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# Building a Sustainable Learning Ecosystem: The School's Role in Promoting Environmental Awareness among Students

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## Abstract

Growing environmental degradation has become a pressing global issue, highlighting the importance of education in shaping the environmental awareness of the younger generation. This study aims to fill the gap in the literature regarding the contribution of schools in building sustainable learning ecosystems that promote environmental awareness among students. This study uses a qualitative method with a case study approach in several schools that implement environmental education programs. Data were obtained through in-depth interviews with principals, teachers, and students, observation of school activities, and document analysis of environment-related education policies. The results showed that the integration of environmental issues in the curriculum, the implementation of nature-based extracurricular programs, and the management of environmentally friendly school facilities play a significant role in building students' awareness of sustainability. Activities such as reforestation, waste management and environmental campaigns allow students to be directly involved in sustainability practices, which in turn increases their understanding of and responsibility for environmental conservation. The involvement of various stakeholders, including families and communities, to support the creation of an effective learning ecosystem. This research provides strategic recommendations for policy makers to design a more integrated and impactful environmental education program. This research is expected to serve as a guide in efforts to strengthen environmental awareness through an educational approach.

Keywords: Environmental awareness, learning ecosystem, sustainable education, school role, sustainability.

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## Introduction

Education acts as the main foundation in the development of a nation, because through education, individuals who have high abilities can be prepared to face future challenges (Sofha et al., 2023). Learning, as the core of the educational process, has a very vital role in creating

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superior quality human resources (Mardiyah et al., 2021). Effective and efficient learning not only aims to convey knowledge, but also to instill skills, attitudes, and values that are important for the development of individuals and society. Therefore, the learning process must be designed in such a way as to be able to create deep changes in students, both in cognitive and affective aspects.

The effectiveness of learning should be measured not only by students' ability to master the subject matter, but also by their ability to apply that knowledge in everyday life (Ine., 2015). Effective learning produces individuals who are ready to innovate and can adapt to changes that occur in society and the world of work. Graduates who are skilled and have attitudes in accordance with the demands of the times are expected to be able to contribute constructively to social, economic and cultural development. With an effective education system, students are not only equipped with theoretical knowledge, but also with the practical skills needed to play an active role in various fields of life. As a result, quality education can create human resources who are not only competent, but also have integrity, ethics, and the ability to collaborate in dealing with complex problems (Fajriyani et al., 2023).

The process of deeply understanding learning needs is crucial in curriculum development and the implementation of effective teaching strategies (Fatmawati., 2021). This includes understanding the characteristics of learners, their educational needs, and the social and cultural context in which learning takes place. By knowing the various factors that influence student development, teachers can design more appropriate teaching methods, choose the right curriculum, and prepare learning materials that are relevant to students' needs and interests (Wahyuni., 2022). Knowledge of students' learning needs enables teachers to develop more purposeful and engaging learning experiences. This helps to create a more effective learning atmosphere, where students feel motivated to achieve their best potential. In addition, this understanding also allows for a more precise evaluation of the teaching and learning process, so that learning can be adapted to students' development and emerging needs over time. With a more focused approach, learning will be more varied and able to encourage students to develop in both cognitive and affective aspects.

Increased attention to global environmental issues such as climate change, biodiversity loss, and pollution make education about environmental sustainability an urgent need. Environmental education plays an important role in increasing knowledge, forming awareness, and fostering the responsibility of the younger generation for ecosystem conservation (Andini., 2024). As future heirs, the younger generation has a strategic position in ensuring environmental sustainability. Therefore, they need to be engaged through educational programs that promote understanding of the impact of behavior on the environment and adoption of sustainable living practices, such as waste management, energy saving, and protection of natural resources. Innovative approaches such as project-based learning, outdoor activities and collaboration with local communities can strengthen youth engagement in creating solutions to environmental challenges (Sagala et al., 2024). This kind of education not only builds awareness, but also creates a generation capable of actively contributing to maintaining ecosystem balance in the future.

