



# CHALLENGES AND NEEDS IN INTEGRATING SUSTAINABLE DEVELOPMENT GOALS (SDGs) INTO HIGH SCHOOL PHYSICS CURRICULUM: A STUDY IN LHOKSEUMAWE, INDONESIA

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**Abstract.** This study examines the challenges and needs faced by high school physics teachers in Lhokseumawe, Indonesia, regarding the integration of Sustainable Development Goals (SDGs) into their curriculum. A cross-sectional survey using a Likert-scale questionnaire was administered to 11 physics teachers to gather data on key barriers such as time constraints, availability of teaching materials, teachers' understanding of SDGs, facility needs, training requirements, and school policy support. The results reveal that time constraints are perceived as a moderate barrier, with 36.36% of teachers reporting occasional difficulty in managing both the physics curriculum and SDG integration. A significant challenge is the limited availability of teaching materials related to SDGs, as 45.45% of teachers indicated a lack of resources to effectively teach these topics. Teachers also expressed a moderate level of difficulty in understanding SDGs, with 36.36% identifying this as a challenge in their teaching. The study highlighted the strong need for training on SDG concepts, with 45.45% of teachers strongly agreeing on the importance of professional development. Adequate facilities for teaching SDGs were less of an issue, as 36.36% of teachers reported that sufficient facilities were available. Finally, while some school policy support exists, 36.36% of teachers noted that policy alignment with SDG integration is still insufficient. These findings emphasize the need for targeted professional development programs, better teaching resources, and stronger policy support to facilitate the integration of SDGs in high school physics education.

## 1. Introduction

Education plays a crucial role in shaping the understanding and awareness of young generations regarding pressing global issues, including the Sustainable Development Goals (SDGs) set forth by the United Nations (UN)[1]. In the context of physics education, integrating SDGs is not only about introducing students to global challenges but also equipping them with critical thinking skills required to understand and solve complex environmental, social, and economic problems[2]. As a subject that addresses fundamental natural principles, physics offers a unique opportunity to link abstract scientific concepts with real-world problems like climate change, renewable energy, and resource management, which are central to the SDGs[3]. Therefore, integrating SDGs into physics education is of paramount importance, particularly in the context of fostering future generations who are both scientifically literate and socially responsible.

Despite its importance, the integration of SDGs into high school physics education faces significant challenges[4]. One of the primary barriers is the lack of teacher understanding of SDG concepts and how to connect them with the subject matter of physics[5]. Many physics teachers are unfamiliar with the SDGs and struggle to incorporate them into the curriculum in a way that feels both meaningful and achievable. This issue is not isolated to Indonesia but has been identified globally. Teachers in various countries face difficulties in embedding sustainability concepts into their science teaching due to limited professional development opportunities and a lack of clear guidance on integrating these global goals into specific subjects like physics [6]. In the case of Indonesia, a country

with vast geographical and socio-economic diversity, the integration of SDGs in education is further complicated by regional disparities in educational resources and teacher training.

Another significant challenge is the limited availability of teaching materials that effectively support the integration of SDGs into physics education. Most teaching resources are traditionally designed around conventional physics content and do not incorporate global sustainability themes in a relevant way. Research has shown that quality teaching materials that link theoretical knowledge with real-world applications are essential for effective learning [7]. In physics, topics such as renewable energy, climate change, and environmental conservation could be taught through an interdisciplinary approach that ties scientific principles to global sustainability challenges. However, the lack of resources—ranging from textbooks to multimedia tools—often leaves teachers without the necessary tools to connect SDGs to their lessons. This issue is exacerbated by the fact that many teachers report insufficient access to updated and contextually appropriate materials for teaching about sustainability in their classrooms) [8].

Teachers' limited understanding of SDGs is another barrier that affects the integration of these goals into the physics curriculum. Without a strong grasp of sustainability concepts, teachers may be hesitant to integrate SDGs, fearing that they lack the expertise to teach them effectively. This issue is highlighted in a study by Kidd & Kossick (2021), which emphasizes that professional development programs focused on sustainability education are crucial for equipping educators with the knowledge and skills to teach SDGs [9]. In the case of physics teachers in Indonesia, many have limited exposure to SDGs, as these goals are not always part of formal teacher training programs. As such, there is a critical need for tailored training and professional development opportunities that focus on SDGs and their relevance to the physics curriculum. This would enable teachers to confidently incorporate sustainability concepts into their lessons, thereby fostering a generation of students who understand the interconnectedness between science and global challenges.

