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Development of E-module toward Mangrove Species Diversity Based on Local Potential of Pulau Dua Nature Reserve Serang Banten to Improve Students' Digital Literacy

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ABSTRACT
This research is the development of e-modules of mangrove species diversity based on the local potential of Pulau Dua Nature Reserve Serang Banten which is a learning media to assist students in introducing the biodiversity of mangrove local potential around and used as teaching materials that are used independently. The purpose of developing this e-module is to produce teaching materials that are valid, practical and effective for use in learning. This local potential-based mangrove species diversity e-module development model uses the Lee & Owens (2004) development model. To see the validity of e-modules, validation of material experts, media experts and teaching materials and field practitioners was carried out. Practicality test with one to one trial of 3 students, small group trial of 12 students and field trial of 36 students. The effectiveness of e-modules was measured objectively using the Simple Paired T test and subjectively using the N-Gain Score on students' digital literacy. The results showed that the e-module of mangrove species diversity developed was valid, practical and effective. There are differences in students' digital literacy before and after being taught with e-modules of mangrove species diversity.

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1. INTRODUCTION

Education is currently entering the era of the industrial revolution 4.0. The progression of the industrial revolutional era has had a major significant impact on the world of education, focusing on the development of future learning skills (Shahroom & Hussin, 2018). The principles of the era of the fourth industrial revolution affect the utilization of rapidly developing digital technology (Baygin et al., 2016; Putriani & Hudaidah, 2021). The learning and methodology used must integrate technological elements (Anaelka, 2018). Teachers and students are required to have the basic ability to access and filter incoming information (Astini, 2019; Nasah et al., 2010). Students must have independent skills in learning and finding credible reading sources through digital literacy and Communication Technology (ICT) literacy (Anaelka, 2018; Yamin & Syahrir, 2020). Teachers have a role to familiarize digital literacy in learning because of the demand for skills that students must have. Integrating digital literacy in learning can determine the success of student learning, so the rapid changes of the times need to be provided by teachers with learning that utilizes digital literacy as support (Jamil et al., 2022).

Learning ideally integrates digital technology as support (Harun, 2021). Teachers and students need to utilize learning platforms that can facilitate access and monitoring by parents (Astuti & Harun, 2020). It is expected that this will trigger the enthusiasm of the students and improve their learning outcomes (Ratnasari et al., 2022). The problem that exists in schools is the lack of utilizing digital technology in learning. Some of the factors include unsupportive facilities, teachers' inability to manage digital media, lack of time and others (Rivalina, 2015).

Digital media including e-modules have benefits which facilitate the ability of students to explore the lessons presented. Some topics in biology subjects cannot be visualized directly so they need learning media (Jayawardana, 2017). The content of the variety a living things in class X has a complex concept so it needs to facilitate media to make it more interesting for students to learn (Azzahra & Atifah, 2023) learning the diversity of living things in schools is material in student textbooks that does not contain local potential, especially to

introduce biodiversity diversity in Indonesia (Lestari et al., 2021). Local potential needs to be introduced as an effort to enrich learning resources for students. It is necessary to explore biodiversity by adjusting the curriculum, infrastructure and school readiness in implementing local potential in learning (B. Pratiwi et al., 2019). One of the local potentials of Serang Banten is mangrove diversity in the Pulau Dua Nature Reserve of Serang Banten.

Digital literacy is the ability to research and sort messages, critically reflect, create, cooperate with other individuals, effectively connect, and care about e-safety and the continuously evolving cross-cultural social (O'Brien, 2022). Digital literacy is an integrated concept between visual literacy, computer literacy and information literacy (Boyd & Crawford, 2012). A person is considered to have good digital literacy in terms of 2 (two) criteria. The first is technical ability, which is technical expertise in using technology and the skills to utilize computers and the internet (Syah et al., 2019). Digital literacy plays an important role in supporting successful learning (Handayani et al., 2020). The role of digital literacy in education and learning is to develop knowledge and skills on learning materials by encouraging curiosity and honing students' digitalization abilities (O'Brien, 2022). Digital literacy serves an important function to increase self-regulation (Prior et al., 2016), which is a sense of confidence to recognize all the potential that exists in themselves (Sa'adah et al., 2020; Salsabilla et al., 2023).

