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## **Empowering Sustainable Education Through Differentiated Learning: A Systematic Review in Primary School**

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**Abstract:** Differentiated learning has significant potential to address diverse learner needs and promote sustainable education, particularly in primary schools. Implementation in Indonesia, however, faces challenges such as limited teacher training, rigid curricula, and logistical constraints. The study aimed to explore the role of differentiated learning in fostering sustainable education within the Indonesian context. A systematic literature review was conducted, analyzing 97 peer-reviewed articles published between 2018 and 2024. Data were sourced from Scopus, Publish or Perish, Google Scholar, SAGE Journals, Emerald Insight, and ERIC, with findings synthesized through thematic analysis. Results showed that differentiated strategies, supported by educational technology, community-based projects, and alternative assessments, enhanced critical thinking, problem-solving, and ecological literacy. Challenges included insufficient resources and professional development, while opportunities emerged through curriculum reforms and technology integration. The study concluded that differentiated learning when effectively supported, has the potential to align primary education with sustainability principles.

**Keywords:** differentiated learning, Sustainable education, Primary schools, Educational strategies

## **INTRODUCTION**

Education plays a pivotal role in shaping future generations and addressing global challenges (Membrillo-Hernández et al., 2023). In recent years, sustainable education has gained significant attention as a mechanism to equip students with the knowledge, skills, and values (Anenene & Oyewole, 2020), needed to address complex global issues such as climate change, resource depletion, and social inequality (Bucea-Manea-țoniș et al., 2021). The United Nations' Sustainable Development Goals (SDGs), particularly Goal 4: Quality Education, emphasize the importance of providing inclusive, equitable, and quality education while promoting lifelong learning opportunities for all (Arkorful et al., 2020). Sustainable education focuses on cognitive development and fostering critical thinking, adaptability, and ecological literacy among students to prepare them for the challenges of the 21st century (K. Wang et al., 2024).

Despite global efforts to enhance education, educators still face challenges in

addressing the diverse needs of learners in increasingly heterogeneous classrooms (Utaminingsih, 2023). Students' cognitive abilities, interests, learning styles, and socio-cultural backgrounds differ. Traditional "one-size-fits-all" approaches often fail to cater to these differences, limiting student engagement and achievement (Nakamichi et al., 2022). Differentiated learning has emerged as a promising pedagogical strategy to address this issue, allowing educators to personalize instruction and ensure equitable learning opportunities for all students while aligning with the principles of sustainable education (Hasanah & Sukartono, 2024).

As a developing country with a population exceeding 270 million, Indonesia faces unique educational system challenges. The nation has made significant progress in increasing access to education, evidenced by improved enrolment rates in primary schools (Dianimdri & Yuliani, 2018). However, the quality of education remains a pressing concern. Reports from the OECD's Programme for International Student Assessment (PISA) have consistently shown that Indonesian

students underperform in literacy, numeracy, and problem-solving skills compared to their international peers (K. Wang et al., 2024).

Indonesia is also highly vulnerable to environmental challenges, including deforestation, natural disasters, and climate change (Kumar et al., 2023). These issues highlight the urgent need for integrating sustainability concepts into the education system to foster environmental stewardship among students (Solís-Espallargas & Morón-Monge, 2020). Despite this need, many schools in Indonesia continue to rely on rigid, traditional teaching methods that prioritize rote memorization over critical thinking and problem-solving (Utaminingsih, Anwar, et al., 2024). Such approaches hinder the development of skills necessary for sustainable living and global citizenship.

Differentiated learning has the potential to address these challenges by tailoring instructional methods to the diverse needs of Indonesian students while embedding sustainability principles into the curriculum (Sukmawati, 2022). However, little evidence exists regarding its implementation and effectiveness in Indonesia, particularly in the context of sustainable education (Meizar et al., 2023). This research gap calls for a deeper understanding of how differentiated learning can address the nation's educational challenges and contribute to global sustainability efforts.

Many studies have explored the role of differentiated learning in enhancing student engagement and academic achievement (Nurlaili, Suranda, 2024). However, few have examined its potential to promote sustainable education (Maulidina & Prastio, 2024). Research on sustainable education often focuses on macro-level policies or subject-specific approaches, such as environmental education or STEM integration (Utaminingsih & Ellianawati, 2025). Conversely, studies on differentiated learning generally emphasize academic performance without linking it to broader educational goals, such as sustainability (Arhinza et al., 2023).

In Indonesia, the connection between differentiated learning and sustainable education remains underexplored, particularly at the primary school level (Adit et al., 2024). Existing research tends to focus on general pedagogical challenges or specific interventions without addressing how differentiated learning strategies can bridge the gap between individual learner

needs and the systemic demand for sustainability (Hasanah & Sukartono, 2024). This lack of comprehensive understanding limits the ability of educators to design and implement strategies that align with both the diversity of students and the principles of sustainable education (Arkorful et al., 2020).

