

NEEDS ASSESSMENT FOR INTEGRATING SDG-ALIGNED ECO-PEDAGOGICAL STRATEGIES IN BIOLOGY

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Received: (April 9, 2025); Revised: (May 3, 2025); Accepted: May 5, 2025)

Citation:



Tadena, M. T. G., & Salic-Hairulla, M. A. (2025). Needs assessment for integrating SDG-aligned eco-pedagogical strategies in biology. *Journal of Research and Innovation for Sustainability (JRIS)*, 2(3), 63–85.

ABSTRACT

This study aimed to assess the integration needs of junior high school biology teachers in adopting Sustainable Development Goal (SDG)-aligned eco-pedagogical strategies. Specifically, it evaluated teachers' familiarity with SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land); identified challenges hindering their ability to implement these strategies; and explored their perceived needs for professional development and resources. Using a descriptive survey research design, the study developed, validated, and implemented a needs assessment questionnaire. Quantitative data were collected through Likert-scale questions, while open-ended responses provided qualitative insights. Findings revealed that while most teachers were moderately familiar with sustainability topics they could not clearly connect these to specific SDGs. The most common challenges identified were insufficient training, limited access to teaching resources, and difficulty fitting sustainability topics into an already full curriculum. Teachers expressed that they struggled to design relevant lessons due to these constraints, especially when lacking multimedia materials or context-based examples. The study highlights the importance of targeted interventions, such as resource development and capacity-building programs, to bridge the gap between existing practices and sustainability-focused education. Recommendations include designing training modules, aligning curricula with SDG principles, and fostering institutional support to enable teachers to implement SDG-aligned strategies effectively.

Keyword: eco-pedagogy, eco-pedagogical strategies, needs assessment, Sustainable Development Goals (SDGs), SDG integration

1. Introduction

The global push for sustainable development, as outlined by the United Nations' Sustainable Development Goals (SDGs), emphasizes the importance of education in addressing critical environmental and societal challenges. Specifically, SDG 4.7 calls for the integration of sustainability education to ensure that learners acquire the knowledge and skills necessary for sustainable development. For biology education, the Sustainable Development Goals (SDGs) can be integrated across a wide range of topics, including human health, nutrition, and environmental sustainability (UNESCO, 2017). SDG 3 (Good Health and Well-being), for example, connects directly to lessons on body systems, disease prevention, and healthy lifestyles. However, with growing environmental challenges, there is an increasing need to highlight the ecological dimension of biology. This includes fostering ecological awareness and equipping learners with the tools to address pressing issues such as climate change (SDG 13), life below water (SDG 14), and life on land (SDG 15).

In the Philippines, the Basic Education Development Plan (BEDP) 2030 identifies a lack of contextualized resources and teacher preparedness as barriers to implementing sustainability-focused education (Department of Education, 2021). These challenges are particularly pronounced in science education, where integrating sustainability concepts often requires not just new content but also a shift in teaching mindset and pedagogy. While efforts to integrate sustainability in Philippine education are growing, research shows that actual implementation remains uneven and largely dependent on teacher initiative and institutional support. For example, Alvero (2024) documented how integrating SDGs in a private higher education institution in Laguna demanded comprehensive teacher training, curriculum redesign, and a strong leadership push to align educational goals with sustainability principles. Similarly, Duran and Mariñas (2024) found that though teachers may express positive intentions to integrate sustainability, their actions are often

constrained by structural and contextual limitations. Eco-pedagogy, a teaching approach rooted in critical pedagogy and transformative learning, has been identified as a promising strategy for aligning educational practices with sustainability goals (Gadotti, 2010; Kahn, 2010).

This study focused on assessing the integration needs of biology teachers in adopting SDG-aligned eco-pedagogical strategies. By identifying gaps in knowledge, skills, and resources, the study aimed to provide actionable insights for professional development programs tailored to enhance teachers' capacities for transformative, sustainability-focused education. While the potential of eco-pedagogy to advance sustainability education is well-documented, there is limited research on its practical integration into biology curricula, particularly in the context of developing countries like the Philippines.

2. Research Objectives

The general objective of this study is to assess the integration needs of biology teachers for adopting SDG-aligned eco-pedagogical strategies. Specifically, it aims to:

1. Determine biology teachers' familiarity with eco-pedagogical strategies related to Sustainable Development Goals (SDGs).
2. Identify teachers' challenges and perceived needs in integrating these strategies into biology education.
3. Formulate recommendations to support the adoption of SDG-aligned eco-pedagogical approaches.

3. Theoretical framework

The theoretical framework of this study integrates three key theories that provide a sound foundation for examining the challenges and needs of biology teachers in integrating SDG-aligned eco-pedagogical strategies.

Ecological Systems Theory (Bronfenbrenner, 1979). Ecological Systems Theory emphasizes the interconnected systems in which individuals operate, including the microsystem (classroom), mesosystem (school), exosystem (community), and macrosystem (educational policies and global influences). This theory highlights the dynamic interaction between these systems and their influence on individuals' behaviors and capacities. In this study, the theory emphasizes the contextual factors that affect biology teachers' ability to integrate SDG-aligned strategies. These factors include administrative support, curriculum alignment, resource availability, and community engagement. Understanding how these systems interact provides insights into the barriers teachers face and the resources they need to align their teaching with sustainability goals.

Needs Assessment Theory (Kaufman & English, 1979). Needs Assessment Theory provides a systematic framework for identifying gaps between the current state (existing practices, knowledge, and resources) and the desired state (effective SDG integration in teaching). This theory emphasizes gap analysis, prioritization of needs, and the alignment of interventions with identified gaps. In this study, Needs Assessment Theory guided the development, validation, and implementation of the Needs Assessment Questionnaire. It ensured that the instrument captured relevant data on teachers' familiarity with SDGs, perceived challenges, and specific needs. The theory also supports the interpretation of findings, ensuring that the study's recommendations are

evidence-based and directly address the identified gaps in professional development and resource availability.

