

# Development of E-Modules Based on Local Wisdom on Ecosystem Material to Increase Scientific Literacy

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## ABSTRACT

This study aims to evaluate the validity, effectiveness, and practicality of an E-Module developed based on local wisdom. The research employs the ADDIE development model and includes both limited and expanded trials. The study utilizes a development research (R&D) approach, conducting small-scale trials with 10 students and large-scale trials with 26 grade IV students at SDIT Aliya. The validity of the product is assessed through validation tests of the material, media, language, and usage by students and teachers. Effectiveness is measured using pretest-posttest results and analyzed with t-tests. The E-Module was found to be highly valid, with teacher assessments indicating excellent content, presentation, and language appropriateness. Both teacher and student responses in the trials were classified as very good. Effectiveness analysis revealed an N-Gain score of 0.57, indicating a medium improvement. The paired t-test for pretest and posttest results yielded a significant value of 0.00, confirming the effectiveness of the module. The significant improvement in students' scientific literacy suggests that the local wisdom-based E-Module enhances meaningful learning. By connecting the content to students' local identity, the module fosters a deeper understanding of scientific concepts, demonstrating its potential as an effective educational tool. The E-Module based on local wisdom is valid, effective, and practical, leading to a notable improvement in students' scientific literacy.

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## 1. INTRODUCTION

Scientific literacy is a key focus of 21st-century education, yet current levels of scientific literacy among students remain low. This is evident from the results of international scientific literacy assessments, such as the Program for International Student Assessment (PISA), conducted by the

Organization for Economic Co-operation and Development (OECD). Indonesia has participated in PISA since 2000, with consistent challenges in improving students' scientific literacy (Rusilowati, 2018; Ayub et al., 2022).

In elementary schools (SD), science education plays a crucial role in laying the foundation for scientific literacy. However, the scientific literacy of Indonesian elementary school students is still relatively low. One contributing factor is the lack of engaging and contextually relevant learning materials, which limits students' understanding and interest in science.

Research has shown that incorporating local wisdom into learning materials can enhance relevance and engagement, particularly in science education. Local wisdom connects scientific concepts to students' everyday experiences and surroundings. However, there is limited research on the development of e-modules specifically designed to integrate local wisdom, especially in ecosystem topics, to improve scientific literacy in elementary school students.

Furthermore, most teaching materials based on local wisdom are still in traditional print formats, which are less engaging for students in the digital age. E-modules that incorporate local wisdom offer a promising alternative, providing interactive, engaging, and contextual learning experiences. With the rapid advancement of technology, the use of technology-based teaching materials, such as e-modules, is increasingly essential. These digital resources can enhance students' understanding of science by aligning with both technological trends and students' digital media preferences.

Previous studies have shown that the use of module media can enhance learning achievement. The key advantage of electronic modules is their ability to facilitate independent learning, allowing students to explore content at their own pace. This reduces the reliance on teachers as the sole source of information, fostering a more student-centered approach to learning (Darmayasa et al., 2018). Constructivist e-modules, such as those developed using 3D Pageflip Professional software, offer a valuable tool for teaching, as they engage students in the learning process through interactive and visual materials (Syahrial et al., 2019). Additionally, e-modules based on ethnoconstructivism have proven effective in motivating students and enhancing their learning experiences (Kurniawati, 2020).

Integrating local wisdom into learning is crucial for improving scientific literacy, as it makes the material more relevant, applicable, and easier for students to understand. Local wisdom-based learning encourages students to engage in problem-solving activities that reflect real-world issues within their community. By utilizing local knowledge, students can activate their cognitive skills to critically analyze problems in their environment and creatively propose solutions rooted in cultural values. This approach fosters the development of critical and creative thinking, essential components of scientific literacy. Research indicates that local wisdom-based learning not only enhances students' academic performance but also builds character and nurtures their role as environmental conservation agents (Alimah, 2019; Asrorul Azizi, Muh. Zaini Hasanul Muttaqin, 2021). Through such learning, students are better equipped to understand and address local environmental issues, strengthening their cognitive and problem-solving abilities.

Specific aspects of scientific literacy discussed include: understanding scientific concepts, applying science in everyday life, critical thinking and decision making, environmental awareness and concern for the ecosystem. Traditional learning/not integrated with local wisdom tends to be abstract and general, with a focus on global concepts that are difficult for students to understand because they are less related to their daily environment. Traditional learning makes students less critical because they are not used to evaluating problems from the perspective of the surrounding environment.

