Validity of PBL E-Modules Integrated with Local Wisdom in Improving Students' Literacy and Science Process Skills

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Abstract *- This study aims to develop and evaluate the validity of e-modules based on problem-based learning (PBL) integrated with local wisdom to improve students' science literacy and science process skills. The e-module was developed using the 4D development model (define, design, develop, disseminate). Validation of the e-module involved three experts by assessing aspects of content, presentation, and language and was tested using Aiken's V analysis. The validation results showed that the e-module had a high level of validity with the category "very valid," in the aspects of content, presentation and language. In addition, the results of the validation of learning tools such as the flow of learning objectives, teaching modules, and test instruments for science literacy and science process skills also produced good assessments. These results indicate that this PBL-based e-module is not only valid for use in learning, but also effective in supporting the improvement of understanding of science concepts, appreciation of local culture, as well as science literacy and science process skills of students. Thus, this e-module has the potential to be an innovative solution for science learning that is contextual, interactive, and relevant to the needs of the 21st century.*

Keywords*: E-Module; Problem Based Learning; Local Wisdom; Science Literacy; Science Process Skills*

INTRODUCTION

The development of science education in the 21st century demands innovative learning approaches that can improve students' science literacy and science process skills. Science literacy not only involves understanding the basic concepts of science but also includes the ability to use scientific knowledge in the context of everyday life (OECD, 2019). These competencies are important to equip learners to face global challenges (Afandi et al., 2019), including environmental, technological and socio-cultural issues.

To meet this need, the PBL approach has been identified as an effective strategy (Tanna, 2022; Lesmana, 2024). PBL is a learning model that encourages students to develop critical thinking skills by responding to and finding solutions to various problems faced (Apriana et al., 2024). In learning activities, this model involves more student activities so that learning is more student-centered (Suryani et al., 2017). So that they can learn or find out the knowledge related to the problem as well as have the skills to solve problems (Wardani, 2023).

In addition, local wisdom-based education plays an important role in connecting learning with learners' cultural context (Laksana et al., 2023). Local wisdom includes values, knowledge and cultural practices passed down through generations, which not only contribute to contextualized learning but also build cultural identity and appreciation of local wealth (Kundarni & Kosasih, 2024). Research shows that the integration of local wisdom in learning can increase learning motivation, build cultural identity, and enrich students' conceptual understanding (Amaliyah et al., 2023). In the context of science education, local wisdom provides a contextual approach to explain

scientific phenomena more relevantly (Puspasari et al., 2019).

Digital technology has opened new opportunities in supporting PBL-based learning and local wisdom through interactive media such as e-modules (Widayanti, 2022). E-modules are independent learning materials that are organized systematically, in electronic format, audio, animation and navigation (Seruni et al., 2019; Prayudha, 2017). PBL-based e-modules integrated with local wisdom offer great potential in improving the quality of learning (Setyorini, 2022; Hamidi et al., 2024). With the utilization of digital technology, this e-module allows the presentation of interactive, flexible, and interesting material, and encourages independent learning (Cecep & Bambang, 2013) and Palupi & Subiyantoro (2020), explained that PBL-based e-modules are instructional methods that challenge students to learn, work together in groups, increase curiosity and find solutions to problems. In this study, e-modules were developed with a focus on the theme "Temperature, Heat, and Expansion" for grade VII students, which is integrated with the local wisdom of the Sade Village Traditional House in Lombok. This approach is expected to be able to connect science theory with local experiences, improve understanding of concepts as well as appreciation of local culture.

The purpose of this study is to evaluate the validity of e-modules that have been developed based on content, presentation, and language criteria. Validation was conducted by experts to ensure that this learning product is feasible and effective to use. This research also contributes to the development of science literacy and science process skills, which are important elements in 21st century learning.

Through this research, it is expected that PBL-based e-modules integrated with local wisdom can be an alternative solution in science learning that not only supports the achievement of academic learning outcomes, but also builds character, creativity, improves science literacy and science process skills of students.

RESEARCH METHODS

The type of research used is research & development (R&D). The model used to develop this PBL-based e-module integrated with local wisdom is using the 4D development model suggested by Thiagarajan, Semmel & Semmel. The 4D model consists of 4 main stages namely define, design, develop, and disseminate, (Thiagarajan, et al., 1974).

