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Siti Nurawaliyah
*Department of Science
Education,
Universitas Garut,
Indonesia*

Shinta Purnamasari*)
*Department of Science
Education,
Universitas Garut,
Indonesia*

Abdul Latip
*Department of Science
Education,
Universitas Garut,
Indonesia*

FEASIBILITY AND READABILITY OF EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD) BASED MODULE ON GLOBAL WARMING MATERIAL GRADE VII

Abstract: This research and development (R&D) aimed at creating an Education for Sustainable Development (ESD) based module for seventh-grade global warming material that has good feasibility and readability. The research process involves preliminary studies, planning, draft development of the product, initial field trials, and revisions based on trial results. During the initial field trial stage, an assessment of the module's feasibility and readability was conducted. The data sources for this research include experts and students. Data collection was carried out using feasibility assessment sheets, readability question sheets, and readability questionnaires. The results of the module feasibility assessment yielded an average final score of 88.25%, interpreted as excellent. Similarly, the results of the module readability test showed an average final score of 88.44%, also interpreted as excellent.

Keyword: Feasibility, Readability, ESD based Modules, Global Warming

*) Correspondence Author:
shintapurnamasari@uniga.ac.id

INTRODUCTION

Quality education is one of the goals of the 2030 Education Agenda to achieve the Sustainable Development Goals (SDGs). This can be achieved by directing or guiding learners towards sustainable living in their educational process. Education that can realize these SDGs is known as Education for Sustainable Development (ESD). ESD can develop specific learning outcomes needed to achieve certain SDGs. ESD can also develop multifunctional competencies that are not only relevant to specific SDGs but also to all SDGs (Karaarslan & Teksöz, 2016; Purnamasari & Nurawaliyah, 2023). The implementation of ESD can be done in various ways, such as integrating SDGs into the curriculum, teaching materials, or teacher education (UNESCO, 2017).

One of the topics in science learning that aligns with the SDGs is Climate Action, focusing on the topic of global warming. The learning objective of SDG 13 is to enable the swift adoption of measures to mitigate climate change and its impacts. In addressing climate change resulting from global warming, learners must possess adequate knowledge regarding the causes of global warming, the processes involved, and the side effects on life and ecosystems. However, learners often encounter difficulties in mastering the knowledge necessary for taking action in this regard (Hasibuan et al., 2022; Wardoyo, 2023). Consequently, the topic of global warming is considered challenging for learners and results in learning outcomes that fall short of expectations (Afeni et al., 2020; Arizah & Admoko, 2023; Hasibuan et al., 2022).

During the learning process, there exists an interactive relationship between learners and educators or learners and learning resources. Herein lies the role of educators in integrating ESD into the learning process, one of which involves integrating ESD into learning resources or materials. Modules represent one type of instructional material available and are assessed to possess numerous advantages. According to Lubis et al., (2021) modules that are comprehensively and systematically structured can assist learners in achieving learning objectives. Through the use of modules, learners are enabled to engage in self-directed learning at their own pace. Other advantages of modules include their straightforward content, ability to address time allocation constraints, enhancement of learner motivation, and facilitation of independent learning assessment (Prastowo, 2015). Thus, the utilization of ESD-integrated modules supports the learning process while instilling sustainability values in learners.

However, ESD-based modules on the topic of global warming are still relatively scarce. Some ESD-based modules that are available are primarily focused on other topics such as water, ecology, and biotechnology (Fitria et al., 2022; Fitriyanur & Hamdu, 2021; Rahman et al., 2019). The limited availability of modules on the topic of global warming is further supported by research findings conducted by Afeni et al., (2020), which suggest that supporting materials such as modules and other instructional resources on global warming are still incomplete. This inadequacy results in both educators and learners encountering difficulties in the teaching and learning process as they are still reliant on limited textbook resources. Similar outcomes are also evident from field surveys conducted in schools. Based on a field survey involving 12 junior high school science teachers, 50% of them expressed that ESD-based modules or instructional materials are still highly limited. Consequently, they encounter challenges in implementing or integrating ESD into classroom instruction. This underscores the importance of developing ESD-based modules on global warming materials for middle school students.

A good module must meet the criteria of instructional material feasibility to be utilized by both learners and educators in the learning process. In addition to meeting feasibility criteria, a good module must also meet readability criteria. According to Nurdiana et al. (2016), one criterion of a good module is that its readability level should be satisfactory. Readability refers to the overall aspects present in a text or manuscript that influence the reader's success in comprehending the text or manuscript at an optimal reading pace. Based on the aforementioned exposition, it is

necessary to develop ESD-based modules on seventh-grade global warming material that possess both feasibility and good readability.