The primary objective of this study is to develop e-module teaching materials based on local wisdom for teaching ecosystem concepts. The research also aims to assess the feasibility of these materials, evaluate their impact on students' scientific literacy, and examine students' responses to this approach.

The study explores several key questions, including how e-module teaching materials based on local wisdom can be developed for ecosystem learning, the feasibility of using these materials in teaching ecosystem concepts, the impact of local wisdom-based e-modules on students' scientific literacy, and how students respond to these e-modules. By addressing these questions, the research seeks to contribute to the integration of local wisdom in science education and highlight its potential to enhance scientific literacy among elementary school students.

## 2. METHODS

This study employs a Research and Development (R&D) method, specifically utilizing the ADDIE design model, which is widely applied in the development of teaching materials. The ADDIE model comprises five stages: Analysis, Design, Development, Implementation, and Evaluation (Cahyadi, 2019). This model is flexible and can be adapted for various learning strategies, teaching models, media, and materials, making it suitable for developing e-modules tailored to local wisdom and ecosystem concepts.

The research was conducted at SDIT Aliya in Bogor City, located on Jl. Gardu Raya RT 03 RW 11, Bubulak Village, West Bogor District, West Java. The study took place during the even semester of the 2023-2024 academic year. The participants included validators, consisting of two language expert lecturers, one media expert, and one class teacher acting as the material expert. The selection of validators was based on their qualifications, experience, and credibility in their respective fields. During the needs analysis phase, 28 students and 7 teachers from various schools participated, providing insight into the needs and expectations for the e-module development.

The trial phase involved 20 teachers, followed by a limited trial with 10 students. For the effectiveness test, 25 students from class 4A at SDIT Aliya were selected as the experimental group to assess student responses and improvements in scientific literacy. The effectiveness of the e-module was measured using a one-group pretest-posttest design. Data collection instruments included expert and teacher validation questionnaires to assess the feasibility of the e-module, scientific literacy tests to measure students' literacy levels, and response questionnaires to gauge both teacher and student feedback on the teaching materials.

The data analysis process involved several stages: needs analysis, e-module feasibility analysis, teacher and student response analysis, pretest-posttest analysis using N Gain, normality testing, and t-test to evaluate the significance of the effectiveness of the e-module in improving scientific literacy. This comprehensive approach ensures that the development of the e-module is based on reliable data and can be effectively assessed for its impact on learning outcomes.

## 3. FINDINGS AND DISCUSSION

### 3.1 *E-Module Development Based on Local Wisdom*

This research and development aims to produce the development of an E-Module based on local wisdom to increase the scientific literacy of elementary school students. The following are details of the development steps for this research.

#### 3.1.1 Analysis

The researchers conducted a needs analysis by distributing questionnaires to 28 respondents. The results revealed that 83.3% of students preferred teaching materials that included pictures, animations, videos, and vibrant colors. Additionally, 79.17% of students expressed a strong preference for using mobile phones, computers, or the internet in the learning process. An impressive 91.67% of students

indicated that they did not face any difficulties using communication technologies such as cell phones and computers for learning purposes.

Among the 7 teacher respondents from various schools, 100% agreed that the use of appropriate teaching materials significantly contributes to the success of the learning process. The teachers mentioned that the primary teaching materials used in their classrooms were books or handouts. Furthermore, 71% of the teachers noted that they had never used e-module teaching materials in their lessons. The material analysis for the e-module development was conducted, ensuring that the content aligns with students' needs and expectations.

An analysis of the learning environment at one of the Integrated Islamic schools showed that the facilities, including computer labs, LCD projectors, and internet access, were adequate for implementing technology-based learning. Additionally, an evaluation of the existing teaching materials highlighted both their strengths and weaknesses. While the existing materials were helpful for student learning, they lacked integration with local wisdom, failed to present real-life contexts, and did not include problems that could foster scientific literacy. To make teaching materials more engaging and effective, it was suggested that they be made interactive, incorporating videos and digital practice questions to capture students' interest and promote deeper learning.

### 3.1.2 Design

At this stage, the researcher designs the initial prototype, which closely resembles traditional printed modules but incorporates several key differences. The E-Module features an engaging design with animations, images, videos with audio, and digital practice questions. Additionally, the content is linked to local wisdom, making it more relevant to students' lives. To create the E-Module, various applications are used, including Canva, Quizwhizzer, Wordwall, Hyperlink, and Heyzine Flipbook, which enhance the interactivity and visual appeal of the learning materials.