The validity test of e-modules based on problem-based learning integrated with local wisdom was carried out by three expert validators by filling in the validation instrument sheet. Expert validators in this study consisted of lecturers in the field of science education, who have academic qualifications and extensive experience in developing teaching materials and innovative learning methods, as well as having competence in curriculum design based on innovative learning models, such as PBL, and technology integration in learning.

The validation instrument in this study covers three main aspects, namely content, presentation, and language, each of which has specific indicators to assess the quality of e-modules. The content aspect includes the suitability of the material with the curriculum, the accuracy of science concepts, the integration with Problem Based Learning (PBL), and the integration of local wisdom. The presentation aspect assesses the layout, readability, completeness of digital navigation, use of multimedia (images, videos, and

animations), and interactivity of e-modules in supporting independent learning. The language aspect focuses on clarity of delivery, suitability to the cognitive level of learners, and accuracy of spelling and grammar. The assessment is conducted using a Likert scale rubric with a range of 1 (invalid) to 4 (very valid), and the results are calculated to determine the validity level of the e-module. This rubric helps validators provide objective and systematic feedback for e-module improvement before implementation.

The results of validation by validators were analyzed using Aiken's V formula (Retnawati, 2016).

$$V = \frac{\sum s}{[n(c-1)]} \quad (1)$$

Description:
V = Expert agreement index
$\sum s$ = Total score
s = r - Lo
r = The value given by the expert
Lo = The lowest validity assessment value
n = Number of experts/respondents
c = The highest validity assessment value

The level of validity is determined based on Table 1.

Table 1. Validity Categories

Range of Values	Category of Validity
0,0 – 0,4	Less valid
0,41 – 0,80	Valid
0,81 – 1,00	Very valid

RESULTS AND DISCUSSION

Results

The PBL-based e-module integrated with local wisdom developed contains science material for grade VII semester 1 on the subject of temperature, heat and expansion, local wisdom in Lombok, West Nusa Tenggara, namely the Sade Village Traditional House, as well as questions and activities that can trigger students in improving science literacy and science process skills. In the preparation of e-modules based on problem-based learning integrated with local wisdom that is feasible, practical and effective to use in learning, the development steps refer to the 4D development stages of Thiagarajan, Semmel & Semmel (Thiagarajan, et al., 1974).

In this study, the 4D model (Define, Design, Develop, Disseminate) was used to develop e-modules based on Problem Based Learning (PBL) integrated with local wisdom. In the Define stage, a needs analysis was conducted through literature studies, teacher interviews, and curriculum analysis to identify the problem of low science literacy (LS) and science process skills (KPS) and the relevance of the Sade Village Customary House as integrated local wisdom. In the Design stage, the e-module framework was developed, including an interactive display, user-friendly navigation, as well as PBL-based LKPD, and interactive multimedia. The integration of local wisdom is done by presenting a case study of the Sade Village Traditional House in the context of conduction, convection, and heat radiation, as well as local culture-based exploration tasks. At the Develop stage, the e-modules were validated by expert validators, tested for implementation by teachers, and tested for practicality based on teacher response questionnaires and student response questionnaires. Finally, at the Disseminate stage, the e-module is disseminated by implementing the e-module in other classes at the research location. At this stage, the effectiveness is tested through pretest-posttest.

The following are the results of device validation by validators as follows:

1. Expert Validation Results

The product developed in this research is a PBL-based e-module integrated with local wisdom, designed to improve students' science literacy and science process skills. This e-module contains temperature, heat, and expansion materials, with a PBL

approach that directs learners to solve real problems, one of which is through exploring science concepts in the Sade Village Traditional House in Lombok. This module was developed in an interactive digital format using Heyzine Flipbook, which allows learners to access it flexibly through laptops, tablets, or smartphones. In addition to text and images, this e-module is equipped with videos, animations, practice questions, and Learner Worksheets (LKPD) to support active and independent learning. Its uniqueness lies in the integration of local cultural values with modern science concepts, making learning more contextual, interesting, and applicable for students.

The draft PBL-based e-module integrated with local wisdom that has been developed and consulted with the supervisor is validated by experts. Product validation is important to ensure that the products and learning tools to be used have accurate and reliable results (Madzík & Pelantová, 2018). Validation was carried out by three expert validators by giving an assessment on each component of the product and learning tools. Products and learning devices that were validated were PBL-based e-modules integrated with local wisdom, flow of learning objectives (ATP), teaching modules, and test about science literacy (SL) and science process skills (CPS). The results obtained are listed in Table 2.

