Analysis of Education for Sustainable Development (ESD) as a Basis for Development of Biotechnology Teaching Materials

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Abstract. This research is a solution to the problems teachers face in dealing with the development of science, technology, and communication, which brings rapid changes to the world of education. Education has a great responsibility to face the challenges and aspirations of the 21st century, specifically globalization, where Information and Communication Technology (ICT) is developing very rapidly. Teachers are required to innovate in the learning process at school. The purpose of this study is to analyze students' and teachers' understanding of Education for Sustainable Development to meet their needs by using a balanced and integrated approach to the economy, society, and environment. The analysis was carried out descriptively on teachers and students consisting of 80 students in junior high school class IX in the form of a questionnaire. These results can be seen from 80 students, 100% of students are aware of the importance of learning resources in the learning process, 88.8% of students have difficulty in determining an action from the problems encountered in science learning, and as many as 63.7% of students have difficulty understanding the language used in printed books. Based on student questionnaires, 63.7% of students have never heard of the term Education for Sustainable Development (ESD which is an important part of knowledge to maintain the sustainability of life on earth. Based on the results of interview questionnaires with junior high school teachers, most of the teachers also needed help understanding the term ESD. This shows the need for further introduction of ESD to students and teachers, one of which is by including ESD elements in biotechnology teaching materials used in schools.

1 Introduction

Education is a conscious and deliberate effort carried out through a learning process that aims to develop the potential contained in humans, both in terms of knowledge, attitudes, and skills [1]. Education is very important in pursuing the 2030 sustainable development agenda, known as the Sustainable Development Goals (SDGs) [2,3]. United Nations Educational,

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Scientific and Cultural Organization [3] wrote that the SDGs have 17 goals that must be achieved with 169 measurable results, one of which is in the form of Education for Sustainable Development (ESD). ESD aims to include environmental, economic, and social aspects in the learning process [4–7]. The integration of ESD is applied in the 2013 curriculum to train students' abilities in social thinking, science and technology skills, performing arts and cultural activities, critical thinking, creativity, communication, collaboration, and productivity, as well as acting to support sustainable community life [5]. This explains that the application of ESD in learning in the 21st century is very important with the skills of "The 6Cs," which include critical thinking, creative thinking, collaboration, communication, computational logic, and character. The learning process is seen as a very important aspect of education. Education must play an important role in achieving a sustainable society [8].

Education for Sustainable Development ESD provides an impetus for changing knowledge, skills, and attitudes for a sustainable and equitable life for all [8,9]. ESD is a learning process based on the principle of sustainable noble ideals, with a focus at all levels to provide quality education and encourage sustainable human development [8]. According to UNESCO [3] [7], ESD is a lesson to (1) appreciate, evaluate, and maintain the values of past achievements and successes, (2) respect everyone on earth, (3) live on earth where everyone can eat enough to live a productive and healthy life, (4) use, care for and improve natural conditions, (5) enjoy fairer, safer and better earth, and (6) become citizens of the earth who care and exercise their rights and responsibilities responsible locally, nationally and globally.

ESD aims to equip current and future generations to meet their needs with a balanced and integrated approach from economic, social, and environmental aspects. ESD also plays a role in informing and involving the community in developing problem-solving skills in both science and social education [6] [8]. There are several components that support the learning process, including students, educators, teaching resources or materials, media, learning methods, and models [8]. The development of one of the learning components, such as the development of teaching materials, is recommended to be carried out by educators so that learning becomes more effective and efficient and stays consistent with the competencies to be achieved. The purpose of this study is to analyze students' and teachers' understanding of Education for Sustainable Development to meet their needs by using a balanced and integrated approach to the economy, society, and environment.

2 Methods

The type of research used is descriptive research, to describe phenomena that occur in a real, realistic, actual, systematic, factual, and accurate manner regarding the facts, properties, and relationships between the phenomena being investigated [8,10]. The indicators and aspects that are used as benchmarks to get data on the needs analysis of students are (1) students' opinions about science learning, (2) student responses to the learning resources used, (3) students' difficulties in practicing critical thinking skills and (4) students' needs for the development of ESD-based modules. This study used a student population of SMPN 1 Tembilahan. The research sample used to obtain the required data was 80 grade IX students at SMPN 1 Tembilahan. The questions in the questionnaire are grouped into four categories, with 15 items in **Table 1**.

Table 1. Question categories on the questionnaire

No	Question category	Question number	Amount
1	Student opinion about science learning	1, 2	2
2	Student responses to the learning resources used	3, 4, 5, 6, 7	5
3	Difficulty in practicing critical thinking skills	8, 9, 10, 11, 12	5
4	Student needs for the development of ESD-based modules	13, 14, 15	3

The teacher interview questionnaire consisted of 10 open-ended questions given to junior high school teachers in Tembilahan District with indicators, namely (1) the approach and learning model used by the teacher, (2) the teaching materials used in learning, and (3) the teacher's knowledge of Education for Sustainable Development (ESD).

The data collection technique used in this study was a questionnaire method to find out the problems experienced by students related to the teaching materials used. The needs analysis questionnaire was distributed online in the form of a Google form platform to grade IX students at SMPN 1 Tembilahan and junior high school teachers in Tembilahan. Furthermore, the collected questionnaire data were analyzed using certain data analysis techniques. The data analysis technique used in this study is descriptive statistical analysis, which serves to describe or provide an overview of the object under study through sample or population data obtained [11].

