Local wisdom-based science e-module to improve cultural literacy and critical thinking skills of elementary school students

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Abstract
The low critical thinking skills and cultural literacy of elementary school students, along with the absence of teaching materials that integrate local wisdom into science and social studies (IPAS) learning, present challenges that need to be addressed. This study aims to develop a local wisdom-based IPAS e-module to enhance students' critical thinking skills and cultural literacy. The research employed the ADDIE development model, encompassing the stages of analysis, design, development, implementation, and evaluation, with feasibility tests conducted by material, media, and instructional experts. Practicality tests were carried out through one-to-one trials, small group trials, and field trials, while effectiveness tests applied a quasi-experimental design with control and experimental classes analyzed using pretest–posttest data and N-gain calculations. The results indicated that the e-module was rated "highly feasible" by all validators, with "highly practical" ratings from teachers and students. Effectiveness tests showed an improvement in critical thinking skills with an N-gain of 0.70 (high category) and an improvement in cultural literacy with an N-gain of 0.44 (medium category) in the experimental class, while the control class remained in the low category. This study concludes that the local wisdom-based IPAS e-module is effective as a learning resource for improving critical thinking skills and cultural literacy, while also serving as a medium for preserving regional culture in elementary schools.

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1. Introduction

Critical thinking skills are an important competency to have in order to adapt and keep up with developments in world life in this era (Lubbe et al., 2025; Novitskyi et al., 2025; Wang et al., 2025). The flow of technological developments is driving acceleration in many aspects, including information that is so fast and easy to obtain (Liamruk et al., 2025; Tomczyk, 2024). Such rapid information requires strong critical thinking skills to be able to digest the information wisely and according to needs and circumstances (Fajeriadi et al., 2024; Luo et al., 2025). In this regard, elementary school students need to be equipped and honed in their critical thinking skills to prepare them for facing and adapting to changing times. The use of complementary learning media that are appropriate to current developments and student needs has received significant attention, particularly through various media development projects and teacher coaching and training activities (Ar et al., 2023; Pertiwi et al., 2024).

The rapid development of technology and the flow of information also have an impact on the existence of local wisdom (Hadianto et al., 2021; Farmer, 2023). The shift in students' interests and introduction and understanding of local culture and wisdom appears to be decreasing. (Lubis et al., 2022) and (Yusuf, 2023) stated that students' understanding of issues related to culture and local wisdom is declining due to changes in their interests and passions. Cultural literacy is an important part of developing character and skills that can equip students for the future. Cultural literacy, which focuses on local wisdom, provides students with a sense of identity and pride in their culture (Humairoh, 2023; Zajda et al., 2022).

Both critical thinking skills and cultural literacy play an important role in developing student competencies. Cultural literacy refers to an individual's ability to understand, appreciate, and interact with the culture around them (Kale et al., 2023; Maine et al., 2019; Ruslan & Irham, 2022). As a form of service and to fulfill the teacher's role as a facilitator, the use of appropriate media and/or methods is necessary to convey learning objectives to students. The use of technological media assistance is a trend that has had many positive

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impacts on achieving learning objectives (Wahyudi et al., 2025; Masie et al., 2025; Patricia & Zamzam, 2021). Integrating technology into learning can improve students' critical thinking skills. The use of technology not only increases access to information but also encourages students to collaborate on projects and presentations (De & Chacón-Prado, 2023; Nguyen et al., 2024).

Field findings from the initial research process with teachers and students indicate that the learning process is still textual and does not explore students' critical thinking skills. Students' cultural literacy is also at a low level, indicated by minimal knowledge of local cultural diversity and the values contained therein. Critical thinking skills are also still low, indicated by difficulties in asking in-depth questions, analyzing information, and connecting learning concepts to everyday life. In-depth interviews with teachers revealed limited media and learning resources as inhibiting factors in facilitating student learning, especially in social science (IPAS) subjects. In the field, there are no modules or teaching materials available that specifically integrate material with local wisdom so that the potential of the surrounding cultural environment can be optimally utilized in the educational process. The results of this initial research are presented in Figure 1 below.

