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Development of Education for Sustainable Development Integrated Coastal Conservation Education Kit in Junior High Schools

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Abstract

Student knowledge regarding abrasion must be instilled as soon as possible. The developed ESD (Education for Sustainable Development) integrated coastal conservation edukit (education kit) can be an interactive medium that helps students understand the factors and impacts of abrasion. This study aims to develop an ESD-integrated coastal conservation education kit suitable for use in Indonesian ecological materials and biological habitats. This development research modifies the ADDIE model with four stages: 1) Analysis, 2) Design, 3) Development, 4) Evaluation. Data collection techniques were carried out through interviews and questionnaires. Expert lecturers' coastal conservation edukit validation results show an average of 98.5% and guidebooks 100% with very suitable criteria. The teacher and student readability test results regarding coastal coral edukit showed an average of 92.3% and guidebooks 93.3% with very decent criteria. Based on the results of expert validation and readability tests, the ESD-integrated coastal conservation education kit and its guidebook have been tested to be very appropriate for learning.

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Introduction

Indonesia is a country with a coastline of $\pm 81,000$ km, which makes it the country with the longest coastline in the world

after Canada (Siswanto, 2018). According to Hidayati & Isdianto (2017), the beach is a meeting point between land and sea, and the condition may change over time due to sea tides. Coastal changes can be in the absence of the land (wear) or changes in the coastline to the sea (accretion).

One of the threats to people living around the coast is the beach abrasion. There are 40% of Indonesia's 81,000 km coastline damaged by abrasion (Siswanto, 2018). The damage to the coastline is caused by disturbances in the natural balance (Setiyarso & Muryani, 2016). Moreover, the cause of this beach abrasion is not only caused by natural factors, but also due to human factors (Isdianto et al., 2020). If the coastal abrasion is left over to continue, it will have an alarming impact on the communities in coastal areas (Damaywanti, 2013). Some of the impacts are the narrowing of the coastal area, the ecosystem will be disrupted, and if left unchecked, it will damage the infrastructure such as roads, bridges, or even sink an island (Pinto, 2016).

Based on data from a quick field study by the Regional Disaster Management Agency or Badan Penanggulangan Bencana Daerah (BPBD) for Kebumen Regency (2021), big waves pose a threat to soil erosion on the coast. The inaRISK analysis data stated that Kebumen Regency has a coastal area prone to abrasion phenomena. This condition causes the coastline in the Kebumen Regency area to become narrower. The results of research by Fuad et al., (2021), several beaches in Situbondo Regency experienced abrasion, such as Tampora Beach and Dubibir Beach. Due to the lack of media to withstand the waves, the land around the coastline slowly erodes or further causes damage to existing infrastructure along the coast.

According to Mochtar, et al (2014), sustainable development is a development by balancing all the needs of humans with also considering the environmental balance, so these needs can be met for a long time or unlimited, without reducing the ability of future generations. To realize sustainable development as a framework for fulfilling a better future, education will play a somewhat important role (Mohctar, 2015). According to the Ministry of National Education quoted by Shantini (2016), education for sustainable development is defined as education that provides awareness and competence for all people, especially for future generations to contribute to a better present or future.

The importance of education for sustainable development (ESD) can further be included in a part of the subject at all levels of education, such as from kindergarten to university (Ghani, 2018; Åhlberg et al., 2005). Student knowledge regarding abrasion is very important to be instilled as early as possible. From this knowledge, students will know and act on what should be done regarding how to protect coastal areas so that the abrasion disaster can be reduced. Students are expected to know about strategies for prevention, mitigation, and adaptation at different levels such as response to disasters and reducing the risk of disasters. Students are also expected to be able to know that global climate protection is an important task for all people (UNESCO, 2017).