Table 2. Validation Result

Val.	ATP			Teaching Module			E-Module			LS Test			KPS Test		
	a	**b**	**c**	**a**	**b**	**c**	**a**	**b**	**c**	**a**	**b**	**c**	**a**	**b**	**c**
1	11	12	9	14	12	9	17	19	19	8	7	12	6	6	12
2	10	11	9	14	12	9	18	16	18	9	8	9	10	7	9
3	11	11	9	14	12	9	17	18	19	9	8	12	7	7	10
∑s	32	34	18	42	36	18	52	53	56	26	23	33	23	20	31
V	0.89	0.94	0.75	0.88	0.75	0.75	0.87	0.88	0.93	0.72	0.96	0.92	0.64	0.83	0.86
Av.	0.86			0.79			0.89			0.87			0.78		
Cate.	Very valid			Valid			Very valid			Very valid			Valid		

Description:
Val. = validator
Cate. = category
a = content
b = view
c = language
Av. = average

2. Results of Draft I

In addition to assessing the products and learning tools developed, the three validators also provided input/suggestions for improvement to improve the quality of the products and learning tools developed so that the revised results are called draft II. According to Ibrahim, et al, (2020), Utami, et al,. (2019), Sudirman, et al., (2017) state that input and suggestions from validators can be used by researchers as material for consideration to make revisions in order to improve learning devices that are suitable for use. The suggestions and revision results are detailed as follows:

a. ATP

Expert validator suggestions and revisions to the ATP are presented in Table 3.

Table 3. Expert Validator Suggestions and Revision Results of ATP

No.	Validator Suggestion	Revision Result
1.	Learning objectives are arranged with attention to ABCD Revise learning objectives with attention to ABCD	Revise learning objectives with attention to ABCD
2.	The display in the ATP table is adjusted again so that there are no empty columns	Improve the ATP table by adjusting the contents with the columns so

		that there are no empty parts
3.	Competencies to be achieved can be spread over each learning objective	Already spread each competency to be achieved in each learning objective

b. Teaching Module

Expert validator suggestions and revisions to the teaching module are presented in Table 4.

Table 4. Expert Validator Suggestions and Teaching Module Revision Results

No.	Validator Suggestion	Revision Result
1.	Check the allocation of learning time for junior high school	Check and revise the allocation of learning time in junior high school
2.	Check whether the PBL syntax with teacher activities with learner activities	Check and readjust between PBL syntax with teacher activities with learner activities
3.	Revise and adjust the appearance of the learning activity table	Revise the appearance of the learning activity table and adjust it to the time allocation

c. E-modules based on PBL integrated local wisdom

Expert validators' suggestions and revisions to the PBL-based e-modules integrated with local wisdom are presented in Table 5.

Table 5. Expert Validator Suggestions and Revision Results of PBL-Based E-Modules Integrated with Local Wisdom

No.	Validator Suggestion	Revision Result
1.	E-modules have not characterized PBL-based e-modules	Revise the e-modules by including PBL syntax in the learning activities in the e-modules
2.	Need to give numbering to each equation	Already gave numbering to each equation
3.	The final test of the module should help prepare for the final test, so there must be synchronization with the dependent variable	Revise the e-module final test according to the dependent variable, namely SL and KPS
4.	The picture on the e-module is in accordance with Tulisa. Do not exceed or less	Already improve the appearance of the image on the e-module so that its position is parallel or neither exceeds nor is less than the discourse
5.	Try to make the title more prominent	Revise each title by changing the title font to be larger and bolded

d. SL Test Instrument

Expert validator suggestions and the results of revisions to SL test are presented in Table 6.

Table 6. Expert Validator Suggestions and Revision Results of SL Test Instrument

No.	Validator Suggestion	Revision Result
1.	Option on multiple choice questions should only use lowercase letters	Correct the option on multiple choice questions to lowercase letters
2.	Reconsider the assessment rubric used	Recheck and adjust the assessment rubric that will be used
3.	At the end of the test write “good work, good luck” to motivate students	Have written a motivational sentence at the end of the question

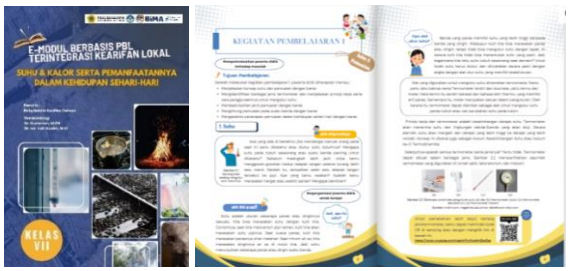
e. KPS Test Instrument

Expert validator suggestions and the results of revisions to the KPS test are presented in Table 7.

