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Development of a Marine-Based E-Module in Grenden Village to Enhance Science Literacy of Junior High School Students

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Abstract: Development of a Marine-Based E-Module in Grenden Village to Enhance Science Literacy of Junior High School Students. The purpose of this study was to examine the content validity, construct validity, and response to improve students' science literacy. The development of an e-module based on marine potential for the material of plant and animal reproduction systems is based on the consideration of students to get learning experiences by utilizing the surrounding environment and being aware of preserving the marine environment. The research method used was the ADDIE development design consisting of three stages, namely analysis, design, and development. The results showed that (1) the percentage of content validity of the e-module based on marine potential was 85%, (2) the percentage of practicality of the e-module based on marine potential was 90% with an N-gain of 0.77, (3) the percentage of response to the e-module based on marine potential was 76%, so it can be concluded that the e-module based on marine potential is valid in terms of content and construct with a positive response to improve junior high school students' science literacy

Keywords: E-Modul, science learning, science literacy

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1. Introduction

Education in the digital era demands a paradigm shift in learning. Beyond mastering the subject matter, students need to be trained to face the complexities of the future (Zakiyyah, et al., 2024). PISA, or the Programme for International Student Assessment, defines science literacy as the ability to understand and apply scientific concepts in everyday life to solve problems scientifically and help make responsible and sustainable decisions (OECD, 2023). The results of the PISA survey in 2022 for Indonesia ranked 68th with an average score of 383 points in the field of science literacy out of 81 participating countries, or nearly 13 points lower than the 2018 PISA, meaning that the majority of Indonesian students are still lagging behind in science literacy (OECD, 2023).

The weakness of students' science literacy in East Java supported by the results of previous research, such as in the research of Amala & Yushardi, (2022) at SMP IT Al-Ghozali Jember which identified the results of science literacy with the highest percentage indicator of 40% being in students' problem-solving abilities, meaning that the lack of students' science literacy is at the level of understanding and mastery of students in the context of science literacy which is categorized as low. This is in line with the research conducted by Mabsutsah, et al. (2021) on students of SMP Ibrahimy 3 Situbondo who have science literacy with an average content understanding of 55.9%, in process application of 54.70%, and in context application of 57.4%, these figures indicate that students' science literacy is still low. Research by Nuzula & Sudibyo, (2022) at SMPN 32 Surabaya shows a decrease in students' science literacy with an N-Gain of 0.23, which is included in the low criteria.

Based on several previous studies, it shows that this can be caused by less interesting teaching methods, a lack of relevance of the material to everyday life (Latif et al., 2022). Learning that relies on printed books in delivering material can have an impact in the form of minimal interaction and a lack of student focus due to boredom (Miladanta & Muharrom, 2021). The results of interviews with teachers at SMPN 2 Puger that in learning, students find it difficult to focus and interact because they do not understand the context of learning. Limited ability to communicate, relate, and ask various science topics makes it difficult for students to connect science concepts with applications in everyday life. As a result, students also experience difficulties in using science to solve various problems they face (Yusmar & Fadilah, 2023). Increasing science literacy can be done by utilizing teaching materials that have an impact on science literacy and assessment instruments that support teachers in evaluating students' science literacy abilities (Novita et al., 2021).

Electronic modules or e-modules are attractive and informative digital self-learning materials. E-modules are designed to facilitate independent student learning without always being accompanied by teachers and can be personalized to meet the needs of each individual. E-modules can be accessed anytime and anywhere, thus providing flexibility for students to learn (Herditiya et al., 2023). The development of e-modules is more practical with attractive visual features through the appearance of images and can be in the form of interactive elements such as quizzes, games, and simulations which help increase student engagement and make learning more enjoyable (Auliya & Nurmawati, 2021).

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The development of e-modules can be based on local potential in the surrounding environment. This potential can be in the form of natural resources, culture, or society. One of the local potentials is marine potential. Marine potential is all the resources, strengths, and capabilities possessed by an area that can be developed to improve the welfare of the community (Nopi et al., 2021). Nopi et al. (2021) define as resources that can improve community welfare. The existing educational landscape often fails to consistently and systematically integrate these rich local contexts into learning materials. Marine potential can be an interesting and useful educational medium to meet the learning needs of humans in the form of goods or services (Arianto, 2020). The diversity of marine potential can have an impact on education in the form of providing marine resources as a learning medium for students. The utilization of marine potential for learning must be carried out by considering the sustainability of the functions and balance of the environment in coastal areas (Wahyuni et al, 2021). By focusing on marine potential, e-module inherently opens avenues to embed principles of sustainability and environmental stewardship. This can go beyond mere mention, potentially incorporating activities that highlight responsible resource management, conservation efforts, or the impact of human activity on marine ecosystems, directly addressing the gap identified

The development of e-modules based on marine potential becomes a solution in facilitating and providing learning experiences for students to understand science learning well by utilizing their surroundings. The development of sustainable e-modules based on marine potential can help students to be aware of preserving the marine environment.