In addition to understanding the content, adequate facilities and teaching infrastructure are essential for effectively integrating SDGs into physics teaching[6]. While many schools have basic physics laboratory setups, they often lack the specialized equipment or technology needed to demonstrate real-world applications of SDG-related concepts such as renewable energy technologies or environmental monitoring tools. A study by Ruitenber (2019) highlighted that access to up-to-date facilities is a key factor influencing the success of sustainability education[10]. For instance, teaching renewable energy through hands-on experiments or simulations requires specific tools and resources that are often unavailable in schools. The lack of such facilities limits the ability of teachers to deliver engaging, practical lessons that connect scientific theory with sustainable practices.

Finally, school policy support plays a pivotal role in facilitating or hindering the integration of SDGs into the curriculum. While there may be general support for the idea of teaching sustainability, the absence of clear institutional guidelines and a curriculum framework that explicitly incorporates SDGs can leave teachers feeling unsupported. Without strong institutional backing and alignment between educational policies and global sustainability goals, teachers may find it difficult to prioritize SDGs in their teaching. In Indonesia, although there is a national commitment to sustainable development, the integration of SDGs into school curricula has been slow, and many teachers report a lack of policy support from their schools. There is a pressing need for educational policies that explicitly encourage and facilitate the integration of SDGs across subjects, including physics. Policy support could include the provision of funding for resources, mandatory teacher training on sustainability, and the development of curriculum materials that embed SDGs in a meaningful and applicable way.

Given these challenges, this study aims to explore the specific barriers and needs faced by high school physics teachers in Lhokseumawe, Indonesia, in integrating SDGs into their teaching. The findings of this research will not only contribute to the understanding of local challenges but also offer insights into the broader issue of SDG integration in physics education. Understanding these obstacles is crucial for informing the development of policies, professional development programs, and teaching resources that can support teachers in this important educational endeavor. Furthermore, the research aims to highlight how the integration of SDGs in physics education can be enhanced through better

teacher training, the provision of relevant teaching materials, and stronger institutional support, ultimately contributing to the creation of a more sustainable and scientifically informed society.

## 2. Method

This study employs a descriptive qualitative research approach, with a quantitative component through the use of a survey, to analyze the challenges and needs faced by high school physics teachers in integrating Sustainable Development Goals (SDGs) into their curriculum. The research design is a cross-sectional survey, which allows for the collection of data at a single point in time. The population of the study consists of high school physics teachers in Lhokseumawe, Indonesia, with a purposive sample of 11 teachers selected based on their relevance and experience in teaching physics.

The primary data collection instrument is a Likert-scale questionnaire, designed to assess teachers' perceptions and experiences related to various aspects of SDG integration, including time constraints, resource availability, understanding of SDGs, facility needs, training requirements, and institutional support. The questionnaire includes items that measure the level of agreement or disagreement on a 5-point scale, ranging from "strongly disagree" to "strongly agree." This instrument provides quantitative data that is then analyzed using descriptive statistics, including frequency counts and percentage distribution, to gain a clear understanding of the challenges and needs identified by the teachers.

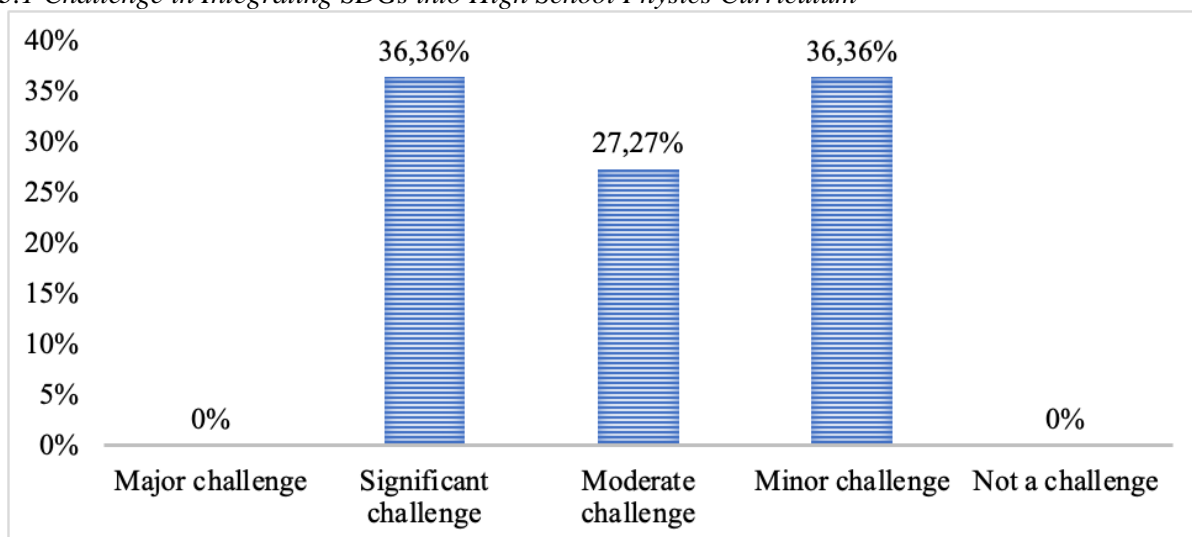
The data collection process involves distributing the questionnaire to the 11 selected teachers, either in person or online, ensuring high participation rates and accurate responses. Prior to the actual data collection, a pilot test was conducted to ensure the clarity and relevance of the questionnaire. The data collected from the survey is analyzed descriptively to identify trends and patterns in teachers' responses, which are then presented in tables or graphs to provide a clear overview of the findings.

