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Indications of Gaps in SDG Integration in STEM-Based Lesson Plans for Junior High School Teachers: Analysis of Learning Planning Documents

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Abstract: The integration of the Sustainable Development Goals (SDGs) into learning planning is an important requirement in 21st century education, particularly through Science, Technology, Engineering, and Mathematics (STEM)-based learning relevant to sustainability issues. This study aims to analyze the indications of SDG integration gaps in STEM-based Lesson Plans (RPPs) developed by junior high school teachers. This study uses a qualitative approach with a document analysis design from 15 STEM-based RPPs that were deliberately selected from a total of 74 documents collected. The analysis was carried out by examining three main aspects, namely the general level of SDG integration, SDG integration in STEM-based learning activities, and SDG integration in learning assessment. The results showed that 53.4% of the RPPs implicitly integrated the SDGs in learning activities, while 53.4% of the RPPs still used assessments that were not based on the SDGs. At the general level of integration, the limited and inconsistent category was the most dominant pattern (33.3%), while only 20% of the RPPs showed explicit and complete SDGs integration. SDGs tend to be used as additional context in learning activities without being used as a complete conceptual basis, and have not been systematically integrated into learning assessments. These findings show a conceptual, pedagogical, and evaluative gap between the demands of sustainability-oriented education policies and the actual practices of teacher lesson planning. This research has important implications for strengthening STEM-based lesson planning that is more systematic and aligned with the sustainable development agenda.

INTRODUCTION

21st century education is no longer understood solely as a process of cognitive knowledge transfer, but as a strategic means to shape global awareness, social responsibility, and commitment to sustainability. In this context, the Sustainable Development Goals (SDGs) serve as a global framework that affirms the role of education in promoting sustainable development through the integration of social and economic dimensions. Based on the development theory that economic growth is essential to reduce poverty and benefit the poor, education is considered a necessary investment to improve the quality of human resources in the future and achieve economic growth (Ashida, 2023). In line with these goals, the Science, Technology, Engineering, and Mathematics (STEM) approach is considered relevant because it emphasizes authentic problem-solving, interdisciplinary integration, and strengthening students' critical and innovative thinking skills (Hebebci, 2022). In addition, the Independent Curriculum explicitly encourages teachers to design contextual, adaptive, and responsive learning plans that address global issues, including sustainability

issues, so that the integration of SDG values in STEM-based learning plans becomes an ideal expectation in educational practice at the junior high school level

However, according to international data, the implementation of continuing education in learning practices still shows significant gaps. According to the UNESCO Global Education Monitoring (GEM) Report, many countries have integrated sustainability issues into their education policies, but there are still real challenges in implementation at the school and teacher levels, especially in relation to strengthening teacher competencies and aligning learning practices with SDG targets (Development, 2020). Data shows that the existence of policies has not been fully followed by strengthening learning planning practices at the school level. In line with these findings, the results of the PISA Global Competency module show that despite efforts to teach global issues, almost half of students globally fail to demonstrate a minimum level of "global competence", which includes skills to analyse world issues, cultural inclusion, and engagement in sustainable development (OECD, 2018). This fact shows that SDGs integration has not been fully realized at the operational level, including in strategic documents such as the Lesson Plan (RPP), so that in STEM-based learning at the junior high school level, SDGs integration still tends to be limited to contexts or themes without an explicit connection to learning objectives, indicators, and assessments. In this study, the SDGs integration gap is understood in three dimensions, namely conceptual gaps that refer to the absence of explicit linkages between SDGs and learning goals or concepts; pedagogical gaps that refer to the lack of consistent integration of SDGs in learning activities; and evaluative gaps that refer to the lack of SDGs in learning indicators and assessments.

Learning planning is a guideline that educators must follow to ensure the success of their activities. Initial planning activities that can be carried out are to create lesson plans (RPP) based on curriculum development that guide the learning process (Audina & Harahap, 2022). In the context of the Independent Curriculum, quality lesson plans are required to be flexible, contextual, and oriented towards the development of 21st century competencies, one of which can be facilitated through STEM-based learning. STEM education is understood as an integrated and interdisciplinary approach that emphasizes real-world problem-solving through the integration of different fields of knowledge (Tran et al., 2021). These interdisciplinary characteristics make STEM relevant to the integration of the SDGs because various sustainability issues require understanding and problem-solving involving more than one discipline. Thus, STEM can be a pedagogical approach to connect sustainability issues with learning objectives and activities in a contextual manner. In line with this, on September 25, 2015, the 2030 Agenda for Sustainable Development was agreed and adopted by the United Nations. This agenda consists of 17 Sustainable Development Goals (SDGs) and 169 targets (Rashed & Shah, 2020). The Sustainable Development Goals (SDGs), especially SDG 4 on quality education, position education as a strategic means to internalize the values of sustainability, social justice, and environmental responsibility, the implementation of which can be realized through the integration of learning objectives, content, activities, and assessments. Therefore, the integration of SDGs

into STEM-based learning plans needs to be understood as a systematic process that connects learning objectives with global sustainability issues, although in practice teachers still face various conceptual and technical challenges in consistently implementing this integration in lesson planning documents.