2. Method

The research uses the research and development (R&D) with the ADDIE model. Analysis students' needs in terms of scientific literacy and identifies development objectives. Design develops learning media in the form of attractive, interactive, and easy-to-use E-modules to support students' understanding and retention of learning. Development, develops learning materials. Develops, interactive learning media and includes learning media and assessment instruments in the E-module. Implementation conducts a trial of the E-module on students to identify deficiencies and weaknesses. Evaluation, collects data on the effectiveness of the E-module in improving students' scientific literacy. Analyzes data to determine whether the E-module has achieved learning objectives. Revises the E-module based on the evaluation results.

The subjects were three validators consisting of teachers of SMPN 2 Puger and lecturers of Science Education as validators and grade IX students of SMPN 2 Puger as assessors of the effectiveness of the E-module of science learning based on marine potential to improve the science literacy.

Data analysis in this study combined quantitative and qualitative approaches. Quantitative data, such as test scores and student responses, were processed statistically. Meanwhile, qualitative data such as interview results and comments

were analyzed in depth to explore information (Selvia & Tambunan, 2024). The validity results calculated according to the formula:

$$\text{Va}=\frac{Tse}{Tsh}\times 100\%$$

Remark:
Va : valid item
Tse : maximum possible score
Tsh : total score from validator

Table 1. E-module content validity categories

Percentage (%)	Category
86 - 100	Very Worth It
71 - 85	Worthy
56 -70	Decent Enough
41- 55	Not Feasible
25 - 40	Totally Not Worth It

(Arikunto, 2018)

The practicality of the product is analyzed using the following formula.

$$P=\frac{Tse}{Tsh}x100\%$$

P represents the percentage of practicality, TSe represents the total score obtained, and TSh represents the maximum possible score. Based on this formula, the assessment results will be categorized according to the practicality criteria with the following ranges: 25% - 40% as totally not worth it; 41% - 55% as not feasible; 56% - 70% as decent enough; 71% - 85% as worthy; and 86% - 100% as very worth it. (Nuryah dkk., 2022).

The increase in students' pre-test to post-test scores was analyzed using the N-Gain test to provide an overview of the effectiveness of learning and students' level of understanding (Ulfa et al., 2023) using the following formula.

$$N-gain=\frac{(average\ posttest\ score)-(average\ pretest\ score)}{maximal\ score-(average\ pretest\ score)}$$

The N-gain calculation is categorized according to the following criteria: g ≥ 0.70 is considered high; 0.30 ≤ g < 0.70 is considered medium; and g < 0.30 is considered low (Hake, 1998). The analysis technique for

the response questionnaire is based on the responses filled out by students after using the e-module in learning. The percentage of student responses is calculated using the following formula:

$$(P)=\frac{A}{(B)}x100\%$$

Remark:

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P : percentage of student responses
A : total score
B : maximum score

Table 2. E-module response categories

Percentage (%)	Category
86 - 100	Very Positive
71 - 85	Positive
56 - 70	Fairly Positive
41 - 55	Less Positive
25 - 40	Negative

(Arikunto, 2018)

3. Result and Discussion

The E-modules developed based on marine potential can provide a close connection to everyday life and can be learned from various aspects of local culture (Dwipayana et al., 2020). ---

This development research aimed to examine the validity, practicality, and effectiveness of a product implemented in the learning activities of 9th-grade students at SMP Negeri 2 Puger, focusing on the topic of plant and animal reproductive systems. The product development process followed the ADDIE development model, which consists of five stages, analysis, design, development, implementation, and evaluation.

a. Analyze Phase

The analyze phase consists of analyzing the curriculum, students, and the situation. In the curriculum analysis, it was found that SMP Negeri 2 Puger implements the 2013 curriculum as a reference for school learning. The 2013 curriculum emphasizes character building through literacy and numeracy activities. In the student analysis, it was found that class IX A consists of 30 students, and their learning interest is still considered low, as indicated by their scores, especially in science subjects. During the learning process, students are still quite passive.

b. Design Phase

The design phase began by creating a design on the website editing platform *canva.com*, incorporating learning materials, illustrations, student activities, and assignments tailored to the material on plant and animal reproductive systems. The science e-module based on marine potential also includes aspects or indicators of science literacy in each learning activity and is converted into a PDF format to be transformed into a flipbook format using *Heyzine Flipbooks software*.

c. Development Phase

The development stage which includes the pre-writing stage, draft preparation stage, editing stage, revision 1, validation, effectiveness and practicality testing, and revision 2. The pre-writing stage involves collecting references as material for writing the content in the developed e-module. These references are obtained from books, journals, and scientific articles.

