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The Role of Environmental Education in Fostering Students' Ecological Awareness

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ABSTRACT

This study aims to analyze the role of environmental education in fostering students' ecological awareness and identify learning approaches that can encourage change from knowledge to pro-environmental behavior. This study uses a literature review method by analyzing 20 relevant scientific journal articles. The analysis is carried out through identification, selection, grouping, comparison, and synthesis of previous research results. The results of the study show that environmental education contributes to the improvement of environmental knowledge, attitudes, awareness, intentions, environmental literacy, and pro-environmental behavior of students. However, environmental knowledge does not always directly produce behavioral changes because ecological actions are also influenced by experiences, social norms, perceptions of actionability, school culture, facilities, and student involvement. Experiential learning, problem-based learning, STEAM approach, Education for Sustainable Development (ESD), use of digital media, project-based learning, local cultural integration, and the creation of a school environment that supports sustainability show potential in strengthening ecological awareness. Therefore, environmental education needs to be developed in a contextual, participatory, and sustainable manner so that ecological awareness does not stop at the mastery of knowledge, but develops into real habits and actions in daily life.

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1. INTRODUCTION

The environment is an inseparable part of human life. Humans depend on the environment to obtain various basic needs such as water, air, food, energy, and natural resources. This relationship shows that the quality of human life is greatly influenced by environmental conditions. When the environment is damaged, the impact is not only felt by the ecosystem, but also by the social, health, economic, and sustainable life of the next generation. Various problems such as pollution, increasing waste volume, climate change, biodiversity loss, and excessive use of natural resources show that environmental problems require attention from various fields, including education.

Environmental problems are basically not only caused by technological limitations or weak policies, but also related to human behavior. The way humans use resources, manage waste, use energy, and treat nature is part of behavior that is formed through knowledge, values, habits, and experiences. Therefore, solving environmental problems requires behavioral changes that cannot be achieved through technical approaches alone. Education has an important position because through the educational process a person can build knowledge, values, attitudes, skills, and awareness which can then affect the way they relate to the environment.

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Environmental education is one of the instruments that can be used to build this awareness. Environmental education not only aims to provide knowledge about the environment, but also encourages students to have concern and willingness to take actions that support sustainability. A meta-analysis of 169 studies with 176,007 participants from 43 countries showed that environmental education has a positive influence on the knowledge, attitudes, intentions, and environmental behaviors of children and adolescents (van de Wetering et al., 2022). These findings show that education has real potential in shaping students' responses to environmental problems.

However, environmental education faces an important problem in the form of a gap between knowledge and action. Students can know that littering is an act that damages the environment, understand the dangers of plastics, and know the importance of saving energy, but this knowledge is not necessarily manifested in daily behavior. Research on sustainability consciousness shows that aspects of knowledge, attitudes, and behaviors are dimensions that need to be looked at together in understanding students' sustainability awareness (Ovais, 2023; Khairati et al., 2025).

Ecological awareness is thus a broader concept than just environmental knowledge. Ecological awareness includes the ability to understand environmental conditions, be aware of the relationship between human actions and their impact on nature, have concern for the environment, and have the will to act. Research on sustainability consciousness shows that knowledge, attitudes, and behaviors are interrelated dimensions in describing students' sustainability awareness (Khairati et al., 2025).

Knowledge remains an important basis in forming ecological awareness. A person will more easily understand the importance of protecting the environment if they have adequate information about ecological issues. However, knowledge requires an advanced process to influence attitudes and behaviors. Research on pro-environmental behavior shows that knowledge, attitudes, norms, and perceptions of the ability to act can be related to a person's tendency to engage in pro-environmental behavior (Karimi et al., 2021; Wang & Zhang, 2021).

Therefore, environmental learning needs to provide experiences that allow students to interact directly with the environment. These experiences can be in the form of observing ecosystems, planting plants, managing waste, making compost, observing biodiversity, or conducting conservation activities. Learning that involves hands-on experience can make environmental concepts more concrete so that students do not only understand problems theoretically. Direct activity-based learning can also be used to increase students' environmental awareness and ocean literacy (Costa et al., 2022).

The problem-based approach also has strong relevance in environmental education. Environmental problems are real problems that require the ability to identify problems, analyze causes, consider alternatives, and make decisions. Learning that places students as problem solvers allows them to understand that environmental problems require action, not just theoretical answers. The *problem-based learning approach* can improve the environmental literacy skills of elementary school students (Ilma & Wulandari, 2023), while the integration of *Problem and Design Process Based Learning* with STEAM can increase students' environmental awareness (Syamsudin et al., 2025).