As a prospective educator, the effort can be made regarding this problem by educating students about the importance of protecting coastal areas. One way to educate students is with Edukit learning media. Edukit is a tool to facilitate students' understanding in the school curriculum (Fadilah et al., 2020). The development of this Edukit has been widely used for the learning process. One of them is research conducted by (Fitria & Hamdu, 2021), which is the development of ESD-based mobile learning application products on the topic of clean water for fifth-grade elementary school students. The learning

tools consist of lesson plans, worksheets, modules, learning media, ESD-based questions, attitude assessment, and skills assessment. In this application, there is a discussion related to the concept of ESD and also the importance of clean water. The disadvantages of the developed product are the need to add and remove on several features and the lack of focus on achieving other SDG goals besides clean water and sanitation. Then, a research was conducted by Zahara & Hamdu (2022) on ESD-based virtual field trip learning tools in elementary schools. The learning tools developed consist of E-Modules, E-LKPD, and test questions related to ESD-based numeracy literacy. The deficiencies of the developed product are the limited number of samples, resulting in a lack of the product feasibility that has been developed.

Based on the description of the problem, it is very important to develop an integrated ESD Edukit on Indonesian ecology and biodiversity material by connecting the natural phenomenon of abrasion that occurs in the surrounding environment with its problem-solving (Didham & Ofei-Manu, 2020). This research was expected to be able to create effective learning media in supporting the learning process. According to UNESCO (2017), the SDGs (Sustainable Development Goals) that are in accordance with the problems faced are SDGs 3 (human well-being), SDGs 8 (economic growth), SDGs 9 (Infrastructure), SDGs 13 (Climate), SDGs 14 (life below water), and SDGs 15 (life on land). One example of the suggested topic is coral reefs, beaches, mangroves, and biodiversity. This study aims to develop an ESD-integrated coastal conservation edukit that is suitable to be utilized in Indonesian ecology and biodiversity materials.

Research Method

The type of research conducted is Research and Development (R&D). According to Borg and Gall (1983), this model is a type of research to develop and validate a product developed and then used in the learning process.

The product developed is ESD (Education for Sustainable Development)-based coastal conservation edukit. This edukit product was tested for its feasibility by experts. Moreover, for readability, it was carried out by teachers and students. The research design used was adapted from the ADDIE model, as can be seen in Figure 1 and Figure 2.

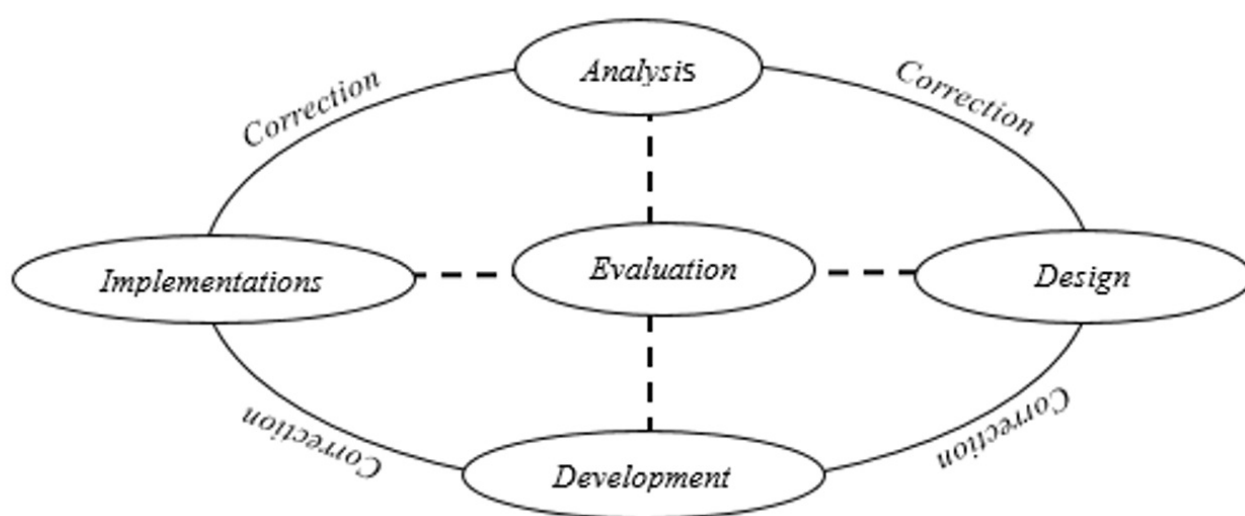


Figure 1. ADDIE Development Model (Dick & Carry 1996)

The development of the ESD-integrated coastal conservation edukit modifies the ADDIE model without going through the implementation phase. The implementation stage would be carried out in further research. The stages of the ADDIE development model can be seen in Table 1.