Previous studies, as revealed by Khalil et al. (2023), showing that STEM-based learning studies at the junior high school level focus more on the application of models and their impact on 21st-century skills, such as critical thinking and problem-solving, without explicitly examining the integration of the Sustainable Development Goals (SDGs) in learning planning. On the other hand, studies that analyze lesson plans focus on several aspects, including format, learning activities, and language (Musyaddad et al., 2025), but have not touched on the global sustainability dimension as part of the educational objectives. Based on these gaps, this study presents a novelty by specifically examining the integration of SDGs in STEM-based lesson plans of junior high school teachers through document analysis, as well as identifying indications of gaps between SDG-oriented education policy requirements and actual learning planning practices in schools.

Based on the ideal conditions of education that encourage the integration of sustainability values, empirical findings in the field, and gaps in previous research, this study aims to analyze the level of gap in the integration of the Sustainable Development Goals (SDGs) in STEM-based learning plans developed by junior high school teachers through document analysis. The analysis includes conceptual, pedagogical, and evaluative dimensions to provide an empirical picture of the integration of SDGs in learning planning. This research has both theoretical and practical significance. Theoretically, this research contributes to the study of sustainable education by placing the integration of SDGs in STEM-based learning planning as the focus of the analysis. Practically, the results of the study are expected to be a basis for reflection for teachers and provide input for policymakers and teacher training program developers in strengthening the integration of SDGs at the learning planning stage.

METHOD

This research uses a qualitative approach with a document analysis design. Document analysis in qualitative research requires examining and interpreting data to generate meaning, gain understanding, and develop empirical knowledge (Armstrong, 2022). Document analysis was chosen because the learning plan is an artifact of learning planning that represents the pedagogical orientation, values, and direction of learning implementation before the learning process takes place. Through document analysis, this research allows the disclosure of patterns, trends, and inconsistencies between continuing education policies and learning planning practices in schools. Thus, this approach is relevant to identify gaps in SDG integration in a systematic and in-depth manner.

The subject of this study was a STEM-based lesson plan document at the junior high school level collected from junior high school teachers in subjects relevant to the STEM approach. A total of 74 lesson plans were collected, which were then treated as research

populations. From this population, 15 lesson plans were selected as research samples for in-depth analysis. The sample size was determined to allow for a more comprehensive qualitative analysis of each document without reducing the representation of emerging SDG integration variations.

The research instrument consists of a document analysis sheet developed based on the conceptual indicators of the SDGs and the characteristics of STEM learning. The analysis was carried out on three main aspects shown in Figure 1. These three aspects are used as an analytical framework to ensure that the research is carried out comprehensively and systematically.

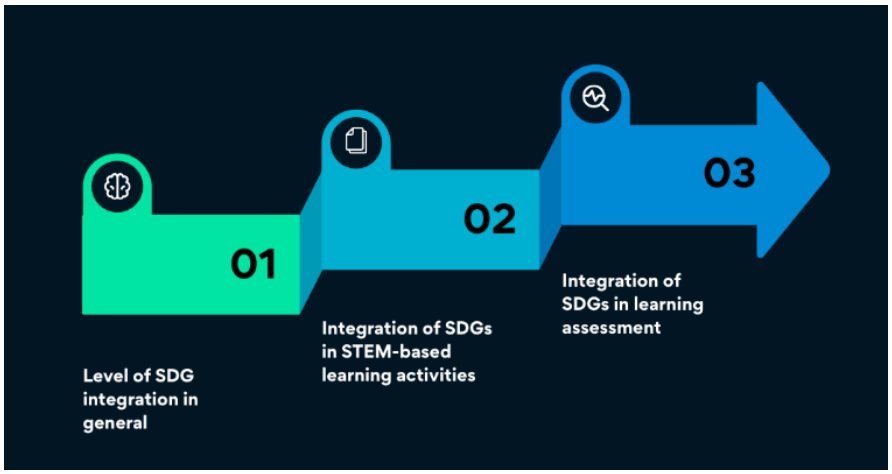


Figure 1. The Three Main Aspects Analyzed

The sampling technique used was purposive sampling, also known as planned sampling or judgment sampling (Ahmad & Wilkins, 2024). In this study, the criteria are presented in Figure 2.

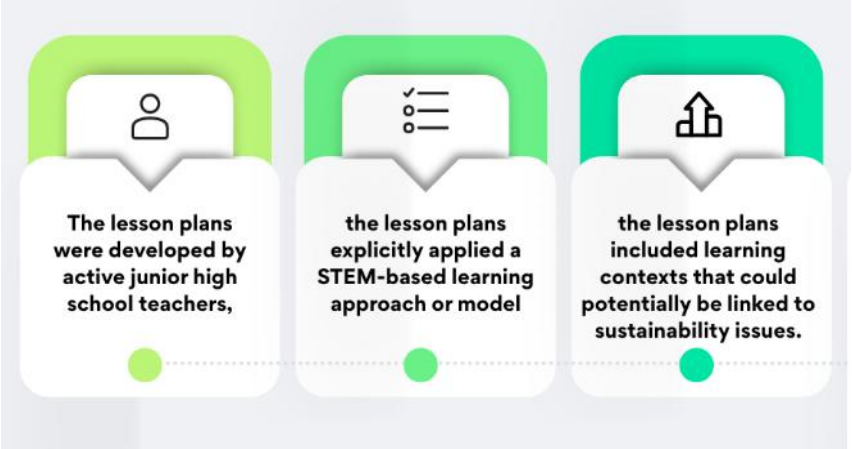


Figure 2. Research Sample Selection Criteria

To maintain the accuracy and consistency of the analysis, this study uses the operational definition of SDG integration in STEM-based lesson plans, which is systematically formulated in Table 1. This operational definition is the basis for categorizing the findings in each lesson plan document so that the analysis process is not subjective.

