Bioedukasi
Jurnal Biologi dan Pembelajarannya

Vol. 23 No 1, February 2025, page 9-16
e-ISSN: 2580-0094; p-ISSN:1693-3931
DOI: 10.19184/bioedu.v23i1.53171
jurnal-dev.unej.ac.id/bioed/index.php/BIOED

Development of a Biodiversity Conservation E-module Containing Local Excellence in East Nusa Tenggara to Empower Students' Digital Literacy

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Article Info

Article history:
Received 18 January, 2025
Revised 19 January, 2025
Accepted 2 February, 2025

Keywords: (A-Z)
Digital literacy
E-module of diversity conservation
East Nusa Tenggara

ABSTRACT

Digital literacy is a 21st century skill that students must have. Digital literacy indicators (finding, using, selecting, evaluating sources, considering the source and effect of the message, and using data to produce original work) can be used as a digital literacy measurement tool. E-module development uses the Lee & Owen model with stages including (1) assessment/analyze (Need assessment and Front-end analysis), (2) design, (3) development, (4) implementation, and (5) evaluation as designed loaded with local excellence. This research is a research & development (R&D) study conducted on 50 Biology Education Students at Nusa Cendana University which aims to empower students' digital literacy through the development of e-modules containing local advantages of East Nusa Tenggara. The e-module developed has been validated as suitable for use by material experts, teaching materials experts and biology education practitioners. Data analysis was carried out using normality and homogeneity tests with significance values > 0.05 and ANCOVA tests with significance < 0.05. The e-module that has been developed has passed the N-gain test with a score of 0.62. The results of this research show that the use of e-modules has a significant effect in empowering digital literacy of biology education students.

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1. INTRODUCTION

Education in the era of technology 5.0 provides opportunities for the development of more inclusive and skills-based learning in line with current developments (Putra *et al.*, 2022). The development of science and technology always goes hand in hand with the times. Understanding technology is important to prepare for life in this era *modern* (Putriana, 2021). This era requires educators to be able to provide technology-based learning methods by integrating the physical and digital worlds (Mega 2022; Fricticarani et al. 2023). Optimal independent learning is needed to hone skills in using good technology or strong digital literacy skills (Catra & Biru, 2020). Digital literacy is defined as the ability to access, understand and use information from digital sources (Naufal, 2021; Cahyani et al. 2024). Digital literacy influences the ability to think and process critical information in the 21st century (Ningsih et al., 2019; Sujana and Rachmatin, 2019; Zamista and Charona, 2023).

The results of the 2022 National Digital Literacy Index Survey of the Ministry of Communication and Information and the Data Insight Center (KIC) show that the Digital Literacy capacity of Indonesian society is at an index of 3.54 out of 5.00. This shows that the level of digital literacy in Indonesia is still in the "medium" category. The integration of technology in education encourages student-centered learning, encourages critical thinking, and maximizes learning potential (Haliq 2018). Recent studies have found that digital literacy has a positive correlation with learning outcomes (Nurramdhani et al. 2023; Soraya & Purnamasari 2023). Digital literacy plays an important role in improving academic achievement and preparing students to face challenges in the digital era (Murtadho et al. 2023; Shopova 2014). The application of digital literacy to develop teaching materials can provide students with experience of digital technology culture and support students to expand their knowledge critically in participating in learning (Liza & Andriyanti, 2020).

The results of the needs analysis of the digital literacy of Biology Education students, Nusa Cendana University in the Biodiversity Conservation course obtained an average of 65% which is included in the medium category. Things that still appear low are students' ability to find relevant sources, use sources in the form of

images, videos and articles from trusted sources and are relevant to the study material or subject matter. Students are also not yet capable enough to select and consider the sources obtained and use data from the sources found to produce works or products that can support the lecture process. Keeping up with the times, digital literacy has become one of the basic skills that must be possessed in the 21st century (Rachmatica et al. 2023). Digital literacy is closely related to e-modules to support learning processes that are in line with developments in information technology that require digital skills and digital literacy (Susarno, 2024). The generation that grew up with unlimited access to digital technology will have different thinking patterns from previous generations (Faridah *et al.*, 2022). Digital literacy plays an important role in supporting successful learning (Handayani et al., 2020). The younger generation must be equipped with adequate literacy skills by being trained and given certain habits. E-modules have been proven to be able to develop independent learning attitudes and effectively increase digital literacy in the technological era (Sanova et al., 2022).