The urgency of this research lies in its potential to provide evidence-based insights that address pressing educational and sustainability challenges in Indonesia. By conducting a systematic review, this study seeks to synthesize global and local evidence, identify best practices, and highlight contextual factors that influence the successful integration of differentiated learning with sustainable education (Huang et al., 2024). The findings aim to fill critical gaps in the literature while offering practical recommendations for policymakers, educators, and curriculum developers.

This study aims to conduct a systematic review to examine the role of differentiated learning in promoting sustainable education at the primary school level, with a specific focus on the Indonesian context. The objectives are: (1) to identify challenges and opportunities in adopting differentiated learning strategies in primary schools, particularly in Indonesia, and (2) to assess the extent to which differentiated learning aligns with the principles of sustainable education and contributes to the development of critical thinking, problem-solving, and ecological literacy among students. By addressing these objectives, this study aims to contribute to the advancement of both educational quality and sustainability, supporting Indonesia's efforts to achieve its SDG targets and prepare future generations for a rapidly changing world.

## METHODS

### Research Design

This study employs a systematic literature review (SLR) to explore the role of differentiated learning in promoting sustainable education in primary schools. The SLR methodology was chosen for its structured, transparent, and replicable approach, which ensures a comprehensive synthesis of existing research while identifying gaps and trends.

### Data Sources and Search Strategy

Data were collected from six reputable databases: Scopus, Publish or Perish, Google

Scholar, SAGE Journals, Emerald Insight, and ERIC. These platforms were selected for their extensive coverage of peer-reviewed and high-quality educational research. The search focused on articles published between 2018 and 2024 to ensure contemporary relevance. Keywords and Boolean operators were used to refine the search. Key terms included "Differentiated learning," "Differentiated instruction," "Sustainable education," "Education for sustainability," and "Primary schools." For example, a typical search string was:

("Differentiated learning" OR "Differentiated instruction") AND ("Sustainable education" OR "Education for sustainability") AND ("Primary schools" OR "Elementary education").

### Screening and Selection Process

The process began with the identification of 572 articles from the selected databases. Titles

and abstracts were reviewed to exclude irrelevant articles, resulting in the exclusion of 310 articles. A full-text review was conducted for the remaining 262 articles. During this phase, articles were excluded if they lacked focus on primary education, exhibited methodological weaknesses, or did not directly address differentiated learning or sustainable education. This rigorous process resulted in selecting 97 articles that met all inclusion criteria.

### Visual Representation of the Screening Process

The flowchart illustrates the systematic steps undertaken during the article selection process, starting from the initial identification of articles to the final inclusion of 97 studies. The steps of the screening and selection process are summarized in the flowchart presented in Figure 1.

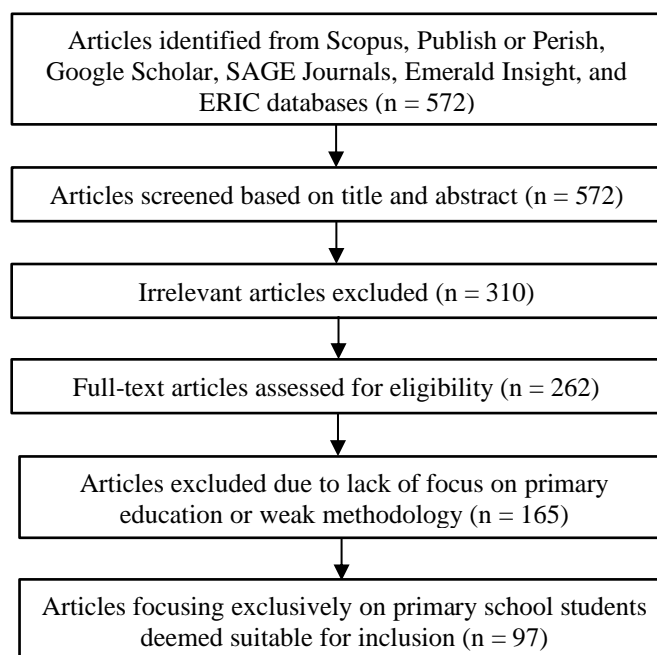


Figure 1. The Matplotlib Chart Illustrating the Systematic Process

### Data Extraction and Quality Assessment

The selected articles underwent a detailed data extraction process to document key information, including the author(s), year of publication, research objectives, methodologies, key findings, and contextual factors such as geographical focus and subject population. Quality assessment criteria included (a) clarity of research objectives, (b) methodological rigor, (c) relevance to the research focus, and (d) validity

and robustness of findings. Articles that failed to meet these standards were excluded during the full-text review.