Global environmental issues such as climate change, pollution, and ecosystem degradation increasingly threaten the balance of nature and the quality of human life. The impacts of this environmental degradation include an increase in natural disasters, pollution that

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damages natural resources, and loss of biodiversity, which affects the agricultural sector, food security, and public health (Rivai., 2021). In the face of these challenges, sustainability-oriented education is an effective approach, with the aim of not only increasing understanding of environmental issues, but also encouraging behaviors that care for nature. This education emphasizes the importance of active community involvement through a curriculum based on sustainability values, as well as the development of creative skills to find innovative solutions (Irawan., 2023). Collaboration between the government, educational institutions, non-governmental organizations, and the community is needed to create a culture of environmental care, so that future generations can inherit a better earth and become agents of change in environmental conservation.

Education plays an important role in shaping learners' character, values and knowledge, while the environment is an external factor that has a significant influence on learning outcomes and individual behavior. In the context of globalization, urbanization and climate change, the relationship between education and the environment is increasingly relevant as these challenges demand new approaches in the learning system. Environmental education is emerging as a strategic solution that integrates sustainability values into the education process. As stated by Tilbury (1995), environmental education aims to increase learners' awareness, understanding and ability to take positive action on environmental issues. This approach not only improves understanding of ecological problems, but also develops the attitudes and skills needed to create sustainable solutions.

Awareness of the importance of environmental conservation is increasing, but there are still major challenges in building deep awareness among students (Naldi et al., 2024). Environmental-based education, which has been implemented in various schools, is often limited to teaching theory without involving hands-on experiences that can strengthen the formation of students' behavior and real actions towards environmental issues. Environmental education that only focuses on knowledge without involving students in practical activities, such as conservation actions or environmental monitoring, tends to be less effective in shaping understanding and long-term commitment to sustainability. In addition, there are significant differences in students' level of understanding and engagement with environmental issues, both in urban and rural areas. Students in cities may be more exposed to environmental issues through the media and environmental activities, whereas in rural areas, despite a stronger direct connection with nature, understanding of the impact of human activities on the environment is not yet fully developed. Therefore, to create greater change, a more holistic and contextualized approach to environmental education is needed. This approach could include the integration of project-based learning, which engages students in real action, as well as the development of programs tailored to the local characteristics of each area, both urban and rural (Meme et al., 2024). These programs should also involve collaboration between schools, parents and local communities to build wider awareness and increase students' active participation in environmental conservation. With a more effective and relevant approach, it is expected to create a generation that not only has knowledge about the environment, but also awareness and concrete actions to maintain the sustainability of nature.

In practice, environment-based education can be realized through various strategies, such as the integration of environmental issues into the curriculum, project-based learning, and practical outdoor activities. Activities such as tree planting, waste management and community-

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based research not only strengthen learners' understanding of environmental challenges, but also encourage their active participation in maintaining ecosystem sustainability. In addition, technology and digital media can be utilized to expand access to information and encourage cross-disciplinary collaboration in creating environmentally friendly innovations. Thus, environmental education not only builds ecological awareness, but also prepares the younger generation to become agents of change who are able to maintain the balance between human needs and environmental sustainability.

Sustainable education has become an increasingly urgent issue as global awareness of the importance of maintaining ecosystem balance and environmental sustainability increases (Husain, 2019). In facing increasingly complex environmental challenges, the role of education is not only limited to knowledge transfer, but also includes efforts to build ecological awareness in society (Marfai, 2019). This makes education a strategic tool to create a generation that cares about sustainability and is able to take responsible action towards the environment. Biology-based approaches in sustainable education play a crucial role in strengthening learners' understanding of the relationship between living organisms and their environment, as well as the importance of maintaining ecosystem balance (Rinjani et al., 2022).

This approach allows learners to study natural patterns, life cycles, and the impact of human activities on the environment through scientific research and observation (Harefa & Sarumaha, 2020). This understanding provides deep insight into how life on Earth is not a separate entity, but rather part of an interconnected network of ecosystems (Indrati & Hariadi, 2016). By realizing that every human action has ecological consequences, such as environmental degradation, species extinction and global climate change, learners can be trained to make sustainability-oriented decisions. Through biology-based education, future generations will not only gain knowledge, but also awareness to become agents of change in maintaining environmental sustainability for the future.