Table 1. Operational Definition of SDG Integration in STEM-Based Lesson Plans

Aspects Analyzed	Categories	Operational Definition
The level of integration of the SDGs in general	Not appearing / symbolic	The SDGs are not listed or only mentioned in general without any connection to learning objectives, activities, and assessments.
	Limited and inconsistent	SDGs appear in one of the components of the RPP (objectives/activities/assessment), but it is not continuous between components.
	Contextual and relatively consistent	The SDGs are integrated into more than one component of the lesson plan and are used as a learning context, but have not yet become the basis for assessment.
	Explicit and intact	The SDGs are clearly the basis for the formulation of integrated learning objectives, activities, and assessments.
Integration of SDGs in STEM-Based Learning Activities	Not integrated	STEM activities do not contain the context of sustainability issues or SDGs.
	Implicit	The learning activities contain the context of real issues related to sustainability, but without explicitly mentioning the SDGs.
	Explicit	Learning activities clearly raise the issue of SDGs or sustainability indicators as the focus of learning.
Integration of SDGs in learning assessment	Not based on SDGs	The assessment only measures the cognitive aspects or STEM skills without linking sustainability issues.
	SDGs-based	Assessments are designed to assess students' ability to analyze, evaluate, or reflect on sustainability issues.

Based on this operational definition, each sample lesson plan is analyzed in terms of learning objectives, learning activities, and assessments. The analysis process is carried out by identifying the existence of SDG indicators, then grouping the findings into predetermined categories. Next, the researchers perform thematic coding to reveal patterns of integration and gaps between the components of the lesson plan. To ensure coding consistency, the documents are coded independently by two coders using the same operational definitions and categories as listed in Table 1. The agreement between the coders is evaluated using the Cohen's kappa coefficient. If differences in coding results are found, the two coders discuss the differences by referring back to the operational definition until a consensus is reached. This stage is repeated to ensure the accuracy and consistency of the analysis results.

In addition to descriptive qualitative analysis, this study also uses percentage analysis to strengthen the interpretation of the SDGs integration gap level. The percentage of integration categories is calculated based on the number of lesson plans that meet certain criteria compared to the total number of samples. To avoid ambiguity in interpretation, the x value in Table 2 is defined as the percentage of documents that show a gap to the expected SDG integration criteria, rather than as a percentage of the integration level. Thus, the greater the x, the greater the gap found and the lower the SDG integration rate. Conversely, the smaller the x value, the smaller the gap and the higher the integration rate. The percentage results are then interpreted using the gap level criteria presented in Table 2 below.

Table 2. SDG Integration Gap Level Criteria

Percentage	Categories
x > 55%	Very Low Integration
40% < x ≤ 55%	Low Integration
25% < x ≤ 40%	Medium Integration
10% < x ≤ 25%	High Integration

The use of this percentage criterion aims to give analytical meaning to the simple quantification data generated from the analysis of the document. The categories in Table 2 are interpretations of the magnitude of the gap, so the relationship between the value of x and the level of integration is in the opposite direction: the higher the percentage of gaps, the lower the level of SDG integration, while the lower the percentage of gaps, the higher the level of integration. By combining qualitative content analysis and percentage interpretation, this study not only describes the form of SDGs integration but also shows the level of gap in a more measurable way. This approach strengthens the argument of the research results and makes it easier for readers to understand the urgency of SDG integration in STEM-based RPPs.

To ensure the validity of the data, this study applied a credibility and reliability strategy through checking the consistency of coding results between coders. Because the main data source of the research is in the form of documents and does not involve participants as a source of interview data, member checking is not used as a validation strategy. The credibility and reliability of the analysis are strengthened through the use of explicit operational definitions, independent coding by two coder, measurement of agreement between coders using Cohen's kappa, and settlement of differences in coding results through consensus. In addition, the use of clear indicators, explicit analytical frameworks, and transparent analysis procedures strengthen the reliability and credibility of the research results. Thus, this research method meets the principles of methodological rigor and is suitable for use as a basis for scientific analysis.

RESULT AND DISCUSSION

The study involved 15 STEM-based lesson plans developed by junior high school teachers. The lesson plans analyzed covered a wide range of learning topics and were generally designed using contextual problem-solving approaches and project activities. The initial analysis focused on mapping the level of SDG integration in the LPP document, before conducting a more in-depth analysis of each component of the lesson plan listed in Table 3.