Ethical considerations in this study include obtaining informed consent from participants, ensuring the confidentiality of their responses, and using the data solely for academic purposes. Teachers were fully informed about the study's aims and procedures, and their voluntary participation was emphasized.

While the small sample size of 11 teachers limits the generalizability of the findings, the study provides valuable insights into the challenges and needs of physics teachers in integrating SDGs. The results of this study can inform recommendations for policy improvements, professional development, and curriculum design aimed at enhancing the integration of SDGs into high school physics education.

## 3. Result and Discussion

### 3.1 Challenge in Integrating SDGs into High School Physics Curriculum

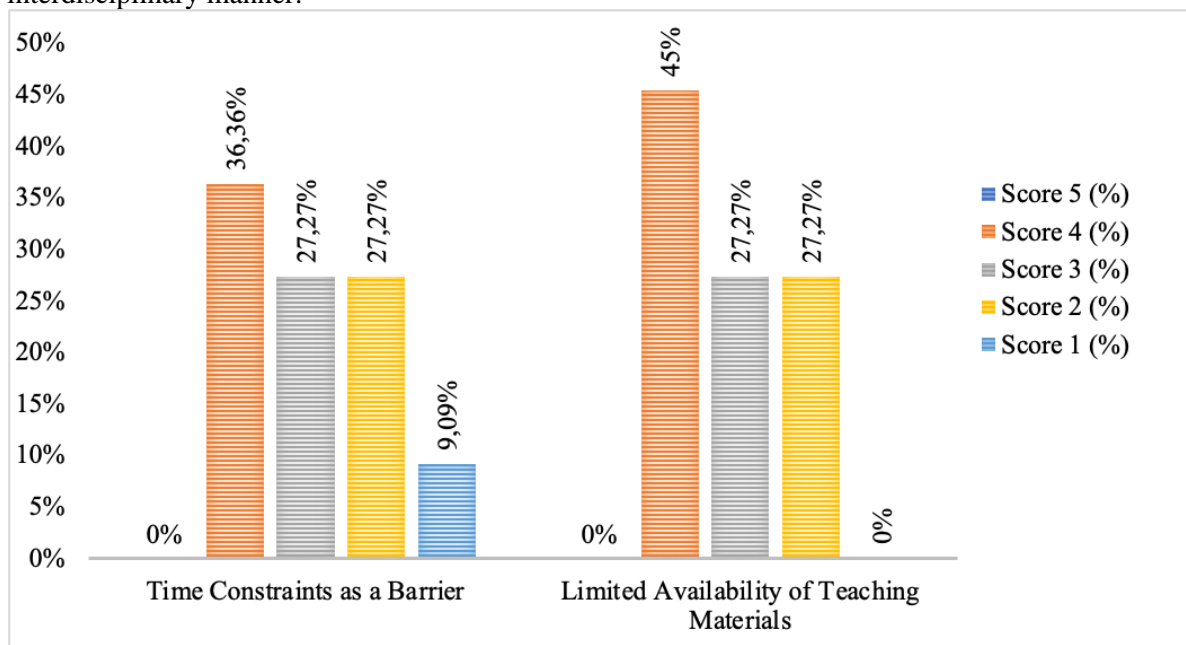


**Figure 1.** Teachers' Perception of SDGs as a Challenge to Integration with Physics

The data reveals that teachers' perception of SDGs poses a significant challenge in their integration into physics education. With 36.36% of teachers reporting moderate understanding (Significant Challenge) and 36.36% feeling they had insufficient perception (Minor Challenge), it is clear that professional development on SDGs is essential. The gap in perception might be due to the complexity of SDGs, which require a deep understanding of global issues across multiple disciplines.