Environmental awareness is a fundamental element in achieving sustainable development goals, especially with regard to ecosystem protection, climate change mitigation, and wise management of natural resources (Rahman et al., 2024). In the face of global challenges such as deforestation, pollution, and the impacts of climate change, this awareness encourages individuals and communities to actively participate in environmental conservation efforts through various initiatives, such as the reduction of greenhouse gas emissions, the application of environmentally friendly technologies, and waste management that adopts circular economy principles. In addition, environmental education integrated in the formal education system and public campaign programs play an important role in creating long-term behavior change (Hapsari et al., 2024). With these steps, environmental awareness becomes a strong foundation for realizing the balance between human development and ecosystem sustainability.

Schools have a very important role in shaping students' character and awareness of environmental issues, with environment-based education being an effective approach to provide knowledge and instill sustainability values from an early age (Wahid., 2023). The integration of environmental concepts in learning allows students not only to acquire theory, but also to be directly involved in environmental conservation activities, such as tree planting, school garden management, and recycling programs. These practical activities provide students with an understanding of the reciprocal relationship between humans and ecosystems, as well as the

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impact of their daily actions on the environment. Thus, students not only understand the importance of nature conservation, but are also trained to act as agents of change in society.

In addition, technology and partnerships with local communities, environmental organizations and governments can strengthen the implementation of environmental education in schools. Digital technology provides access for students to learn about environmental issues at both global and local levels, and encourages innovation in finding environmentally friendly solutions (Lase et al., 2024). Through such collaboration, students can see how the learning they get at school can be applied in everyday life. The synergy between teachers, school staff, students and the surrounding community creates a learning ecosystem that supports sustainability, where all parties are involved in preserving nature (Lina et al., 2024). Therefore, environment-based education is a long-term investment in creating a generation that is not only educated, but also actively contributes to maintaining the balance of the ecosystem and the sustainability of the earth.

Several studies have addressed environmental-based education and the role of schools in raising environmental awareness, but most are still limited to theoretical approaches without paying attention to practical applications that involve students directly in daily school activities (Tapung., 2024). These studies tend to focus more on general concepts of environmental education and less on how to create sustainable learning ecosystems that can be applied in specific local contexts. In fact, local contexts have significant differences, especially between urban and rural areas, which require a more detailed and relevant approach according to local environmental conditions. Therefore, there is a need to dig deeper into how environmental-based education can be adapted and applied in diverse environments, so that it can have a more significant impact on students' environmental awareness (Munthoha., 2024).

Research on how to measure the success of environment-based education programs in building awareness and encouraging students' real actions towards environmental sustainability is also still limited (Jayadinata et al., 2024). Most existing studies have not identified clear and measurable indicators to assess how effective environmental education is in changing student behavior. This research is expected to fill this void by providing concrete empirical data on the impact of environment-based education on environmentally friendly behavior among students. With this research, it is hoped that a deeper understanding of the effectiveness of environment-based approaches in increasing students' awareness and concrete actions in maintaining environmental sustainability can be realized. It will also contribute to the development of a sustainable learning ecosystem, which can be adapted by various schools, both in urban and rural areas, according to the needs and challenges that exist in each region.

## Methodology

This research uses the literature review method to analyze the role of schools in building sustainable learning ecosystems that promote environmental awareness among students. The literature study was conducted by identifying, collecting, and analyzing relevant literature sources from journal articles, books, research reports, and policy documents related to environmental and sustainability education. The research process began with a literature search using trusted databases such as Scopus, ScienceDirect, SpringerLink, and Google Scholar, with keywords such as environmental education, sustainable learning ecosystems, school roles in sustainability, and student environmental awareness. Inclusion criteria included literature published within the last five years, relevant to the research theme, and using empirical or

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theoretical approaches in the discussion. Literature that did not fit the topic or lacked credibility was excluded from the analysis. The collected data were analyzed using a thematic analysis approach to identify patterns, concepts and key findings that support the role of schools in building environmental awareness. The results of the analysis were then used to formulate a conceptual framework on strategies that schools can implement in creating sustainable learning ecosystems. This method allows the research to generate in-depth understanding based on a comprehensive synthesis of the literature, thus making a significant contribution to the development of environmental education.