### 3.1.3 Develop

#### a. Structure of E-Module Teaching Materials Based on Local Wisdom on Ecosystem Material

The teaching materials developed include reading displays, video animations and practice questions. The prototype of teaching materials developed in this research contains:

- 1) The cover of the E-Module based on local wisdom includes the name of the E-Module title, author, educational unit level, student level allocation in class and semester.
- 2) Foreword: The foreword to this E-Module contains the author's words of gratitude and gratitude for the completion of this paper
- 3) List of contents: The table of contents in the E-Module functions to make it easier to quickly find the title of the article without having to search one by one and immediately click on the title so that the page in the E-Module will change according to the title clicked in the table of contents.
- 4) E-Module Instructions for Use
- 5) Learning Outcomes and Learning Objectives

The E-Module begins with a video showcasing phenomena resulting from ecosystem damage, followed by the title page for Topic A, "Food Chain," which introduces essential questions and statements related to the topic. On Page 3, students watch a learning video on the food chain, while Page 4 provides instructions for practicing the topic using the Quizwhizzer game application. Page 5 features an exercise titled "Let's Do an Investigation," designed to challenge students. The following page introduces a local wisdom section titled "Did You Know?" to spark students' curiosity about environmental knowledge. Page 7 presents facts illustrating ecosystem damage.

The next section covers Topic B, "Eating and Being Eaten," following a similar structure to Topic A. It begins with a title page containing essential questions and statements related to the topic, followed by a video on Topic B. The Quizwhizzer game continues on the next page, with Page 11 containing

another "Let's Do an Investigation" exercise. Pages 12-13, titled "Did You Know?" provide local wisdom related to the environment, and Pages 14-15 present facts about the decline in medicinal plant production in Bogor District and the reduction in West Java's forest areas during 2017-2018.

Topic C, "Harmonious Ecosystems," follows the same structure as the previous topics. The title page presents essential questions and statements, followed by a video on the topic. On Page 18, students engage in a Wordwall game related to the material. Page 19 features another "Let's Do an Investigation" exercise, and Pages 20-22, titled "Did You Know?" showcase examples of Sundanese local wisdom in environmental protection. Page 23 presents a video on local wisdom related to ecosystems, and Pages 24-25 provide facts showing that human activities are the primary cause of Earth's ecological damage.

- 6) Answer key: Contains Answer Key to Practice Questions on Topics A, B, C
- 7) Summative Exercises: Contains Summative Exercises and answer key
- 8) Material Summary: Contains a summary of material from topic A about food chains, topic B, eating and being eaten to topic C, a harmonious ecosystem
- 9) Glossary: Column containing a list of words or terms
- 10) Bibliography: Contains reference sources used in preparing teaching materials
- 11) Author biography

#### b. Content in E-Module Teaching Materials

According to the PISA 2015 Framework, scientific literacy describes the literacy domain consisting of competence, knowledge, context and attitudes. The knowledge described in this E-Module includes ecosystem material. This concept is presented in a sequence of material that refers to the science literacy domain as shown in Table 1.

**Table 1.** Literacy Domains, Literacy Indicators and Context of E-Module Teaching Materials

No	Literacy Domain	Indicator Literacy	Context of E-Module Teaching Materials
1	Competence	Explain scientific phenomenon	Starting with a video of phenomena that occur due to ecosystem damage, then continues with the title page for Topic A Food Chain which contains essential questions and statements related to this topic.
		Planning and evaluating scientific investigations	On Topic A, B and C there is a page titled Let's do research
		Interpret can scientific data and evidence	Presented on topics A, B, C information containing facts
2	Knowledge	<ol style="list-style-type: none"> <li>1. Content</li> <li>2. Design and evaluate scientific investigations</li> <li>3. Interpret</li> <li>4. scientific data and evidence</li> </ol>	The content presented in the E-Module material is based on local wisdom in accordance with student development, can present theories with scientific concepts

3	Attitude	<ol style="list-style-type: none"> <li>1. Interest in science</li> <li>2. Appreciate the scientific approach in research</li> </ol>	In the E-Module teaching materials based on local wisdom, scientific attitudes are expected to build students' environmental awareness
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Overall, the content of the E-Module teaching materials has accommodated students' needs to develop three literacy domains, namely the knowledge domain, competency domain and attitude domain.