In the context of physics, SDGs may not always seem immediately relevant, as they require knowledge of other domains such as economics, environmental science, and policy. Teachers may struggle to see how to connect SDGs with the highly technical and quantitative nature of physics topics. In addition to professional development in SDGs, teachers would benefit from specialized training in interdisciplinary teaching strategies. This would help them link physical concepts with global sustainability challenges, thereby making SDGs more accessible and relevant to physics students.

Additionally, the findings reflect the necessity of creating a shared understanding of SDGs across the education system, not just within the science curriculum but also in areas such as social sciences and geography. Providing teachers with a holistic view of SDGs, including their social, economic, and environmental dimensions, can improve their ability to teach SDGs in a more interconnected and interdisciplinary manner.

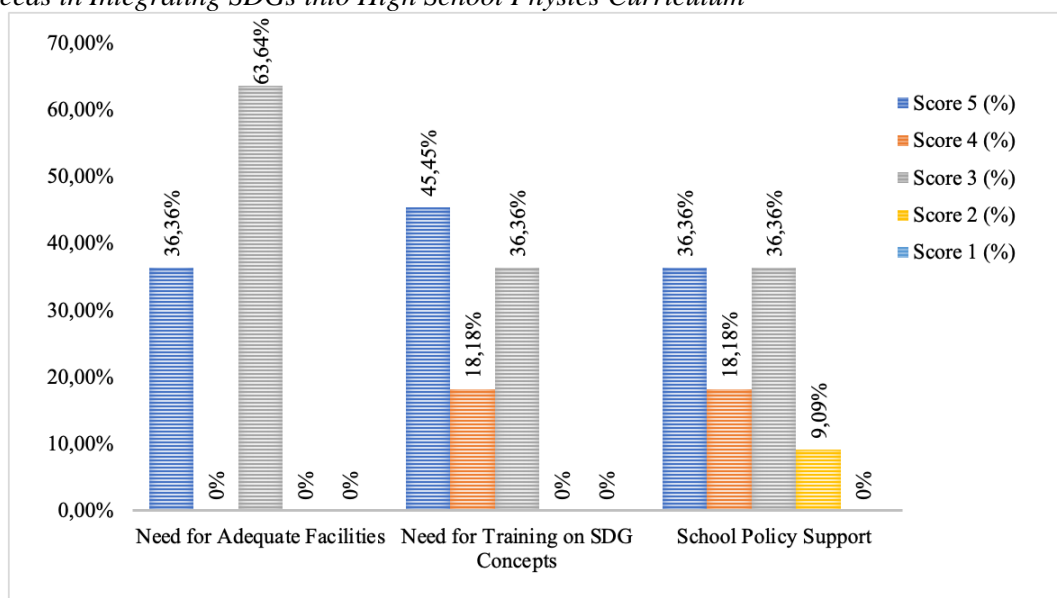


**Figure 2.** Challenges in Integrating SDGs into High School Physics Curriculum

Time constraints were identified as a significant barrier in integrating SDG concepts, with a majority of teachers perceiving this as a moderate issue (36.36% at Score 4) or somewhat of a challenge (27.27% at Score 3 and Score 2). The relative absence of responses indicating "no issue" (Score 1) suggests that teachers recognize the time-consuming nature of adapting existing curricula to include SDGs, which could require reworking lesson plans or additional preparation for specialized content related to sustainable energy, climate change, and global sustainability. Globally, time constraints in education are a well-documented barrier to the incorporation of interdisciplinary topics like SDGs. In many educational settings, the pressure to meet standard curriculum requirements, especially in subjects like physics, can restrict opportunities for teachers to introduce new, global themes. This issue is particularly pertinent in physics, where topics are often taught in a very structured, concept-driven manner. One potential solution could be the integration of SDGs into existing topics, such as linking climate change (SDG 13) with concepts in thermodynamics or energy systems, thereby reducing the need for additional time allocation. Furthermore, supporting flexible curricula or the inclusion of SDG-based modules that can complement standard physics topics could provide a more sustainable way forward.

The lack of adequate teaching materials to support SDG integration is a prominent issue, with 45.45% of teachers acknowledging moderate limitations (Score 4) in access to relevant resources. While 27.27% identified a more significant limitation (Score 2), none indicated that they had no limitations (Score 1). The absence of Score 5 responses suggests that teachers might have some basic resources (e.g., general science textbooks or online resources) but feel they are insufficient for effectively addressing SDGs. The scarcity of teaching materials tailored to SDG education is a challenge recognized in many regions. According to the UNESCO Education for Sustainable Development (ESD) framework, there is a pressing need for resources that not only convey scientific knowledge but also foster critical thinking, global awareness, and active participation in sustainability efforts. Teachers could benefit from specialized teaching materials such as SDG-aligned curriculum guides, interactive tools (e.g., simulations and case studies), and real-world examples that connect physics concepts to global issues. Additionally, collaboration between educational stakeholders (government agencies, NGOs, and international organizations) could facilitate the development and distribution of such resources, ensuring that teachers are equipped with the necessary tools to effectively teach SDGs.