Eco-Pedagogical Perspective. The eco-pedagogical perspective draws on principles from environmental education and critical pedagogy, emphasizing the need for contextualized, action-oriented teaching approaches that foster ecological literacy and sustainability awareness. Inspired by Paulo Freire's critical pedagogy (1970), Gregory A. Smith's place-based education (Smith & Sobel, 2010), and David Sobel's environmental education strategies (Sobel, 1996), eco-pedagogy seeks to connect global sustainability goals with local realities. In this study, the eco-pedagogical perspective serves as a conceptual guide for exploring how biology teachers can align their teaching practices with the Sustainable Development Goals (SDGs). It highlights the importance of equipping teachers with resources and training to promote sustainability-focused lessons, engage students in real-world environmental challenges, and foster critical thinking about global and local ecological issues.

Together, these theories and perspectives provide a comprehensive foundation for examining the challenges and needs of biology teachers. Ecological Systems Theory contextualizes the external and systemic factors influencing teaching practices, while Needs Assessment Theory ensures the study systematically identifies and addresses gaps. The eco-pedagogical perspective enriches the study by offering a practical, action-oriented lens for integrating SDG-aligned strategies into biology teaching. This integrative framework ensures the study not only captures the current state of teachers' preparedness but also informs meaningful interventions to support their professional growth and the advancement of sustainability education.

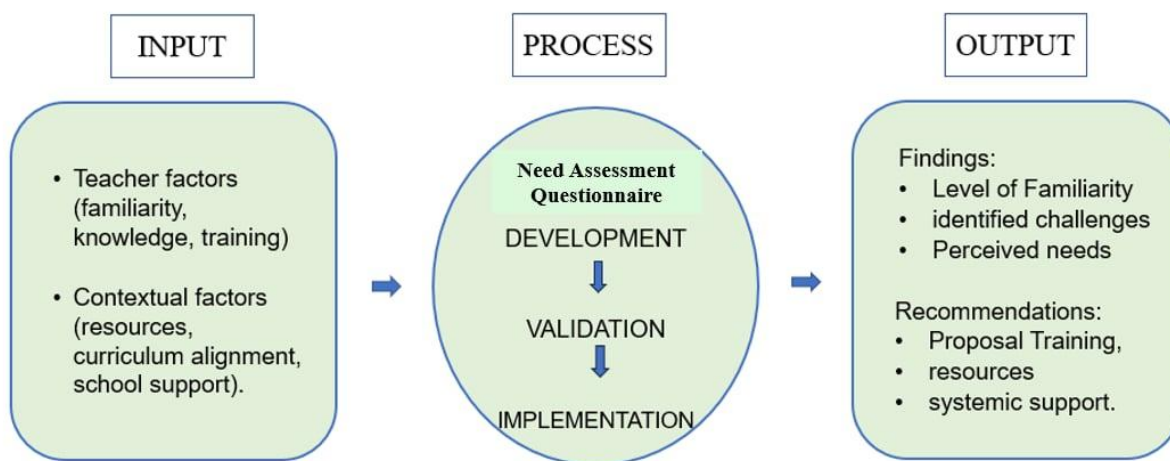


Figure 1 Research Paradigm of the Study (The I-P-O Model)

Figure 1 presents the study's flow using the input-process-output framework. The input includes teacher-related and contextual factors. The process involves conducting a needs assessment through a researcher-developed questionnaire, which underwent the processes development, validation and implementation. The output consists of the findings and recommendations based on the results of the study.

4. Research methodology

4.1 Research design

This study employed a descriptive survey research design using a mixed-methods approach to explore biology teachers' familiarity, challenges, and perceived needs regarding the integration of SDG-aligned eco-pedagogical strategies. The design involved quantitative data collection through Likert-scale questionnaire items and qualitative responses through open-ended questions.

4.2 Research Participants

The research participants were 15 junior high school biology teachers from five selected schools in Iligan City. The schools were chosen to reflect contextual diversity, three of which were small schools in rural areas, while the two were larger, urban-based schools. A purposive sampling technique was used to ensure that participants had relevant experience in biology instruction. This approach was suitable in the exploratory nature of the study and of its goal in assessing the teacher needs within the local context. The inclusion of respondents from a range of school types and settings within Iligan City helped provide rich, diverse perspectives and meaningful insights into the local realities of biology teaching and the potential for integrating SDG-aligned eco-pedagogical strategies..

4.3 Research Instruments

The primary instrument used in this study was the Needs Assessment for Integrating SDG-Aligned Eco-Pedagogical Strategies in Biology questionnaire, which was developed and validated through an instrumentation research process. The development process included a literature review (UNESCO, 2017), consultations with experts, face validation, and content validation by five specialists to ensure clarity, relevance, and alignment with the study goals (Fraenkel & Wallen, 2012; Creswell & Plano, 2014). Feedback from validators informed revisions and refinement of the instrument.

The *Needs Assessment for Integrating SDG-Aligned Eco-Pedagogical Strategies in Biology* (see Appendix) included five sections: demographic data, familiarity with SDGs, eco-pedagogical knowledge and practices, challenges in SDG integration, and professional development needs. This instrument development was informed by the theoretical framework of the study that helped shape the content and structure of the questionnaire. This framework which consisted of three theories, Bronfenbrenner's Ecological Systems Theory, Needs Assessment Theory, and the Eco-Pedagogical Perspective, emphasized the interplay of contextual factors, the identification of specific gaps and needs in eco-pedagogical practice, and the aligning of questions with sustainable development themes. Items were developed through expert consultations and underwent validation to ensure clarity and relevance. Likert-scaled items provided the quantitative data and open-ended questions provided qualitative insights.

4.3.1 Validation results of the needs assessment questionnaire. The validation process of the Needs Assessment Questionnaire involved five expert validators who assessed the instrument based on eight key criteria: Clarity of Questions, Relevance to Study Objectives, Logical Flow of Items, Appropriateness of Response Scales, Overall Structure, Completeness of the Instrument, Instructions and Guidance, and Cultural and Contextual Appropriateness. The ratings were provided on a scale of 1 to 4, where 4 indicated "Excellent."

