

SDGs-Based Green Curriculum Design in Secondary Schools: Analysis of Assessment and Needs

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Article Info	Abstrak
<p>Article history: Received 08-02-2026 Revised 21-02-2026 Accepted 28-03-2026 Published 30-04-2026</p> <p>How to cite: Amsal, M. F., & Sagita, D. D. (2026). SDGs-Based Green Curriculum Design in Secondary Schools: Analysis of Assessment and Needs. <i>Edcomtech: Jurnal Kajian Teknologi Pendidikan</i>, 11(1), 199–208. https://doi.org/10.17977/um039v11i12026p199-208</p> <p>© The Author(s)  This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License</p>	<p><i>Integrasi keberlanjutan dalam pendidikan menjadi kebutuhan mendesak dalam menghadapi krisis lingkungan global. Penelitian ini bertujuan untuk menganalisis penilaian guru, mengidentifikasi kebutuhan integrasi, serta merancang model Green Curriculum berbasis Sustainable Development Goals (SDGs) pada Sekolah Menengah Atas (SMA) di Sumatera Barat. Penelitian menggunakan pendekatan mixed methods dengan desain sequential explanatory. Subjek penelitian meliputi 10 SMA negeri dan swasta dengan total 102 guru dan 312 siswa. Data dikumpulkan melalui angket, wawancara, FGD, observasi, dan analisis dokumen. Hasil penelitian menunjukkan bahwa dukungan guru terhadap Green Curriculum berada pada kategori tinggi (82,1%), sedangkan capaian siswa berada pada kategori sedang (58,4%), dengan kelemahan utama pada pemahaman konseptual SDGs (rata-rata 49,8%). Temuan menunjukkan adanya kesenjangan antara dukungan struktural dan internalisasi pembelajaran. Kebutuhan utama meliputi penguatan asesmen autentik, integrasi SDGs dalam mata pelajaran, peningkatan kompetensi guru, dan dukungan kebijakan sekolah. Penelitian ini menghasilkan model konseptual Green Curriculum berbasis SDGs yang bersifat integratif, kontekstual, dan transformatif. Model ini berkontribusi terhadap pencapaian SDG 4 dan SDG 13 dalam konteks pendidikan menengah di Indonesia.</i></p> <p>Kata Kunci: Green Curriculum; SDGs; Pendidikan Berkelanjutan; Sekolah Menengah.</p> <p>Abstract The integration of sustainability into education has become an urgent need in response to the global environmental crisis. This study aims to analyze teachers' assessments, identify integration needs, and design a Sustainable Development Goals (SDGs)-based Green Curriculum model for senior high schools in West Sumatra. This study employed a mixed-methods approach with a sequential explanatory design. The research subjects comprised 10 public and private senior high schools, involving 102 teachers and 312 students. Data were collected through questionnaires, interviews, focus group discussions, observations, and document analysis. The findings revealed that teachers' support for the Green Curriculum was categorized as high (82.1%), whereas students'</p>

	<p>achievement was categorized as moderate (58.4%), with the main weakness found in their conceptual understanding of the SDGs, with an average score of 49.8%. The findings indicate a gap between structural support and the internalization of sustainability-oriented learning. The primary needs identified include strengthening authentic assessment, integrating the SDGs into school subjects, improving teachers' competencies, and enhancing school policy support. This study produced a conceptual model of an SDGs-based Green Curriculum that is integrative, contextual, and transformative. The proposed model contributes to the achievement of SDG 4 and SDG 13 within the context of secondary education in Indonesia.</p>
	<p>Keywords: <i>Green Curriculum; SDGs; Sustainable Education; Secondary Schools.</i></p>

INTRODUCTION

Climate change, environmental degradation, and the sustainability crisis constitute increasingly complex global challenges with multidimensional impacts on human life. The United Nations has emphasized that the current climate crisis has become a serious threat to ecosystem stability, food security, public health, and global economic sustainability (World Health Organization, 2022; Chala, 2023). In this context, education plays a strategic role as a transformative instrument in shaping a generation that not only understands sustainability issues but is also able to act critically and responsibly.

In line with the global agenda of the Sustainable Development Goals (SDGs), sustainable education has become a major priority, particularly within the framework of SDG 4 on quality education. UNESCO emphasizes that Education for Sustainable Development (ESD) is not limited to the transfer of knowledge but also focuses on developing critical thinking skills, problem-solving abilities, and values and attitudes that support sustainability (Molina et al., 2023). This approach requires curriculum transformation that can holistically integrate environmental, social, and economic dimensions.