### c. Characteristics of E-Module Teaching Materials

E-module teaching materials based on local wisdom have the following characteristics:

1. E-Module teaching materials were developed to increase students' scientific literacy
2. Teaching materials are equipped with videos of phenomena related to ecosystem damage, thereby arousing students' interest in reading
3. Teaching materials are equipped with trigger questions that can increase students' interest and motivation in studying the E-Module
4. Teaching materials are equipped with digital exercises through game applications *Quizwhizzer* And *Wordwall*.
5. The teaching material is equipped with a page labeled Let's do research that contains a problem that must be solved.
6. Teaching materials are equipped with local wisdom literacy titled " Did you know?"
7. Teaching materials are equipped with a page entitled facts, which contains information from data that shows ecosystem damage.
8. This teaching material can help teachers build students' interest in learning because it is contextual, such as linking lesson material to local wisdom.

### d. Display of E-Module Teaching Materials

The design of these teaching materials aims to enhance students' scientific literacy and environmental awareness. The E-Module includes videos that are intended to capture students' attention and encourage them to engage with the content.

### e. Results of Validation of E-Module Teaching Materials

The E-Module teaching materials, based on local wisdom and focused on ecosystem content, underwent validation before being tested and researched. The validation process involved material experts, media experts, and language experts. Afterward, the teaching materials were assessed by 20 elementary school teachers, followed by a limited trial with 10 students.

The media expert validation aimed to evaluate the teaching materials from a media perspective. The media experts gave the E-Module a score of 94, within the 80%-100% range, indicating that it was very good. This suggests that the E-Module met the criteria for proper text use, readability, attractive imagery, harmonious colors, and clear instructions. The first round of validation also included feedback to enhance the navigation structure for better user clarity and to optimize image displays to match the topics more effectively. After improvements were made, the second round of validation resulted in a perfect score of 100, confirming that the E-Module was user-friendly and functionally effective.

Language expert validation focused on assessing the linguistic aspects of the teaching materials. The first validation gave a score of 93.33, indicating that the language used was very good. The expert suggested minor improvements, which were then addressed. The second round of validation resulted in a score of 96.67, confirming that the language used was straightforward, simple, and clear, aligning with student characteristics, and effectively motivating students. The language was also consistent in terms of symbols and punctuation.

Material expert validation aimed to assess the content's accuracy and relevance. In the first validation, the material expert gave a score of 94.0, indicating that the materials were very good. The second round of validation resulted in a score of 98, confirming that the content met the necessary standards. The results of the media, language, and material expert validations are summarized in Table 2.

**Table 2.** Recapitulation of Media, Language and Material Expert Validation Questionnaire Results

Validator	Validation	Validity	Average Total Validity
Members of the Media	1	94	97
	2	100	
Linguist	1	92	94
	2	96	
Materials Expert	1	94	96
	2	98	
Total		574	
Average		95.67	

The validation results indicate an average score of 95.67, falling within the 80-100% range, which signifies that the E-Module based on local wisdom is classified as "very good." This confirms that the E-Module is highly suitable for use, as it aligns well with learning outcomes and objectives. The material is presented in a sequential, easy-to-understand, clear, and precise manner. Additionally, the content is relevant, comprehensive, and designed to capture students' attention, making it an effective learning tool.

The assessment by 20 elementary school teachers was conducted to evaluate the teaching materials from pedagogical, content, technical, and aesthetic perspectives. The feedback gathered from these assessments is summarized in Table 3.

**Table 3.** Evaluation of E-Module Teaching Materials by Elementary School Teachers

No	Statement	TOTAL ( $\Sigma$ CVR)	$\Sigma$ CVI
A	Content Eligibility	10.5	0.955
B	Feasibility of Presentation	10.8	0.90
C	Language qualification	10.9	0.908
Total (CVR)		32.2	
CVI			0.921

Based on Table 3, the assessment of this E-Module teaching material uses CVR and CVI. The number of CVRs is generated from calculating the number of validators who answer the appropriate statement. The minimum CVR value to meet valid criteria according to Lawse (1975) for a number of respondents of 20 is 0.42. The CVI value is obtained from the calculation of the total CVR value divided by the total number of statements given to the validator. The average CVI value of 0.921 indicates a valid category with very good criteria. This shows that the E-Module is relevant to the learning objectives, comprehensive and easy for users to understand.

#### f. Teacher and Student Responses

The analysis of elementary school teachers' responses to the E-Module teaching materials was conducted to assess various aspects, including the appearance, presentation, and benefits of the materials. The following table presents the results of the teacher responses, providing insight into their

evaluation of the E-Module's effectiveness in the teaching and learning process. The data reflects the teachers' overall satisfaction with the E-Module and its potential to enhance students' learning experiences.

