The Role of Science Education in Strengthening the Sustainable Development Goals (SDGs): A Literature Analysis on Environmental Education

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ABSTRACT. Science education plays a strategic role in supporting the achievement of Sustainable Development Goals (SDGs), particularly in the aspects of quality education, climate action, and environmental preservation. The urgency of this research is based on the increasing complexity of global challenges such as climate change, environmental degradation, and energy crises that demand the presence of sustainability-oriented science learning. This study aims to analyze the contribution of science education in strengthening the achievement of SDGs through an environmental education literature approach. The research uses a literature study method by reviewing relevant scientific articles, books, and research reports from the last five years. The analysis is carried out descriptively and qualitatively to identify patterns, concepts, and practices of science education aligned with the values of sustainability. The results of the study show that environment-based science education can enhance ecological literacy, critical awareness, and foster environmental care attitudes among students. In addition, the integration of science education with the SDGs provides a real contribution to building 21st-century competencies, including collaboration, systems thinking, and eco-friendly innovation. The conclusion of the study emphasizes that science education plays an important role in internalizing the principles of sustainability into the education system, thereby supporting the realization of just and inclusive sustainable development.

Keywords: *science education, environmental education, SDGs.*

INTRODUCTION

Sustainable development is a global issue that continues to receive attention, especially since the adoption of the sustainable development goals (sdgs) by the united nations in 2015. The sdgs consist of 17 goals covering various aspects, ranging from quality education and poverty alleviation to action against climate change. One of the key factors in achieving the sdgs is education, particularly science education, which can equip learners with the knowledge, skills, and values of sustainability (unesco, 2020). Science education is expected not only to emphasize the understanding of scientific concepts but also to build critical awareness of environmental issues that have a broad impact on human life (ramdani & subekti, 2021).

The urgency of this research is driven by the increasing complexity of global environmental problems. Climate change, deforestation, air pollution, and the clean water crisis are real challenges that require both scientific and educational responses. The younger generation, as agents of change,

needs to be equipped with scientific literacy and environmental literacy to be able to contribute to maintaining ecosystem balance. Therefore, science education holds a strategic position in instilling environmental care values while preparing students to face the challenges of the 21st century (hakim & suryana, 2020).

The problem formulation in this study is how science education can strengthen the achievement of the sdgs, particularly within the framework of environmental education. The focus of the study is directed toward learning strategies, curriculum integration, and the contribution of science education to changing students' attitudes and behaviors. The purpose of this study is to critically analyze literature that discusses the relationship between science education, environmental education, and the sdgs, as well as to identify its conceptual contribution to strengthening sustainability (putri & anam, 2022).

Previous studies have shown that environment-based science education is effective in improving ecological literacy and students' awareness of sustainability issues (wahyuni & kurniawan, 2019). Other studies emphasize that project-based learning in science education can foster collaboration, creativity, and problem-solving skills that align with 21st-century competencies (yulianto & hasanah, 2021). However, the research gap identified is the limited number of conceptual studies that specifically link science education with the systematic achievement of the sdgs. Most previous studies only highlight the aspect of environmental education without directly connecting it to the sdgs framework (anwar & lestari, 2020).

The novelty of this research lies in its effort to present a synthesis of literature that integrates science education, environmental education, and the sdgs into a single conceptual framework. This study not only provides a theoretical foundation but also practical guidance for educators and policymakers in developing sustainability-oriented learning strategies. Thus, the scientific contribution of this research is to expand academic discourse while providing practical solutions for the education sector in supporting the sustainable development agenda (prasetyo & dewi, 2021).

Overall, this introduction emphasizes that science education plays an important role in strengthening the achievement of the sdgs through the integration of sustainability values into curriculum and learning. By positioning students as empowered active subjects in environmental stewardship, science education can become a transformative means to build a generation that is scientifically literate, environmentally conscious, and committed to global sustainability.

METHOD

This study uses a qualitative approach with a type of library research. The library research method was chosen because the focus of the study is to analyze the contribution of science education in strengthening the sdgs through environmental education. This method allows the researcher to identify patterns, compare findings, and synthesize conceptual ideas from existing literature (zed, 2019).

Data sources

the data sources of this research consist of nationally accredited journal articles, reputable international journals, academic books, and scientific proceedings published within the last five years. In addition, classical literature such as constructivism theory is still used to strengthen the theoretical foundation (arifin & sari, 2020).

Data collection techniques

the data collection technique was carried out through a systematic search on databases such as google scholar, garuda, doaj, and sciencedirect. The keywords used included science education, sustainable development goals, environmental education, and sustainability literacy. The selected

articles were then filtered based on inclusion criteria: relevance to the topic, relation to the sdgs, and being based on scientific research (handayani & yusuf, 2021).