Table 1. Stages of the development conducted

No.	Procedure	Instruments Used	Output
1.	<i>Analysis</i>	1. Teacher interview questionnaire	1. Analyze the learning process and create concepts related to Indonesian ecology and biodiversity according to the SDGs
2.	<i>Design</i>	1. Design of coastal conservation edukit and guidebook	1. Designing an ESD-integrated coastal conservation edukit plan with the guidebook
3.	<i>Development</i>	1. Validation of the questionnaire by experts in the learning media and the subject material 2. Questionnaire to test the readability of teachers and students 3. Field notes	1. Developing the product in a concrete form based on suggestions and input from advisors 2. The results of the feasibility test by learning media and subject material experts 3. Readability test results
4.	<i>Evaluation</i>	1. ESD-integrated coastal conservation edukit prototype along with its box and guidebook 2. Scientific article	1. Revisions based on the analysis of the results of the readability test 2. Compiling the scientific articles

Qualitative and quantitative data are obtained to determine a learning media's feasibility level. Qualitative data is based on the validator, teacher, and student scores. The data is in the form of comments and suggestions for improving the learning media developed. Quantitative data were obtained from the validator, teacher, and student scores in the form of a Likert scale.

According to Bahrin et al., (2018), the Likert scale is a scale utilized in collecting data to determine the value of attitudes and opinions. This scale is usually used to complete a questionnaire that contains the level of agreement by respondents from several questions. The Likert scale assessment criteria can be seen in Table 2.

Table 2. Likert Scale Assessment Criteria

Project	Description
1	If the respondent gives an assessment of strongly disagree/very unclear/very unattractive/very unfavorable
2	If the respondent gives an assessment that does not agree / is not clear / is not interesting / is not good
3	If the respondent gives an assessment of agree/clear/interesting/good rating
4	If the respondent gives a very agree/very clear/very interesting/very good rating

(Likert, 1932)

The data analysis technique used in processing the validation data results is from calculating the average score of the validator's assessment and also the research subjects. The results of the data obtained are then converted into percentage form using the following calculation formula:

$$P = \frac{\sum X}{i} \times 100\%$$

Description:

- *P*: Percentage of feasibility scores
- $\sum X$: Total score
- *i*: Maximum total score

(Rahmatina et al., 2020)

The value of the resulting percentage is converted into qualitative data according to the product feasibility level criteria. Aspects of the product feasibility level criteria can be seen in Table 3.

Table 3. Product Feasibility Level Criteria		
No.	Project	Description
1	<20%	Very unfeasible
2	21 - 40 %	Unfeasible
3	41 - 60 %	Feasible enough
4	61 - 80 %	Feasible
5	81 - 100 %	Strongly Feasible

(Tarawi, 2020)

ESD-integrated coastal conservation edukit learning media can be concluded to be feasible if it gets a minimum feasibility percentage of 61%. If the percentage of the product scores below 61%, it can be said that the media developed needs to be revised again to make the product better and suitable for use by students.

The readability test conducted aims to discover the opinions of respondents regarding the coastal conservation edukit products that have been developed by researchers. The subjects for the readability test were 1 science teacher and 22 seventh-grade students at an Islamic school in Probolinggo. The readability test was carried out by distributing questionnaires containing ratings using a Likert scale (Table 2) and suggestions for ESD-integrated coastal conservation edukit as product improvements. The data from the readability test results is processed to determine the feasibility level of

the product. The product feasibility criteria can be seen in Table 3.