Digital literacy needs to be integrated in learning, for example by developing media that suits student needs ((Desi, 2020; Rahayu et al., 2019). Learning that utilizes media such as e-modules will increase student enthusiasm and simplify a concept so that it is better understood by students (Aziza et al., 2022). The urgency of developing mangrove diversity e-modules based on local potential is to provide an introduction to the local potential of Serang Banten to students who are packaged attractively through e-modules. Biology learning that utilizes e-module media will make it easier for students to learn because the e-module presentation is very complete starting from videos, pictures, complete material explanations, student worksheets, per-content evaluations, there are problem articles that can be discussed to find solutions (Mursali & Safnowandi, 2016; Salsabilla et al., 2023).

Based on the description that has been explained, the aim of the present research is to develop an e-module of mangrove species diversity based on the local potential of the Pulau Dua Nature Reserve in Serang Banten to exercise students' digital literacy that is valid, practical and effective.

2. RESEARCH METHOD

This research went through two stages of research, namely pure research to determine the diversity of mangrove species and e-module development research. This kind of study is the research and development that produces products in the form of learning media (Amali et al., 2019). The research and development model used is from Lee and Owen. There are five stages in the development of research including analyzing steps, designing steps, developing steps, implementing steps, and evaluating steps (Lee & Owens, 2004). The choice of development model is based on the consideration that the media to be developed is digital or multimedia media (Saifudin et al., 2020). The e-module that has been developed will be tested by validation of material, media and learning experts and biology education practitioners. The following is the formula used to calculate the level of validity criteria.

$$v=\frac{Tse}{Tsh} \times 100$$

Description:
V : Percentage of e-module validity
TSe : Total validator assessment score
TSh : Total maximum score

Table 1. Criteria for E-module Validity and Practicality Results

Value (%)	Criteria	Criteria Description
100	Very Valid / Very Practical	E-module is used without revision
81- 99	Very Valid / Very Practical	E-module is used with minor revisions
61- 80	Practical	E-module used with moderate revision
41- 60	Less Valid/ less practical	E-module is not recommended for use because it needs major revisions
21- 40	Invalid	E-module cannot be used
0 - 20	Very impractical	E-module cannot be used

Source: Akbar adaptation (2013: 41)

Description: Material validity criteria must be 100%

Sampling is done with Purposive sampling technique, which is a sampling technique determined by the researcher with certain considerations (Sugiono, 2015). After the e-module of mangrove species diversity has

been developed, the next stage is the validation test that each validator has been selected based on their expertise. The material expert is someone who has an expert in the field of plants and more or less knows mangroves. Media and teaching material experts are someone who is skilled in making, assessing and evaluating media development. Biology education practitioner is a teacher who has taught at least 5 years of service so that he can provide advice and evaluation of media improvement. The data collection technique in the validation test is to use a questionnaire that has been prepared based on indicators whose answers are Likert scale.

The next stage is to test the practicality of using the e-module. The sample selected was adjusted to the needs of the researcher. For the one to one trial stage, 3 students were selected to fill out the student response questionnaire. These students are distinguished by high, medium and low academic abilities with the assumption that this e-module will be used by all students who have heterogeneous abilities in the classroom. Small group trial testing was tested on 12 students. The conduct a pilot test was tested on 36 students. The data collection technique used student response sheets.

To determine the effectiveness of using e-modules to train digital literacy, namely by conducting pretest and posttest digital literacy questionnaires. The instrument used to determine students' digital literacy is a digital literacy questionnaire that refers to the indicators of Greeinstain (2012) including finds uses multiple sources, selects, evaluates, considers sources, message effects and uses product original work. There are 18 statement items in the digital literacy questionnaire that refer to these indicators. The results of student answers are in the form of a 1-5 Likert scale. The Likert scale scores obtained by students were then analyzed quantitatively by calculating the paired sample t test to see whether there were differences in students' digital literacy before and after learning with the e-module. Qualitative measurement using N-Gain score.