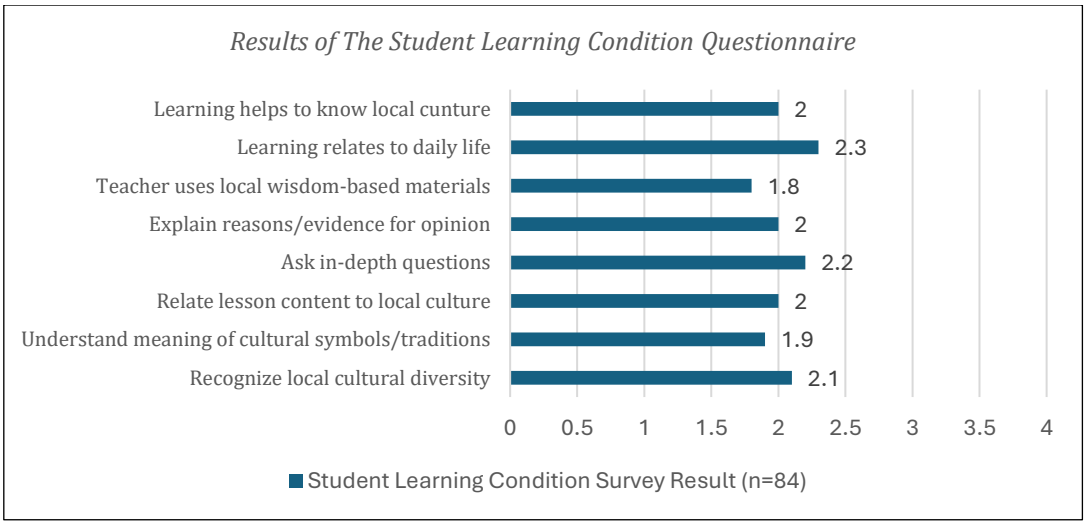

Figure 1. Results of The Student Learning Condition Questionnaire

The development of local wisdom-based science e-modules is urgently needed by students and teachers as a learning tool that can enhance critical thinking skills and cultural literacy, particularly on topics related to cultural diversity. Integrating local wisdom into e-modules allows students to learn contextually, enabling them to connect knowledge to their surrounding cultural environment (Ly et al., 2024; Wijayanto et al., 2023). Compared to other learning media, e-modules have advantages in terms of technology, which is easy to access through various digital devices, is interactive, and can be updated quickly according to material developments (Makhrus et al., 2025; Setiaji et al., 2025; Sofyan et al., 2019). Moreover, its innovative and flexible nature provides a more engaging, personal, and relevant learning experience to the needs of 21st-century learning.

This research was designed to develop a local wisdom-based science and science e-module as an innovation relevant to students' needs. The development of this e-module took into account various aspects to enhance students' critical thinking skills and cultural literacy through contextual, interactive, and relevant materials. Thus, the resulting product not only serves as an effective learning resource but also as a means of preserving local culture in the educational process.

2. Method

This research is a development research using the ADDIE model (Branch, 2009). The final product is a local wisdom-based social studies e-module that can improve critical thinking skills and cultural literacy in elementary school students. The development process is shown in Figure 2.

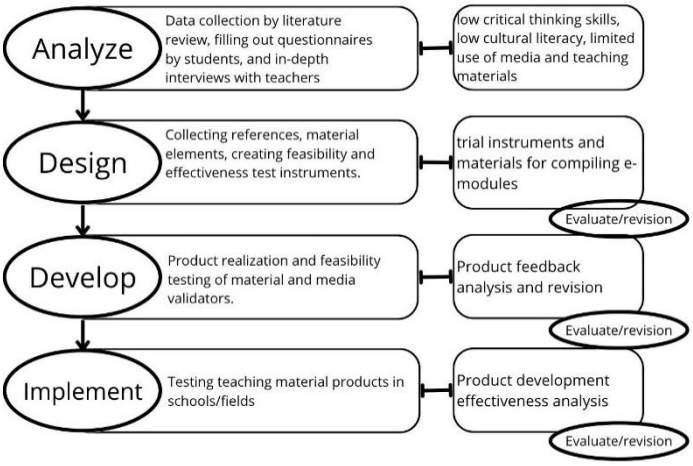

Figure 2. Research and Development Flow

Various tests were conducted in this development research, namely a feasibility test by material experts, instructional experts, and media experts at the development stage. Furthermore, a practicality test with a one-to-one trial on 3 students at Cengkawakrejo Elementary School, a small group trial on 9 students at Borokulon Elementary School, and a field trial on 16 students at Kledungkradenan Elementary School, which was also carried out at the development stage. Furthermore, the product effectiveness test was conducted at the implementation stage involving 60 fifth-grade students at Condongsari Elementary School and Popongan Elementary School as the control and experimental classes.