However, recent studies indicate that the implementation of ESD and the integration of the SDGs into curricula continue to face various challenges. Global studies show that sustainability integration in curricula remains uneven and tends to be more widely implemented in higher education than in secondary education (Iyengar & Kwauk, 2020). In addition, although sustainability issues have begun to be incorporated into learning content, their impact on students' behavioral change and competencies remains relatively limited (Filho et al., 2021).

Furthermore, recent reviews reveal that many students across different countries still have an inadequate understanding of the basic concepts of sustainability and the SDGs. This condition indicates a gap between educational policy and classroom implementation. The situation is further complicated by teachers' limited competence in developing sustainability-based learning and the suboptimal integration of authentic assessment into the curriculum (Kärkkäinen et al., 2023).

On the other hand, the development of digital technologies, including the use of Artificial Intelligence (AI), offers new opportunities to support more adaptive and contextual sustainability learning. Such technologies enable learning personalization and deeper data analysis, thereby increasing learning effectiveness when integrated into an appropriate curriculum design (Holmes et al., 2019). However, without a structured and sustainability-

oriented curriculum framework, the use of technology will not significantly improve students' environmental literacy.

In the context of secondary education, particularly senior high schools, the integration of sustainability has become increasingly important. At this stage, students are in a phase of cognitive and moral development that enables the deeper internalization of sustainability values. Research shows that project-based learning and challenge-based learning approaches can enhance student engagement and their ability to solve real-world problems related to environmental issues (Ballard et al., 2024). Therefore, the curriculum at this level needs to be designed in a more contextual, transformative, and action-oriented manner.

In Indonesia, efforts to integrate sustainability into education have begun to be accommodated through the Merdeka Curriculum, particularly through the Strengthening Pancasila Student Profile Project. Nevertheless, previous studies indicate that the implementation of the Green Curriculum remains partial and programmatic and has not yet become the main framework in learning planning and implementation. In addition, there is a gap between teachers' relatively high level of understanding and students' still limited understanding, particularly regarding the conceptual aspects of the SDGs.

This gap suggests that, although structural support from teachers and school policies exists, the internalization of sustainability values and concepts among students has not been optimally achieved. This condition indicates the need for a more integrative and systemic curriculum approach that positions sustainability not merely as additional content but as a core framework for learning. Based on this rationale, the development of a Green Curriculum at the senior high school level is an urgent need to respond to global challenges while strengthening the relevance of education to future needs. The Green Curriculum should be designed as a holistic, interdisciplinary, and action-oriented approach that can bridge the gap between sustainability knowledge and practice.

Therefore, this study focuses on analyzing teachers' assessments, identifying the needs for sustainability integration, and designing a SDGs-based Green Curriculum model in 10 senior high schools in West Sumatra. This study is expected to provide theoretical contributions to the development of sustainable education curricula and practical contributions as a reference for implementing a Green Curriculum that is adaptive to the local Indonesian context.

METHOD

This study employed a mixed-methods approach with a sequential explanatory design. Quantitative data were collected and analyzed first to map teachers' assessments, students' achievement, and the gap between both groups. Qualitative data were then used to explain the statistical patterns and to identify contextual needs for designing a SDGs-based Green Curriculum model. This design was selected because the study did not merely measure perceptions, but also sought to interpret why sustainability learning had not been fully internalized by students.

The study was conducted in 10 public and private senior high schools in West Sumatra. The participants consisted of 102 teachers and 312 students. Teachers were selected to represent different subject areas and school contexts, while students were involved to provide evidence on sustainability learning outcomes. Qualitative informants included teachers, curriculum coordinators, and school leaders who were directly involved in curriculum planning, classroom implementation, or environmental programs.

Quantitative data were collected using two structured questionnaires. The first questionnaire measured teachers' assessment of Green Curriculum implementation through five indicators: understanding of sustainability concepts, integration of the SDGs into learning, innovative learning strategies, environment-based learning evaluation, and support for implementation. The second questionnaire measured students' achievement in sustainability-based learning through environmental literacy, environmentally friendly behavior, understanding of the SDGs, and participation in environmental activities. Instrument validity was examined through expert judgment and item analysis, while reliability was assessed using Cronbach's alpha. The instruments were considered adequate for field use after revisions based on expert feedback.