METHODS

In this study, the Research and Development (R&D) research method by Borg and Gall, limited to the fifth step, was employed. According to Sukmadinata (2016), research and development, or R&D, constitutes a series of processes aimed at developing a new product or refining existing ones, which can be considered or justified. The steps of this research consist of preliminary studies, planning, product draft development, initial field trials, and revising trial results. The identification of the availability of ESD-based teaching materials on global warming topics and field surveys related to the integration of ESD in science education were conducted during the preliminary study phase. Subsequently, during the planning phase, the development of ESD-based modules on global warming for seventh-grade middle school was planned. Planning included mapping competencies and learning objectives in line with SDG 13 (climate action), mapping important concepts related to global warming, and designing tasks to be presented in the module. During the product draft development stage, drafting and optimization of ESD-based modules on global warming material were carried out based on the criteria of a good module. In the initial field trial phase, the feasibility assessment by experts and module readability tests were conducted, with data sources comprising 3 university lecturers and 3 middle school science teachers as experts, and 34 students as readability test respondents. Based on the data from the initial field trials, revisions were made to the developed ESD-based module. Instruments utilized during the initial field trial stage include feasibility assessment sheets, readability items test, and readability questionnaires. Data obtained using these instruments were then converted into percentages and interpreted into categories as presented in Table 1.

Table 1. Interpretation of Module Feasibility and Readability

Percentage (%)	Interpretation
$80 < P \leq 100$	Excellent
$60 < P \leq 80$	Good
$40 < P \leq 60$	Fair
$20 < P \leq 40$	Poor
$0 < P \leq 20$	Very poor

(Source: Lubis *et al.*, 2021)

RESULTS AND DISCUSSION

1. Results

a. Feasibility of ESD-Based Modules on Global Warming Materials

The development of the module resulted in a product in the form of an ESD-based module on the topic of global warming. According to Prastowo (2015), a comprehensive module comprises various essential components. These components, delineating the module's structure, encompass the title, basic competencies, instructional content, supplementary information, exercises or tasks, and assessment. In this study, the module title is prominently featured on the module's cover, facilitating a clear representation of its contents through the cover pages, as depicted in Figure 1.

The subsequent component in the developed module is the competencies to be achieved after studying the module. This section includes the Core Competencies (KI), Basic Competencies (KD), Competency Achievement Indicators, and Learning Objectives, as depicted in Figure 2. The selected Basic Competencies are 3.9 and 4.9 for the seventh-grade Science subject are presented

in Table 2. Following this, the instructional content component comprises knowledge, skills, and attitudes that learners must acquire and master. The instructional content in the developed module encompasses greenhouse effect, causes and impacts of the greenhouse effect, global warming, causes and impacts of global warming, and efforts to mitigate global warming. Some parts of the instructional content contained within the module are illustrated in Figure 3.

Table 2. The Competencies in the ESD-Based Module

Core Competencies (KI)	Basic Competencies (KD)
3. Memahami dan menerapkan pengetahuan (faktual, konseptual, dan prosedural) berdasarkan rasa ingin tahunya tentang ilmu pengetahuan, teknologi, seni, budaya terkait fenomena dan kejadian tampak mata.	3.9 Menganalisis perubahan iklim dan dampaknya bagi ekosistem (Analyzing climate change and its impacts on ecosystems)
4. Mengolah, menyaji, dan menalar dalam ranah konkrit (menggunakan, mengurai, merangkai, memodifikasi, dan membuat) dan ranah abstrak (menulis, membaca, menghitung, menggambar, dan mengarang) sesuai dengan yang dipelajari di sekolah dan sumber lain yang sama dalam sudut pandang/teori.	4.9 Membuat tulisan tentang gagasan adaptasi/penanggulangan masalah perubahan iklim. (Writing ideas for adaptation/mitigation of climate change issues)

The exercise or task component in the developed module encompasses greenhouse effect experimentation activities and the identification of several cases related to the greenhouse effect and global warming, as depicted in Figure 4. Subsequently, Figure 5 presents the supporting information component incorporated into the developed module. This supporting information includes aspects of ESD integrated into the module, essential information containing additional details related to the module's content, and a glossary. The ESD-based module developed integrates Sustainable Development Goals (SDGs) into its instructional content. The SDG chosen for the development of this module is goal number 13 concerning climate action. The final component in the developed module is assessment in the form of formative tests, as illustrated in Figure 6. These formative tests serve to measure learners' proficiency in mastering the content contained within the module.