The instruments used in the feasibility test were material, instructional, and media validation questionnaires. The practicality test used teacher and student response questionnaires developed from the adapted material and media validation instruments. The feasibility and practicality categories of the e-module were analyzed by assessing the average scores in the categories shown in Table 1 below.

Table 1. conversion Interval of The Average Value of The Feasibility and Practicality Test

Average value	Category
3,26 – 4,00	Very feasible/Very practical
2,51 – 3,25	Feasible/Practical
1,76 – 2,50	Less feasible/Less practical
1,00 – 1,75	Not feasible/Not practical

The effectiveness test instrument used pretest-posttest questions and a student self-assessment questionnaire to determine improvements in critical thinking and cultural literacy skills. Improvement scores were calculated by calculating standard scores for the categories in Table 2 below.

Table 2. Standard N-gain Category (Hake, 1998)

Interval	Category
$(g) \geq 0,7$	High
$0,7 \geq (g) \geq 0,3$	Medium
$(g) < 0,3$	Low

3. Results and Discussion

3.1. Results

This research resulted in a product in the form of a local wisdom-based science and science e-module to improve students' critical thinking skills and cultural literacy using the ADDIE development model. The stages of this model are analysis, design, development, implementation, and evaluation (Branch, 2009; Mohammad Basir et al., 2025; Norouzkhani et al., 2025). In the analysis phase, preliminary research was conducted to determine the needs of students and teachers as research subjects. Based on the results of the initial research obtained from student questionnaires and in-depth interviews with teachers, it was discovered that teachers had difficulties in delivering science subjects that must integrate technology due to the demands of the times. The breadth of material and the limitations of modules or learning resources containing local wisdom also became obstacles for teachers in learning. Constraints in learning resulted in students who also had limitations in critical thinking skills and cultural literacy as a result of a series of problems encountered. The limitations of

important teaching materials that could facilitate the learning process became the basis for the development of e-modules based on local wisdom which was continued in the design phase.

The next stage is design, which involves preparing assets and materials for the local wisdom-based science e-module. Reference collection and analysis of CP and the characteristics of fifth-grade students are key considerations in developing the material and using language. The selection of image assets and displays also takes these factors into account. This stage also includes the development of instruments to test its feasibility, practicality, and effectiveness.

The third stage is development, which involves compiling a complete e-module. The application used is Canva for Edu, which then outputs it in PDF and Flip HTML5 formats. Both formats are used to facilitate user convenience in the event of potential network limitations. The product design developed can be seen in Figure 3.

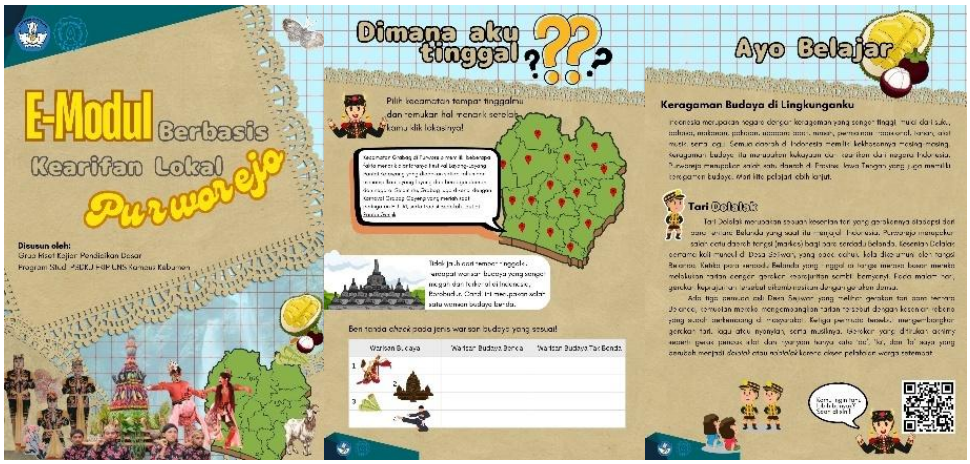

Figure 3. Design of E-Modules for Science and Natural Sciences Based on Local Wisdom

After the product was finished, a feasibility test was conducted with material experts, instructional experts, and media experts. The results of this test can be seen in Table 3 below.