Qualitative data were collected through semi-structured interviews, focus group discussions, classroom observations, and document analysis. Interviews and FGDs explored teachers' experiences in integrating SDGs, barriers to implementation, assessment practices, and school policy support. Observations focused on the presence of sustainability-oriented learning activities, student participation, and the use of project-based or contextual strategies. Document analysis examined lesson plans, school programs, assessment documents, and curriculum-related policies.

Quantitative data were analyzed descriptively using mean percentages and categories. A comparative analysis was conducted to examine the gap between teachers' assessment and students' achievement. Pearson correlation analysis was also used to examine the association between teachers' assessment indicators and students' sustainability achievement. Qualitative data were analyzed through thematic coding following the stages of data condensation, data display, and conclusion drawing. Coding was conducted in three stages: open coding to identify meaningful statements, axial coding to group related codes into categories, and selective coding to formulate major themes related to curriculum integration needs.

Triangulation was applied by comparing questionnaire results, interview and FGD data, observation notes, and curriculum documents. The integration of quantitative and qualitative findings was carried out at the interpretation stage. Quantitative findings provided the empirical pattern, while qualitative findings explained the causes of the gap and supported the formulation of the proposed Green Curriculum model.

RESULTS

Teachers' Assessment of the Green Curriculum

The findings indicate that teachers' assessment of the implementation of the Green Curriculum across 10 senior high schools in Padang city was categorized as high, with an average score of 82.1%. The detailed result for each indicator is presented in table 1.

Table 1. Teachers' Assessment of the Green Curriculum

NO	Indicator	Mean (%)	category
1	Understanding of sustainability concepts	84.2	High
2	Integration of the SDGs into learning	78.5	High
3	Innovative learning strategies	80.1	High
4	Environment-based learning evaluation	76.4	High
5	Support for implementation	90.3	High
	Average	82.1	High

Based on Table 1, the highest score was found in the indicator of support for implementation, indicating that teachers demonstrated a strong commitment to applying the Green Curriculum. However, the learning evaluation indicator received a relatively lower score, suggesting that teachers still face challenges in developing sustainability-based assessment. This finding is consistent with previous research, which states that although teachers have a high level of awareness of sustainability education, its implementation in pedagogical and evaluative aspects still requires further strengthening (Kärkkäinen et al., 2023).

Students' Achievement in Sustainability-Based Learning

Students' achievement showed lower result than teacher assessment, with an average score of 58.4%, which falls into the moderate category. The detailed results of students' achievement are presented in Table 2.

Table 2. Students' Achievement

NO	Aspect	Mean (%)	Category
1	Environmental literacy	65.8	Moderate
2	Environmentally friendly behavior	71.2	High
3	Understanding of the SDGs	49.8	Low
4	Participation in environmental activities	56.7	Moderate
	Average	58.4	Moderate

Table 2 shows that environmentally friendly behavior obtained the highest score, whereas understanding of the SDGs was categorized as low. This indicates that students tend to understand environmental practices at a basic level but have not yet developed a strong conceptual understanding of global sustainability. This condition is consistent with research suggesting that environmental education often succeeds in shaping behavior but remains less optimal in developing systematic understanding (Ballard et al., 2024).

The Gap between Teachers' Support and Students' Achievement

To examine the difference between teachers' assessment and students' achievement, a comparative analysis was conducted, as presented in Table 3.

Table 3. Comparison between Teachers' Assessment and Students' Achievement

Aspect	Teachers (%)	Students (%)	Difference
Overall average	82.1	58.4	23.7

The results in table 3 reveal a gap of 23.7% between teachers' assessment and students' achievement. This gap indicates that strong structural support has not yet been followed by optimal learning outcomes among students. This phenomenon may be caused by learning approaches that remain largely conventional and by the limited use of experiential learning methods. Previous research shows that sustainability learning requires participatory and real-context-based approaches to enhance students' understanding in a more meaningful way (Tafese & Kopp, 2025).

Thematic Coding and Need for Green Curriculum Development

The qualitative data were coded into five major themes. The coding process showed that Green Curriculum implementation was still fragmented across schools. Sustainability

topics appeared in several learning activities and school programs, but they were not yet consistently connected to learning objectives, teaching materials, assessment rubrics, and school policy. The main needs identified from interviews, FGDs, observations, and document analysis are presented in Table 4.

Table 4. Needs for Green Curriculum Development

No	Need	Finding
1	SDGs integration	Not yet systematic
2	Project-based learning	Still limited
3	Authentic assessment	Not yet optimal
4	Teacher competence	Training is needed
5	School policy	Not yet structured

Table 4 indicates that the implementation of the Green Curriculum remains partial. This finding emphasizes the need for a systematic approach that integrates curriculum, learning processes, and school policies in a comprehensive manner (Iyengar & Kwauk, 2021).