Table 3. Mapping the Level of SDG Integration in 15 STEM-Based LPPs

RPP Code	General Level of SDG Integration				Integration of SDGs in STEM Learning Activities			Integration of SDGs in Learning Assessment	
	Not appear-ing/ symbolic	Limited and inconsistent	Contextual and relatively consistent	Explicit and intact	Not integrated	Implicit	Explicit	Not based on SDGs	Based on SDGs
RPP-1				✓			✓		✓
RPP-2		✓				✓		✓	
RPP-3				✓			✓		✓
RPP-4			✓			✓			✓
RPP-5		✓				✓		✓	
RPP-6	✓				✓			✓	
RPP-7		✓				✓		✓	
RPP-8		✓					✓		✓
RPP-9			✓			✓			✓
RPP-10	✓						✓	✓	
RPP-11	✓				✓			✓	
RPP-12		✓					✓		✓
RPP-13			✓			✓		✓	
RPP-14			✓			✓		✓	
RPP-15				✓		✓			✓

Based on Table 3, the SDGs have appeared in most of the STEM-based lesson plans analyzed, but with varying degrees of integration. Therefore, further analysis focuses more deeply on three main aspects, namely the level of SDG integration in general, the integration of SDGs in STEM-based learning activities, and the integration of SDGs in learning assessments. These three aspects are further used to identify three forms of gaps, namely conceptual gaps in the consistency of SDGs integration in the overall structure of the RPP, pedagogical gaps in STEM learning activities, and evaluative gaps in assessment components.

Specifically, the conceptual gap is most clearly seen in RPP-6, RPP-10, and RPP-11 which at the general level are in the category of non-emerging/symbolic; RPP-2, RPP-5, RPP-7, RPP-8, and RPP-12 show that integration is still limited and inconsistent. The pedagogical gap can be seen in RPP-6 and RPP-11 which do not integrate SDGs in learning activities as well as in RPP-2, RPP-4, RPP-5, RPP-7, RPP-9, RPP-13, RPP-14, and RPP-15 which still integrate them implicitly. Meanwhile, evaluative gaps were found in RPP-2, RPP-5, RPP-6, RPP-7, RPP-10, RPP-11, RPP-13, and RPP-14 whose assessments were not yet based on SDGs.

General Level of SDG Integration

The initial analysis was directed at mapping the general level of integration of the Sustainable Development Goals (SDGs) in STEM-based lesson plans. This mapping aims to provide an initial overview of how the SDGs are integrated by teachers in the lesson

planning document before being studied in more depth in each component of the lesson plan. This approach is important to identify indications of gaps between the demands of continuing education and learning planning practices in junior high schools.

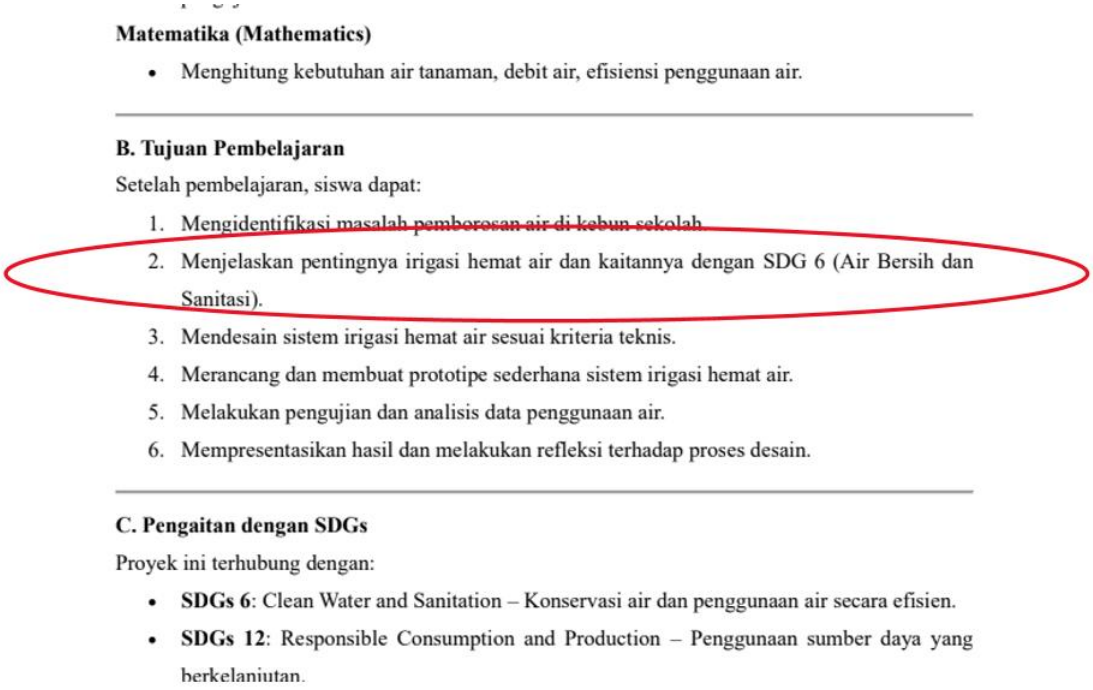
Table 4. General Level of SDG Integration

SDGs Integration Rate	Number of RPPs	Percentage	Categories
Not appearing / symbolic	3	20%	High Integration
Limited and inconsistent	5	33,3%	Medium Integration
Contextual and relatively consistent	4	26,7%	Medium Integration
Explicit and intact	3	20%	High Integration
Total	**15**	**100%**	

Table 4 shows that most lesson plans fall into the category of limited and inconsistent (33.3%), followed by contextual and relatively consistent (26.7%), while explicit and complete integration accounts for only 20.0%. Some lesson plans do not even mention the SDGs at all or only refer to them symbolically (20.0%). The pattern in Table 4 shows that the main problem lies not only in the presence or absence of SDGs in the RPP, but also in the continuity of their integration in all planning components. Most lesson plans have not achieved explicit and full integration, so the existence of SDGs in one part of the document has not been consistently followed by alignment between objectives, activities, and learning assessments.

