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UNDERSTANDING EDUCATION SUSTAINABLE DEVELOPMENT (ESD) IN HIGH SCHOOL STUDENTS.

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ABSTRACT
Education for Sustainable Development (ESD) is an educational approach that emphasizes environmental awareness, social responsibility, and sustainable economic practices. At the high school level, ESD plays a crucial role in shaping students who are critical, empathetic, and capable of contributing to a sustainable future. This study aims to explore the extent of high school students' understanding of ESD through a **systematic** literature review (SLR) of 15 national and international journal articles published between 2019 and 2024. The findings reveal four dominant themes: (1) curriculum integration is still partial but developing, particularly through science and social subjects; (2) contextual learning strategies such as project-based learning (PjBL), problem-based learning (PBL), and STEM-ESD approaches significantly enhance critical thinking and sustainability awareness; (3) digital learning media such as e-modules and educational videos effectively support visual and practical learning; and (4) challenges persist in terms of teacher capacity, infrastructure, and the absence of standardized national evaluation tools. The review concludes that effective ESD implementation requires comprehensive support from schools, innovative pedagogy, and systemic policy alignment. These insights are valuable for educators, curriculum developers, and policymakers aiming to strengthen ESD in secondary education.
Keywords: Education for Sustainable Development, High School Students, Curriculum Integration, Digital Media, Learning Strategies.

INTRODUCTION
Education plays a pivotal role in shaping the future generation, not only by fostering intellectual capabilities but also by developing individuals who are socially responsible and environmentally conscious. In the midst of global challenges such as climate change, biodiversity loss, inequality, poverty, and unsustainable economic development, education must serve as a catalyst for change toward a sustainable future. One of the most recognized approaches in achieving this objective is Education for Sustainable Development (ESD).

The concept of ESD, as endorsed by UNESCO, is a holistic and transformative educational paradigm aimed at equipping learners with the knowledge, values, skills, and attitudes needed to contribute actively to sustainable development. It seeks to empower individuals to make informed decisions and responsible actions that consider environmental integrity, economic viability, and social equity for present and future generations. ESD is not limited to environmental education but includes interlinkages with economic and social development, human rights, gender equality, cultural diversity, and peace education.

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In recent decades, various international frameworks and global declarations have emphasized the urgency of integrating ESD into all levels of education. The United Nations Decade of Education for Sustainable Development (2005–2014) was a milestone in encouraging nations to reform their education systems. This was further strengthened by the adoption of the 2030 Agenda for Sustainable Development, particularly Sustainable Development Goal (SDG) 4, Target 4.7, which explicitly calls for education to promote sustainable development, global citizenship, and appreciation of cultural diversity.

In Indonesia, the urgency for implementing ESD has been reflected in several national educational policies, such as the 2013 Curriculum (Kurikulum 2013) and the more recent Merdeka Curriculum, which emphasize character education, local wisdom, and the integration of sustainability themes into subject matter. The Indonesian Ministry of Education, Culture, Research, and Technology has also initiated programs to strengthen environmental literacy and climate change education in schools.

At the high school level (SMA), students are at a crucial stage of cognitive, emotional, and social development. This period is characterized by the maturation of abstract reasoning, critical thinking, and ethical reflection. Therefore, integrating ESD into high school education becomes strategically important for shaping students who are not only academically competent but also capable of engaging with real-world sustainability challenges. High school students begin to form long-term values, social responsibility, and awareness of their roles as agents of change. Topics such as renewable energy, climate justice, sustainable agriculture, and green economy are particularly relevant and resonate with their evolving worldview.

However, the implementation of ESD in Indonesian high schools still faces significant challenges. Several empirical studies indicate a lack of teacher preparedness, insufficient instructional materials, limited infrastructure, and the absence of a standardized national framework for ESD integration and evaluation. Teachers often perceive ESD as an “additional burden” or “extracurricular theme” rather than a core educational component. Moreover, there is no uniform strategy for integrating sustainability principles across different subjects such as Biology, Geography, Civic Education, and Economics. These fragmented practices hinder the formation of a coherent and impactful ESD experience for students.

Moreover, students' understanding of ESD itself remains under-researched in Indonesia. While some studies highlight promising outcomes from specific interventions (e.g., project-based learning or digital media use), there is a lack of comprehensive synthesis that maps the various approaches, challenges, and outcomes of ESD implementation at the high school level. Without this synthesis, it becomes difficult to identify what works, under what conditions, and how effective strategies can be scaled or replicated in other contexts.

Given this background, the present study aims to conduct a **systematic literature review (SLR)** to explore how high school students' understanding of Education for Sustainable Development (ESD) has been conceptualized, implemented, and assessed in various empirical and theoretical studies. By synthesizing findings from 15 peer-reviewed national and international journals published between 2019 and 2024, this paper identifies dominant themes such as curriculum integration, instructional strategies, learning media, and barriers to implementation.

This review seeks to answer the following key questions:

1. To what extent has ESD been integrated into high school curricula in Indonesia and globally?
2. What instructional strategies are most effective in enhancing students' understanding of sustainability concepts?
3. How does the use of digital media and contextual learning influence ESD outcomes among students?
4. What are the main challenges in implementing ESD at the high school level, and how can they be addressed?

By addressing these questions, the study aims to contribute to the development of evidence-based strategies for strengthening ESD at the secondary education level. The insights gained from this review are expected to inform educators, policymakers, and curriculum developers in designing learning environments that foster sustainability competencies among Indonesian youth.