The results of the pretest and posttest of digital literacy referring to Greenstein's indicators (2012). Outcomes of pretest and posttest scores were further analyzed quantitatively by testing the Paired Sample T Test with a preliminary test of normality test. Qualitative analysis used is by measuring the N-Gain Score to be able to compare whether or not there is a significant difference after being taught with the e-module. The following is the N-Gain Score formula:

$$\textbf{Normalized Gain (g)} = \frac{\textbf{Posttest score} - \textbf{pretest score}}{\textbf{Maximum score} - \textbf{pretest score}}$$

According to the results of the effectiveness of the e-module with the N-Gain formula, it will be interpreted qualitatively. The following is a description of the effectiveness assessment in Table 2.

Table 2. Mangrove Diversity E-module Effectiveness Assessment

Criteria for Achieving	Effectiveness Level Value
n-gain > 0,7	High effectiveness
0,3 ≤ n-gain ≤ 0,7	Medium effectiveness
n-gain < 0,3	Low effectiveness

Source: Hake (1999:1)

3. RESULT AND DISCUSSION

Based on the development stages of the Lee and Owen (2004) model, there are 5 stages, which are 1:

1. Analys

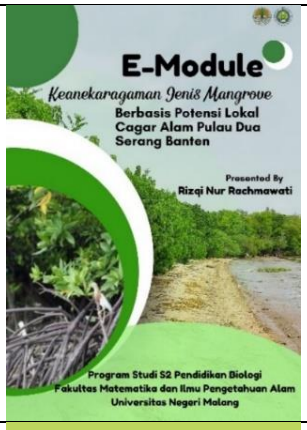
Learning needs analysis to students and biology teachers of class X at SMAN 5 Serang City on February 23, 2023. Based on the results of the needs analysis, students have difficulty learning biology so that learning media is needed to make it easier for students to learn. Learning activities are still in the form of memorization and have not introduced contextual examples that exist in the student's environment. Biology teachers have not utilized the local mangrove potential of the Pulau Dua Nature Reserve in learning. Mangroves have an important role in the ecosystem that students need to know and have the potential to be used as learning content. Students need to be introduced to the potential of their region to be wise in carrying out activities by considering environmental aspects.

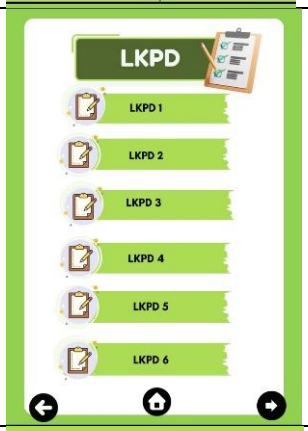
Researchers conducted a technology analysis and user analysis related to facilities and infrastructure at SMAN 5 Serang City which has available Wireless networking (WiFi) automatically connected to each classroom. Students and teachers can also utilize the internet connection when conducting learning activities. The existing facilities at SMAN 5 Kota Serang in supporting learning is LCD projector. Based on the analysis of existing technology at SMAN 5 Kota Serang, students are able to access the e-module of mangrove species diversity through their devices or laptops. Learning carried out at school has also not utilized the advances in the internet and technology because only textbooks are used as a support for student learning. The teaching materials used by teachers have also not integrated technology in learning. Based on these needs, this research will be integrated with digital literacy.

2. Design

The design stage consists of preparing the sequence of material content in the form of teaching modules and prototype designs in the e-module. The developed teaching module is integrated with digital literacy. Based on this, the preparation of digital literacy questionnaires and environmental attitudes is adjusted to digital literacy indicators that refer to Greenstein (2012). The product developed is an e-module based on mangrove diversity in the Pulau Dua Nature Reserve in Serang Banten to train digital literacy. The material in the e-module is compiled based on the demands of the E phase Merdeka curriculum by integrating the Problem Based Learning model. The mangrove diversity e-module of Pulau Dua Nature Reserve consists of 3 main components, namely the initial part consisting of the front cover, preface and instructions for using the e-module. The content section consists of the menu in the e-module, concept map, material and learning activities and evaluation consists of evaluation of each activity and LKPD. The final section consists of a glossary, author profile, index and reference list. The mangrove diversity e-module consists of 6 learning activities 1 of which discusses the introduction of mangroves, learning activity 2 about the types of mangroves found in the Pulau Dua Nature Reserve Serang Banten, learning activity 3 abiotic factors, learning activity 4 about the role of mangroves, activity 5 about the threat of mangrove ecosystems and activity 6 the role of mangroves. The following is a table 3 that explains the e-module design.