These findings reflect a significant conceptual gap, where the SDGs have not been used as a key conceptual framework in learning planning. This is in line with the findings Afandi & Rachmadtullah (2025), that teachers' perceptions of SDG-based education vary widely. Some teachers may relate learning to social sustainability issues, but many experience limitations related to training and resources for deeper integration into their learning planning.

In addition to training and resource limitations, the fragmentation can be related to institutional factors, such as limited operational guidance that explicitly bridges the Independent Curriculum with SDGs targets, workload pressures, limited planning time, and the need for cross-disciplinary coordination in STEM learning. These factors were not directly measured in this study and are positioned as possible explanations for the patterns found, rather than as proven causal relationships. To provide direct evidence from the document, Figure 3 shows an example of a lesson plan that explicitly lists SDG 6 in the learning objectives and links the project to SDG 6 and SDG 12. This example is chosen as an illustrative case to show patterns when the SDGs have emerged on certain components, but based on the coding results have not been consistently integrated across the components of the RPP.



Matematika (Mathematics)

- Menghitung kebutuhan air tanaman, debit air, efisiensi penggunaan air.

B. Tujuan Pembelajaran

Setelah pembelajaran, siswa dapat:

1. Mengidentifikasi masalah pemborosan air di kebun sekolah.
2. Menjelaskan pentingnya irigasi hemat air dan kaitannya dengan SDG 6 (Air Bersih dan Sanitasi).
3. Mendesain sistem irigasi hemat air sesuai kriteria teknis.
4. Merancang dan membuat prototipe sederhana sistem irigasi hemat air.
5. Melakukan pengujian dan analisis data penggunaan air.
6. Mempresentasikan hasil dan melakukan refleksi terhadap proses desain.

C. Pengaitan dengan SDGs

Proyek ini terhubung dengan:

- **SDGs 6**: Clean Water and Sanitation – Konservasi air dan penggunaan air secara efisien.
- **SDGs 12**: Responsible Consumption and Production – Penggunaan sumber daya yang berkelanjutan.

Figure 3. The Lesson Plans Show that the SDGs Appear in One Component of the Lesson Plan (Objectives/Activities/Assessment) but are Not Consistent Across Components

In Figure 3, the learning objectives explicitly include the importance of water-efficient irrigation and its relation to SDG 6, while the link to SDGs sections list SDGs 6 and SDG 12. This evidence suggests that sustainability orientation has been evident in certain parts of the document. However, based on the overall coding of the lesson plan, the integration has not been consistently passed on across all planning components. Therefore, this example is used to illustrate a pattern of integration fragmentation, rather than as evidence that the SDGs do not emerge at all. The pattern reinforces the interpretation that in some lesson plans, the SDGs still function as an additional context rather than as a conceptual foundation that connects goals, activities, and assessments as a whole.

In contrast, RPP-1, RPP-3, and RPP-15 are positive findings because they have reached the category of "explicit and whole" integration. RPP-1 and RPP-3 show the strongest alignment, namely learning activities that explicitly integrate the SDGs and the assessment is also based on SDGs. RPP-15 shows a slightly different pattern because the level of integration is generally explicit and intact and the assessment is SDG-based, but the learning activities are still implicit. These findings suggest that a more systematic integration of the SDGs can be realized. However, this study did not collect data on the characteristics of teachers, training experience, or institutional support of the RPPs, so the factors that make their practices different cannot be determined from the available data.

Integration of SDGs in STEM Learning Activities

The analysis of the components of learning activities focuses on the extent to which the STEM learning context reflects the SDG issues and values. This analysis is important to see the depth of SDG integration as well as indications of gaps between the real-world context used and the global sustainability orientation.

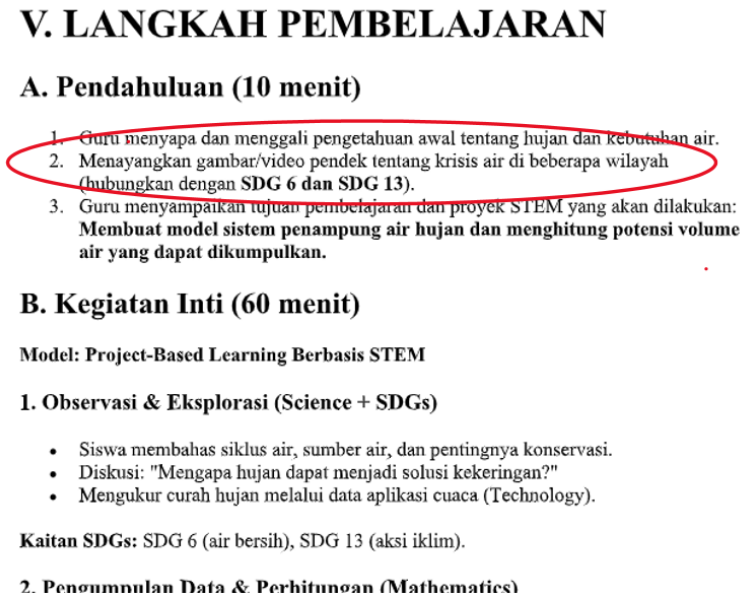
Table 5. Integration of SDGs in STEM Learning Activities