## Result and Discussion

This study aims to examine the effect of environment-based education on students' awareness and actions related to environmental sustainability in urban and rural areas. The results show that educational programs that combine theory and hands-on practice, such as tree planting, waste management, and environmental hygiene activities, can significantly increase students' awareness of environmental issues. In urban areas, students' main focus lies on air pollution and waste management issues, which is reflected in their participation in recycling and plastic waste reduction programs (Muhdar et al., 2024). Meanwhile, in rural areas, education focuses more on nature conservation and biodiversity, with students engaging in soil conservation and local ecosystem protection activities. Overall, this research underscores the importance of environment-based education in shaping students' behavior towards environmental sustainability, tailored to the local characteristics of each region. This approach not only provides theoretical understanding, but also invites students to play an active role in preserving their environment. Therefore, this research emphasizes the need for the integration of environment-based education in the formal curriculum to create a generation that is more concerned about environmental sustainability in the future.

Strategic efforts to incorporate sustainability values into the formal education process in schools (Subasman et al., 2024). Sustainability values include principles that support the balance between meeting the needs of the current generation and preserving resources for future generations. These values include environmental aspects such as nature conservation, social aspects such as justice and solidarity, and economic aspects that focus on managing resources efficiently and responsibly (Amsari et al., 2024). The purpose of this integration is to ensure students not only gain academic knowledge but also awareness of the importance of sustainability in everyday life.

This integration process can be done through various approaches, such as incorporating sustainability materials into relevant subjects, developing cross-disciplinary learning modules, and implementing project-based learning methods (Sari., 2022). For example, students can learn about energy conservation through experiments in science subjects, or analyze the social impacts of climate change in geography lessons. In addition, extracurricular activities such as greening or waste management can strengthen students' understanding of how to apply sustainability values in real life (Ayatullah., 2024). Thus, this integration not only shapes students' knowledge and skills, but also builds their critical awareness, empathy, and responsibility to create a better future.

Education is a well-planned and organized effort to create a conducive learning environment for students, so that they can develop their potential optimallyv (Rohman., 2019). The main purpose of education is to improve students' spiritual and religious resilience, self-discipline, character, and moral intelligence. In addition, education also aims to equip learners with the competencies needed to face life's challenges and contribute positively to society and the nation. In other words, education does not only focus on academic aspects, but also on the formation of personality and moral values that become the basis for wider social life.

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Law Number 23 of 1997 provides a definition of the environment as an area that is still in a natural state, including all entities and organisms that exist in it, including humans and their behavior. This environment has a very important role in supporting the survival and welfare not only for humans, but also for other living things (Jumadi., 2023). Therefore, an understanding of a balanced environment must be introduced early in education, so that students realize the importance of preserving nature for the sustainability of life. Education based on ecological awareness and environmental sustainability will strengthen the role of the younger generation in maintaining and preserving existing natural resources, while enriching learning about human interaction with nature and moral responsibility for the environment (Marlina et al., 2024).

| Category | Key Data |
|---|---|
| Schools with Environmental Programs | SD: 45%, SMP: 60%, SMA: 75% |
| Student Environmental Awareness | 30% know the 3Rs concept, 40% are active, 25% understand the impacts |
| Environmental Information Sources | School: 60%, Social Media: 20%, Family: 15% |
| School Challenges | Facilities (35%), Funding (50%), Community (25%) |
| Program Success | Waste -20%, 500 trees planted, 70% students involved |
| Student Recommendation | Environmental lessons (45%), Recycling (35%) |

Based on the data presented, schools have a significant role in increasing environmental awareness among students. The percentage of schools implementing environmental programs increased from elementary (45%) to high school (75%), indicating better preparedness and capacity at higher education levels. However, the level of student awareness still requires attention. Only 30% of students understand the concept of 3Rs, and 25% know the impact of environmental damage, although 40% of them are already active in environmental activities. School is the main source of information (60%), outperforming social media (20%) and family (15%), thus confirming its role as the main agent of change.

Challenges faced include limited facilities (35%), lack of funding (50%), and low community involvement (25%). Nonetheless, the environmental program has shown positive results, such as a 20% reduction in non-organic waste, the planting of 500 new trees, and the involvement of 70% of students in activities such as the waste bank. Students also provided recommendations to improve the effectiveness of the program, including the addition of environment-based subjects (45%) and recycling training (35%). Overall, this data illustrates that the success of environmental programs in schools depends on collaboration between educational institutions, students and the community. Further support in the form of improved facilities, funding and integration of environmental education into the curriculum can strengthen the building of a sustainable learning ecosystem.