The development of science and technology and the demands of the times require educators to be able to innovate in implementing the learning process (Rohman, 2018). Technology can make it easier for students to access, find out and apply various kinds of information sources (Asrizal et al., 2018). *E-module* be the right choice to use in today's learning. Learning media in the realm of education that is effective, appropriate, and at par with current developments, directs students in fun learning, and increases interest in the learning process by collaborating with technology units (Kurniawan *et al.*, 2021). The literacy level of students who are used to using technology will be higher than those who do not use technology (Jan, 2018). *E-module* containing the local advantages of certain areas, which have their own charm and usefulness. Local excellence-based education is a learning program that is organized according to regional needs, by utilizing various natural resources, human resources, geographical, cultural, historical and other regional potentials that are useful in the competency development process in accordance with the potential talents and interests of students. Local excellence here can be interpreted as all the potential and work in an area that is characteristic of that area (Trisnawaty, 2017).

2. RESEARCH METHOD

This type of research is research and development. E-module for the Biodiversity Conservation course at Nusa Cendana University, East Nusa Tenggara using the Lee & Owens (2004) model. The stages include, (1) *assessment/analyze* (assessment/analysis) *(2) design* (design) *(3) development* (development), *(4) Implementation* (implementation), and *(5) Evaluation* (evaluation). E-module designed to empower biology students' digital literacy. The indicators used as benchmarks for students to be digitally literate are if students are able to find sources, use sources, select sources, evaluate sources, consider sources and message effects, and use (data) to produce original work. The research design is as shown in table 2.1.

Table 2. 1 Research Design Design

Experiment	*Group 1*	Obs	Tx	Obs
Control	*Group 2*	Obs	-	Obs

Source: Leedy & Ormrod, (2015)

Information:
Tx: Indicates that a treatment (reflecting the independent variable) is presented.
Obs: Indicates that observations (reflecting the dependent variable) have been carried out.
—: Indicates that nothing happened for a certain period of time.

The following is the N-gain Score formula. (g) =Posttest score-pretest scoreMaximum score-pretest score Effectiveness *E-module* related to students' digital literacy abilities obtained through results *pretest* and *posttest*. Students' digital literacy is measured by comparing scores *pretest* And *posttest* through testing *N-gain*. Effectiveness criteria *E-module* based on scores *N-gain* found in Table 2.2.

Table 2.2 Biodiversity Conservation E-Module

Achievement Criteria	**Assess the Level of Effectiveness**
n-profit > 0.7	High
0.3 ≤ n-profit ≤ 0.7	Currently
n-profit < 0.3	Low

Source: Hake (1999:1)

3. RESULT AND DISCUSSION

E-module development refers to the Lee and Owens (2004) model with the following stages:

a. Assessment/Analysis

Analysis of the needs for e-module development was carried out on sixth semester students of the Biology Education Study Program at Nusa Cendana University. Analysis is carried out through several stages; 1) audience analysis, 2) technology analysis, 3) situation analysis 4) task analysis, 5) critical incident analysis, 6) problem analysis, 7) goal analysis, 8) media analysis, 9) data analysis and cost and benefit analysis. The findings show that students do not yet have learning media that can be used as a learning resource E-module development refers to the Lee and Owens (2004) model with the following stages: during the lecture process. Apart from that, analysis of biology students' responses to the digital literacy questionnaire got a score of 65%. Learning designs during the lecture process are in the form of simple projects but do not yet train 21st century skills. Contextual-based learning that is relevant to the study material has also not been integrated optimally. The fact that there is no learning media capable of supporting the learning process and practicing 21st century skills makes this a serious problem. Based on the results of the needs analysis, the development of an e-module based on project based learning combined with the case method was designed and integrated with the local advantages of East Nusa Tenggara as an effort to empower the digital literacy of biology education students.

b. Design

At this stage the e-module is designed according to student needs by reviewing material on biodiversity conservation which includes the local advantages of East Nusa Tenggara. The e-module is designed in accordance with the provisions of the e-module creation guidelines according to the Ministry of Education and Culture (2018) which consists of; cover, instructions for use, learning activities, and glossary. The following is an image that explains the e-module design.