### Data Synthesis

The synthesis of the selected articles followed a thematic approach. Studies were grouped based on recurring themes such as implementing differentiated learning strategies, integrating sustainability principles in primary

education, and the combined impact of differentiated learning and sustainable education on student outcomes. Patterns, trends, and gaps were identified to understand the topic comprehensively. This thematic analysis facilitated the identification of best practices and challenges in applying differentiated learning to promote sustainable education.

### **Ethical Considerations**

This research relied solely on secondary data analysis. Proper citation of all reviewed articles ensured respect for intellectual property rights. Additionally, transparency in reporting methods and findings was maintained to uphold academic integrity and credibility.

## **RESULT AND DISCUSSION**

This systematic review analyzed 97 articles to examine the role of differentiated learning in promoting sustainable education at the primary school level, with a particular focus on Indonesia. The findings are organized into three themes: challenges in implementing differentiated learning, opportunities for integrating differentiation and sustainability, and the role of assessment in supporting these efforts. These findings are discussed in detail to provide insights into the complexities and transformative potential of differentiated learning.

### **Challenges in Implementing Differentiated Learning in Indonesian Primary Schools**

Implementing differentiated learning in Indonesian primary schools faces significant challenges due to systemic, logistical, and cultural factors (Ana, 2022). The lack of teacher preparedness and professional development emerged as a significant barrier. Studies consistently reported that most teachers lacked the foundational knowledge and skills to design differentiated lessons effectively (Lukitaningtyas, 2022). Maryono & Budiono (2021) emphasized that pre-service teacher education in Indonesia rarely includes training on differentiation strategies, leaving educators unprepared to address the diverse needs of their students. Additionally, in-service professional development programs often focus on general pedagogy, neglecting the specific demands of differentiated instruction (Riyanto et al., 2023).

Another challenge was the rigidity of the national curriculum, which is highly centralized and standardized. Teachers must often adhere

strictly to a uniform curriculum and meet predefined benchmarks, leaving little room for innovation or adaptation (Wilson et al., 2020). Aidoo (2023) found that this rigidity conflicts with the core principles of differentiated learning, which emphasize flexibility and responsiveness to individual learner needs. This challenge is exacerbated by the high-stakes nature of national examinations, which incentivize teachers to prioritize test preparation over innovative teaching methods (Nipyraakis et al., 2023).

Large class sizes also posed logistical difficulties. In many Indonesian primary schools, classrooms often have 35 to 40 students, making it nearly impossible for teachers to provide personalized instruction. This issue is particularly prevalent in rural areas, where resources are scarce and teacher-to-student ratios are even higher (Admasie et al., 2022). Liu et al. (2022) highlighted that teachers in such contexts often resort to traditional, teacher-centered methods, further limiting the effectiveness of differentiated instruction.

Furthermore, cultural expectations and parental perceptions were identified as barriers. In some communities, parents prioritize rote learning and exam performance over innovative approaches like differentiated learning (Ana, 2022). This cultural resistance to change limits the willingness of teachers to adopt new methods, even when provided with training or resources.

### **Opportunities for Integrating Differentiated Learning and Sustainability Education**

Despite these challenges, the review identified numerous opportunities to integrate differentiated learning with sustainability education in Indonesian primary schools (Pebriyanti, 2023). One of the most significant opportunities lies in the increasing adoption of educational technology. Tools such as adaptive learning software, online platforms, and gamified educational apps have enabled teachers to personalize instruction more efficiently (Ihza Pramudya & Narendrany Hidayati, 2023). For example, Gusteti & Neviyarni (2022) demonstrated that gamified apps allowed students to engage with sustainability topics, such as energy conservation and waste management, at their own pace. These technologies also support real-time assessment, enabling teachers to monitor progress and adjust instruction dynamically.

The Merdeka Belajar (Freedom to Learn) initiative introduced by the Ministry of Education has also provided a platform for integrating differentiation and sustainability education. This policy grants teacher's greater autonomy in designing their lessons, allowing for incorporating local contexts and sustainability principles. Studies by Lukitaningtyas (2022) revealed that teachers who embraced this flexibility could design tiered assignments and project-based learning activities that catered to diverse student needs while addressing real-world sustainability challenges.

Community-based learning emerged as another promising avenue. By involving students in projects that address local environmental or social issues, teachers can create meaningful learning experiences that align with the principles of both differentiation and sustainability (Solís-Espallargas & Morón-Monge, 2020). For instance, a study by Wang et al. (2024) described a community recycling project where students were grouped based on their interests and abilities, allowing them to contribute meaningfully while learning about waste management. These projects enhanced student engagement and strengthened connections between schools and their communities.