Table 1 below shows the results of the content validation. Results reveal an overall

grand mean of 3.81, indicating a high level of agreement among validators regarding the quality of the questionnaire. Among the criteria, Relevance to Study Objectives and Logical Flow of Items received the highest average ratings, emphasizing the strong alignment of the questionnaire's content with the study's goals.

Table 1 Average Ratings of Content Validators by Criteria

CRITERION	Validator 1	Validator 2	Validator 3	Validator 4	Validator 5	Ave Rating
Clarity of Questions	4	4	4	3	3.4	3.68
Relevance to Study Objectives	4	4	4	4	3.8	3.96
Logical Flow of Items	4	4	4	4	3.6	3.92
Appropriateness Response Scales	3.8	4	4	4	3.6	3.88
Overall Structures	4	4	4	3.8	3.8	3.92
Completeness of the Instrument	3.6	3.8	3.8	3.6	3.4	3.64
Instructions and Guidance	3.8	4	4	3.8	3.6	3.84
Cultural and Contextual Appropriateness	3.4	3.8	3.6	3.4	3.6	3.56
Grand Mean						3.81

However, slightly lower ratings were observed for Completeness of the Instrument and Cultural and Contextual Appropriateness, suggesting areas where refinements were necessary. While content validators suggested categorizing schools by urban or rural settings, the absence of official listings by the division office limited this refinement. This emphasized the importance of aligning instrument design with practical data collection considerations, as highlighted by Taherdoost (2016), who emphasized the role of pilot testing and iterative refinement in questionnaire validation.

4.3.2 Consolidated feedback from content validators. The following table presents the consolidated feedback provided by content validators, summarizing their comments and suggestions regarding the content and structure of the Needs Assessment Questionnaire. The content validation process offered essential insights for refining the questionnaire to better align with the study's objectives. These insights helped ensure that the instrument was both relevant and comprehensive, addressing key areas of inquiry. The feedback also served to improve the clarity and appropriateness of the questions, enhancing the overall quality of the data collection process.

Table 2 below contains key suggestions from validators focused on enhancing clarity, contextual relevance, and thematic organization. For instance, validators recommended adding demographic variables like school location (rural or urban) to reveal location-specific challenges. This was addressed by incorporating a question on school classification. Similarly, open-ended questions were included to explore respondents' experiences and understanding, such as how they integrate SDGs into their teaching practices.

Table 2 Summary of Comments and Suggestions from Content Validators

Validator Comment or Suggestion	Action Taken
Add more demographic variables, such as school location (rural or urban).	Included a question on school classification to account for location-specific challenges
Specify options for Question 3 to guide respondents on SDG-related needs (e.g., workshops, certifications).	Added specific choices such as workshops, seminars, certifications, and degree programs for clarity.
Reorganize challenges and needs into thematic groups.	Questions were grouped into clearer thematic sections to improve logical flow.
Include a brief purpose statement in each section for clarity.	Purpose statements were added to the start of each section to provide context.
Add options to account for local differences in SDG implementation (e.g., rural vs. urban).	Incorporated options to reflect rural and urban teaching contexts.
Add open-ended questions to explore understanding and experiences with SDGs.	Included open-ended items like: “Can you provide an example of how you integrate SDGs into teaching?”
For Question 9, add “access to SDG-specific case studies or real-world examples.”	Revised Question 9 to include “access to SDG-specific case studies” as an option.
For Question 10, add “cross-disciplinary integration of SDGs in teaching” as a training topic.	Revised Question 10 to include cross-disciplinary integration as an additional option.

Validators also highlighted the need for specific examples and options to guide respondents. For instance, Question 3 was revised to include choices such as workshops, seminars, and certifications, providing clarity for respondents unfamiliar with SDG-related professional development opportunities. The inclusion of “cross-disciplinary integration” in Question 10 and “SDG-specific case studies” in Question 9 further aligned the questionnaire with the study’s objectives.

Additionally, structural improvements were made based on feedback to reorganize challenges and needs into thematic sections. Brief purpose statements were added at the start of each section to enhance clarity and guide respondents. These revisions ensured the instrument was logically organized and culturally appropriate for diverse teaching contexts, including rural and urban schools.

Overall, the integration of these comments and suggestions significantly enhanced the questionnaire’s quality and usability. By addressing these areas of improvement, the instrument was refined to capture meaningful and actionable data on the needs of biology teachers in integrating SDG-aligned eco-pedagogical strategies.

4.4 Data Gathering Procedure

The validated questionnaire was disseminated to 15 junior high school biology teachers from five schools in Iligan City, purposively selected to represent small rural and big urban school contexts. The questionnaire included Likert-scale items and open-ended questions. Focus group discussions complemented survey data, enabling participants to elaborate on responses and share experiences. Triangulation of survey and discussion data ensured a holistic analysis.

4.5 Data Analysis

Quantitative data from Likert-scale items were analyzed using descriptive statistics, including frequencies, percentages, standard deviation and mean ratings, to identify trends and

priorities. Qualitative data from open-ended responses and focus group discussions were analyzed thematically to uncover patterns and unique perspectives. To support the reliability of the analysis, similar patterns across sources were checked, and initial interpretations were revisited for consistency and alignment with the data collected.

4.6 Ethical Considerations

Participation was voluntary, and respondents were informed of their right to withdraw at any time. Confidentiality was maintained, with optional disclosure of names. Study objectives and consent forms were provided. The focus group discussions, participants received program details and guiding questions in advance. Modest tokens of gratitude were given as appreciation.

5. Research Findings and Discussions

5.1 Needs Assessment Participants

A researcher-developed and validated questionnaire was administered to 15 biology teachers from different public junior high schools in Iligan City. Following expert validation, the sampling included teachers from urban and rural schools. This represents diverse instructional backgrounds and environmental contexts.