Figure 1. Cover of the Module Being Developed

Figure 2. Competencies in the Modules Developed

Figure 3. Instructional Content in the Module Being Developed

Figure 4. Exercises or Tasks in the Developed Module

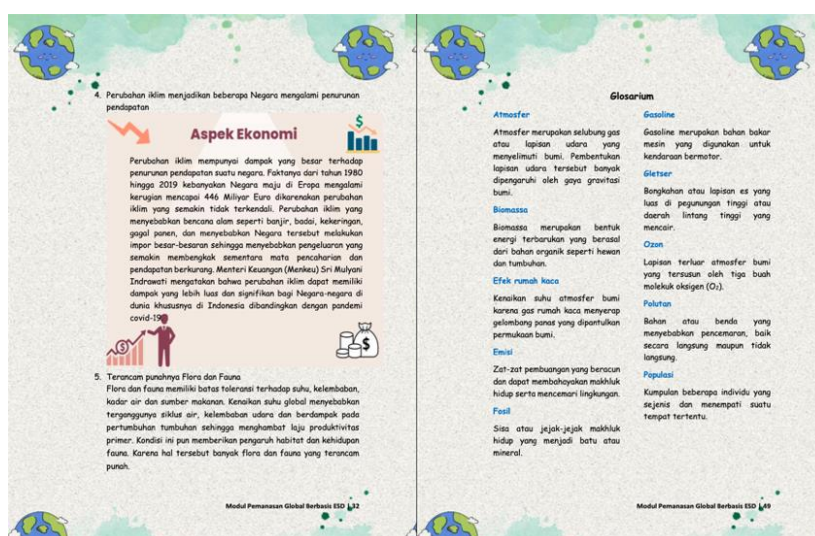


Figure 5. Supporting Information in the Developed Module



Figure 6. Formative Tests in the Developed Module

Following the completion of the ESD-based module on global warming material, the next step involves assessment to determine the feasibility of the developed module. Module feasibility assessment is conducted using expert assessment sheets. Table 3 presents the results of the feasibility assessment of the developed module.

Table 3. Module Feasibility Assessment Results

No	Module Qualification Assessment	Percentage (%)
1	Content Eligibility	96,75
2	Language Qualification	83
3	Presentation Validity	85
Average		88,25

b. Readability of ESD-Based Modules on Global Warming Material

In addition to assessing the feasibility of the module, an evaluation of the readability of the developed module is also conducted. Module readability assessment is carried out using essay

questions and readability questionnaires as instruments. The results of the readability assessment of the developed module can be observed in Table 4.

Table 4. Module Readability Test Results

No	Module Readability Assestment	Percentage (%)
1	Readability Items Test	89,46
2	Readability Questionnaire	87,42
	Average	88,44

2. Discussion

Modules, as a form of instructional material playing a crucial role in the learning process, must meet certain feasibility criteria. The feasibility of the module assessed in this study includes content eligibility, linguistic qualification, and presentation validity. According to Table 2, the aspect of content eligibility obtained the highest percentage, at 96.75%. This indicates that the developed module exhibits excellent content eligibility. The developed module is deemed consistent with curriculum demands, presenting accurate and appropriate information, aligned with ESD concepts, meeting learners' needs, and adhering to concept hierarchy. Sari *et al.* (2019) assert that a well-structured module should be aligned with curriculum requirements and learners' needs. The concepts presented in the module should adhere to a concept hierarchy. Modules organized from simple to complex concepts, from basic knowledge to application, facilitate learners in comprehending the module content (Metasari *et al.*, 2019).

The next aspect of feasibility is linguistic qualification. According to Table 2, linguistic qualification obtained a percentage of 83%. Despite receiving the lowest percentage among the three assessed feasibility aspects, this aspect still falls within the criteria of excellent. This implies that the language used in the module adheres to PUEBI standards, employing simple and effective sentence structures that are communicative. The use of appropriate language, sentence structures, and vocabulary aids learners in comprehending the module content (Purnamasari, 2020). It is advised that sentences or paragraphs within the module should not be excessively long or short. Sentences in the module should be clear, concise, and straightforward to ensure learners feel comfortable while reading the module (Sari *et al.*, 2019).