**Table 4.** Analysis of Teacher Responses to E-Module Teaching Materials

No	Aspect	Score(%)	Category
1	Appearance	93	Very good
2	Presentation	94.33	Very good
3	Benefit	95.8	Very good
Respondent		26	
Total Score		1100	
Average		94.64	

Based on Table 4, the results of the teacher responses to the teaching materials show an average score of 94.64, falling within the 80%-100% range, which indicates the "Very Good" category. This suggests that the E-Module developed is highly engaging in terms of appearance, has a clear and well-structured presentation, enhances literacy, and is very beneficial. It not only facilitates teaching but also allows for independent student learning. The teacher evaluation and assessment details are provided in the table below:

**Table 5.** Evaluation/assessment from Teachers

No	Aspect	Evaluation
1.	Appearance	The font/writing is too small, the font is not thick enough, so reading is not comfortable.
		The colors of the slides are more colorful to make them more interesting
		It's good enough, nice and complete, but it would be better if the image selection could be more tailored to your needs, and the placement should also be adjusted.
		The layout of images and text is adjusted so that it is more efficient and beautiful to read.
2.	<b>Structure and content</b>	The practice questions provided make it easier for teachers to evaluate learning outcomes
		Problem solving is a little simplified again.
		The composition of teaching materials is formulated clearly and coherently (essential questions, teaching materials meet students' learning styles through videos, games can attract interest in learning
3.	<b>Attractiveness</b>	Teaching materials are interesting because they are in accordance with current developments and the interests of the current generation. in general the module is interesting and cool
		It's good, interesting for students, interactive OK, it can be used as a reference for others

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The teaching module is good and interesting

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Interesting learning modules and updates on current phenomena. This module can also be used for interactive learning activities.

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Very good, interesting and effective teaching module for learning material. Using problem solving that stimulates children to think critically

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The sequence is good, coherent and clear, only for learning, the signal must be strong and the school must have the infrastructure for cellphones, computers/laptops

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Very clear, detailed, interesting. Hopefully it will increase the enthusiasm of students

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It's appropriate and very good

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It's good, if permitted, it can be used when teaching the Ecosystem chapter in class.

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The analysis of student responses to the E-Module teaching materials in the limited trial phase was conducted to evaluate how well the materials were received and their effectiveness in engaging students. The following table presents the results of the limited trial, providing insight into students' perceptions and feedback on the E-Module.

**Table 6.** Results of Limited Trial Analysis

No	Activity	Score (%)	Category
1	Aspect of usefulness	90.8	Very good
2	Design and display	84.8	Very good
3	Presentation	90.5	Very good
Respondent		10	
Total Score		620	
Average		88.6	

Based on Table 6, the results from the limited trials show an average score of 88.6, which falls within the 80%-100% range, indicating the "Very Good" category. This suggests that the E-Module was well-received by students. It was found to be engaging, easy to understand, and user-friendly. Students also expressed that the content was motivating and highly relevant, as it connected well with everyday phenomena. The E-Module not only encouraged students to learn more but also inspired them to apply scientific concepts to their daily lives, demonstrating its effectiveness in promoting practical learning. To further assess the effectiveness of the E-Module, student responses were gathered through questionnaires distributed to 26 students. These responses provide valuable insights into how the students interacted with the teaching materials and their overall experience. The results of these student responses are presented in Table 7.

**Table 7** Results of Analysis of Student Responses to E-Module Teaching Materials

No	Activity	Score (%)	Category
1	Aspect of usefulness	93.69	Very good
2	Design and appearance	91.69	Very good
3	Presentation	90	Very good
Respondent		26	
Total Score		1611	
Average		91.92	

Based on table 7, it shows an average value of 91.92. This value is between 80%-100% which indicates the Very Good category.

### 3.1.4 Implementation

The E-Module based on local wisdom has been deemed suitable for implementation in classroom learning with 26 class 4A students at SDIT Aliya, located in West Bogor Subdistrict, Bogor City. At this stage, a scientific literacy test instrument, which had previously undergone validity and reliability testing, was employed to assess the effectiveness of the E-Module in enhancing students' scientific literacy. Additionally, a questionnaire was distributed to gather students' opinions and feedback regarding their experiences with the E-Module. The scientific literacy instrument aimed to measure the impact of the E-Module on students' ability to understand and apply scientific concepts, providing valuable data on its effectiveness in fostering critical thinking and practical science skills.