Figure 1. E-Module Design View a) Cover Part, b) List of Contents, c) Instructions for Use, d) KI KD Display, e) Chapter Material, f) Main Contents, g) Summary, h) Bibliography, i) Glossary

The preparation of e-modules based on marine potential includes aspects or indicators of scientific literacy in each learning activity and is designed using the editing website *canva.com*.

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Figure 2. Aspect Literacy Sains in E-Modul a) Process Sains, b) Consept Sains, c) Context Sains

The editing stage carried out by three validators. The validation carried out in this development research is content validation and construct validation as follows.

Table 3. Validation result by Validator

No	Aspect	Percentage Validator (%)			Percentage (%)	Category
		1	2	3		
1.	Content validation					
	a. Content and Materials	71	92	87	83	Worthy
2.	Construct validation					
	a. Presentation	75	83	100	86	Very Worth It
	b. Language	75	87	87	83	Worthy
	c. Graphics	75	96	87	86	Very Worthy
Average Percentage (%)		**74**	**89**	**91**	**85**	**Worthy**

The results of the validation of the marine-based e-module in Table 4 from the three validators show that the average percentage of validity is 85%, categorized as worthy. The validation results indicate that the marine-based e-module is suitable for use with minor revisions, so that when implemented in learning activities, it becomes a perfect product.

The product trial will obtain data on the implementation of learning while using the marine-based e-module, which will be analyzed to obtain practicality data. Practicality data is obtained based on the assessment results from three observers. The results and analysis of the practicality data of the marine-based e-module in the following table.

Table 4. Practicality Data Result by Validator

No	Assessment Aspects	Percentage (%)	Category
1.	Ability To Open Lessons	88	Very Worth It
2.	Learning Process	86	Very Worth It
3.	Mastery Of Learning Materials	89	Very Worth It
4.	Implementation Of Learning Steps	90	Very Worth It
5.	Use Of Learning Media	91	Very Worth It
6.	Evaluation	92	Very Worth It
7.	Ability To Close Lessons	91	Very Worth It
Average Percentage (%)		**90**	**Very Worth It**

The practicality results from the observation assessment of the implementation of learning using the marine-based e-module by the three observers show that the average percentage is 89%. The assessment results from the three observers in each observed meeting also obtained a very worth it category with percentages of 91% in the first meeting, 88% in the second meeting, and 89% in the third meeting. The results of the practicality of using the product in learning that have been described indicate that the marine-based e-module is categorized as very practical to use.

Measuring the effectiveness of the marine-based e-module in learning activities in class IX A is obtained in two ways: from the results of the pretest and posttest to determine the increase in students' science literacy by conducting an N-gain test and filling out student response questionnaires to find out students' responses after using the marine-based e-module.

The analysis of the effectiveness of the marine-based e-module in improving students' science literacy is obtained from the results of tests and student response questionnaires. The test used was a pretest and posttest covering science literacy indicators and competency achievement indicators with 7 questions. The test scores will be analyzed regarding the differences in the results obtained and the average test scores of students' science literacy will be measured as shown in the following figure.

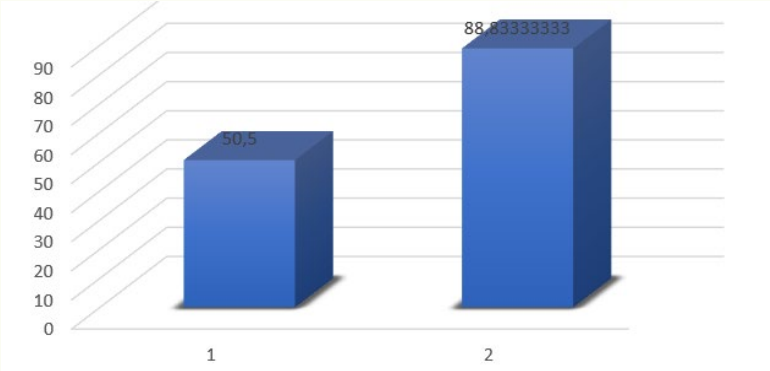

Figure 3. Graph of Average Postest-Pretest Result

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The average scores of the pretest and posttest show a difference, meaning that the marine-based e-module is effective when used in learning. The average pretest score of students before using the marine-based e-module was 50.5, while after using the marine-based e-module, the average posttest score of students was 88.83. The analysis of the effectiveness of using the marine-based e-module is calculated using the N-gain test as shown in the following Table 5.