Table 3 Demographic Profile of Biology Teachers

Profile Variable	Category	Frequency	Percent (%)
Sex	Male	1	6.67
	Female	14	93.33
Years of Teaching	0–2 years	2	13.33
	3–5 years	2	13.33
	6–10 years	4	26.67
	11–15 years	7	46.67
Highest Educational Attainment	Bachelor's Degree	4	26.67
	With Master's Units	2	13.33
	Master's Degree	7	46.67
	With Doctoral Units	2	6.67
	Doctorate Degree	0	0.00
School Size	Urban School	9	60.0
	Rural School	6	40.0

All 15 respondents are biology teachers. The majority are female (93.33%) and most have been teaching for 11–15 years (46.67%), indicating a well-experienced group. In terms of education, 46.67% hold a master's degree, and two has taken doctoral units. Most teach in urban schools (60.0%). This suggests a highly educated, predominantly female group of biology teachers working in larger institutions, with solid teaching experience, particularly in the mid-career range of 11 to 15 years. The lower representation (40.0%) is teaching in rural schools, which can be attributed to the common staffing pattern in rural junior high schools typically each school has only one science teacher assigned at every grade level. The teachers in rural schools also demonstrated solid teaching experience in the range of 11-15 years.

5.2 Implementation Results: Teachers' Familiarity with SDGs

The following data summarizes the results of the assessment on teachers' familiarity with specific Sustainable Development Goals (SDGs) 13, 14 and 15.

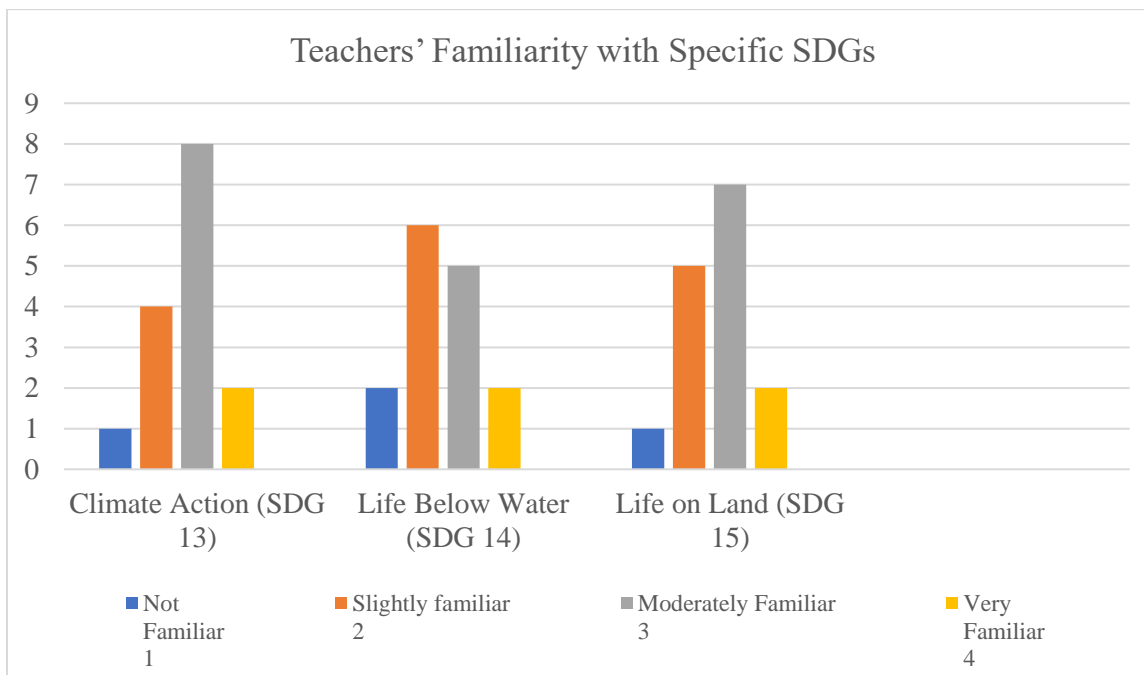


Figure 2 Teachers' Familiarity with Specific SDGs

The results presented in Figure 2 reveal varying levels of familiarity among teachers with the specific SDGs related to Climate Action (SDG 13), Life Below Water (SDG 14), and Life on Land (SDG 15). While teachers appear to have a foundational awareness of these topics, their knowledge is largely conceptual and not explicitly tied to the corresponding SDG numbers. For Climate Action (SDG 13), the mean rating of 2.73 indicates that most teachers are moderately familiar with the topic, with 8 respondents identifying as moderately familiar and 2 as very familiar. This suggests that climate change is widely recognized, but its direct connection to SDG 13 is not fully understood. This finding aligns with the study by Parry and Metzger (2023), which found that teachers are generally more familiar with the environmental dimension of sustainability, including climate-related issues.

Familiarity with Life Below Water (SDG 14) is slightly lower, with a mean rating of 2.47. Six respondents rated themselves as slightly familiar, and 2 admitted being unfamiliar with this SDG altogether. This indicates a significant gap in understanding marine ecosystems and their role in sustainability. This could be attributed to the limited emphasis on marine issues in teaching contexts or training programs. Agirreazkuenaga. (2019) highlighted that SDGs are still largely unknown to teaching staff, suggesting a need for increased awareness and integration of all SDGs, including those related to marine life, into educational frameworks. Similarly, for Life on Land (SDG 15), the mean rating of 2.67 reflects moderate familiarity, with 7 respondents rating themselves as moderately familiar and 2 as very familiar. While teachers generally understand topics related to biodiversity and terrestrial ecosystems, their awareness of its link to SDG 15

remains limited. This observation is supported by Anyolo et al. (2018), who found that teachers often recognize the importance of sustainability topics but may lack specific knowledge or resources to effectively integrate them into their teaching practices.