Table 3. Validation Value Recap

Validation	Aspect	Score	Total	Average	Category
Media validation	Appearance	27	47	3,61	Very feasible
	Technical	20			
Instructional design validation	Objective	4	36	3,60	Very feasible
	Strategy	20			
	evaluation	12			
Content validation	Curriculum	12	47	3,60	Very feasible
	Material	23			
	Language	8			
	Evaluation	12			

Some of the input included simplifying the language. Furthermore, there was input on the Purworejo local wisdom material, including the addition of Cing Pho Ling, whose presence has significantly declined. The media validator's input concerned the e-module format, ensuring it can be accessed on various operating systems, including Windows, Android, and iOS.

During the development phase, practicality testing was also conducted, measured by questionnaires of student and teacher responses to the use of the local wisdom-based science and science e-module. The testing was conducted in three stages: one-to-one trials, small group trials, and field trials. The results of the trials can be seen in Figure 4 below.

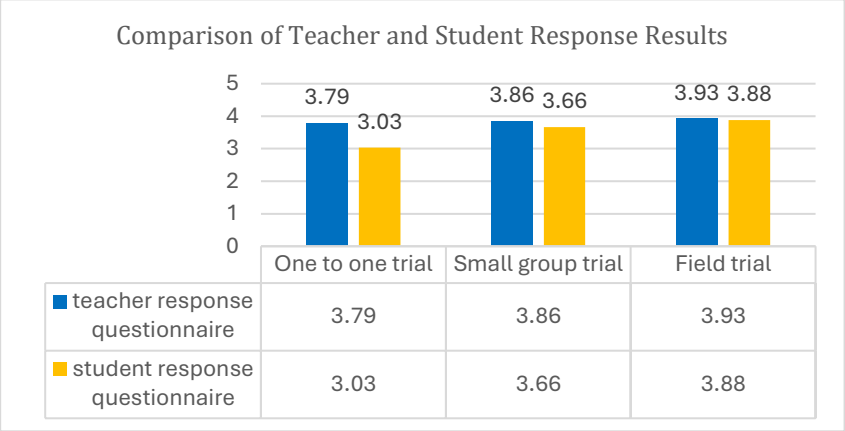

Figure 4. Comparison of Teacher and Student Response Results

Based on these calculations, it can be concluded that the practicality test of the local wisdom-based science and science e-module conducted on teachers and students showed very practical results. During the testing process, revisions were also made, such as larger font size, the use of illustrations featuring children, and the addition of Ching Pho Ling content, which previously only included Dolalak local wisdom.

The next stage is implementation by testing the effectiveness of the developed local wisdom-based science and education e-module. This test used a quasi-experiment with a control and experimental class. A prerequisite test with a pretest was previously conducted on both the control and experimental classes, and a significance value of > 0.05 was obtained, indicating normal and homogeneous data. The gain value was then calculated, with results as in Table 4 below.

Table 4. Pretest Posttest Gain Value of Critical Thinking Ability

No	Class	Average Value		N-Gain	Category
		Pretest	Posttest		
1	Experiment	38	45	0,70	High
2	Control	37	39	0,20	Low

Based on these data, it can be seen that there is a significant difference between the control and experimental classes regarding the gain scores on the critical thinking ability variable, as measured by a test. For the cultural literacy variable, the gain scores were also measured using a student self-assessment instrument, with results as in Table 5 below.

Table 5. Cultural Literacy Gain Value

No	Class	Average Value		N-Gain	Category
		Pretest	Posttest		
1	Experiment	20	25	0,44	Medium
2	Control	21	22	0,10	Low

Based on the data from the gain score calculation for the students' cultural literacy skills, there was also a difference between the control and experimental classes. In the experimental class, students' cultural literacy skills were in the moderate category, while in the control class, their cultural literacy skills were in the low category. This indicates an improvement from the use of the local wisdom-based science and education e-module.