### 3.1.5 Evaluation

At this stage, data analysis is conducted to draw conclusions from the collected data. A comprehensive evaluation is carried out, covering all stages of the research process, including analysis, design, development, and implementation. To assess the impact of the local wisdom-based E-Modules on students' scientific literacy and environmental awareness, an experimental research method was employed, specifically using a pre-experimental design with a one-group pretest-posttest design. This approach allows for a thorough evaluation of how the E-Module influences students' understanding of scientific concepts and their awareness of environmental issues. The following is the data analysis based on the implementation of the E-Module, which provides insights into its effectiveness and the students' responses to the learning experience.

### 3.2 Testing of the Effectiveness E-Module on Achieving Scientific Literacy

The effectiveness of the teaching materials was tested on 26 students. Data were collected using a scientific literacy questionnaire to evaluate the impact of the E-Module on students' scientific literacy. The effectiveness of the E-Module in enhancing scientific literacy was assessed by analyzing the results of the pretest and posttest. The test consisted of 13 multiple-choice questions focused on ecosystem content. The analysis of the pretest and posttest results, which reflect the students' progress in scientific literacy, is presented in Table 8.

**Table 8.** Results of Pretest and Posttest Analysis of Scientific Literacy

No	Data	Pretest	Posttest
1	Number of students	26	26
2	The highest score	77	100
3	Lowest value	23	39
4	N Gain	0.57	
5	%N Gain	57% (medium category)	

Based on the table above, the results of the pretest and posttest analysis of scientific literacy show an N Gain of 0.57, which means that after students use the E-Module in learning there is an increase in scientific literacy in the medium category.

**Table 9** Analysis of Pretest and Posttest Results for Scientific Literacy per indicator

No	Indicator Science Literacy	Question No	Score		N Gain	Criteria
			Pretest	Posttest		
1.	Explain scientific phenomena	1-5	51.54	86.15	0.69	Currently
2.	Evaluate and design scientific research	6-9	62.5	74.03	0.45	Currently
3.	Interpret scientific data and evidence	10-13	28.85	71.15	0.57	Currently
Average					0.57	Currently

### Discussion

Teaching materials play a crucial role in the teaching and learning process, significantly contributing to the success of learning activities (Suratman, 2019). In science education, one of the primary goals is to enhance student literacy, which requires engaging learning methods that capture students' interest. The use of E-Modules, which are interactive and engaging, offers a promising approach to achieving this goal. When developed and used effectively, E-Module teaching materials can enhance scientific literacy.

The E-Module developed in this study follows a standard module format, including elements such as a cover, hyperlinks, a foreword, table of contents, instructional pages, trigger questions, practice questions, and "Let's Do an Investigation" tasks that introduce problems related to the material. The module also integrates sections titled "Did You Know?" to present local wisdom related to environmental sustainability, and "Facts" that provide evidence of ecosystem damage from various sources. Additionally, answer keys, summative practice questions, summaries, a glossary, and a bibliography are included to support learning. During the presentation phase, students watch a video on the phenomenon of wild animals entering human settlements, followed by trigger questions and a learning video that covers the material. Teachers suggested adding more positive elements, such as an "I Can" section, simplifying the layout for questions and exercises, and accompanying videos with teacher guidance.

The validation results from language, media, and material experts, as well as the assessments from elementary school teachers, indicated that the E-Module was highly suitable for use. Media experts rated it at 97%, language experts at 94%, and material experts at 96%. The validation by 20 teachers resulted in a CVR score of 32, with an average CVR of 10.7 and a total CVI of 95.5, all of which fall

within the "very good" category. According to Astriani & Akmalia (2022), a CVI index score greater than 0.50 is considered good, further confirming that the E-Module was highly rated by experts.

To assess the effectiveness of the E-Module, students' responses were gathered during a limited trial. The students gave the E-Module an average score of 88.6, categorizing it as "very good." When implemented in the classroom with 26 students, the E-Module received an even higher average score of 91.92, indicating its effectiveness in engaging students. Teachers also provided positive feedback, with an average score of 94.64, further supporting the conclusion that the teaching materials were well-received.

After expert validation and limited trials, the E-Module was implemented with class 4A students. Pretests were conducted before using the E-Module, followed by 4 hours of learning with the materials displayed via an infocus projector. A posttest was administered to assess students' scientific literacy. The pretest average score was 48, while the posttest score increased to 77, resulting in an N Gain of 0.57, which indicates a medium improvement in scientific literacy. The increase in scientific literacy was significant, as shown by the paired t-test analysis.