Forms of SDGs Integration	Number of RPPs	Percentage	Categories
Not Integrated	2	13,3%	High Integration
Implicit	8	53,4%	Low Integration
Explicit	5	33,3%	Medium Integration
Total	**15**	**100%**	

The pattern in Table 5 shows that pedagogical gaps mainly arise when sustainability issues are used as a learning context, but have not been translated into explicit SDG goals or indicators. This implicit approach is generally carried out through the context of the project and real issues such as the environment or social issues, but does not directly refer to specific SDG goals or indicators. This is in line with the findings Alm et al. (2021), that when learning raises sustainability issues without explicit reference to the SDGs, this has an impact on the development of students' competencies towards specific sustainability goals. This condition shows a pedagogical gap, where the contextualization of real-world problems has not been followed by an emphasis on the competencies essential for sustainability mapped by the SDGs.

At the document level, RPP-6 and RPP-11 do not integrate the SDGs in learning activities; RPP-2, RPP-4, RPP-5, RPP-7, RPP-9, RPP-13, RPP-14, and RPP-15 integrate them implicitly; while RPP-1, RPP-3, RPP-8, RPP-10, and RPP-12 have explicitly included the SDGs. Interestingly, RPP-10 shows a pattern that is not entirely linear: the learning activities have explicitly integrated the SDGs, but the assessments are not yet based on SDGs. This pattern shows that strengthening activities alone does not guarantee the continuity of integration up to the assessment stage.

As a comparative case against the dominant implicit pattern, Figure 4 shows learning activities that have explicitly linked water crisis contexts and rainwater harvesting projects to SDG 6 and SDG 13. This example was chosen to show that pedagogical gaps do not occur uniformly across lesson plans.



V. LANGKAH PEMBELAJARAN

A. Pendahuluan (10 menit)

1. Guru menyapa dan menggali pengetahuan awal tentang hujan dan kebutuhan air.
2. Menayangkan gambar/video pendek tentang krisis air di beberapa wilayah (hubungkan dengan **SDG 6 dan SDG 13**).
3. Guru menyampaikan tujuan pembelajaran dan proyek STEM yang akan dilakukan: **Membuat model sistem penampung air hujan dan menghitung potensi volume air yang dapat dikumpulkan.**

B. Kegiatan Inti (60 menit)

Model: Project-Based Learning Berbasis STEM

1. Observasi & Eksplorasi (Science + SDGs)

- Siswa membahas siklus air, sumber air, dan pentingnya konservasi.
- Diskusi: "Mengapa hujan dapat menjadi solusi kekeringan?"
- Mengukur curah hujan melalui data aplikasi cuaca (Technology).

Kaitan SDGs: SDG 6 (air bersih), SDG 13 (aksi iklim).

2. Pengumpulan Data & Perhitungan (Mathematics)

Figure 4. The Lesson Plan Shows that the Learning Activities Contain Real-World Contexts Related to Sustainability, but Without Explicit Mention of the SDGs

Figure 4 shows that the preliminary activities link the issue of the water crisis to SDG 6 and SDG 13, while the core activities directly include the linkages of learning with SDG 6 on clean water and SDG 13 on climate action. This evidence shows a more explicit form of pedagogical integration and confirms the variation in the quality of integration between lesson plans. However, the variation also shows that the existence of explicit integration in activities needs to be read together with other components in order to assess whether the alignment of the SDGs has been fully formed.

Integration of SDGs in Learning Assessment

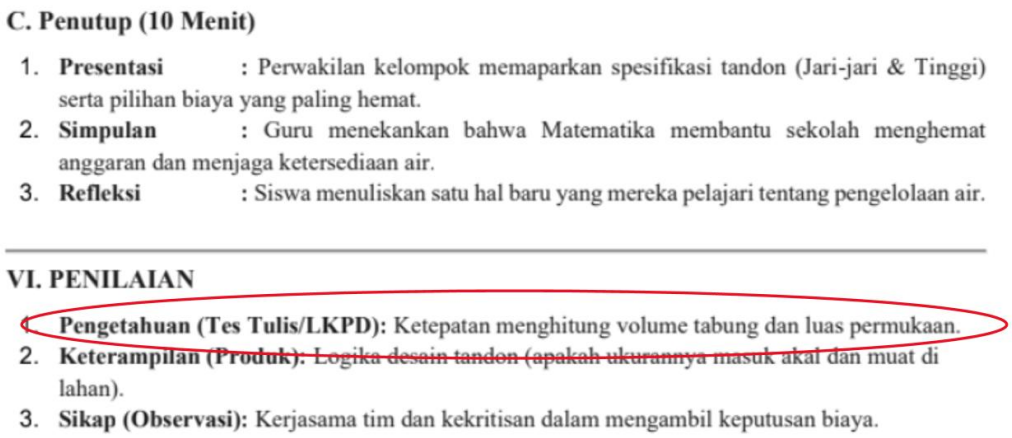
The assessment component has a strategic role in ensuring the achievement of learning objectives, including monitoring whether students understand and internalize sustainability values. Analysis of lesson plan assessments is carried out to see if the assessment provides space for the SDGs dimension in assessing student learning outcomes.