3 Results and Discussion

The results of the analysis of students' and teachers' understanding of Education for Sustainable Development through Google Forms by providing 15 questions with yes or no options can be seen in **Table 2**. **Table 2** provides an overview of the percentage of answers to questions related to the need for developing teaching-based materials ESD.

Table 2. Percentage of students on the needs analysis questionnaire for the development of teaching materials

No	QUESTION	YES (%)	NO (%)
1	Do you have difficulty studying Natural Sciences?	21,2	78,8
2	Is learning science in class interesting?	96,3	3,7
3	Is it important to use learning resources?	100	0
4	Do you often study science using print sources?	71,3	28,7
5	Do you have difficulty understanding the language used in science books??	63,7	36,3
6	Do teachers use media in the teaching and learning process of science?	73,8	26,2
7	Do teachers use modules in the science teaching and learning process?	97,5	2,5
8	Do you have difficulty in science lessons in giving simple explanations when asked by the teacher?	32,5	67,5
9	Do you have difficulty giving reasons for the selected answers?	50	50
10	Do you have difficulty reading and reporting information from the data presented in science learning?	23,8	76,2

No	QUESTION	YES (%)	NO (%)
11	Do you have difficulty in building arguments when asked to provide further explanations in science learning?	67,5	32,5
12	Is it without direction from the teacher, you have difficulty in determining an action from the problems encountered in learning science?	88,8	11,2
13	Have you ever heard of education for sustainable development (ESD) or education for sustainable development?	36,3	63,7
14	In your opinion, should education support sustainable development in the environmental, social, and economic fields?	96,3	3,7
15	If a science teacher develops an ESD-based science module as an alternative teaching material to support the science learning process, are you interested in learning science with this media?	91,3	8,7

Based on the questionnaire, it can be seen from 80 students, 100% of students recognize the importance of learning resources in the learning process, and as many as 63.7% of students have difficulty understanding the language used in printed books. Be a concern because learning resources or teaching materials should be able to facilitate students in understanding learning materials because teaching materials play an important role in learning that can help students learn smoothly [12]. Based on the questionnaire, it was also known that 50% of students had difficulty in giving reasons for the selected answers, 67.5% of students had difficulty in building arguments when asked to provide further explanations in science learning, and 88.8% of students had difficulty in determining an action from the problems encountered in learning science. The difficulties faced by these students are part of the critical thinking indicators. This means that students still find it difficult to develop their critical thinking skills in science learning.

Based on the questionnaire, there are 63.7% of students have never heard of the term Education for Sustainable Development (ESD), which is an important part of knowledge to maintain sustainable life on earth. Based on the results of interview questionnaires with junior high school teachers in the Tembilahan sub-district, most of the teachers also did not understand the term ESD. This shows the need for further introduction of ESD to students and teachers, one of which is to include ESD elements in the modules used in schools. The questionnaire also showed a response of 91.3% of students agreeing that the science teacher should develop an ESD-based science module as an alternative teaching material to support the science learning process. The development of modules as teaching materials provides several advantages, including (1) providing immediate feedback; (2) can be adjusted to the ability of individual students by giving freedom in determining the speed of learning and understanding, the form and material of the lesson; (3) after the evaluation, the teacher and students will know which parts of the module the students have succeeded in achieving and which parts of the learning objectives have not been achieved; and (4) students achieve learning objectives according to their abilities [12–14].

There are four priorities in the implementation of ESD based on Chapter 36 Agenda 21, which was produced in the environmental declaration at the 1992 Rio de Janeiro high-level conference, are:

1. Promote and improve the quality of education: All rights and opportunities in education to expand knowledge, skills, values , and perspectives that encourage community participation and support decision-making.
2. Reorient education at all levels for sustainable development: Ensure a preschool to university curriculum that emphasizes education, knowledge, skills, values , and perspectives related to a sustainable future. The focus is on readjusting the curriculum and improving the quality of education.

3. Increase public awareness of the concept of sustainable development: Public education, both formal and informal, aims to build an understanding of sustainable development and community participation.
4. Human resource training: Human resources to build decision-making capabilities and performance related to sustainable behavior and to implement sustainable practices at local, regional, and national levels.

ESD teaches knowledge, skills, and values to process information, make decisions, and act responsibly toward the environment, economic sustainability, and just society for present and future generations [14–16]. The important role of science and technology in sustainable development in modern life shows the close relationship between science learning using science and technology and sustainable science learning as part of the curriculum [17]. ESD implementation guidelines and their implementation can create awareness of resource scarcity and how to consume resources properly. Students are given the trust to complete sustainable development projects that require students to explore and develop an understanding of the natural, social, and cultural dimensions. The school encourages students to participate in science fairs and present their innovative ideas [18,19].

According to KNIU [20], there are seven ESD criteria, namely (1) student-centered and depending on the needs, abilities, interests, and learning styles of students, the teacher is only a facilitator (2) interdisciplinary and holistic education (3) educational approach in a different way (4) education based on systems thinking approach (5) education that creates value, increases participation, responsibility in decision making, and improves critical thinking and problem-solving skills (6) local cultural approach, prioritizing regional issues other than global issues, and use language that is understood by all and (7) lifelong learning.

4 Conclusion

The conclusion from the research results is that students and teachers still lack knowledge about the relationship between various dimensions of sustainability, which is an important part of knowledge to maintain the sustainability of life on earth, so teaching materials are needed that include elements of Education for Sustainable Development (ESD). Improvements in the learning process need to be carried out, one of which can be assisted through the development of teaching materials that have the potential to train critical skills. This shows the need for further introduction of ESD to students and teachers, one of which is by incorporating ESD elements in biotechnology teaching materials used in schools.

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