The Education for Sustainable Development (ESD) approach is also one of the important developments in environmental education. ESD expands the discussion of the environment by connecting it with social and economic dimensions. Students are not only invited to understand that the environment must be protected, but also to understand the relationship between human decisions, development, welfare, justice, and the future. The

integration of ESD into the curriculum can expand students' understanding of sustainable development (Ferguson et al., 2022).

Sustainability pedagogy that uses case studies, discussions, debates, critical events, and problem-based learning can also increase students' sustainability consciousness (Nousheen & Kalsoom, 2022). The research shows that an active pedagogical approach can encourage sustainability awareness more than lecture-oriented learning.

The application of ESD is becoming increasingly relevant at the elementary education level. School-age students are in an important stage of habit formation. Simple habits such as throwing garbage in its place, saving water, caring for plants, reducing plastic use, and maintaining cleanliness can be the basis for ecological behavior in the future. The integration of ESD with learning and *green behavior* in elementary schools can be one of the strategies to build students' sustainability awareness (Mulyadiprana et al., 2023).

Technology also provides new opportunities in the development of environmental education. Materials on climate change, biodiversity, pollution, and ecosystem damage can be presented through videos, simulations, interactive multimedia, and electronic modules. The use of web-based animated videos discussing climate change, mangroves, waste recycling, biodiversity, and ozone depletion shows a positive influence on the environmental education of elementary school students (Safitri et al., 2021).

The use of technology can be more meaningful if it is followed by discussions, reflections, investigations, and real activities. Technology should be positioned as a tool that helps students understand environmental issues, not as a learning goal. Thus, the use of digital media must still be directed at the development of knowledge, attitudes, skills, and actions.

The context of the local environment is also important in environmental education. Students will more easily understand problems if the problems discussed are close to their lives. Waste in schools, river pollution, mangrove damage, drought, flooding, beach abrasion, or the use of plastics in the surrounding environment can be used as a source of learning. The integration of Indonesian local culture with environmental education can also strengthen students' awareness and support sustainable development goals (Yolida et al., 2023).

Schools also have a strategic position because they are a social environment where students develop habits. Environmental education will be less effective if the grades taught in the classroom are not in accordance with school conditions. If students are taught the importance of sorting waste but the school does not provide sorting facilities, for example, students do not have the opportunity to apply this knowledge. Research on schools that implement *zero waste* policies shows that the practice is related to students' high environmental awareness (Karacaoğlu, 2024).

Based on this description, environmental education has a strategic role in shaping ecological awareness, but its success is not sufficiently determined by the provision of materials. Education needs to connect knowledge with experiences, attitudes, values, the ability to act, and environmental support. Therefore, the study of the role of environmental education is important to understand how the educational process can transform students from simply knowing environmental problems to individuals who have concern and are able to take ecological actions.

This article aims to analyze the role of environmental education in fostering students' ecological awareness based on the results of previous research. This study also aims to identify learning approaches and educational conditions that can strengthen the

relationship between environmental knowledge and pro-environmental attitudes and behaviors.

2. RESEARCH METHODS

This study uses *a literature review* method with a descriptive-qualitative approach. This method is used to identify, compare, and synthesize the results of previous research on environmental education and ecological awareness of students.

The literature used consists of 20 scientific journal articles published in the 2021–2025 period and has searchable DOIs. The selection of articles is carried out based on relevance to the topics of environmental education, environmental awareness, environmental literacy, sustainability consciousness, Education for Sustainable Development, and pro-environmental behavior.

Inclusion criteria include articles that discuss students or students in the context of education, have a direct relationship with environmental education or sustainability awareness, are published in scientific journals, and have a DOI. Articles that are not directly related to the focus of the study are not included in the analysis.

The analysis is carried out through four stages, namely identification of key information, grouping of findings, comparison of research results, and synthesis. The information studied includes the research objectives, characteristics of respondents, learning approaches, research methods, variables used, and main research results.

The synthesis was carried out by looking for repeating patterns from the 20 studies. The main patterns found included the relationship between environmental education and knowledge, attitudes, intentions, pro-environmental behaviors, sustainability consciousness, experiential learning, ESD, learning technology, local culture, and school environmental support.

This research is a literature research so it does not use primary data. Therefore, all empirical findings presented in the results and discussion section are the results of research from the analyzed sources and not the results of the author's field data collection.

