illustrated storybook. The design of this media is shown in Figure 8.

Based on in-depth discussions with validators, the researcher gains an understanding of the perspectives and challenges faced by educators in implementing ESD. The developed learning tools are expected to assist Early Childhood Education (PAUD/TK/RA) teachers in conducting environmental education, fostering sensitivity, interest, and care for the environment among children.



Figure 7. Design of environmental education teaching module

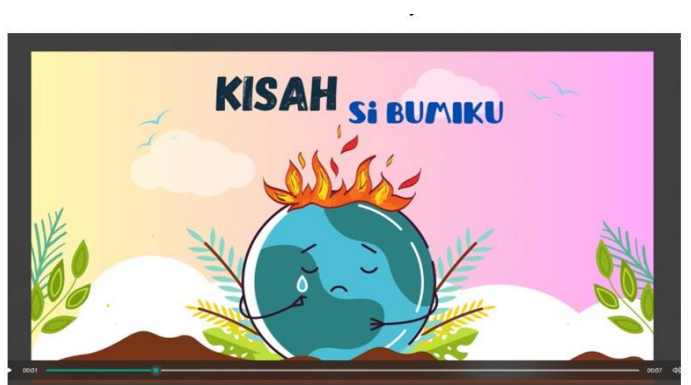


Figure 8. Design of the learning video



Figure 9. The Design of the illustrated storybook

4. Discussion

Based on the findings of this research, detailed insights into the process of developing an environmental education model for early childhood were obtained, consisting of three stages: needs analysis, product development, and validation (Djemari Mardapi, 2018). The initial stage of this research focused on data collection through literature reviews and field surveys to understand the context of environmental education in Early Childhood Education (ECE) institutions in Malang City. The interaction between the researcher and several ECE teachers and practitioners depicted the challenges in implementing environmental education for young

children with a sustainable approach, as reflected in the initial survey findings. The majority of ECE institutions in Malang City have integrated environmental education, although still within the scope of the "I Love Earth" theme. This indicates that a holistic approach to teaching the environment still needs to be strengthened. Teachers play a crucial role in introducing the goals of Education for Sustainable Development (ESD) to early childhood (Engdahl et al., 2023; Vyas, 2022), even when the existing curriculum has not fully adopted ESD principles (Öztürk & Olgan, 2016).

Product development was conducted considering child development theories and constructivist learning concepts. Learning modules and learning media such as videos and illustrated storybooks were designed to provide engaging learning experiences appropriate for children's developmental stages. The selection of learning materials should include sustainability values, such as storybooks teaching environmental conservation or environmentally friendly toys, which can be effective tools (Kewalramani et al., 2023; Nath, 2023).

Input from validators provided direction for the development of learning modules. Suggestions to add practical activities and variation in learning media reflect the need for a creative approach in teaching environmental education. The integration of local values, as done by Sekolah Alam Gaharu, demonstrates a holistic approach to educating young children. In addition to facilities and infrastructure, concrete and easily understandable learning materials are needed, such as environmentally friendly toys, pictures, and storybooks that highlight sustainability values and the urgency of environmental conservation (Iwasaki, 2022; Pangestu & Hariri, 2022).

Schools that begin to integrate environmental education should provide facilities and infrastructure, such as environmental laboratories, recycling facilities, and access to open nature, which are crucial for facilitating in-depth environmental education. The available facilities and infrastructure can transform a school into not only a supportive learning environment but also provide real experiences for students to understand and apply sustainability principles. As a first step, it is important for schools to provide a natural and environmentally friendly play area, such as a garden, where children can interact directly with natural elements. Schools need to ensure the availability of open environmental areas to support students' understanding of the importance of wise waste management through direct involvement in learning. Thus, teachers can act as change agents, introducing sustainability concepts early on, allowing students to delve deeper into environmental concepts and understand their relevance to daily life.

In the context of early childhood education and ESD, it is important to integrate the latest theories and practices (Kopnina & Meijers, 2014; Ssossé et al., 2021). Thus, the development of learning modules not only produces relevant products but also adopts an approach consistent with current theories and practices in early childhood education and ESD (Khadim et al., 2023; Ryzhova, 2021). Teachers play a crucial role in providing direct experiences, such as observing plant growth or teaching the proper way to manage waste (Kartodihardjo et al., 2020). Through this approach, it is hoped that children can build an understanding of the importance of caring for and preserving the environment from an early age (Chawla, 2020; K. Chen & Hamel, 2023). The selection of learning materials should include sustainability values, such as storybooks teaching environmental conservation or environmentally friendly toys, which can be effective tools (Nath, 2023).

Thus, this research provides a solid foundation for the development of effective environmental education for early childhood. The products developed, including learning modules and learning media such as videos and illustrated storybooks, offer engaging and developmentally appropriate learning experiences. The strengths of these products lie in their integration of sustainability values and their adaptability to the latest theories and practices in early childhood education and ESD. Consequently, the implications of this research in the field of early childhood education within the context of ESD are profound. It paves the way for fostering environmental awareness and instilling sustainable behaviors in young children, thereby contributing to the cultivation of a generation that is conscious of and committed to environmental conservation and sustainable development from an early age.

5. Conclusion

This research provides a detailed insight into the development process of an environmental education model for early childhood, consisting of needs analysis, product development, and validation stages. Initial data collection through literature review and field surveys in Early Childhood Education (PAUD/TK/RA) institutions in Malang City highlighted the need for clear and sustainable guidelines for effective environmental education. Product development systematically set learning objectives, identified relevant content, and designed engaging activities, incorporating expert feedback and adding illustrated storybooks as learning media. The developed products aim to enhance environmental education effectiveness and foster pro-environmental attitudes and behaviors in children. The implications are significant for education and sustainable development, emphasizing the importance of environmental preservation from an early age. This research underscores the importance of structured and innovative learning models to shape a future generation that is caring and responsible towards the environment. Future steps should focus on implementing these products in everyday educational contexts and continuously evaluating and improving them to achieve better learning outcomes.

Declarations

Author contribution statement

Akhmad Mukhlis conceived the idea, conducted data collection, and performed the analysis. Melly Elvira and Sandy Tegariyani Putri Santoso developed the theory of environmental learning, early childhood education, and sustainable development education. All authors engaged in discussions regarding the findings and made contributions to the final manuscript.

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The dataset generated and analyzed during the research is available from the corresponding author upon reasonable request.


Declaration of interests statement


All authors declare that they have no financial or personal interests that could influence the work presented in this manuscript.

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