Table 3. E-module Components

No.	Picture	Description
1.		Cover e-module
2.		Instructions for using the e-module
3.		Menu in the e-module

4.		Material selection based on activity units
5.		LKPD menu on e-module based on mangrove ecosystem problems
6.		E-module is equipped with qr code
7.		E-module is equipped with a glossary

3. Development

a. Pre-Production

E-module of mangrove species diversity is developed based on the storyboard that has been made. This mangrove diversity e-module is adapted to develop indicators that can train digital literacy, environmental attitudes and cognitive learning outcomes.

b. Production

1. Pure Research Results

The content in the e-module was developed based on the results of the exploration of mangrove diversity in the Pulau Dua Nature Reserve in Serang Banten. Research on mangrove diversity in Pulau Dua Nature Reserve Serang Banten.

2. Abiotic Factors of Mangrove Area of Serang Banten Nature Reserve

Abiotic factors observed based on this research are temperature, air humidity, light intensity, soil moisture, soil pH and salinity levels. Abiotic factors can be a marker of mangrove growth tolerance range at that location.

3. Post Production and Quality Review

The stages of developing teaching materials in the form of e-modules include the process of designing e-module media and then testing to determine the validity and practicality of e-modules by experts. The outcome of research and development in the shape of teaching materials in the form of e-modules of mangrove species diversity Pulau Dua Nature Reserve Serang Banten. This e-module will be used in Biology class X at SMAN 5 Serang City. The results of mangrove diversity will be used as content on the E-module used as a learning medium for students. E-module that has been developed before being disseminated to students conducted validation stage by material experts. Material validation is carried out with the aim of assessing and evaluating the appropriateness of the content before it is used. The purpose of material expert validation is to assess the content and presentation of enrichment materials based on the variables measur (Salsabilla et al., 2023). Indicators that are assessed are material organization (title, completeness of presentation, language suitability), material depth (identifying mangroves based on their characteristics, analyzing mangrove diversity groupings, analyzing interactions the relationship among biotic and abiotic factors in mangrove ecosystems, analyzing the role of mangroves as local potential, analyzing various problems and threats to mangrove ecosystems, and analyzing alternative solutions and efforts in mangrove conservation). The aspects assessed from the media validation sheet and teaching materials are the feasibility of cover graphics, the feasibility of content graphics, e-module characteristics (self-instruction, self-contained, stand alone, adaptive, user friendly) the closing section and access to the use of e-modules (Ruslan & Rauddin, 2022). The following are the consolidated results of the validation of subject matter experts, multimedia and field practitioners in Table 4.

Table 4. The validation outcome

No.	Experts	Score	Description
1.	Material expert (Dr. Elsje Theodora Masawet, M.Pd.)	100%	Very Valid
2.	Media and teaching material experts (Prof. Dr. Dedi Kuswandi, M.Pd.)	98,77%	Very Valid
3.	Field practitioners (Estu Wijayaningsih, S.Pd., M.Pd)	100%	Very Practical

After refining suggestions and revisions from material experts, media and teaching material experts and field practitioners. Before being used in learning, the e-module was tested for practicality including an individual test of 3 students, a small group test conducted on 12 students and a conduct a pilot test conducted on 36 students.

Table 5. practicality of test

No.	Testing	Subjects	Average Score (%)	Description
1.	One to One Trial	3	93,33	Very Practical
2.	Small Group Trial	12	89,41	Very Practical
3.	Conduct a pilot test	36	86,2	Very Practical

4. Implementation

a. Results of Preparing the Teacher

This implementation was carried out in class X MIPA 3 with myself teaching the class accompanied by an observer to assess the implementation of PBL syntax. The researcher acted as a teacher teaching according to the teaching module to implement the use of e-modules of mangrove species diversity to train digital literacy.

b. Results of Preparing the Students (prepare the student)

Researchers as teachers act to condition students to provide direction on the use of e-modules on the diversity of living things in each learning activity. The teacher briefs observers on how to conduct assessments during learning activities.

c. Results of Evaluate Stages

Based on the research activities that have been carried out, the next stage is the evaluation stage. The results of the evaluation include looking at the results of digital literacy.

5. Evaluation

Based on a digital literacy questionnaire that refers to indicators according to Greenstain (2012). There was a significant percentage difference between the pretest and posttest of the digital literacy questionnaire. The following is a comparison picture of Pretest and Posttest Digital Literacy in Figures 1 and 2.