3. RESULTS AND DISCUSSION

The results of the synthesis of 20 articles show that environmental education has a positive contribution to the development of students' ecological awareness. This contribution can be seen through increasing knowledge, attitudes, intentions, environmental literacy, sustainability awareness, and pro-environmental behavior. The strongest evidence comes from a meta-analysis that includes 169 studies, 512 *effect sizes*, and 176,007 participants from 43 countries. Environmental education resulted in an increase in environmental knowledge with *an effect size* of 0.953, an attitude of 0.384, an intention of 0.256, and a behavior of 0.410 (van de Wetering et al., 2022).

The findings show that environmental education is not just an additional activity in learning, but can be an instrument to shape the way students understand and respond to ecological problems. Increasing knowledge is an important starting point because students need an understanding of the relationship between humans and the environment before they can make decisions related to sustainability. However, the high influence on knowledge compared to other aspects also shows that the educational process must go beyond information transfer.

One of the problems that arises is the gap between knowledge and action. Students can understand environmental problems but do not necessarily engage in pro-environmental behavior in daily life. Studies on sustainability consciousness show that knowledge, attitudes, and behaviors are different dimensions so that success in one

dimension does not automatically indicate success in another dimension (Ovais, 2023; Khairati et al., 2025).

These gaps show that ecological awareness needs to be built through a more comprehensive process. Education should provide space for learners to understand the reasons for the importance of ecological actions, feel their benefits, and have the opportunity to practice them. Attitudes towards the environment, social norms, and perceptions of the ability to take action also play a role in shaping pro-environmental behaviors (Karimi et al., 2021; Wang & Zhang, 2021).

The results of Kurokawa et al.'s research show that environmental education can improve students' basic knowledge and concern for the problem of plastic waste, while the application of *nudges* and *boosts* can help encourage pro-environmental behavior when the cost of behavior change is relatively low (Kurokawa et al., 2023). The findings suggest that behavior change depends not only on what students know, but also on the conditions they face when they want to act.

Similar findings were seen in Jaime et al.'s study that used field experiments on fourth-graders in Chile. Environmental education programs have a positive impact on children's knowledge, attitudes, and practices, but do not produce the same effect on parental behavior (Jaime et al., 2023).

These findings show that environmental education in schools can directly affect students, but broader behavioral changes require support from the family environment. Experiential learning is one approach that can help reduce the gap between knowledge and action. Through direct experience, students not only receive information about the environment, but also interact with environmental objects and problems in real life. Direct activities in environmental learning can increase environmental awareness and ocean literacy because students gain more concrete experiences than learning that is only theoretical (Costa et al., 2022).

Problem-based learning also provides opportunities for students to develop ecological awareness. In this approach, environmental problems are used as a starting point for learning so that students need to identify problems, seek information, analyze causes, and formulate solutions. The application of *problem-based learning* can improve the environmental literacy skills of elementary school students (Ilma & Wulandari, 2023).

This approach is even stronger when combined with STEAM. Syamsudin et al.'s research shows that the *Problem and Design Process Based Learning* model through the STEAM approach is able to increase the environmental awareness of students in rural and urban schools (Syamsudin et al., 2025). This approach is important because environmental problems basically require multidisciplinary skills. Students not only need scientific knowledge, but also the ability to design, calculate, communicate, create solutions, and consider social aspects.

ESD provides a broader framework because it connects the environment with social and economic dimensions. The integration of ESD in the curriculum can broaden students' understanding of sustainable development and help them understand that environmental issues do not stand alone (Ferguson et al., 2022). This makes ESD relevant as an educational approach that prepares students to face complex sustainability issues.

Sustainability pedagogy also has an important role to play in shaping ecological awareness. The use of case studies, discussions, debates, critical events, and problem-based learning can increase sustainability awareness compared to lecture-oriented approaches (Nousheen & Kalsoom, 2022). This kind of learning encourages students to question problems, consider different perspectives, and develop arguments.

At the elementary school level, ESD can also be applied through the formation of daily habits. Environmental education will be more meaningful if students have the opportunity to apply sustainability principles through simple activities such as waste reduction, waste sorting, reuse of goods, energy savings, and plant care. The application of ESD can help build sustainability awareness in the knowledge aspect of elementary school students (Mulyadiprana et al., 2023).

Digital technology can be used to strengthen these processes. Research by Safitri et al. shows that web-based animated videos discussing climate change, mangroves, waste recycling, biodiversity, and ozone depletion have a positive influence on the environmental education of elementary school students (Safitri et al., 2021). Digital media can help learners understand phenomena that are difficult to observe directly.

However, technology should not replace real experiences. Digital media will be more effective if it is used to spark curiosity, provide information, and then continue with investigation and action activities. Thus, students do not stop as consumers of digital information, but become individuals who are able to use information to understand and solve environmental problems.