Based on Table 2, the presentation aspect of the module obtained an average percentage of 85% with an excellent interpretation. The developed module is evaluated to have excellent and appealing presentation in terms of typography, images, colors, and layout. Presentation utilizing an attractive combination of colors and images creates a pleasant impression and encourages learners to explore information aligned with the module's development objectives (Sari *et al.*, 2019). An engaging module presentation also aids learners in focusing attention and building motivation to read and retain the lesson materials within the module (Purnamasari, 2020; Sari *et al.*, 2019). The average validity assessment results yielded a percentage of 88.25% with an excellent interpretation.

Module readability refers to learners' ability to comprehend and understand the content and purpose of the developed module. According to Gül (2021) module readability can be assessed using readability testing instruments, encompassing aspects such as the ease of understanding the language used, the level of difficulty of the material, and the organization of information presentation within the module. The aim of measuring module readability is to evaluate and enhance the quality of learning modules to make them more easily understandable and effective in supporting the learning process. The use of item questions and readability questionnaires complements and reinforces each other in the module readability testing process.

Based on Table 3, the average result of the readability test yielded a percentage of 88.44% with an excellent interpretation, indicating that the module is deemed easily readable. Sarip *et al.*

(2022) assert that effective learning modules should also possess good readability levels to facilitate learners' comprehension. Furthermore, the high readability test results indicate that the linguistic and presentation aspects of the module are excellent and appropriate. One method of assessing module readability is by utilizing essay questions. Essay questions allow learners to express their understanding more freely and comprehensively compared to multiple-choice or fill-in-the-blank questions. Thus, essay questions can provide a more accurate depiction of the extent to which learners comprehend the material and the readability of the module (Hamdani & Rahmawati, 2021; Saptono & Ningsih, 2014).

According to Nunoo *et al.* (2022), a readability questionnaire is one of the tools used to measure the readability level of instructional materials, texts, or modules. Herman *et al.* (2016) suggest that using a readability questionnaire is suitable for testing module readability as it can provide information and results regarding the ease or difficulty of module readability for learners. This aligns with the statements of Mawarni *et al.* (2022) stating that a module is considered linguistically appropriate if it can effectively and clearly communicate its content to the target audience. To achieve this, the module should use language appropriate for the target audience, be free from grammatical errors, spelling mistakes, punctuation errors, and syntax errors, be well-structured and organized, culturally sensitive and inclusive, and visually appealing. By meeting these criteria, a module can become an effective tool in facilitating learning and achieving desired learning outcomes.

The ESD-based module on global warming material will align science learning with sustainable development goals, making it more relevant and meaningful for students. Through the content and context in the module, it can help raise awareness among students about the importance of addressing climate change and its impacts, fostering a sense of responsibility towards environmental sustainability (Koçulu & Topçu, 2024; Trott & Weinberg, 2020). The integration of SDG 13 into the module will promote interdisciplinary learning by connecting climate-related topics with various subjects such as sciences, geography, economics, and social studies. This promotes critical thinking and problem-solving skills as students explore complex issues related to climate change mitigation and adaptation (Eilks, 2015; Karaarslan & Teksöz, 2016).

Within the developed ESD-based module, there are instructional content and tasks that assist students in understanding and determining strategies for preventing and mitigating disasters caused by climate change. These resources are designed to aid students in comprehending the intricacies of climate change and in formulating effective strategies for disaster prevention and mitigation stemming from its impacts. Through the exploration of various mitigation strategies embedded within the module, students are not only equipped with knowledge but also empowered to take proactive measures, both independently and collaboratively, in addressing environmental challenges. In essence, the educational content pertaining to SDG 13 encapsulated within the module is envisaged to instill a profound sense of sustainability. Such an educational approach holds the potential to yield enduring positive repercussions, not only on an individual level but also on a communal scale, thereby contributing significantly to the cultivation of a more sustainable future for all.

CONCLUSION

Based on the preliminary field trial results of the ESD-based module on global warming material, which integrates ESD (SDGs 13 regarding climate action), the following conclusions were drawn:

1. Expert assessment of the developed module yielded an average percentage score of 88.25% with an excellent interpretation of feasibility.

2. Readability testing by students on the developed module resulted in an average percentage score of 88.44% with an excellent interpretation.

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Siti Nurawaliyah

Student in Department of Science Education, Universitas Garut, can be contacted through e-mail: nurawaliyahsiti6@gmail.com

Shinta Purnamasari

Lecturer in Department of Science Education, Universitas Garut, can be contacted through e-mail: shintapurnamasari@uniga.ac.id

Abdul Latip

Lecturer in Department of Science Education, Universitas Garut, can be contacted through e-mail: abdullatip@uniga.ac.id