Research Result

The product produced in this development research is in the form of an ESD (Education for Sustainable Development)-integrated coastal conservation edukit on ecology and biodiversity material. The SDGs contained in the developed media are SDGs 3 (human well-being), SDGs 8 (economic growth), SDGs 9 (infrastructure), SDGs 13 (climate), SDGs 14 (life below water), and SDGs 15 (life on land). The results of the teacher's need analysis interviews showed that the media that are commonly used in Indonesian ecology and biodiversity lessons are still in the form of worksheets (LKPD and LKS) and textbooks. The learning media integrated with ESD or other interactive media have never been used, so learning media innovations is required to support the learning and teaching process. This is in accordance with research (Giwangsa et al., 2022) which states that there is a need for innovative learning media to attract students' interest and focus in the learning process. So that the learning objectives can be achieved optimally.

The second stage is designing. At this stage, the draft of the guidebook and ESD-integrated coastal conservation edukit design was produced. The design of the ESD-integrated coastal conservation edukit can be seen in Figure 2.

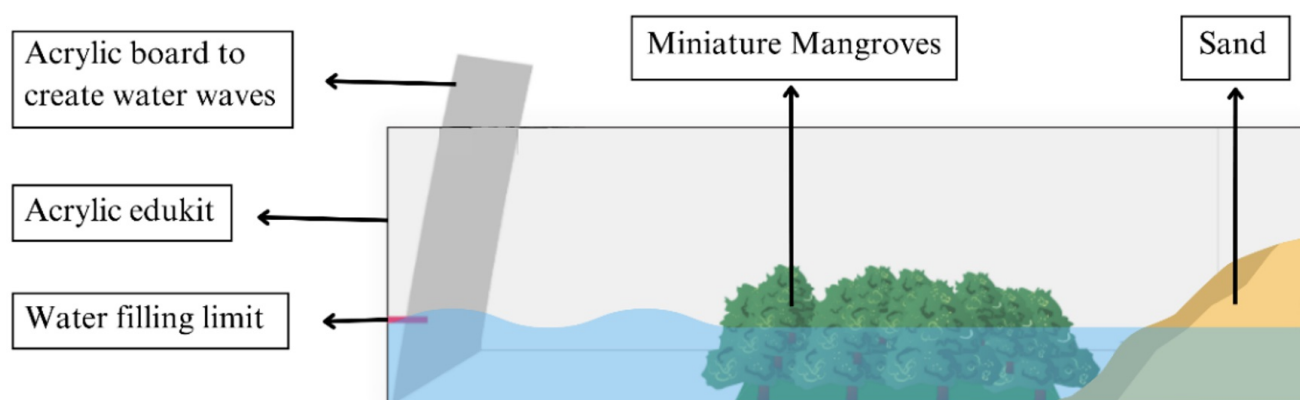


Figure 2. Preliminary design of coastal conservation edukit

The third stage is development. The results of this stage are in the form of a prototype of ESD-integrated coastal conservation edukit, complete with a guidebook. The components of the coastal conservation edukit include an aquarium and a miniature ladder made of acrylic, and to make it not easily broken, the thickness is 3 mm. In detail, it is an acrylic board with a size of 25.8 cm x 16.8 cm and a thickness of 3 mm as a medium for making waves connected to the edukit with acrylic hinges of 4.5 cm in size, miniature mangrove trees with leaves made from synthetic materials and plant roots using copper wire with a thickness of 0.7 mm to be easily shaped. Plasticine and wet flower foam were used as a planting medium so it doesn't float easily when the aquarium is filled with water. Next, there is a hose, which is used to minimize pressure during the process of filling water into the aquarium, then beach sand and stones are used for beach abrasion simulation media. Plastic shovels are also used to make it easier to take sand and stones. This coastal conservation

edukit is packaged in a cardboard shoe hard box with an AP print, laminated on dop white background, measuring 63.0 cm x 21.5 cm x 30.0 cm.

The guidebook is printed in A5 size (14.8 cm x 21.0 cm) using art paper. The components in the guidebook consist of work safety, learning outcomes, experimental objectives, introduction, aspects of student skills, activity 1 (tools and materials, experimental procedures, experimental results), activity 2 (analyzing articles), conclusions, and meaningful understanding. The development of this learning media is used in Indonesian ecology and biodiversity material by seventh-grade students of junior high school (SMP/MTs). The results of the product development can be seen in Figure 3.