Overall, none of the three SDGs achieved a mean rating of 3.0 or higher, which would indicate strong familiarity. This is consistent with the findings of Jimenez and Babaran (2024), who observed varying levels of knowledge among teacher education students regarding the Sustainable Development Goals, with less emphasis on goals such as SDG 14 and SDG 15 in teacher training curricula. In addition, the study of Tusoy, Gueco, et.al (2024) found that familiarity with SDG 14 remained low among Filipino teacher education students, with a mean rating of 2.47. Six respondents considered themselves slightly familiar, while two admitted being unfamiliar with the goal altogether. This suggests a notable gap in understanding marine ecosystems and their relevance to sustainability. The authors attributed this gap to the limited focus on marine-related issues within teacher training programs. They emphasized the need for professional development and curriculum revisions to better integrate all Sustainable Development Goals (SDGs), particularly those like SDG 14 that are often overlooked in education contexts. This emphasizes the need for targeted professional development programs and curriculum enhancements that explicitly introduce SDGs and their application to biology teaching. Addressing these gaps, particularly the low familiarity with marine topics under SDG 14, can help teachers build a deeper understanding of sustainability concepts and effectively integrate them into their classrooms. These findings highlight the importance of bridging the gap between general environmental awareness and the formal frameworks of SDGs to empower teachers in fostering sustainability education. Purwianingsih, et al. (2021) emphasized the importance of integrating Education for Sustainable Development (ESD) into teacher education programs to enhance teachers' competencies in delivering sustainability content.

5.3 Implementation Results: Teachers' Examples of Integrating SDGs into Teaching Practice

The table 4 outlines examples of how teachers have integrated Sustainable Development Goals (SDGs) into their teaching practices. While some of these examples may not fully align with specific SDGs, the teachers believed that these practices contribute to promoting sustainability.

Table 4 Teachers' Examples of Integrating SDGs into Teaching Practice

Themes	Responses
Renewable Energy and Climate Action	"I will integrate the renewable energy in our community."
	"Conduct hands-on activities to demonstrate greenhouse effect, research topics like renewable energy, waste reduction, deforestation."
	"Let students write an action plan on global climate solutions and protecting ecosystems."
	"Provide short videos on climate action and discuss why climate change is a global issue."
	"Integrate climate action in Quarter 3, which is about climate and climate change."
	"Teach students about climate change."
Local and Contextualized Examples	"Introduce topics that make use of local materials."

Themes	Responses
Experiential Learning Activities	"Incorporating contextualized examples that target specific SDGs to support curriculum topics and activities."
	"Give real-life examples and assign performance tasks emphasizing SDGs."
	"Teach learners about proper waste disposal, tree planting activities."
	"Give case study analyses on protecting rainforests."
	"Let students do backyard documentation on plant and animal species and note potential threats."
	"Collaborate on sustainability initiatives."

The responses to the question, *"Can you provide an example of how you integrate SDGs into your teaching practice?"* revealed a mix of promising ideas and areas for improvement in teachers' approaches to incorporating sustainability concepts. The examples provided by the respondents highlighted three key themes: renewable energy and climate action, local and contextualized examples, and experiential learning activities. Many teachers focused on topics related to renewable energy, climate change, and ecosystem protection, which are closely aligned with SDG 13 (Climate Action) and SDG 15 (Life on Land). Activities such as creating action plans, conducting hands-on experiments, and assigning performance tasks were frequently mentioned, demonstrating a willingness to engage students actively in sustainability initiatives. This aligns with recent findings by Duran and Mariñas (2024), who reported that teachers' intentions to integrate sustainability are often influenced by personal motivation and perceived support within the institutional framework. This also aligns with findings by Wals and Benavot (2017), who emphasized that educators often prioritize environmental topics that have direct, observable relevance to their communities.

Several teachers emphasized the use of local materials and real-life examples, aligning with the principles of contextualized learning. These responses suggest a strong inclination toward making lessons relevant and tangible for students, which is crucial for fostering meaningful connections to SDGs. Studies by Smith and Sobel (2010) have shown that place-based and contextualized learning approaches deepen students' understanding of global sustainability issues by anchoring them in their local environments. Similarly, Cordova (2024) emphasized the role of subject-specific contextualization in making sustainability education meaningful, even in non-science subjects like English, reinforcing its interdisciplinary relevance. Additionally, experiential learning activities, such as tree planting, case study analyses, and documenting local biodiversity, were highlighted as practical approaches to sustainability education. These activities reflect a commitment to engaging students in real-world actions that promote environmental stewardship.

However, a notable gap emerged in the explicit integration of SDGs into teaching practices. While many responses described general environmental education topics, few explicitly referenced SDGs or their formal framework. For instance, although climate change and waste management are inherently linked to SDG 13 and SDG 15, the lack of deliberate framing within the SDG framework indicates limited awareness or training on this aspect. This finding echoes observations by Leicht et al. (2018), who noted that teachers often face challenges in incorporating SDG-specific content due to insufficient training and the absence of curriculum-aligned resources. This is consistent with Plando (2024), who found that teachers' SDG-related performance often hinges

on institutional support, training, and access to concrete materials and resources. One respondent mentioned incorporating SDGs into curriculum topics, but this appears to reflect personal initiative rather than a standardized part of the curriculum.

These findings highlight the need for professional development programs to bridge the gap between general sustainability topics and the explicit integration of SDGs into teaching practices. Workshops, exemplar lesson plans, and curriculum resources on SDG-aligned strategies could empower teachers to make the connection between their current practices and the broader sustainability goals. By equipping teachers with the necessary tools and knowledge, schools can enhance the alignment of classroom activities with global initiatives, fostering a more structured approach to SDG integration in biology education.

5.4 Implementation Results: Teachers' Challenges in Teaching SDG-Aligned Biology Lesson

The results in Table 5 highlight the extent to which various challenges hinder teachers' ability to teach SDG-related content in biology. Among the identified challenges, Limited Time to Cover Additional Topics emerged as the most significant challenge, with a mean rating of 3.33 and standard deviation of 0.98. This finding is supported by the study of Timm and Barth (2020), which reported that educators often struggle to balance the inclusion of sustainability topics with existing curricular demands. Similarly, UNESCO (2021) emphasizes that integrating Education for Sustainable Development (ESD) requires time adjustments within overloaded curricula, suggesting the need for curriculum redesign to effectively include SDG-related content.