Table 6. Integration of SDGs in Learning Assessment

Assessment Orientation	Number of RPPs	Percentage	Categories
Not based on SDGs	8	53,4%	Low Integration
SDGs-based	7	46,6%	Low Integration
Total	**15**	**100%**	

The results of the analysis in Table 6 show that most of the lesson plans (53.4%) use assessments that are not based on the SDGs. Assessments in this lesson plan generally only assess STEM concepts or skills, without linking them to sustainability indicators that reflect students' understanding of the social and environmental impacts or values of the SDGs. The pattern in Table 6 shows that assessment is one of the breaking points in the sustainability of SDGs integration. Although the context of sustainability has emerged in various learning activities, it has not always been passed on as an indicator or assessment task. Specific evaluative gaps were found in RPP-2, RPP-5, RPP-6, RPP-7, RPP-10, RPP-11, RPP-13, and RPP-14, while RPP-1, RPP-3, RPP-4, RPP-8, RPP-9, RPP-12, and RPP-15 have used SDGs-based assessments

Research by Fischer et al. (2025) affirms that the development and use of assessment instruments that are sensitive to the principles of continuing education is essential to ensure that sustainability is not only contextual but truly part of a comprehensive learning assessment process. The following lesson plan document shows that assessments only measure cognitive aspects or STEM skills without linking them to sustainability issues as shown in Figure 5.



C. Penutup (10 Menit)

1. **Presentasi** : Perwakilan kelompok memaparkan spesifikasi tandon (Jari-jari & Tinggi) serta pilihan biaya yang paling hemat.
2. **Simpulan** : Guru menekankan bahwa Matematika membantu sekolah menghemat anggaran dan menjaga ketersediaan air.
3. **Refleksi** : Siswa menuliskan satu hal baru yang mereka pelajari tentang pengelolaan air.

VI. PENILAIAN

1. **Pengetahuan (Tes Tulis/LKPD):** Ketepatan menghitung volume tabung dan luas permukaan.
2. **Keterampilan (Produk):** Logika desain tandon (apakah ukurannya masuk akal dan muat di lahan).
3. **Sikap (Observasi):** Kerjasama tim dan kekritisan dalam mengambil keputusan biaya.

Figure 5. The Lesson Plan Shows that the Assessment Only Measures Cognitive Aspects or STEM Skills Without Linking Them to Sustainability Issues

Figure 5 is chosen as a typical case of the RPP group whose assessment is not yet based on SDGs. In this example, the knowledge aspect assesses the accuracy of calculating the volume of the tube and surface area, the skill aspect of assessing the reservoir design logic, and the attitude aspect of assessing teamwork and criticality in making cost decisions. Although these indicators are relevant to STEM competencies, there are no indicators that explicitly assess students' understanding, analysis, or reflection on sustainability and SDGs goals. As a result, although learning activities raise real problems, the achievement of students' sustainability competencies has not been clearly measured.

As a comparison to the integration pattern that is still limited to some of the lesson plans, Figure 6 shows one example of a more explicit and targeted integration of SDGs in STEM learning planning. In the lesson plan, simple water filtration projects are not only generally associated with sustainability issues, but are clearly mapped to SDG 6 (Clean Water and Decent Sanitation), SDG 3 (Healthy and Prosperous Lives), and SDG 4 (Quality Education). The linkage is also accompanied by an explanation of the relevance of each SDG goal to learning activities. For example, water filtration projects are directly linked to Target 6.1 regarding universal and equitable access to safe and affordable drinking water. In addition, the linkage with SDG 3 is explained through the contribution of clean water availability to the prevention of waterborne diseases, while SDG 4 is associated with the development of critical thinking skills, creativity, and problem-solving through STEM-based learning.

This example shows that stronger SDGs integration does not stop at the inclusion of SDG names or symbols, but describes the substantive relationship between the problems studied, STEM activities, and the sustainability goals to be achieved. Thus, the SDGs can be used as a comparative example against the SDGs that only integrate the SDGs symbolically or implicitly. This pattern shows that the SDGs can be placed as part of the conceptual framework of learning, so that students not only complete STEM projects, but also understand the relevance of the solutions developed to broader sustainability issues.