Ecological awareness can also be strengthened through the integration of moral and religious values. Environmental education is not only related to aspects of knowledge and skills, but also concerns human responsibility towards nature. The integration of religious values in biology learning can be an approach to connect environmental knowledge with the formation of students' character and environmental awareness (Fitriana et al., 2025).

The context of local culture also has an important position in environmental education. The environment in which students live has certain social and cultural characteristics that can be used as a learning resource. The integration of Indonesian local culture with environmental awareness shows a positive relationship with the awareness of responsibility and the ability to find solutions to environmental problems and their relationship with the SDGs (Yolida et al., 2023).

A local culture-based approach can make environmental education more relevant. Students not only learn about general environmental concepts, but also understand how the surrounding community interacts with nature. Local knowledge about water, agriculture, forests, sea, plants, or resource management can be part of learning that strengthens students' relationship with their environment.

School culture is also an important part of shaping ecological behavior. Students will more easily build habits if the school environment provides supportive conditions. Karacaoğlu's research shows that students in schools that implement *zero waste* policies have a high level of environmental awareness and show sensitivity to issues of air, water, soil, and ecological balance (Karacaoğlu, 2024).

The findings show that environmental education is not enough through classroom learning activities. Schools must be tangible examples of the environmental values taught. When schools teach water saving but leave taps leaking, teach waste reduction but use a lot of single-use plastics, or teach greening but not care for plants, there is a mismatch between material and practice.

The physical environment of the school can also be an educational medium. The existence of green spaces can provide opportunities for students to interact with the natural environment while creating a space that supports pro-environmental behavior. Research on students shows that there is a relationship between the perception of green space and pro-environmental behavior (Tusyanah et al., 2023).

In addition to the school environment, students' awareness is also influenced by the way they view the environment. Research on environmental concern and the new environmental paradigm shows that concern for the environment can affect students' environmental paradigm and pro-environmental behavior (Puspaningrum et al., 2023). This shows that education needs to help students build a perspective that sees humans as part of the environment, not as a party completely separate from nature.

Research on sustainability consciousness also shows that sustainability awareness can be analyzed through the dimensions of knowledge, attitudes, and behaviors. The use of instruments that measure these three aspects provides a more complete picture of the ecological awareness condition of students (Khairati et al., 2025). Thus, environmental education evaluation should not only use knowledge tests, but also measure attitudes, intentions, and behaviors.

In the end, the success of environmental education cannot be measured only by the ability of students to answer questions about the environment. A more important indicator is whether students are able to apply their knowledge in daily life. Ecological awareness can be said to develop if students are able to recognize problems, have concerns, feel responsible, and are willing to take action.

Based on the overall results of the research, effective environmental education needs to integrate four main processes, namely knowing, understanding, caring, and acting. Knowledge provides a cognitive foundation, experience helps build relationships with the environment, values and attitudes shape care, while opportunities to act allow knowledge and care to be embodied in behavior.

Therefore, environmental education should not be placed as additional material that is only given at certain times. Environmental education needs to be part of the learning culture and school culture. Teachers need to connect the material with real problems, schools need to provide a supportive environment, and students need to be involved as change actors. In this way, environmental education can develop from just a process of delivering information to a process of forming ecological character.

4. CONCLUSION

Based on the results of a study of 20 journal articles, it can be concluded that environmental education has an important role in fostering students' ecological awareness. Environmental education can improve knowledge, attitudes, intentions, environmental literacy, sustainability awareness, and pro-environmental behavior. These findings show that education has great potential in preparing a generation that is able to understand and respond to environmental problems.

However, increasing knowledge has not automatically resulted in behavioral changes. The gap between knowledge and action is influenced by attitudes, social norms, perceptions of ability to act, experiences, facilities, family, and school culture. Therefore, environmental education needs to be designed more comprehensively and does not stop at the delivery of material.

Experiential learning, *problem-based learning*, STEAM, ESD, the use of digital technology, the integration of local culture, the integration of moral values, and the creation of a school environment that supports sustainability are some of the approaches that can be used to strengthen students' ecological awareness. This approach allows students not only to know about environmental problems, but also to understand, care, be responsible, and take action.

Thus, environmental education needs to be directed from the transfer of knowledge to the formation of ecological awareness and action. Schools, teachers, families, and communities need to create an environment that is consistent with sustainability values so that students have the opportunity to apply what they learn. Ecological awareness built since primary education is expected to develop into habits and characters that support environmental sustainability in the long term.

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