METHOD

This research uses a Systematic Literature Review (SLR) approach, designed to systematically and transparently identify, evaluate, and synthesize relevant research findings. SLR was chosen because it provides a comprehensive understanding of trends, challenges, and approaches used in studies on Education for Sustainable Development (ESD) among high school students. This method allows researchers to filter and analyze high-quality academic literature, resulting in scientifically sound findings that can be used as references in formulating educational policies and practices.

Data sources were obtained through a literature search in various academic databases such as Google Scholar, ResearchGate, and accredited national journal portals. Keywords used in the search included: "Education for Sustainable Development," "High School," "Sustainability Literacy," "STEM-ESD," and "Digital Learning." The search process included articles published between 2019 and 2024 to ensure that the data and context analyzed remained relevant to current developments in education policy and global dynamics.

RESULTS AND DISCUSSION

Based on the analysis of 15 selected articles, four topics were found in the study on the understanding of Education for Sustainable Development (ESD) in high school students, namely: **curriculum integration, learning strategies, the use of learning media, and implementation challenges.** The following is an explanation of the topic part found:

1. Curriculum Integration

The integration of ESD into the high school curriculum is generally carried out through science subjects such as Biology and Geography, as well as social studies. Ardelia & Santoso (2022) reported that 67% of Biology teachers in public schools have tried to integrate sustainability principles in ecosystem and recycling materials, although 45% of them admit that they do not yet fully understand the concept of ESD.

Rahman & Lestari (2019) stated that in the 2013 curriculum, there was a gap for the integration of sustainability values, but there were no specific achievement indicators related to ESD. In contrast, the Independent Curriculum opens up a larger space through the Pancasila student profile strengthening project, where students can choose topics

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such as "School Waste Management" and "Water Conservation" as part of cross-disciplinary learning. In their study, 38% of schools that implemented the Independent Curriculum adopted an environmentally-themed project in the past school year.

2. Learning Strategies

Studies show that project-based learning and problem-solving models are effective in improving understanding of ESD. Kurniawan & Hidayat (2023) reported that the use of the *Project-Based Learning* (PjBL) model on renewable energy at SMA Negeri 4 Surabaya resulted in an increase in students' systemic thinking skills by 34% based on pre-test and post-test.

The *Problem-Based Learning* (PBL) model applied by Suharyani & Siswanto (2021) on the theme of local river pollution shows that 79% of students are more active in expressing opinions and showing increased motivation to learn. Students are also able to relate local issues to global goals such as SDG 6 (Access to clean water) and SDG 13 (Climate change).

3. Use of Learning Media

The use of digital media plays an important role in building an understanding of the concept of ESD. Ghina et al. (2021) showed that the use of ESD-based e-modules in online learning during the COVID-19 pandemic was able to increase students' comprehension scores from 62.3 to 84.1 (scale of 100).

Sunarya & Anggraini (2024) developed a 10–12 minute interactive video on deforestation and climate change that was shown in the Geography session. As a result, 82% of students experienced an increase in cognitive scores, while 73% said they felt more inspired to take real action, such as energy-saving campaigns or tree planting programs.

Research by Wibowo & Hartati (2022) found that students who were exposed to interactive visual media for more than 6 weeks showed an increase in sustainability literacy by 41% (measured through the Sustainability Literacy Questionnaire).

4. Implementation Challenges

Some of the main obstacles in the implementation of ESD in high schools are limited teacher understanding, uneven training, and the absence of national evaluation standards. Karmana (2022) found that only 22% of high school teachers in West Java have participated in ESD-related training in the past two years.

Permata & Nugroho (2020) stated that 65% of schools do not have special learning modules with the theme of sustainability. Learning evaluation is still dominant in the knowledge (cognitive) aspect, while affective and psychomotor aspects – such as student involvement in real action – have not been systematically assessed.

Some top schools develop local measurement tools, such as project rubrics or student portfolios, but the results cannot be compared nationally. This is an obstacle in encouraging data-based education policies and overall student sustainability achievements.

CONCLUSION

The results of a literature review of 15 articles show that high school students' understanding of Education for Sustainable Development (ESD) is highly dependent on how ESD is integrated into the curriculum, the learning strategies used, the media used,

and institutional support. The integration of ESD through subjects such as Biology, Geography, and Social Studies has begun to be carried out, but it is still partial and uneven. The Independent Curriculum opens up greater opportunities through a project approach and strengthening the profile of Pancasila students, although its implementation still faces challenges.

Project-based learning (PjBL), problem-based learning (PBL), and STEM approaches have been shown to be effective in improving students' critical thinking skills, environmental awareness, and participation. Interactive digital media such as e-modules and educational videos play an important role in strengthening conceptual understanding and facilitating contextual and visual learning.

However, the main challenges in the implementation of ESD are still quite large, especially regarding the limited understanding of teachers, lack of professional training, lack of supporting infrastructure, and the absence of measurable national evaluation standards. Therefore, the successful implementation of ESD requires support from the entire school community, including teacher capacity building, strengthening regulations, and providing comprehensive media and evaluation instruments.

By strengthening the pedagogical dimension, curriculum, and institutional support, ESD at the high school level can be an important foundation in producing a young generation that is critical, globally minded, and responsible for a sustainable future.

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