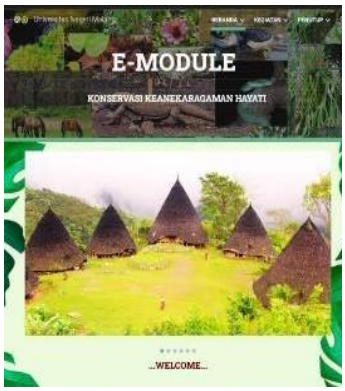

Figure 3.1 E-module homepage


Figure 3.2 E-module menu

Figure 3.3 e-module MFI

Figure 3.4 E-module video

Figure 3.5 E-module article

Figure 3.6 E-module glossary

c. Development

Goal of the stage *development* is to realize the ideas of the designs that have been created. The development stages according to Lee & Owens (2004) are: *praproduction, production, dan postproduction*. At this development stage, product development and product validation are carried out involving media and teaching materials experts, material experts and field practitioners to ensure the quality and effectiveness of the e-modules that have been developed. The validation results by each expert are presented in table 3. 1

Table 3. 1 Results of e-module validation

No.	The experts	Score	Information
1.	Members of the media and teaching materials	100%	Very Valid
2.	Materials Expert	100%	Very Valid
3.	Field practitioners	100%	Very Practical

After improvements have been made according to suggestions and revisions from media and teaching materials experts, material experts and field practitioners, before proceeding to the implementation stage, the e-module has gone through a practical test which includes individual testing on 3 students, small group testing on 12 students and field trials on 25 students. The practicality test results are as shown in table 4.

Table 3.2 E-module Practicality Test Results

No	Testing	Subject	Average Score (%)	Information
1.	One Individual Trial	3	88	Very Practical
2.	*Small Group Trials*	12	90	Very Practical
3.	Do a test run	25	91	Very Practical

d. Implementation

This stage was carried out to determine the effectiveness of project-based e-modules containing local advantages learning combined with the case method which was applied to 21 sixth semester biology education students who were taking biodiversity conservation courses with 29 comparison class students who were not given e-modules or any treatment. The following are the results of the digital literacy test in the experimental class and control class, which can be seen in Figure 3.7

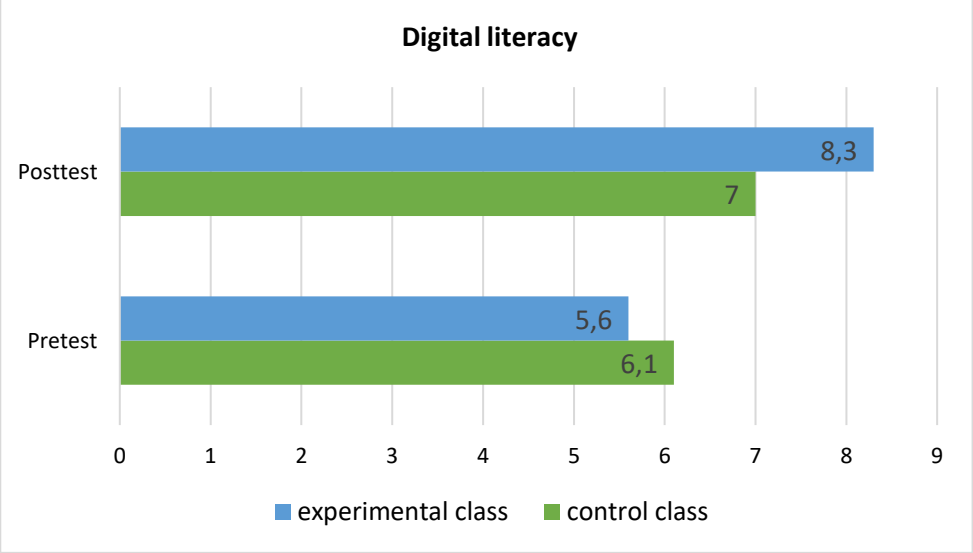

Figure 3.7 Comparison of pretest and posttest digital literacy scores in class experiment and control.