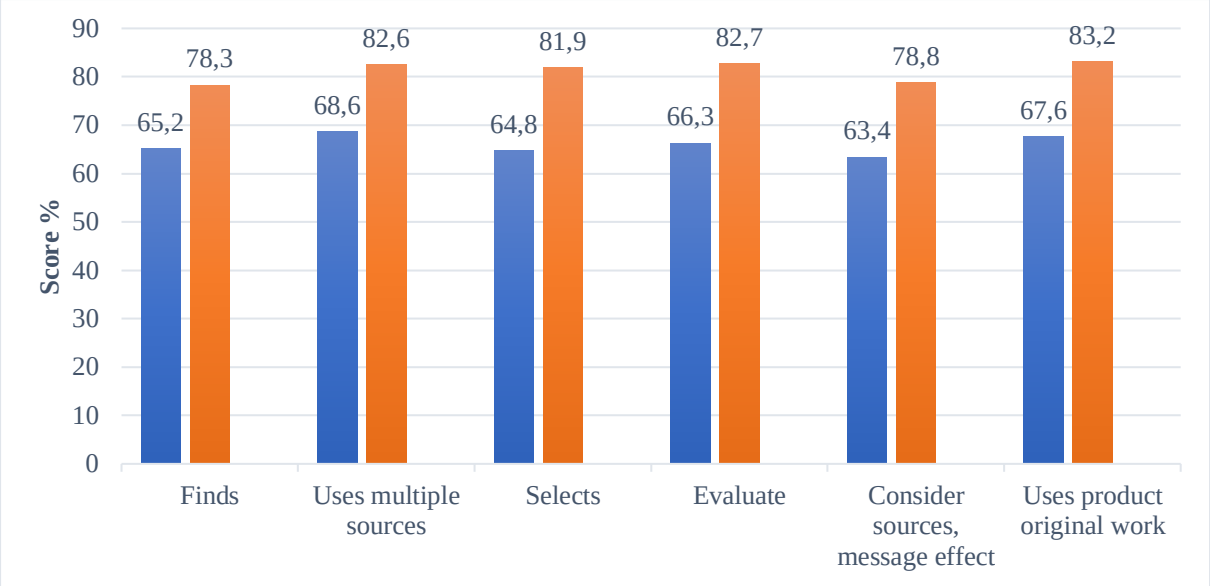


Figure 1. Comparison of scores of each indicator on pretest and posttest of digital literacy

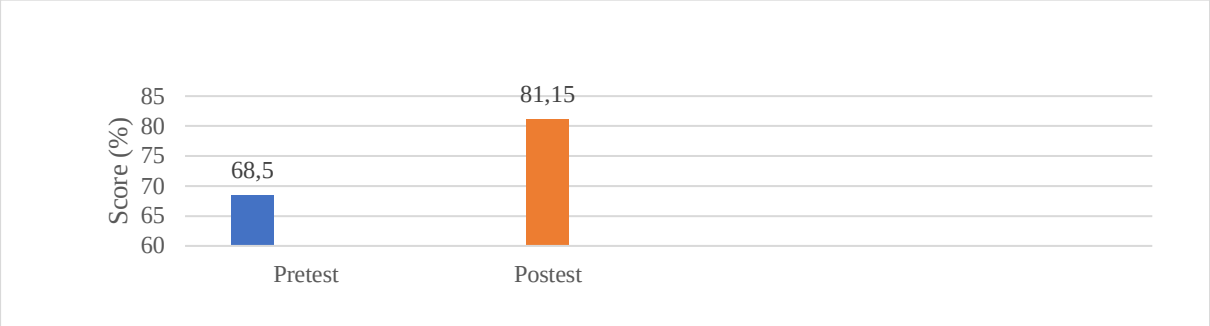


Figure 2. Comparison of scores on pretest and posttest of digital literacy

From the research results, the mean percentage of students' digital literacy in the pretest activity was 68.5 and increased in the post-test activity with an average value of 81.15. Based on the post-test results, it increased 18.46% from the pretest results of the digital literacy questionnaire. The indicator that showed the highest increase was the indicator of using original work products with a percentage of 83.2% and the lowest indicator increase was 78.3%. The results suggest that the first indicator of digital literacy decreased lower than other indicators because students were not accustomed to finding accurate sources. Students are asked to solve problems by finding accurate sources through digital literacy indicators, namely finding, using multiple sources, selecting, evaluating, considering sources, message effects and using original work products (Greenstain, 2012). Based on research (Pratiwi & Indana, 2022) which states that providing e-modules can improve digital literacy if adjusted to the selection of appropriate media, considering the availability of technology that can be accessed by students (Firmansyah & Hariyanto, 2019).