Triangulation confirmed that the main problem was not the absence of teacher support, but the absence of a structured implementation framework. Teachers generally agreed with sustainability education, yet many still needed examples of lesson design, assessment instruments, and cross-subject integration strategies.

Proposed SDGs-Based Green Curriculum Model

Based on the quantitative and qualitative findings, this study proposes a SDGs-based Green Curriculum model consisting of six interconnected components; SDGs as the core framework, curriculum goals, learning content. Learning strategies, authentic assessment, and school support. The model emphasizes that sustainability should not be treated as an additional school program, but as a central framework that guides planning, learning, assessment, and school culture.

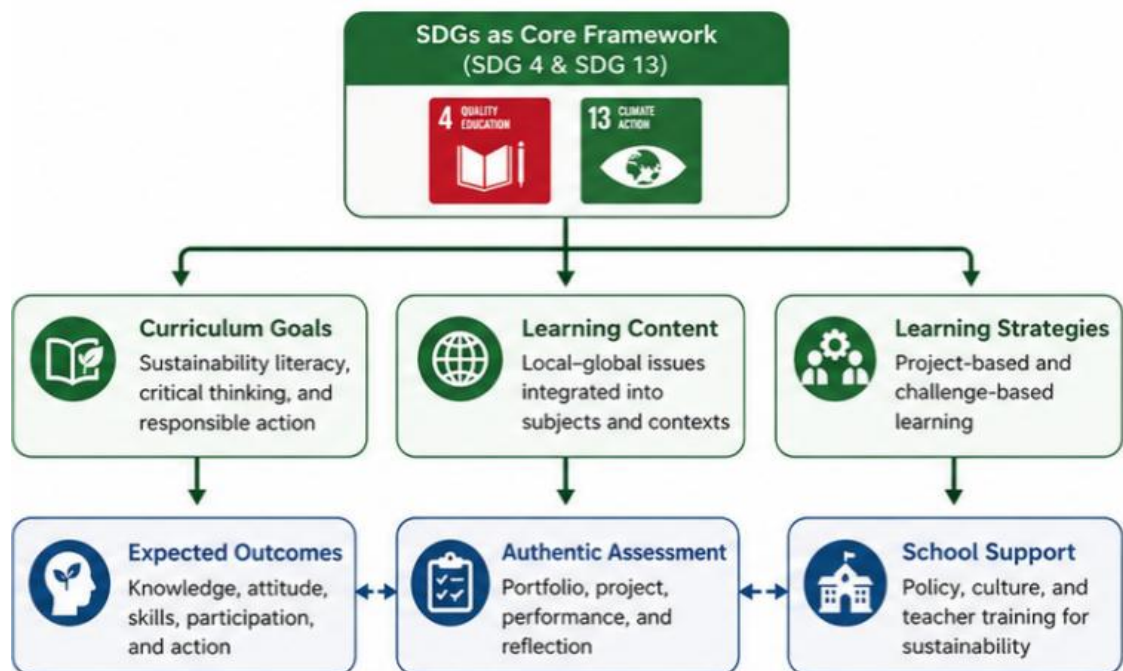


Figure 1. Conceptual framework of the SDGs-based Green Curriculum model

The model begins with SDG 4 and SDG 13 as the core orientation. These goals are translated into curriculum objectives that strengthen sustainability literacy, critical thinking, and responsible action. Learning content connects local environmental issues with global sustainability challenges. Learning strategies use project-based and challenge-based learning so that students can investigate real problems in their school or community. Authentic assessment measures not only knowledge, but also attitudes, skills, participation, and action. School support strengthens implementation through teacher training, policy alignment, learning resources, and a sustainability-oriented school culture.

DISCUSSION

The Gap between Policy, Teachers and Students' Achievement

The findings indicate a significant gap between teachers' high level of readiness and students' achievement, which remains in the moderate category. This phenomenon does not only occur in the local context but also represents a global issue in the implementation of Education for Sustainable Development (ESD). Recent studies have shown a consistent gap between sustainability education policies and actual classroom implementation, in which many curricula have normatively adopted the concept of sustainability but have not yet been able to generate transformative learning outcomes (Hastangka et al., 2025). This gap suggests that the successful implementation of the Green Curriculum is not determined solely by teachers' understanding, but also by the capacity of the education system to transform learning approaches. In many cases, sustainability education remains declarative and has not been deeply integrated into pedagogical practices. This condition is reinforced by the concept of the policy practice gap, which refers to the mismatch between policy and implementation in practice (Hastangka et al., 2025).