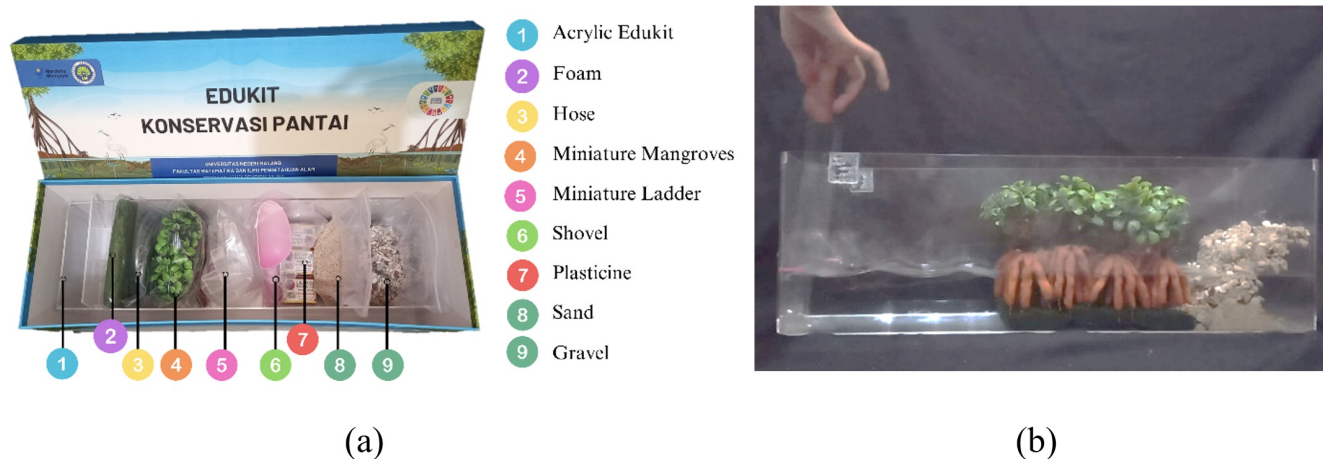


Figure 3. a) Edukit before assembling; b) Edukit after assembling

The results of the ESD-integrated coastal conservation edukit validation showed an average of 98.5% with very suitable criteria for use in Indonesian ecology and biodiversity studies. The validation results of the ESD-integrated coastal conservation edukit media can be seen in Table 4.

Table 4. Quantitative Data of Coastal Conservation Edukit Validation Results by Lecturers

No.	Rated aspect	Feasibility (%)	Criteria
1.	Display Presentation of ESD-Integrated Coastal Conservation Edukit	96,9%	Strongly Feasible
2.	Compatibility Aspects of Coastal Conservation Edukit with ESD (Education for Sustainable Development)	100%	Strongly Feasible
Average		98,5%	Strongly Feasible

The results of material validation of the ESD-integrated coastal conservation edukit guidebook showed an average result of 100% with very suitable criteria for use in Indonesian ecology and biodiversity studies. The results of material validation of the ESD-integrated coastal conservation edukit guidebook can be seen in Table 5.

Table 5. Quantitative Data Validation Result of Coastal Conservation Edukit Guidebook by Lecturers

No.	Rated Aspects	Feasibility (%)	Criteria
1.	Feasibility of Guidebook Content	100%	Strongly Feasible
2.	Feasibility of Tools and Material Functions	100%	Strongly Feasible
3.	Languages	100%	Strongly Feasible
4.	Concept Validity	100%	Strongly Feasible
	Average	100%	Strongly Feasible

In the ESD-integrated coastal conservation edukit, in addition, to acquiring quantitative assessments, comments and suggestions from expert lecturers were also obtained. The suggestions given include presenting the display of the ESD-integrated coastal conservation edukit which can be seen in Table 6.