Government and NGO partnerships were identified as additional opportunities (Nakidien et al., 2021). Several NGOs in Indonesia have developed sustainability-focused educational programs that provide schools with resources and training (Wagner & Samuelsson, 2019). When coupled with differentiated strategies, these programs can help address both environmental challenges and the diverse needs of students (Alm et al., 2021).

### **The Role of Assessment in Supporting Differentiated Learning for Sustainability**

Assessment plays a critical role in ensuring the success of differentiated learning and its alignment with sustainability education (Haqqoni et al., 2024). The review revealed that traditional assessment methods, such as standardized tests, often undermine the goals of differentiated learning and sustainability education (Utaminingsih, Intania, et al., 2024). These methods emphasize rote memorization and uniformity, which are incompatible with differentiated instruction's individualized and critical thinking-oriented nature (Balkist et al., 2023)

Alternative assessment strategies were identified as more effective in supporting differentiated learning. Formative assessments, for example, allow teachers to track individual student progress and adapt their teaching methods accordingly (Sukmawati, 2022). This type of assessment encourages continuous feedback and helps students reflect on their learning processes. Portfolio-based evaluations were particularly effective in the context of sustainability education. Avandra & Desyandri (2022) reported that portfolios let students document their learning experiences, including projects and reflections on sustainability topics. These assessments evaluated academic outcomes and encouraged students to engage deeply with sustainability principles (Utaminingsih, Ellianawati, et al., 2024).

Self-assessment and peer-assessment were also highlighted as valuable tools. These methods encourage students to take ownership of their learning and develop critical thinking and collaboration skills (Pramudya & Hidayati, 2023). In a study by Martanti et al. (2022), primary school students who engaged in self-assessment of their sustainability projects demonstrated improved understanding and application of ecological principles.

The findings also emphasized the importance of aligning assessment with local contexts. Culturally relevant assessment tools that reflect students' communities' environmental and social realities are essential for meaningful learning (Naibaho, 2023). For example, teachers in rural areas developed rubrics that evaluated students' contributions to local farming or conservation projects, providing a practical and contextually relevant framework for assessment (Adit et al., 2024).

### **Integrating Findings and Implications**

The findings of this review underscore both the challenges and transformative potential of differentiated learning in promoting sustainable education. The challenges, such as insufficient teacher training, rigid curricula, and large class sizes, highlight systemic barriers that must be addressed through targeted policies and professional development programs (Lu et al., 2022). Teachers must have the skills and resources to effectively design differentiated instruction that integrates sustainability concepts (Utaminingsih & Purwati, 2024).

The opportunities identified, mainly through educational technology, community-based learning, and the Merdeka Belajar initiative, provide pathways for overcoming these barriers (Irawati et al., 2022). Technology can facilitate personalized learning even in resource-constrained settings, while community projects offer meaningful, context-specific learning experiences that align with sustainability goals (Hakiky et al., 2023). Assessment strategies must also evolve to support differentiated learning and sustainability education goals (Kioupi & Voulvoulis, 2022). Moving away from standardized tests and toward formative, portfolio-based, and culturally relevant assessments can ensure that students are evaluated on their ability to think critically and apply their knowledge to real-world challenges (Chen et al., 2022).

Policymakers should prioritize reforms that enhance teacher training and provide flexibility in curriculum design. Investments in digital infrastructure and developing culturally relevant educational materials are essential for scaling differentiated learning across diverse contexts (Jiang et al., 2024). Finally, fostering partnerships between schools, communities, and NGOs can enhance the relevance and impact of sustainability education (Wagner & Pramling Samuelsson, 2019). By addressing these challenges and leveraging existing opportunities, differentiated learning can play a pivotal role in equipping Indonesian primary school students with the skills, values, and knowledge needed to navigate the complexities of the 21st century and contribute to a sustainable future (Nakidien et al., 2021).

## CONCLUSION

The systematic review demonstrated that differentiated learning could transform sustainable education in Indonesian primary schools. Despite challenges such as inadequate teacher training, rigid curricula, and logistical barriers, differentiated strategies, when integrated with innovative approaches like educational technology and community-based projects, enhanced critical thinking, problem-solving, and ecological literacy among students. Alternative assessment methods, including portfolio-based and formative evaluations, aligned better with sustainability principles and provided a more holistic measure of student

outcomes. Investments in teacher professional development, curriculum flexibility, digital resources, and culturally relevant materials were deemed essential to maximize its impact. Addressing these challenges and leveraging available opportunities enabled differentiated learning to equip students with the skills and values needed to navigate global challenges and contribute to a sustainable future.

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