Table 7. Expert Validator Suggestions and Revision Results of KPS Test Instrument

No.	Validator Suggestion	Revision Result
1.	The questions do not represent the learning objectives	Revise each existing question and adjust it to the learning objectives so that the expected learning objectives can be achieved
2.	Check whether the questions are in accordance with the indicators	Check again and adjust the questions to the KPS indicators used

The e-module display after being revised based on suggestions and feedback from expert validators can be seen in Figure 1.



(a) (b)

Figure 1. E-Module Display after Revision (a) Cover; (b) Learning Activities

Discussion

Based on the validation results above, it can be seen that the results obtained on each product in each aspect of both content, view, and language are different. However, when viewed from the average of all aspects of each product, the figure above shows valid to very valid criteria. The ATP validation results show a relatively high value of 0.86, with the category "very valid". This indicates that the ATP has been well designed and meets the established validation criteria. Overall, the validated ATP is considered very valid and suitable to be used as a guideline in the implementation of learning.

The average validation of the teaching module was 0.79, with the category "valid". It can be seen that the content validity score is quite high, but the presentation and language validity scores are slightly lower. This indicates the need for improvement in presentation and linguistic aspects. Improvements can be made by improving the suitability of the teaching module display for grammatical errors, adjusting the problem-based learning syntax with teacher and learner activities, and editing sentences that are less effective.

Then, the average validation of e-modules based on problem-based learning integrated with local wisdom is 0.89. These results indicate that the e-module has been designed very well, consistent across all categories, and meets the established validation criteria. The validity of the content, presentation, and language of the e-module is rated high, indicating that the material presented is relevant, interesting, easy to understand, and in accordance with the needs of students. This is in line with the statement of Muzijah et al. (2020) that the e-module developed in accordance with standard rules should be so that this e-module is able to meet the criteria of good teaching materials so that it is considered suitable for use as an effective and efficient independent learning resource. This can be seen from the learning images contained in the e-module that support temperature and heat material by integrating local wisdom in the form of the Sade Village Traditional House in it. Hmelo-Silver (2004) states that PBL is effective in building deep conceptual understanding through solving real problems, which in this study is realized by exploring the concepts of temperature, heat, and expansion in the Sade Village Traditional House. In addition, the high validity of the e-module is in line with the research of Gunawan et al. (2019) which showed that PBL-based interactive media can improve science process skills (KPS) and student learning motivation. The integration of local wisdom in e-learning, as supported by Setyorini et al. (2022), proved to be able to make learning more contextual and applicable, which is in line with the results of the validation of e-modules in this study. Therefore, the validation results of this e-module fully support the existing theory.

The science process skills questions showed a lower validation value than the science literacy questions, where the average validation of science literacy questions was

0.87 with the category “very valid”, while the average validation of science process skills questions was 0.78 with the category “valid”. This indicates that it is necessary to review and improve the content and quality of these questions. The content validity of the questions needs to be improved by ensuring that the questions presented are relevant to the learning objectives and cover all the material that has been learned. The validity of the presentation of the questions needs to be improved by ensuring that the questions are presented in a clear, straightforward and unambiguous manner. The validity of the question language needs to be improved by ensuring that the language used is appropriate to the level of understanding of students and does not contain grammatical errors. In line with Gultom's research (2017) that the products developed are in the very valid to valid category based on the results of the validation test so that the products developed can be used in the learning process. However, the developed product needs to be refined based on suggestions or input from expert validators so that the product can be presented completely and supported by a display that attracts students to read it.

CONCLUSION

PBL-based e-module products integrated with local wisdom developed in the aspects of content, presentation, and language are on very valid criteria, learning tools developed include ATP, teaching modules, science literacy test instruments and science process skills test instruments are on valid to very criteria. It can be concluded that the problem-based learning e-module products integrated with local wisdom and learning tools developed are valid and feasible to use in classroom learning to improve students' science literacy and science process skills with revisions according to the validator's suggestions.

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