### 3.2 Needs in Integrating SDGs into High School Physics Curriculum



The need for adequate facilities to support SDG integration, particularly those related to renewable energy and environmental science, is highlighted by the 36.36% of teachers who rated it as crucial (Score 5). While there are no extreme limitations (Score 2 or 1), the overwhelming response (63.64%) of moderate need (Score 3) suggests that schools lack some essential physical or technological infrastructure. This might include access to laboratories, renewable energy equipment for demonstrations (e.g., solar panels, wind turbines), or computing resources for simulations and data analysis. Research supports the idea that hands-on, interactive learning experiences significantly enhance students' understanding of complex topics like SDGs. For physics educators, having access to modern laboratories and teaching tools that reflect real-world renewable energy technologies would make SDG concepts more tangible for students. Educational policymakers should prioritize investment in these facilities, as they are integral to fostering an engaging and effective learning environment for SDG-based education.

Training was the most strongly identified need, with 45.45% of teachers acknowledging a high need for professional development on SDGs. This high demand for training is consistent with global trends, where many teachers feel unprepared to integrate SDGs due to a lack of knowledge and resources. The fact that 36.36% rated the need as moderate (Score 3) underscores that even teachers

who are somewhat familiar with SDGs still seek further support in implementing them effectively in their teaching practice.

Professional development programs must be designed to bridge the gap between theoretical understanding and practical application. Training could focus on a range of areas, from understanding the SDGs in the context of physics to developing skills for creating interdisciplinary lesson plans that integrate SDG themes. Furthermore, workshops and online courses could be offered to provide teachers with the tools they need to embed SDGs in their everyday teaching practices.

School policy support is another critical factor in the integration of SDGs, with 36.36% of teachers indicating that school policy provided sufficient support (Score 5), and another 36.36% reporting moderate support (Score 3). While this suggests that institutional backing exists to some degree, the lack of stronger consensus in Score 5 responses indicates that there may be room for improvement. School policies that clearly promote SDGs and provide explicit guidelines for integration would help educators align their teaching with global sustainability goals more effectively. Educational authorities should work with schools to establish clear and supportive policies for SDG integration. This could involve setting curriculum expectations, providing incentives for teachers, or establishing partnerships with external organizations that specialize in sustainability education. Ensuring that SDGs are embedded into the institutional framework of schools will encourage teachers to prioritize their integration.

The study reveals that while high school physics teachers in Lhokseumawe, Indonesia, recognize the importance of integrating SDGs into their curriculum, they face several barriers, including time constraints, limited resources, gaps in understanding, and inadequate institutional support. To address these challenges, it is essential for stakeholders—governments, educational authorities, and professional organizations—to prioritize professional development, provide access to relevant teaching materials, and invest in school infrastructure.

Furthermore, facilitating interdisciplinary teaching and promoting a whole-school approach to SDG education will empower teachers to incorporate sustainability into their lessons more effectively. By addressing the needs outlined in this study, we can create an educational environment where SDGs are not only taught but embraced by both teachers and students, ultimately contributing to the global effort toward sustainable development.

#### 4. Conclusion

Based on the findings of this study, it can be concluded that while high school physics teachers in Lhokseumawe, Indonesia, recognize the importance of integrating the Sustainable Development Goals (SDGs) into their teaching, they face significant challenges. Time constraints are seen as a moderate barrier, with many teachers reporting difficulty balancing the physics curriculum with SDG integration. Additionally, the lack of relevant and accessible teaching materials for SDGs is a major challenge, as most teachers indicated limited resources to effectively teach these topics.

Teachers' understanding of SDGs also poses a barrier to integration, with many feeling the need for further training on these concepts. This highlights a strong demand for professional development programs that would enhance teachers' understanding and their ability to teach SDG-related content effectively.

In terms of facilities, most teachers reported that the available facilities are adequate for physics instruction, but there is still a need for further development of teaching tools and technologies related to SDGs. While there is some institutional support for SDG integration, many teachers feel that existing school policies are insufficient to fully support the widespread and structured implementation of SDGs within the physics curriculum.

Overall, the study indicates that while challenges exist, high school physics teachers in Lhokseumawe are eager to integrate SDGs into their teaching. To support this, targeted professional development, the creation of relevant teaching materials, and stronger school policies are needed to ensure that SDGs can be effectively and sustainably integrated into physics education.

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