Limited Integration of the SDGs into the Senior High School Curriculum

The low level of students' understanding of the SDGs in this study indicates that the integration of sustainability concepts into the curriculum remains partial. This finding is consistent with global studies showing that sustainability education at the secondary school level is still not well structured, resulting in students' limited literacy reviews indicate that the implementation of the SDGs in the curriculum often appears only in the form of supplementary activities, such as environmental project or school programs, without systematic integration into core subject (Xuan & Lindqvist, 2025).

As a result, students are unable to comprehensively connect sustainability concepts with real life context. From an educational perspective, this condition indicates that the curriculum of ESD. In fact, the development of sustainability competencies requires the simultaneous integration of cognitive, affective, and behavioral dimensions (Sposab & Rieckmann, 2024).

The Strategic Role of Learning in Enhancing Sustainability Competencies

The findings of the study show that learning approaches have a significant influence on students' achievement. Schools that have begun to implement project-based learning approaches demonstrated better student achievement than schools that still rely on conventional methods. This finding is in line with research stating that project based and contextual learning is effective approaches in sustainability education because they can enhance student engagement and connect learning with real-world problems (Ballard et al., 2024). Furthermore, these approaches allow students to develop critical, systemic, and reflective thinking skills, which are central to sustainability competencies (Rieckmann, 2022).

Challenge-based learning has also been proven effective in improving students' ability to solve complex sustainability problems because it encourages active engagement and experiential learning (Schutte et al., 2025).

The Importance of Authentic Assessment in the Green Curriculum

One of the key findings of this study is the limited practice of sustainability-based assessment. This indicates that the learning evaluation system has not yet been able to comprehensively measure students' competencies. In the context of ESD, assessment does not only function to measure learning outcomes but also serves as a tool to encourage reflection, participation, and behavioral change among students (Filho et al., 2021). Research shows that authentic assessment, such as project, portfolios, and performance-based assessment, is more effective in measuring sustainability competencies than conventional tests (Kärkkäinen et al., 2023). This limitation in assessment is also one of the factors contributing to students' low understanding of the SDGs. Without an improving student competencies.

CONCLUSION

This study demonstrates that the implementation of a Green Curriculum based on the Sustainable Development Goals (SDGs) in Senior High Schools (SMA) in West Sumatra has strong potential for further development; however, it continues to face challenges related to the integration and internalization of sustainability learning. The findings reveal that teachers' evaluations of the Green Curriculum fall within the high category, indicating substantial conceptual readiness and support for the implementation of sustainability-based education. In general, teachers have developed an awareness of environmental issues and SDGs and exhibit positive attitudes toward integrating these concepts into classroom learning. Nevertheless, student outcomes remain at a moderate level, with the primary weakness identified in students' conceptual understanding of the SDGs. Although students have demonstrated relatively positive environmentally friendly behaviors, their understanding of the interconnectedness of global, systemic, and sustainability-related issues remains limited. This suggests that current learning practices have not yet fully transformed knowledge into deeper understanding and critical awareness.

A major finding of this study is the existence of a significant gap between teachers' structural support and student learning outcomes. This gap indicates that the implementation of the Green Curriculum remains partial and has not yet been systematically integrated into the curriculum, instructional strategies, and assessment systems. In other words, sustainability education is still positioned as an additional activity rather than as a core framework guiding the teaching and learning process.

Based on the analysis, this study identifies several key needs for the development of Green Curriculum, including the comprehensive integration of SDGs into the curriculum, the strengthening of project-based and challenge-based learning approaches, the development of authentic assessment strategies, the enhancement of teacher competencies, and more structured school policy support. These needs suggest that educational transformation toward sustainability requires a holistic approach involving all components of the educational system.

From a theoretical perspective, this study reinforces the concept of Education for Sustainable Development (ESD), which emphasizes the importance of transforming educational systems comprehensively to achieve sustainability. From a practical perspective,

the findings contribute an implementation model for Green Curriculum that can serve as a reference for schools, teachers, and policymakers in developing SDG-based education in Indonesia.

Therefore, this study highlights that the development of Green Curriculum at the senior high school level is not merely a pedagogical necessity but also a strategic effort to prepare younger generations with sustainability literacy, critical thinking skills, and the capacity to contribute effectively to addressing future global challenges.

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