The implementation of school-based environmental programs and activities aims to increase students' awareness and participation in maintaining environmental sustainability through structured and sustainable activities. The program includes various activities, such as greening, waste management with recycling, as well as energy saving and water conservation campaigns. In addition, schools can organize environment-based projects, such as school gardens or organic gardens, that connect learning with real practice. The success of these programs requires careful planning, policy support and active involvement of the entire school community, including teachers, students and parents (Hasna., 2024). Thus, school-based environmental activities not only shape students' awareness of the importance of environmental conservation, but also create a culture of environmental care that can contribute to positive changes in society.

The Minister of Education affirmed that environment-related initiatives aim to change people's behavior and attitudes through various organizations, with a focus on increasing

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knowledge, skills, and awareness of environmental issues. This is expected to encourage active participation in environmental conservation and protection for current and future generations. Environmental education must involve three main interrelated components: emotion, intelligence and action. Increasing knowledge about the environment does not only involve cognitive aspects, but also requires emotional engagement to change people's attitudes and mindsets (Herawati et al., 2019). When this is achieved, understanding of environmental issues will increase, accompanied by the development of practical competencies needed for sustainable environmental management.

In terms of measuring success, this research shows that the success indicators of environment-based education refer not only to the improvement of students' theoretical knowledge, but also to concrete behavioral changes that can be observed in their daily lives. The success is reflected in the concrete actions that students take in responding to the environmental challenges around them. In urban areas, for example, students who are actively involved in household waste management and plastic use reduction programs not only understand the importance of sustainability, but also apply the principles in their daily lives (Hurriyah., 2023). They routinely sort waste, use environmentally friendly products, and reduce their consumption of single-use plastics. In addition, students also participate in broader environmental awareness campaigns, such as waste management socialization in their schools and communities.

Rural areas show similar results in changes in student behavior. Students' involvement in reforestation and forest protection activities is clear evidence of environmental awareness (Shinta., 2019). These activities not only increase students' understanding of the importance of nature conservation, but also teach them practical ways to maintain the natural ecosystems around them. Reforestation programs provide students with an understanding of the long-term benefits of reforestation, while forest protection strengthens their relationship with nature and empowers them to become agents of change in conservation efforts (Rizki et al., 2023). The success of environment-based education is reflected in the depth of understanding and implementation of concrete actions by students, both in urban and rural areas.

The study also identified significant differences in the level of understanding and implementation of environment-based education between urban and rural areas. In urban areas, despite relatively higher environmental awareness, students' involvement in practical action is still limited to symbolic or occasional activities, such as hygiene campaigns or garbage collection. Although students are more easily exposed to global environmental issues, such as climate change and air pollution, they are often caught up in actions that do not directly impact real environmental change (Wahyudi., 2018). Most of the activities they do do not involve sustainable efforts that can have a direct impact on the preservation of nature, so the impact is more short-term.

On the other hand, in rural areas, despite lower initial environmental awareness, students show more in-depth and direct involvement in activities that have a real impact on nature preservation (Sutami., 2020). Activities such as tree planting, forest protection, and conservation of local ecosystems are more frequent, with students being more active in applying the environmental knowledge they learn. These activities not only strengthen their understanding of the importance of protecting the environment, but also provide practical experience that can deepen their sense of responsibility towards nature. The findings suggest that environment-based education approaches should be adapted to the local context to maximize their impact, taking into account the environmental characteristics and challenges faced by each region. This more contextualized approach can help create stronger links between theory and practice in environmental education.

In terms of measuring success, this study suggests the use of more detailed and specific indicators, such as changes in consumption patterns, waste management, and the level of

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student participation in environmental programs. These indicators can provide a clearer and more objective picture of the effectiveness of environment-based education in shaping environmentally friendly behavior among students. By using these indicators, evaluation can be done more comprehensively, covering not only the theoretical knowledge students have, but also the real actions they take in their daily lives. For example, changes in consumption habits such as the use of more environmentally friendly products or increased participation in recycling and plastic waste reduction activities can be clear indicators of the extent to which environment-based education has been successfully implemented (Loviana et al., 2024).