The improvement in scientific literacy was particularly evident across three key indicators: explaining scientific phenomena (N Gain of 0.69), evaluating and designing scientific research (N Gain of 0.45), and interpreting scientific data and evidence (N Gain of 0.57). The positive responses from both students and teachers suggest that the E-Module based on local wisdom is an effective and engaging tool for enhancing scientific literacy.

These findings align with previous research showing that modules and E-Modules based on local wisdom can foster critical thinking and scientific literacy (R. N. Putri et al., 2023; Mutiaramses & Fitria, 2022; Syahrial et al., 2021). The use of local wisdom in learning materials not only makes the content more relevant to students' lives but also contributes to their understanding of environmental sustainability. As noted by Leni & Suripah (2022), the use of color, illustrations, and well-organized layouts in teaching materials can attract students' interest and effectively enhance their scientific literacy.

To assess the significance of the changes in scientific literacy, a paired sample t-test was conducted. After performing a normality test, the Shapiro-Wilk test confirmed that the data were normally distributed. The paired t-test yielded a significant result ( $p = 0.00$ ), indicating that the E-Module had a substantial impact on students' scientific literacy.

In the context of 21st-century learning, it is essential for students to understand science, communicate effectively, and apply their knowledge to solve real-world problems. The E-Module, integrating technology and local wisdom, provides a contextual and meaningful learning experience, as suggested by Toharudin et al. (2011) and Kemendikbud (2017). By connecting scientific content to students' cultural values and everyday experiences, the E-Module promotes both scientific literacy and character development.

However, this study has some limitations. The testing was conducted on a small scale within a single school, and further research involving multiple schools and different classes is necessary to confirm the generalizability of the findings. Additionally, expanding the sample size and including a control group could provide more robust data on the effectiveness of the E-Module. Despite these limitations, the study demonstrates that local wisdom-based E-Modules are a valuable tool for enhancing students' scientific literacy and environmental awareness.

#### 4. CONCLUSION

The results of the feasibility test indicate that the E-Module is valid and suitable for use as a supporting teaching material in schools. The E-Module, which incorporates ecosystem content adapted to local wisdom, successfully enhances students' understanding of local knowledge while connecting

it to scientific concepts. The implementation of the E-Module led to a medium-level improvement in students' scientific literacy in ecosystem topics, with both students and teachers providing very positive feedback.

The design of the E-Module effectively integrates material with local practices, traditions, and natural phenomena, making the content more relatable to students' daily lives. This approach not only helps students better understand and apply ecosystem concepts but also raises awareness about the importance of maintaining environmental balance.

While the study's findings are promising, there are some limitations. The research was conducted on a small scale with only one class, and the results may not be generalizable to larger populations. Future research should consider conducting trials in multiple schools with diverse student groups and exploring the application of local wisdom-based E-Modules in other subjects, such as energy, biodiversity, or social studies. Additionally, testing the long-term effects of using E-Modules on student performance and engagement would provide valuable insights into their effectiveness.