Table 5 Extent of Challenges in Teaching SDG-Related Content in Biology

Challenges	Not a Challenge 1	Minor Challenge 2	Moderate Challenge 3	Significant Challenge 4	Mean Rating	Standard Deviation (SD)	Rank
Limited time to cover additional topics	0	1	8	6	3.33	0.98	1 st
Insufficient training on SDGs	0	1	9	5	3.27	0.88	2 nd
Inadequate support from school administration	1	3	6	5	3.0	1.2	3 rd
Lack of teaching resources	0	4	8	3	2.93	1.0	4.5 th
Insufficient knowledge on SDGs	1	3	9	2	2.93	0.95	4.5 th
Insufficient access to professional development	3	1	9	2	2.67	1.4	6 th

Insufficient Training on SDGs, with a mean rating of 3.27, underscores the necessity for targeted professional development. This finding corroborates with the study of Anyolo et al.

(2018), who found that teachers' preparedness to integrate sustainability topics is directly influenced by their training and exposure to SDG concepts. The authors advocate for professional development programs tailored to equip teachers with the skills and confidence to integrate SDG-aligned content effectively.

Inadequate Support from School Administration, reflected by a mean rating of 3.00, suggests that institutional support plays a critical role in enabling teachers to adopt SDG-aligned strategies. This finding aligns with the study by Anyolo, et al. (2018), which highlighted that supportive leadership is crucial for fostering Education for Sustainable Development (ESD). Their research emphasized the role of school administrators in providing resources, creating opportunities for professional development, and motivating teachers to implement sustainability-focused practices effectively.

Although Lack of Teaching Resources and Insufficient Knowledge on SDGs both had a mean rating of 2.93, the results indicate that these challenges are moderate to significant for many respondents. This finding is supported by Anyolo, et.al. (2018), who emphasized that limited access to teaching resources and insufficient understanding of sustainability concepts hinder teachers' ability to implement sustainable development goals. Their study highlighted the importance of providing high-quality, SDG-aligned teaching materials to enhance teacher preparedness and effectiveness in delivering sustainability-focused lessons.

Furthermore, the issue of Insufficient Access to Professional Development, with a mean rating of 2.67, remains a moderate challenge. This aligns with the findings of Hamwy et al. (2023), who reported that inadequate training opportunities prevent teachers from effectively integrating SDG-related content into their teaching practices. Their study in Qatar emphasized the need for targeted professional development programs tailored to the unique needs of teachers in diverse educational contexts.

5.5 Implementation Results: Barriers Encountered in Aligning Biology Lessons with SDGs

The following data in table 6 presents the barriers encountered by teachers in aligning biology lessons with the Sustainable Development Goals (SDGs), emphasizing the challenges faced during the implementation process.

Table 6 Specific Barriers Encountered in Aligning Biology Lessons with SDGs

Barriers	Number of respondents (checked)	Percentage	Rank
Limited access to context-specific examples or case studies	11	73	1 st
Student resistance or lack of interest in SDG-related topics	10	67	2 nd
Difficulty in designing lessons that integrate SDGs with biology	9	60	4 th
Insufficient collaboration opportunities with other educators	9	60	4 th
Lack of alignment between the current curriculum and SDG-related topics	9	60	4 th
Other barriers (please specify)	0	0	7 th

The results in Table 6 provide insight into the specific barriers that biology teachers face when attempting to align their lessons with SDGs. The most frequently reported barrier, identified by 73% of respondents, was Limited Access to Context-Specific Examples or Case Studies. This finding underscores the need for localized teaching materials and resources that can help teachers contextualize SDG-related topics for their students. Without relevant examples, teachers may struggle to make lessons relatable and impactful.

Student Resistance or Lack of Interest in SDG-Related Topics was the second most common challenge, noted by 67% of respondents. This highlights the importance of designing engaging and student-centered activities that emphasize the relevance of SDGs to real-world issues. Addressing this resistance may require innovative instructional strategies, such as interactive projects, multimedia resources, and experiential learning opportunities.

Several barriers were equally cited by 60% of respondents, including Difficulty in Designing Lessons that Integrate SDGs with Biology, Lack of Alignment Between the Current Curriculum and SDG-Related Topics, and Insufficient Collaboration Opportunities with Other Educators. These challenges point to systemic issues within the curriculum and the broader educational framework. Teachers need professional development opportunities that equip them with the skills to integrate SDGs effectively, as well as collaborative platforms to share best practices and resources with their peers. Interestingly, none of the respondents identified Other Barriers, suggesting that the listed options captured the most relevant challenges.

These findings are consistent with prior research on barriers to integrating sustainability into education. Verhulst and Lambrechts (2015) identified additional challenges, such as a lack of awareness or knowledge about the principles of sustainable development, resistance to change, lack of senior management support, and insufficient resources, including time, funding, and information. Their findings affirm that systemic and institutional barriers often compound the difficulties teachers face, aligning with the challenges of limited collaboration and curriculum misalignment reported in this study. Foley (2020) identified key obstacles preventing the integration of sustainable development, including the dominant social paradigm, educational structures, and resistance to change within educational institutions. This aligns with the challenges reported in this study, such as curriculum misalignment and insufficient collaboration opportunities. Additionally, Sezen-Gültekin and Argon (2022) explored barriers and facilitators of educational sustainability, emphasizing the need for well-planned integration of sustainable development concepts into teacher education programs.

5.6 Implementation Results: Teachers' Perceived Needs

The following data in table 7 present the teachers' perceived needs for integrating Sustainable Development Goals (SDGs) into their teaching practices, including specific areas where support is required and topics for training that would enhance their capacity to effectively teach SDGs.