3.2. Discussion

The local wisdom-based social studies e-module was developed based on field needs. The e-module is an innovative development because it can cover comprehensive topics while still incorporating technological elements that are easily accessible to many (Lestari et al., 2025; Patras et al., 2025; Yani et al., 2025). The use of e-modules is also a form of technology adaptation in the field of education as a manifestation of the commitment of teachers and academics to innovate (Hudhana et al., 2025; Maigina et al., 2024). The e-IPAS module, which is based on local wisdom, is also an innovation in learning that is more contextual and pays attention to the surrounding culture (Laila et al., 2021; Suwanthada & Yuan, 2024). The local wisdom that is raised is a form of uniqueness of learning because most of the teaching materials or modules that are widely circulated contain culture that is generally known in Indonesia, not specifically local regional culture.

The development of local wisdom-based IPAS e-modules takes into account feasibility factors that have been tested by material, instructional, and media validators (Nugroho & Surjono, 2019; Surjono, 2017). Feasibility testing in product development is an important part (Atmojo et al., 2025; Minsih et al., 2025). Based on the assessment results, it shows that the e-module is very suitable for use with an average value of 3.60 for the material validator, 3.60 for the instructional validator, and 3.61 for the media validator, in the "very suitable" category. The content and display, which often highlight cultural elements with local wisdom, are attractive and provide novelty for students' learning experiences (Paryanto, 2025; Pratiwi et al., 2022).

The practicality of the local wisdom-based science and science e-module showed a score of 3.79 to 3.93 in the teacher response questionnaire and 3.03 to 3.88 in the student response questionnaire. These scores fall into the "very practical" category based on the experiences of both teachers and students. The e-module, which is easier and more flexible to use and has an attractive visual display, can help students be more focused and engaged in its use (Fernando & Marikar, 2017; Jiang, 2022). The active role of students in exploring the use of culture-based science e-modules is considered relevant to the development of technological adaptation which also takes into account cultural elements (Demitrion, 2021; Pawani et al., 2021). E-modules that integrate technology also make it easier for teachers to have teaching materials that suit students' needs and learning objectives (Alyusfitri et al., 2024; Bonnici et al., 2023).

The local wisdom-based science e-module that can improve critical thinking skills is identifying cultural heritage around us, both tangible and intangible. This is evident from the gain value data, where the experimental class has a score of 0.70, which is in the high category. Students are given the experience to find more concrete examples of the surrounding culture, not just examples found in the module in general. The integration of Dolalak and Ching Po Ling dance culture in the material "My proud region" encourages students to be able to analyze, compare, and evaluate information in depth, thereby triggering critical thinking skills (Risda et al., n.d.; Vilmala et al., 2025). This gives them a more meaningful learning experience so that their critical thinking skills are also sharper (Apriani et al., 2025; Murfiah et al., 2024). Learning not only enriches concepts but also facilitates the connection between factual knowledge and the reality of cultural conditions around us (Cong & Ironsi, 2025; Karayol & Umdu Topsakal, 2025). Finally, the use of the developed e-module is able to create a meaningful, reflective, and critical learning process for students.

The local wisdom-based science e-module also plays a significant role in improving students' cultural literacy through understanding and appreciation of regional cultural heritage, as evidenced by the results of the effectiveness test, which showed significant differences in gain scores between the control and experimental classes. The presentation of material that focuses heavily on the cultures around students provides them with the opportunity to recognize, understand, and preserve the cultural values presented in their environment (Dharma et al., 2025; Jember et al., n.d.; D. Wang & Zhang, 2025). This not only broadens students' cultural horizons but also fosters positive attitudes and a sense of pride in one's identity (Dharma et al., 2025; Hodgson & Harris, 2022; Isnaini et al., 2020). Thus, this e-module is able to become an effective learning tool in forming students who are cultured, have character, and appreciate local wisdom as a positive effect of high cultural literacy.

4. Conclusion

Based on the results of the development research on the local wisdom-based science e-module, it showed a very good assessment with a "very feasible" category based on the validator of materials, instructions, and media. In addition, it also received a good response in the form of a "very practical" assessment during the trial with students and teachers. Based on the feasibility, practicality, and effectiveness tests, it can be concluded that the local wisdom-based science e-module can improve students' critical thinking skills and cultural literacy. This e-module can be used by fifth-grade elementary school teachers as a learning companion and makes it easier for students to learn about cultural diversity, especially to get to know the local wisdom around them.

Author Contributions

All authors have equal contributions to the paper. All the authors have read and approved the final manuscript.

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Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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