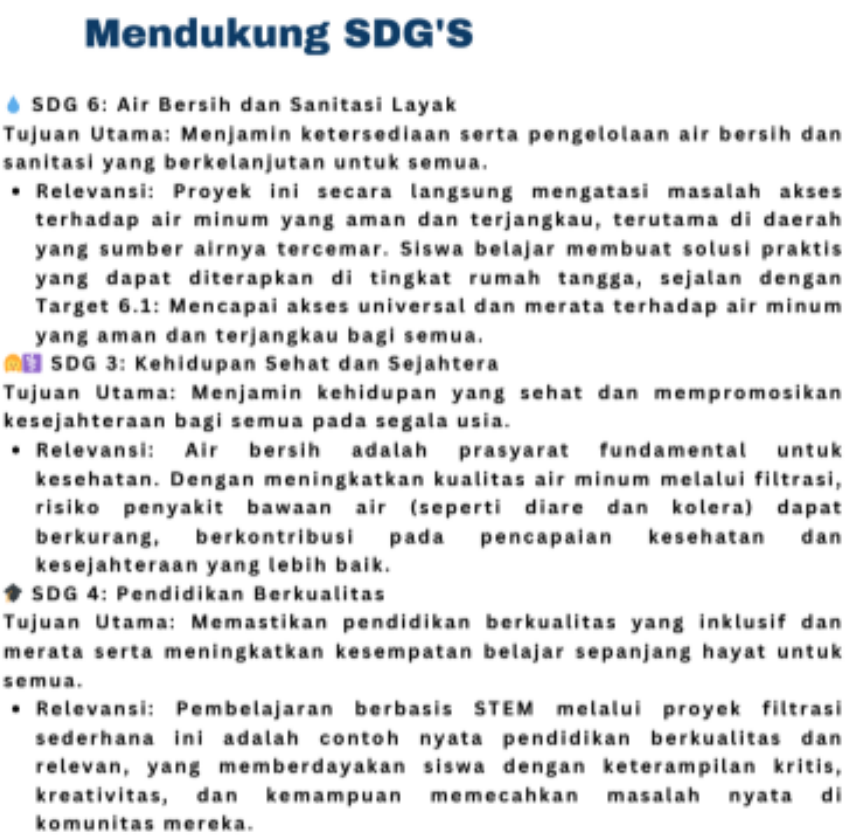


Figure 6. Example of Explicit Integration of SDGs in STEM-Based RPPs through a Simple Water Filtration Project

In general, the analysis of STEM-based lesson plans shows that although the SDGs have emerged in lesson plans, their integration is still fragmented and incomplete; most lesson plans integrate the SDGs only in a limited or implicit manner without strong conceptual continuity across all planning components, from objectives and activities to assessment. At the general level, the SDGs are often mentioned symbolically or only in a few components, indicating a conceptual gap between continuing education policy and teacher learning planning (inconsistencies between lesson plan components). In learning activities, the dominance of implicit integration indicates a pedagogical gap where the context of real-world problems is not directly related to specific SDG goals. In addition, learning assessments generally still focus on mastery of STEM concepts without measuring sustainability competencies, revealing an evaluative gap in assessing SDGs achievement. These findings are consistent with research by Xuan & Lindqvist (2025), which shows that although the SDGs are increasingly integrated into the curriculum at various levels, there are still significant gaps in systematic and holistic implementation, including in the deeper aspects of assessment and pedagogical transformation.

Limitations of the study. The analysis was conducted on 15 STEM-based lesson plans so that the findings illustrate patterns in the analyzed documents and are not intended to be generalized directly to all learning planning practices at the junior high school level. In addition, the study focuses on planning documents so that it is not possible to confirm whether the integration of the written SDGs is actually implemented in classroom learning practices. This study also does not collect direct data on teacher characteristics, training

experience, workload, or institutional support; therefore, these factors cannot be established as empirical causes of the gaps found.

The next direction of research. Subsequent research can expand the number and variety of lesson plans and combine document analysis with teacher interviews and learning observations to assess the appropriateness of planning and implementation of the SDGs in the classroom. Further studies also need to specifically examine lesson plans with explicit and intact integrations to identify planning practices, professional experience, and institutional conditions that support such integration, as well as empirically examine the relationship between teacher training, workload, institutional support, clarity of curriculum guidance, and quality of SDGs integration.

CONCLUSION AND SUGGESTIONS

Based on the research objective to analyze indications of gaps in the integration of Sustainable Development Goals (SDGs) in STEM-based lesson plans for junior high school teachers, the results show that the integration of SDGs in lesson planning documents is still not optimal and tends to be fragmented. Although most lesson plans include STEM-based learning elements and raise real-world issues, SDGs have not been used as the main conceptual framework in lesson planning. The SDGs more often appear symbolically or are limited to certain components without clear continuity between learning objectives, activities, and assessments. These findings confirm the conceptual gap between the demands of sustainability-oriented education policy and learning planning practices at the junior high school level.

Furthermore, the results of the analysis show that the integration of SDGs in STEM-based learning activities is dominated by an implicit approach. Teachers tend to use environmental or social issues as a learning context, but have not explicitly linked them to specific SDG goals or indicators. This condition indicates a pedagogical gap, where the potential of STEM learning to develop students' sustainability competencies has not been fully and purposefully utilized. As a result, the learning designed does not fully support the development of students' understanding of the sustainable development agenda in a systematic manner.

The most prominent gap was found in the learning assessment component. Most lesson plans still focus on measuring mastery of STEM concepts and skills, without including indicators that reflect students' understanding, attitudes, or reflective abilities regarding sustainability issues. This indicates an evaluative gap, where learning success has not been linked to the achievement of sustainability competencies as emphasized in the SDGs. Overall, the findings of this study indicate that the integration of SDGs in junior high school teachers' STEM-based lesson plans still needs to be strengthened to be more comprehensive, consistent, and in line with sustainable education goals.

Based on these findings, it is recommended that teachers and education stakeholders strengthen the integration of SDGs in STEM-based lesson plans explicitly and continuously. Teachers need to be supported through training and technical guidance that helps map

SDGs into learning objectives, project-based learning activities, and assessments that measure students' sustainability competencies. In addition, curriculum developers are expected to provide examples of good practices and more operational planning frameworks so that the integration of SDGs is not only contextual but also becomes a comprehensive pedagogical foundation. Thus, STEM-based learning in junior high schools can contribute significantly to supporting the achievement of the sustainable development agenda through education.

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