Table 6. Qualitative Data Comments and Suggestions from Lecturers

No.	Rated Aspects	Comments and Suggestions
1.	Display Presentation of ESD-Integrated Coastal Conservation Edukit	Adjust to real conditions or erosion reduction factors, such as the plants to be made as similar as possible

The readability test was carried out by 1 science teacher and 22 seventh-grade students. The results of the ESD-integrated coastal conservation edukit readability test conducted by teachers and students showed an average of 92.3%. Based on the results of the coastal conservation edukit readability test, it was found that the students' readability test results were lower than the teacher's readability test. This is because, in the operational aspect of the edukit, additional tools are needed to make it easier to take the stones and sand. The results of the quantitative data on the readability test of coastal conservation edukit by teachers and students can be seen in Table 7.

Table 7. Quantitative Data of Coastal Conservation Edukit Readability Test Results

No.	Indicator	Feasibility (%)	Criteria
1.	Teacher Readability Test	93,8 %	Strongly Feasible
2.	Students Readability Test	90,7 %	Strongly Feasible
	Average	92,3 %	Strongly Feasible

The results of the guidebook readability test showed an average of 93.3%. Based on the results of the guidebook readability test, it was found that the results of the teacher's readability test were lower than the student's readability test. This is because there are several aspects that need to be maximized such as the images displayed, the language used, and the experimental procedures that are presented so that they are more easily understood by students. The results of

the quantitative data on the readability of the guidebook by teachers and students can be seen in Table 8.

Table 8. Quantitative Data on the Readability of the Coastal Conservation Edukit Guidebook			
No.	Indicator	Feasibility (%)	Criteria
1.	Teacher Readability Test	93,2 %	Strongly Feasible
2.	Students Readability Test	93,4 %	Strongly Feasible
	Average	93,3 %	Strongly Feasible

The results of the readability test from the edukit and guidebooks obtained not only quantitative data but also qualitative data in the form of comments and suggestions from teachers and students. The qualitative data can be seen in Table 9 and Table 10.

Table 9. Qualitative Data of Readability Test by Teachers	
No.	Comments and Suggestions
1.	It would be better if the edukit was given a box to make it safer

Table 10. Qualitative Data of Readability Test by Students	
No.	Comments and Suggestions
1.	It would be better if you added a shovel to make it easy to pick up the sand and stones
2.	It seems to me that the plasticine used is better to be in one color
3.	Learning using edukit becomes more fun and understandable
4.	Experiments with coastal conservation edukit give me an idea of the occurrence of beach abrasion
5.	The experiment is easy to do because there is a manual
6.	The manual contains many interesting pictures
7.	I think the guidebook cover is very interesting

Based on the results of the validation test and readability test, it was found that the coastal conservation school and its guidebook met the very feasible criteria. However, there are some suggestions and comments regarding the product being developed. These suggestions and comments are used as revisions to create products suitable for use in the learning process.

Discussions

By linking ESD into the learning process, it is hoped that it will create a generation that cares about the environment. Education is a great hope in building a better future (Wilujeng et al., 2019; Yuliani & Hartanto, 2019). Through learning by linking the ESD, students can experience an attitude change which can later contribute to keep the environment sustainable (Wilujeng, 2019).

The developed coastal conservation edukit can reduce teacher-centered learning. This is in accordance with the research of Andini et al., (2021), that innovative learning media can increase the role of students in it. The purpose of student-centered learning is to create learning by gathering experience and knowledge (Prasetya 2014). Through this coastal conservation edukit, students can carry out experiments independently and skillfully. Not only that, the content in the guidebook provides space for students to discuss and argue. The structure of the guidebook is adapted to the needs of students and refers to the learning outcomes in the curriculum (Fajarani et al., 2016). Through this opportunity, students are able to build knowledge, submit criticism and produce problem-solving through a reasoning process (Eskin & Ogan Bekiroglu, 2013). At the end of learning, students are asked to be able to have an impact or contribute to preserving the coast, and one of which is preserving mangrove forests. In the independent curriculum, students are required to be able to play an active role in guarding, maintaining, managing, and preserving natural resources wisely (Saleh 2020).