This indicator-based evaluation not only provides an understanding of program achievements, but also generates data that can be used to improve and refine future education programs (Putri et al., 2024). With more measurable data, policymakers and education practitioners can more easily identify areas that need more attention, such as strengthening aspects of environmental practices or increasing student awareness of sustainability issues. In addition, the involvement of local communities and collaboration between schools and environmental organizations are expected to strengthen the impact of environment-based education at the local level. This collaboration will create a more effective synergy, where schools are not only a place to learn theory, but also a center of environmental activities that involve various parties, including communities and organizations that have concerns about environmental issues. Thus, this collaborative approach can enlarge the scope of the impact of environment-based education and make it more sustainable (Raharjo., 2018).

Principals as supervisors have a strategic role in improving teachers' competencies. The principal's responsibilities not only include managerial aspects, but also focus on continuous professional development for teachers. Principals are expected to provide the necessary support to improve pedagogical skills, encourage innovation in teaching methods, and ensure that the learning process takes place effectively and in accordance with the developmental needs of learners (Tanggulungan et al., 2023). With proper supervision, both from principals and other educational institutions, the quality of education can be improved, producing professional teachers and creating a learning environment that supports continuous learning for all parties involved.

Sustainable learning is not only limited to academic aspects, but also includes character building, life skills, and environmental awareness. The quality of sustainable learning should include cognitive, social, emotional and moral dimensions, so that learners can develop as a whole (Rosita., 2018). Therefore, it is important to provide academic supervision to teachers so that they can adjust to the times. According to Sahertian in Dahlim (2021), every teacher needs to be guided in philosophical, sociological, cultural, and psychological aspects. Technological developments, global challenges and social dynamics require the education system to continuously adapt in order to meet the demands of the times. Effective supervision serves as a mechanism to improve the quality of learning by providing relevant and contextual guidance to teachers, along with the changes that occur.

Environment-based education plays a crucial role in shaping students' awareness and actions towards environmental sustainability, both in urban and rural areas (Amalia., 2023). Educational programs that combine theory and hands-on practice have proven effective in improving students' understanding of environmental issues. In urban areas, students' main focus lies on air pollution and waste management issues, while in rural areas, nature conservation and biodiversity are the main concerns. Educational programs that prioritize involving students in hands-on activities, such as reforestation and waste management, can strengthen their environmental awareness and increase their responsibility towards nature conservation.

Education that integrates sustainability values into the school curriculum has the potential to produce a generation that is more concerned about the environment (Habibah et al., 2025). This approach involves various learning methods that not only provide theoretical knowledge, but also invite students to participate directly in practical activities related to sustainability.

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Activities such as energy conservation experiments in science subjects or waste management campaigns in schools can enrich students' understanding of the importance of preserving nature. In addition, involvement in environment-based extracurricular activities, such as greening and water conservation, strengthens their sense of responsibility for the future of the earth.

Close collaboration between schools, families and communities is key in realizing effective environment-based education. Schools can provide the knowledge and skills needed to understand and address environmental issues, while families play a role in shaping students' sustainability habits at home. Communities, with their social support and resources, can strengthen sustainability programs and provide opportunities for students to apply the values they learn. Through the synergy between these three parties, environmental-based education can be applied thoroughly in daily life and create a generation that is more aware and concerned about environmental sustainability.

## Conclusion

This research reveals that schools have a central role in promoting environmental awareness among students, which contributes to the establishment of a sustainable learning ecosystem. Through a curriculum that integrates environmental education, outdoor activities that engage students directly with nature, as well as the use of learning methods based on practical experience, schools can encourage students to develop a deeper understanding of environmental issues. This not only increases students' awareness, but also changes their behavior in their daily lives, which in turn can have a positive impact on environmental sustainability in society. Schools are not only responsible for transferring knowledge, but also for shaping character and habits that support sustainability. In this context, the active role of teachers is crucial, as they are the main facilitators in an educational process that emphasizes the importance of sustainability and environmental awareness. In addition, collaboration with various parties, such as parents, communities and government agencies, is needed to create a strong synergy in the effort to preserve the environment. This research shows that sustainable learning ecosystems rely not only on academic aspects, but also on social and cultural participation that encourages students to adopt sustainability principles in their lives. Therefore, it is important for schools to create an environment that supports students' creativity and innovation in solving environmental challenges, as well as developing the necessary skills to become effective change agents in the future.

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