Table 5. *N-Gain* Result

Component	Class of IX A (30 siswa)		*N-gain*(g)	Category
	Pretest	*Postest*		
Lowest Value	35	65	**0.77**	**High**
Highest Value	75	100		

The results of the N-gain test analysis show a value of 0.77, indicating that there is an increase in students' science literacy after using the marine-based e-module on the material of plant and animal reproductive systems, with a high category. The effectiveness of using the marine-based e-module can be analyzed based on each aspect of science literacy.

The analysis of student responses to the marine-based e-module in improving students' science literacy is also obtained from filling out student response questionnaires. The results of the analysis of student response questionnaires can be seen in the following Table 6.

Table 6. Student Responses Result

No	Assessment Indicators	Percentage (%)	Category
1.	Learning objective achievement indicators	73	Positive
2.	Student involvement	76	Positive
3.	Media effectiveness and presentation	73	Positive
4.	Utility	83	Positive
	Average Percentage (%)	**76**	**Positive**

The results from 30 students show a percentage of 76% with a positive category. The results of each assessment reached a positive category. This indicates that the science learning e-module is considered suitable and has a positive response for use because it has a category that is easy to apply in the learning process. After conducting the response test, the next step is revision 2 based on suggestions and input from students.

The construct validity assessment, encompassing presentation, language, and graphics, yielded an impressive 85% with a "valid" category, primarily supported by the e-module's engaging and interactive visual display. This aligns with Asri & Dwiningsih's (2022) findings, which suggest that e-modules designed with a comfortable and readable visual layout optimally facilitate student utilization during the learning process.

Furthermore, the effectiveness of the developed product in enhancing learning was substantiated by improvements observed in student science literacy tests. The application of pretest and posttest measures for science literacy provided robust data, consistent with Muzijah et al.'s (2020) methodology for data collection in such studies.

Specific indicators of science literacy showed significant gains, The "science concepts" indicator demonstrated a high N-gain of 1.00, signifying a profound increase in conceptual understanding. As noted by Sulistiana & Anggraini (2024), this improvement is attributable to the e-module's engaging visualizations and easily comprehensible language, which simplify complex concepts for students.

The "science process" indicator also exhibited a high N-gain of 0.74. Firdausia (2024) suggests that this progress stems from the e-module's inclusion of diverse activities that require students to apply scientific inquiry steps. Specifically, the "Let's Analyze" feature encourages students to discover concepts and principles through a methodical process of scientific fact-gathering, rather than spontaneous insight.

The "science context" indicator recorded a high N-gain of 0.77. This enhancement is consistent with Putri's (2023) research, indicating that e-modules applying scientific knowledge to everyday life help students recognize the relevance of learned material to real-world issues. The "Let's Solve the Problem!" feature further reinforces students' responsiveness to natural environmental problems and phenomena.

The N-gain scores across all science literacy indicators collectively affirm the marine-based e-module's effectiveness in improving students' science literacy. With an average N-gain of 0.77, the e-module is deemed effective, aligning with Hake's (1998) criterion that an N-gain score greater than 0.3 indicates effectiveness.

Student responses to the marine-based e-module were overwhelmingly positive, with an 84% approval rating. This strong reception suggests that the developed product successfully supports the learning process by making it more engaging and by simplifying concept comprehension for students. This finding resonates with Wahyuni et al.'s (2022) study, which concluded that enjoyable learning designs are successful in stimulating high student interest in learning.

Based on the results obtained, the e-module has a category of easy response and there are no suggestions or input from students. Therefore, the e-module does not need to be revised and is declared feasible so that it can be developed to the next stage, namely the implementation and evaluation stages. The final test results prove that the use of marine-based e-modules has a significant impact on learning. This is influenced by the development of visual media that can attract interest and make it easier for students to build conceptual understanding and express it in various forms (Arif & Muthoharoh, 2021).

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4. Conclusion

The science learning e-module based on marine potential for improving junior high school students' science literacy obtained an average content validity percentage of 83% with a valid category, so the e-module is content-wise sound and can be used in the junior high school science learning process. The content validity percentage of the marine-based e-module is 85%, the practicality percentage of the marine-based e-module is 90% with an N-gain of 0.77, the response percentage of the marine-based e-module is 76% with a positive category, so the e-module is suitable for application in schools in junior high school science learning

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