Data analysis techniques

data analysis was conducted using the content analysis method. The stages included data reduction, categorization, synthesis, and conclusion drawing (miles, huberman, & saldaña, 2018). Irrelevant articles were eliminated during the data reduction stage. Relevant information was then categorized into themes such as the contribution of science education to the sdgs, environmental education practices, and implementation challenges. The synthesis was carried out by comparing the literature to identify conceptual relationships.

Data validity

the validity of the data was maintained using source triangulation techniques, which involved comparing findings from various types of literature. The credibility of the research was strengthened by using only sources that had undergone peer review and academic books from reputable publishers (moleong, 2021). In this way, the research results have strong validity and can be scientifically justified.

RESULT AND DISCUSSION

Result

A literature review of 35 articles, books, and proceedings from the past five years reveals three main findings. First, science education contributes significantly to improving students' sustainability literacy. Second, environmental education integrated into the science curriculum is effective in fostering ecological awareness. Third, the implementation of science education aligned with the SDGs faces challenges such as limited infrastructure, teacher competence, and policy support.

Table 1 Summary of Key Research Findings on STEAM

No.	Focus of Study	Key Findings	Source
1	Science education	Improving sustainability literacy and scientific literacy	(Fitriani & Maulana, 2021)
2	Environmental education	Cultivating students' ecological awareness	(Sukmawati & Rohman, 2020)
3	SDGs Integration	Supporting the achievement of goals 4, 13, and 15 of the SDGs	(Fahmi & Rahayu, 2022)

Discussion

Science Education as a Reinforcer of Sustainability Literacy

Science education has been proven to shape students who are literate in sustainability issues. Sustainability literacy not only includes theoretical understanding but also the ability to connect scientific concepts with real environmental challenges (Fitriani & Maulana, 2021). For example, learning about the carbon cycle can be linked to the issue of global climate change. Thus, science

education serves as an integrative means between academic knowledge and practical action to support the SDGs.

The Role of Environmental Education in Science Learning

The integration of environmental education into science learning increases students' ecological awareness. Research shows that students who participate in project-based environmental learning have a higher level of concern for sustainability issues compared to those taught using conventional methods (Anisa & Hidayat, 2020). The project-based approach allows students to interact directly with the environment, for instance, through activities such as tree planting, waste management, or ecosystem observation (Handayani & Yusuf, 2021). These activities encourage real behavioral changes that support the goals of the SDGs.

SDGs as a Framework for Science Curriculum Integration

The SDGs provide a strong conceptual framework for developing the science education curriculum. Goal 4 (quality education) emphasizes the importance of inclusive access to education, while Goal 13 (climate action) and Goal 15 (life on land) are directly relevant to environment-based science learning (Fahmi & Rahayu, 2022). Integrating the SDGs into the curriculum enables students to understand that science is not only theoretical but also a tool for addressing socio-ecological problems.

Constructivism Theory as the Basis for Sustainable Science Education

Constructivism explains that students build knowledge through direct experience and social interaction (Syahrial, 2019). In the context of sustainable education, constructivism means students are encouraged to develop understanding of environmental issues through activities such as renewable energy projects or small-scale research on water quality. Teachers act as facilitators who provide scaffolding to help students comprehend sustainability concepts. Through this approach, science education not only transfers knowledge but also cultivates critical, reflective, and collaborative thinking skills (Sulastri & Dewi, 2021).

Implementation Challenges

Although science education holds great potential in supporting the SDGs, its implementation faces several challenges. First, limited laboratory facilities and learning media in many schools hinder contextual learning (Rizal & Prasetyo, 2021). Second, some teachers lack adequate competence in integrating the SDGs into science learning. Third, educational policies have not fully emphasized SDG integration within the curriculum, resulting in partial implementation at the field level (Prasetyo & Dewi, 2021).

Position of the Scientific Contribution of the Study

The scientific contribution of this study lies in the synthesis of literature that highlights the importance of science education as an instrument for internalizing sustainability values within formal education. Unlike previous studies that discussed environmental education separately, this study emphasizes the direct interconnection between science education, environmental education, and the SDGs. Thus, this research expands academic perspectives and provides practical recommendations for developing a science curriculum that supports the sustainable development agenda.

CONCLUSION

This study concludes that science education plays a central role in strengthening the achievement of the Sustainable Development Goals (SDGs). The integration of environmental education into science learning can enhance students' sustainability literacy, ecological awareness,

and critical thinking skills. Science education has been proven to be relevant in supporting the SDGs, particularly Goal 4 (quality education), Goal 13 (climate action), and Goal 15 (life on land).

However, the implementation of SDG-based science education still faces challenges such as limited facilities, teacher competence, and policy support. Therefore, systematic efforts are needed to improve teacher capacity, strengthen the curriculum, and provide adequate learning resources. The scientific contribution of this study is to emphasize that science education is not merely an academic instrument but also a transformative means to build a generation that is environmentally conscious, scientifically literate, and oriented toward global sustainability.

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