Table 11. Results of a literature review on sustainable development goals (SDGs) in Learning

No.	Author's Name (Years)	Discussion Regarding SDGs Goals
1.	Anggraini Deni (2023)	Only linking the concept of SDG 6 regarding renewable energy
2.	Fitria & Hamdu (2021)	Only linking the concept of SDG 6 regarding clean water and sanitation
3.	Fitrianur Sellin (2021)	Only linking the concept of SDG 6 regarding clean water and sanitation
4.	Khairati (2022)	Only linking the concept of SDG 13 regarding climate action and SDGs 17 concerning the elevation of international cooperation in the energy sector.
5.	Primasti Shelma Ghusa (2021)	Only linking the concept of SDG 3 regarding human well-being and SDGs 8 concerning economic sustainability.
6.	Zahara et al. (2022)	Only linking the concept of SDGs 15 regarding life on land (soil degradation, preventing extinction, protecting and restoring terrestrial ecosystems)

Through Table 11 which displays a review of previous research literature, it shows that research only focuses on one or two SDGs goals in learning. Therefore, this development research links several other sustainable development goals. This is in accordance with UNESCO (2017), the SDGs (Sustainable Development Goals) contained in the developed media, they are SDGs 3 (human well-being), SDGs 8 (economic growth), SDGs 9 (Infrastructure), SDGs 13 (Climate), SDGs 14 (life below water), and SDGs 15 (life on land). Some of the impacts arising from abrasion are the narrowing of the coastal area, the ecosystem will be disrupted, and if left unchecked, it will damage the infrastructure, such as roads, bridges, or even sink an island (Pinto, 2016). The impact arisen is causing unstable economic growth, which then results in a decrease in people's welfare. Therefore, it is necessary to contribute to maintain ecosystems under the water and on land to avoid any extinction.

Participant in decision making is the characteristics of students to be able to analyze, design, and provide decisions in achieving sustainable development (Rahman et al, 2019). Through the content "*Aktivitas 1: Lakukanlah percobaan dibawah ini!* (Activity 1: Do the experiment below!)" students can analyze the causal factors of beach abrasion and their impact on humans and the environment. After that, through the content "*Aktivitas 2: Bacalah artikel dibawah ini!* (Activity 2: Read the article below!)" presented in the guidebook, students are asked to analyze the factors that can damage the ecosystem and provide appropriate solutions. The content "*Pemahaman Bermakna* (Meaningful Understanding)" in the guidebook is one of the goals of using this coastal conservation edukit, which is to increase student awareness so that they can contribute better in preserving biodiversity so that it remains sustainable both in the present and future. After conducting an experiment using the ESD-integrated coastal conservation edukit, the teacher can invite students to contribute to plant the mangrove trees. This activity is one form of achieving sustainable development. The developed product has advantages which can be seen in Table 12 as follows.

Table 12. The advantages of the developed product	
No.	Advantages
1.	Coastal conservation edukit is an alternative media to support a more enjoyable learning process
2.	The materials used in coastal conservation edukit product are safe to use
3.	Equipped with a student manual, so it is easier to operate the tool
4.	The content in the guidebook provides space for students to discuss
5.	Coastal conservation edukit product on ecology and biodiversity are practically new, so it can attract students' interest

After the readability test was conducted on students, there were also observed deficiencies. The drawback of the developed coastal conservation edukit media is that it takes quite a long time during the process of filling water into the coastal conservation edukit, due to the small diameter of the hose used. However, the purpose of using a small diameter hose is to minimize pressure during the water filling process, so that the sand and stones do not slide.

Conclusions

The product developed in this research is the ESD-integrated coastal conservation edukit along with its guidebook which has been tested to be very, very suitable for use in learning about Indonesian ecology and biodiversity. Through the products developed, students are expected to be able to analyze factors that can damage ecosystems and provide appropriate solutions. For example, increasing students' awareness to contribute better in preserving biodiversity, so it remains sustainable both in the present and future. Suggestions for disseminating ESD-integrated coastal conservation edukit products on Indonesian ecology and biodiversity are necessary to test their effectiveness. After the product is confirmed effective, the next step is that the product can be applied to junior high schools (SMP/MTs) as an alternative medium for learning science.

Statements and Declarations

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