Table 7 Importance of Resources for Integrating SDG-Aligned Strategies

Resource	Not Important 1	Slightly Important 2	Moderately Important 3	Extremely Important 4	Mean Rating	Standard Deviation (SD)	Rank
Multimedia teaching materials (e.g., videos)			2	13	3.87	0.0	1 st
Assessment tools aligned with SDGs		1	1	13	3.80	0.2	2.5 th
Professional development workshops/training program		1	1	13	3.80	0.2	2.5 th
Access to SDG-specific case studies		1	3	11	3.67	0.3	4.5 th
Ready-made lesson plans			5	10	3.67	0.3	4.5 th

The results presented in Table 7 highlight the perceived importance of various resources for integrating SDG-aligned strategies into biology teaching. Among the resources, Multimedia Teaching Materials (e.g., videos) were identified as the most important, with a mean rating of 3.87. Thirteen respondents rated this resource as extremely important, emphasizing the value of engaging, visually rich materials in helping students grasp sustainability concepts. This finding aligns with the work of Nugent et al. (2015), who discussed the benefits of multimedia resources in enhancing student engagement and promoting deeper understanding of complex topics, including sustainability. The use of visual and interactive materials significantly boosts motivation and aids in conceptual clarity, especially for abstract or multifaceted issues like SDGs.

Similarly, Assessment Tools Aligned with SDGs and Professional Development Workshops/Training Programs both had a mean rating of 3.80, underscoring the critical role of equipping teachers with the tools and training necessary for effective SDG integration. These results are supported by Guo, Huang, and Chen (2024), who highlighted the importance of professional development and assessment tools in ensuring the integration of sustainability concepts into future science teacher education courses. Their research emphasizes how targeted training and the use of assessment tools can enable teachers to successfully incorporate SDGs into their teaching practices.

Ready-Made Lesson Plans and Access to SDG-Specific Case Studies, each with a mean rating of 3.67, were also rated highly. These findings suggest that teachers appreciate practical, ready-to-use materials that save time while providing structured, context-specific examples. Guo et al. (2024) also support this, highlighting that teachers value comprehensive resources like lesson plans and case studies to integrate sustainability concepts effectively into their teaching. Ready-to-use materials that are contextually relevant help teachers bridge the gap between theoretical knowledge and practical application in the classroom.

Overall, the high ratings across all resources indicate that teachers recognize the need for comprehensive support to align their teaching with SDG principles. These results highlight a strong demand for professional development opportunities, accessible multimedia resources, and structured lesson plans to enhance the integration of SDGs in biology education.

Table 8 below provides insights into the importance of various training topics as perceived by the respondents. Among these, Cross-Disciplinary Integration of SDGs emerged as the most important, with a mean rating of 3.93 and 14 respondents rating it as extremely important. This reflects the growing awareness of the need to connect biology with other disciplines to enhance the relevance and application of SDG concepts in education. This finding is supported by Ferrer-Estévez and Chalmeta (2024), who emphasized that integrating SDG principles into various disciplines fosters a more comprehensive understanding of sustainability challenges. Similarly, Albareda-Tiana et al. (2018) highlighted the value of cross-disciplinary approaches in promoting holistic learning and collaboration.

Table 8 Importance of Training Topics for Integrating SDGs

Training Topic	Not Important 1	Slightly Important 2	Moderately Important 3	Extremely Important 4	Mean Rating	Standard Deviation (SD)	Rank
Cross-disciplinary integration of SDGs			1	14	3.93	1.0	1 st
Basics of Sustainable Development Goals (SDGs)			3	12	3.8	1.2	3 rd
Eco-pedagogical teaching strategies			3	12	3.8	1.2	3 rd
Developing sustainability-focused lessons			3	12	3.8	1.2	3 rd
Transformative learning in science education		1	3	11	3.67	1.0	5 th

Other key training topics, including Basics of SDGs, Eco-Pedagogical Teaching Strategies, and Developing Sustainability-Focused Lessons, all shared a mean rating of 3.80. These results highlight the importance of providing foundational knowledge and practical strategies to empower teachers in implementing SDG-aligned approaches. Mahaffy et al. (2019) noted that systems thinking and practical pedagogical approaches enhance the capacity of educators to teach sustainability. Furthermore, Ferrer-Estévez and Chalmeta (2024) emphasized the need for teacher training programs to provide specific guides and resources that facilitate the adoption of sustainability-focused teaching methods.

Meanwhile, Transformative Learning in Science Education received a slightly lower mean rating of 3.73, but still garnered significant interest, with 11 respondents identifying it as extremely important. This finding suggests that while transformative learning is valued, it may require further emphasis in teacher training programs to ensure effective classroom implementation. Neal (2017)

argued that professional development focused on transformative learning is critical for fostering a mindset shift toward sustainability in both educators and students.

When viewed collectively with the findings in Table 7, the results highlight the pressing need for targeted interventions to support teachers in adopting SDG-aligned strategies. The high demand for multimedia materials and professional development reflects teachers' desire for dynamic, engaging resources and training that address both practical and conceptual aspects of sustainability education. Ferrer-Estévez and Chalmeta (2024) also pointed out that the integration of multimedia and technology can significantly enhance students' acquisition of key competencies in sustainability. The emphasis on cross-disciplinary integration further suggests a recognition of the interconnected nature of SDGs and the value of fostering collaboration across subject areas. Albareda-Tiana et al. (2018) and Ferrer-Estévez and Chalmeta (2024) both argue that interdisciplinary teaching approaches not only improve conceptual understanding but also prepare students to address complex sustainability challenges by promoting critical thinking and problem-solving skills.

These findings provide a roadmap for addressing the perceived needs of biology teachers. Equipping educators with accessible resources, robust training opportunities, and innovative strategies will be crucial in enabling the effective integration of SDG principles into teaching practices. Furthermore, the emphasis on interdisciplinary approaches demonstrates the importance of preparing students to understand and address sustainability challenges within a global and interconnected context.

6. Implications and Future Recommendations

The findings of the study have several practical implications for integrating SDG-aligned eco-pedagogical strategies in teaching biology. Given the identified gaps in familiarity, resources, and training among biology teachers, the following are recommended:

1) Professional Development and Training

Schools and the education sector should organize professional development activities, including workshops and seminars on SDG concepts and eco-pedagogical strategies. Training should also include modules on transformative learning (Mezirow, 1997) and sustainability-focused lesson planning as capacity building for teachers.