Based on the results of the pre-test and post-test comparison of digital literacy from the six indicators. The find indicator has an increase of 20.1%. The indicator uses multiple sources has increased from pre-test to post-test by 20.4%. The select indicator has increased by 26.4%. The consider sources indicator, message effect 24.3% and the uses product original work indicator increased 23.1% from pre-test to post-test results. Based on the data on the increase in pre-test and post-test results, it can be seen that the indicator that experienced the highest increase was the select indicator with an increase of 26.4% and the indicator that experienced an increase from pre-test to post-test was the find indicator, which was 20.1%. Low digital literacy can be caused by students not exploring information sources in learning and assignments that do not utilize the use of digital media (Rahayu & Mayasari, 2018). Ineffective use of digital media affects student behaviour in sorting out the information received (Kurnianingsih et al., 2017). Students who have good digital literacy will have great benefits in learning and student life because they are able to elaborate, disseminate, filter and conclude information and even update information wisely and effectively to make decisions in their lives (Ifadah & Prastiwi, 2021).

The results of the digital literacy analysis are in the form of pre-test and post-test. The instrument used to evaluate digital literacy students using indicators from Greinstein (2012). The next stage is to test the effectiveness of the use of e-module mangrove species diversity will be tested quantitatively with calculations using SPSS on

Simple Paired T test. The prerequisite test that must be done before conducting a paired sample t test is the normality test. Qualitative testing using the N-Gain Score. The following is the Digital Literacy normality test in Table 6.

Table 6. Digital literacy normality test

Testing	Pretest	Post-test	Description
Normality	.306	.144	Pre-test and post-test normally distributed

Digital literacy pre-test and post-test data are normally distributed so that further testing is needed, namely the Digital Literacy Paired T test sample test in Table 7.

Table 7. Simple Paired T test of Digital Literacy

Testing	Mean	Df	*p-value*	Description
Paired Sample T test	.306	.144	.000	There is a significant difference

Digital literacy questionnaire results were measured using pre-test and post-test questionnaires. The analysis of digital literacy questionnaire data is through the N-Gain average to see the effectiveness of the e-module as described in Table 8.

Table 8. Digital Literacy N-Gain Results

$S_{pretest}$	$S_{posttest}$	N-Gain	Description
68,5	81,15	0,41	Medium effectiveness

Based on Table 8. the results of the N-Gain calculation of the digital literacy questionnaire obtained a pretest value of 68.5 and a digital literacy posttest of 81.15. The N-Gain of digital literacy is 0,41 which is in the medium effectiveness category. As a result, the e-module of mangrove species diversity is effectively used in learning to train digital literacy. Based on Wahyuni et al., (2022), research on the use of e-modules is effectively used in learning to train students' digital literacy. E-modules can stimulate students to be enthusiastic in learning because they are tailored to the needs of students so that they can attract students to use them attract learners to use it. According to Setyaningsih et al., (2019), the use of e-modules developed according to student needs and maximizing school facilities needs to be developed to facilitate the demands of the era of information technology development which demands digital literacy.

6. CONCLUSION

Based on the research on the development of e-modules of mangrove species diversity, it can be concluded that the developed e-modules can be applied valid, practical, and effective to use in biology classes. There is a significant comparison between students' digital literacy before and after treatment with e-modules. This is also in accordance with the results of the N-Gain Score 0,41 which means that the e-module has medium effectiveness. The utilization of e-module can be useful to train students' digital literacy because its use is simple and students have access to adequate facilities at school such as WiFi which contributes to the success of learning. The selection of e-modules in learning must also be adjusted to the material to be taught. Raising local potential into learning content for me is currently the right step to insert local wisdom values wrapped in a digital literacy frame that makes learning feel interesting for students.

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