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## REFERENCES

- Alimah, S. (2019). Kearifan lokal dalam Inovasi Pembelajaran Biologi: Strategi Membangun Anak Indonesia yang Literate dan Berkarakter Untuk Konservasi Alam. *5*(1), 1–9.
- Asrorul Azizi, Muh. Zaini Hasanul Muttaqin. (2021). Pengaruh Pembelajaran Mini Riset Berbasis Kearifan Lokal terhadap Penguasaan Materi dan Analisis permasalahan Konservasi Lingkungan. *LAMBDA: Jurnal Ilmiah Pendidikan MIPA Dan Aplikasinya*, *1*(1), 56–62. <https://doi.org/10.58218/lambda.v1i1.71>
- Astriani, L., & Akmalia, S. (2022). Pengembangan Modul Bangun Ruang dan Statistika Berbasis Project Based Learning. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *6*(3), 3431–3442. <https://doi.org/10.31004/cendekia.v6i3.1568>
- Ayub, S., Rokhmat, J., Ramdani, A., & Hakim, A. (2022). Karakteristik Soal Literasi Sains Programme for International Student Assesment (PISA) Tahun 2015. *Jurnal Ilmiah Profesi Pendidikan*, *7*(4b), 2623–2629. <https://doi.org/10.29303/jipp.v7i4b.1039>
- Budiarti, S., Nuswowati, M., & Cahyono, E. (2016). KETERAMPILAN BERPIKIR KRITIS Info Artikel. *Journal of Innovative Science Education*, *5*(2), 144–151. <http://journal.unnes.ac.id/sju/index.php/jise>
- Cahyadi, R. A. H. (2019). Pengembangan Bahan Ajar Berbasis Addie Model. *Halaqa: Islamic Education Journal*, *3*(1), 35–42. <https://doi.org/10.21070/halaqa.v3i1.2124>
- Darmayasa, I. K., Jampel, N., & Simamora, A. (2018). Pengembangan E-Modul Ipa Berorientasi Pendidikan Karakter Di Smp Negeri 1 Singaraja. *Jurnal Edutech*, *6*(1), 53–65.
- Kurniawati, E. F. (2020). Pengimplementasian e-modul etnokonstruktivisme terhadap motivasi belajar peserta didik Kelas V sekolah dasar. *Jurnal Penelitian Ilmu Pendidikan*, *13*(1), 10–21. <https://doi.org/10.21831/jpipfip.v13i1.26589>
- Leni, & Suripah. (2022). Pengembangan Modul Elektronik (E-Modul) Berbasis Flip PDF Profesional pada Tema Pencemaran Lingkungan untuk Meningkatkan Literasi Sains Siswa SMP Kelas VII. *Jurnal Pendidikan MIPA*, *12*(September), 682–689.
- Mutiaramses, M., & Fitria, Y. (2022). Pengembangan Komik Digital Berorientasi Problem Based Learning (PBL) untuk Meningkatkan Literasi Sains Siswa Sekolah Dasar. *Jurnal Penelitian*

- Pendidikan IPA*, 8(2), 699–704. <https://doi.org/10.29303/jppipa.v8i2.1349>
- Putri, N. A., Sukmanasa, E., & Hari Susanto, L. (2023). Pengembangan E-Modul Berbasis Canva Pada Muatan Pelajaran Ilmu Pengetahuan Alam Materi Macam-Macam Gaya. *Didaktik : Jurnal Ilmiah PGSD STKIP Subang*, 9(1), 484–495. <https://doi.org/10.36989/didaktik.v9i1.666>
- Putri, R. N., Hariyadi, S., & Mudakir, I. (2023). Pengembangan Modul Pembelajaran Berbasis Stem pada Materi Pencemaran Lingkungan untuk Meningkatkan Literasi Sains dan Keterampilan Berpikir Kritis Siswa. 12(2).
- Qomariyah, W., Al Muhdhar, M. H. I., & Suarsini, E. (2019). Implementasi Modul Berbasis Problem Based Learning dengan Metode SQ3R Materi Keanekaragaman Hayati untuk Meningkatkan Literasi Sains dan Sikap Peduli Lingkungan. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, 4(3), 374. <https://doi.org/10.17977/jptpp.v4i3.12134>
- Rahmatih, A. N., Mauluda, M. A., & Syazali, M. (2020). Refleksi Nilai Kearifan Lokal (Local Wisdom) dalam Pembelajaran Sains Sekolah Dasar: Literature Review. *Jurnal Pijar Mipa*, 15(2), 151–156. <https://doi.org/10.29303/jpm.v15i2.1663>
- Rusilowati, A. (2018). Asesmen Literasi Sains: Analisis Karakteristik Instrumen dan Kemampuan Siswa Menggunakan Teori Tes Modern Rasch Model. *Prosiding Seminar Nasional Fisika Universitas Riau Ke-3, September*, 2–15.
- Suratman, D. (2019). Pengembangan Bahan Ajar Interaktif Untuk Perolehan Keterampilan Menentukan Luas Daerah Yang Dibatasi Dua Fungsi. *Jurnal Pendidikan Matematika Dan IPA*, 10(2), 55. <https://doi.org/10.26418/jpmipa.v10i2.31026>
- Syahrial, Asrial, Kurniawan, D. A., & Piyana, S. O. (2019). E-Modul Etnokonstruktivisme: Implementasi Pada Kelas V Sekolah Dasar Ditinjau Dari Persepsi, Minat Dan Motivasi. *JTP - Jurnal Teknologi Pendidikan*, 21(2), 165–177. <https://doi.org/10.21009/jtp.v21i2.11030>
- Syahrial, S., Asrial, A., Kurniawan, D. A., & Kiska, N. D. (2021). Improving Environmental Care Characters Through E-Modules Based on Local Wisdom Mangrove Ecotourism. *Jurnal Ilmiah Sekolah Dasar*, 5(3), 378. <https://doi.org/10.23887/jisd.v5i2.35360>