2) Curriculum Alignment

There should be a need to advocate for the integration of SDG-related content into the biology curriculum in the junior high school, and to collaborate with curriculum developers to ensure that SDG themes will be reflected in textbooks, teaching guides and in learning outcomes (UNESCO, 2017). This alignment will help institutionalize sustainability related concepts across levels.

3) Resource Development

Teachers should be provided with contextualized materials like videos and case studies linked to local environmental issues. Ready-to-use lesson plans, assessment tools and instructional guides aligned with SDG principles can reduce teacher workload and support effective classroom implementation.

4) Future Research

Future research may focus on evaluating the effectiveness of developed resources and training in improving classroom practices. It is recommended to explore more on SDG alignment and eco-pedagogical strategies.

7. Conclusion

The study assessed the integration needs of junior high school biology teachers for adopting SDG-aligned eco-pedagogical strategies. The findings reveal moderate level of familiarity with SDGs, with teachers showing awareness of general sustainability topics but lacking explicit connections to specific SDG frameworks. Key challenges include limited access to teaching resources, insufficient training, and time constraints, which hinder the effective integration of SDG-aligned strategies into biology education. Despite these barriers, teachers expressed a strong need for multimedia materials, professional development workshops, and ready-made lesson plans to facilitate the adoption of these strategies.

The study also highlighted the importance of targeted training on cross-disciplinary integration, eco-pedagogical teaching strategies, and sustainability-focused lessons. These results underscore the need for systemic support, including curriculum alignment, resource provision, and teacher capacity-building programs, to bridge the gap between existing practices and the demands of SDG-aligned education. The findings of this study serve as a foundation for future efforts to promote SDG integration in education.

8. Acknowledgements

The authors extend their sincere gratitude to the junior high school biology teachers who generously shared their time and insights as participants in this study. Their valuable contributions made this research possible.

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Appendix A

Needs Assessment for Integrating SDG-Aligned Eco-Pedagogical Strategies in Biology

Instruction: This survey aims to assess your knowledge, challenges, and needs related to incorporating SDG-aligned eco-pedagogical strategies into biology teaching. Please respond honestly. Your responses will be kept confidential and will only be used for research purposes.

- For items with scales, select the number that best represents your response.
- For checkboxes, mark all that apply.
- For open-ended questions, provide detailed answers as applicable.

Section 1: Demographic Information

This section gathers background information about your teaching experience and educational qualifications.

1. How many years have you been teaching biology?

- ☐ 0-2 years
- ☐ 3-5 years
- ☐ 6-10 years
- ☐ 11+ years

2. Have you received any formal training on Sustainable Development Goals (SDGs) or environmental education?

- ☐ Yes
- ☐ No

If yes, please specify the type of training you attended.

3. Are you teaching in a rural or urban school setting?

- ☐ Rural
- ☐ Urban
- ☐ Both

Section 2: Familiarity with SDGs

This section explores your familiarity with specific SDGs.

4. Rate your familiarity with the following Sustainable Development Goals (SDGs):

(Scale: 1 - Not familiar, 2 -slightly familiar, 3 – moderately familiar, 4 - Very familiar)

SDG	1	2	3	4
Climate Action (SDG 13)				
Life Below Water (SDG 14)				
Life on Land (SDG 15)				

5. Can you provide an example of how you integrate SDGs into your teaching practice?

Section 3: Knowledge and Practices

6. Rate your confidence in teaching the following aspects of SDG-aligned biology education:

(Scale: 1 - Not confident, 2 - Slightly Confident, 3 - Moderately Confident, 4 - Very confident)

ASPECT	1	2	3	4
Concepts related to sustainability and the environment				
Using eco-pedagogical approaches in teaching biology				
Incorporating SDG-related themes into lessons				

7. How often do you use the following teaching strategies in your biology classes?

(Scale: 1 - Never, 2 - Rarely, 3 - Sometimes, 5 - Very often)

TEACHING STRATEGY	1	2	3	4
Inquiry-Based Learning				
Place-Based Learning				
Project-Based Learning				
Case Study Approach				
Others, please specify:				

Section 4: Challenges

This section identifies the challenges you encounter in teaching SDG-aligned content.

8. What challenges do you face in incorporating SDG-aligned practices into your biology teaching?

9. Rate the extent to which the following challenges hinder your ability to teach SDG-related content in biology:

(Scale: 1 - Not a challenge, 2 - minor challenge, 3 - moderate challenge, 4 - significant challenge)

Challenge	1	2	3	4
Lack of teaching resources				
Insufficient training on SDGs				
Limited time to cover additional topics				
Inadequate support from school administration				
Insufficient knowledge on SDGs				
Insufficient access to professional development				

10. Which specific barriers do you encounter in aligning your biology lessons with SDGs? (Check all that apply)

- ☐ Difficulty in designing lessons that integrate SDGs with biology.
- ☐ Lack of alignment between the current curriculum and SDG-related topics.
- ☐ Limited access to context-specific examples or case studies.
- ☐ Insufficient collaboration opportunities with other educators.

() Student resistance or lack of interest in SDG-related topics.

Other barriers (please specify): _____.

Section 5: Perceived Needs

This section explores the resources and training you perceive as necessary for teaching SDG-aligned content.

11. Rate the importance of the following resources for helping you integrate SDG-aligned strategies into your biology teaching:

(Scale: 1 - Not important, 2 – slightly important, 3 – moderately important, 4 – Extremely important)

Resource	1	2	3	4
Ready-made lesson plans				
Multimedia teaching materials (e.g., videos)				
Assessment tools aligned with SDGs				
Professional development workshops/training program				
Access to SDG-specific case studies				

12. Rate the importance of training on the following topics:

(Scale: 1 - Not important, 2 – slightly important, 3 – moderately important, 4 – Extremely important)

Training Topic	1	2	3	4
Basics of Sustainable Development Goals (SDGs)				
Eco-pedagogical teaching strategies				
Transformative learning in science education				
Developing sustainability-focused lessons				
Cross-disciplinary integration of SDGs				