Comparison of pretest and posttest scores in class experiment and the control class looks quite significant. In the control class the average pretest score was 6.1 and then the score increased by a percentage of 10% in the posttest score with an average score of 7.1. In class experiment Students experience digital literacy empowerment when implementing biodiversity conservation learning using e-modules with local nuances that contain explanations and treatments to develop digital literacy skills. The experimental class had a pretest score with an average of 5.6 and then experienced a significant increase after learning using e-modules with an average posttest score of 8.3 and a percentage increase in score of 27%. The same increase can also be seen in the percentage of digital literacy indicators achieved in class experiment and control class as in Figure 3.8

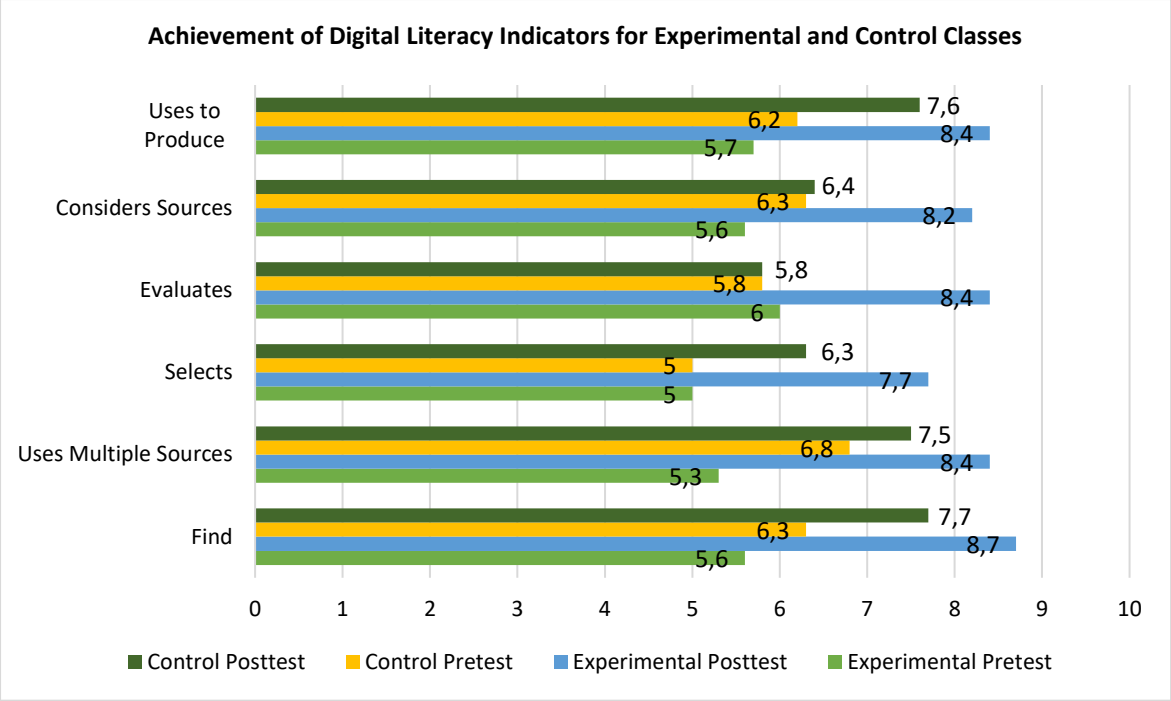

Figure 3.8 Percentage of achievement of class digital literacy indicators experiment and control

Greenstain (2012) explains several indicators of digital literacy, including finding sources, using sources, selecting sources, evaluating sources, considering sources and message effects, and using (data) to produce original work. There is a difference in the percentage of digital literacy pretest and posttest results in the class experiment and control class. The percentage of achievement of the most significant indicator in the experimental class occurred in the indicator of finding sources, namely 31%, which proves that students are able to sort independently and find information that is reliable and relevant to the problem being studied. In the indicator of choosing a source, experimental class students experienced the lowest increase, namely 14%, indicating that students still have difficulty understanding adequate information regarding information sources. nor degree of bias to select credible sources relevant to the required objectives.

e. Evaluation

The evaluation stage can start at the end of the analysis stage or the beginning of the design stage to the implementation stage. The evaluation stage consists of *evaluation strategy* And *evaluation plan*. Data were analyzed based on the Anova test which had previously carried out the prerequisites for normality and homogeneity tests. The normality test results show that the significance value of students' digital literacy is greater than 0.05. Normality test results can be obtained seen in table 3.3

Table 3.3 Digital Literacy Normality Test Results

Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Say.	Statistic	df	Say.
Digital Literacy Pretest (Experiment)	.211	21	.015	.908	21	.049
Digital Literacy Posttest (Ex)	.161	21	.162	.871	21	.010
Digital Literacy Pretest (Con)	.158	29	.063	.922	29	.035
Digital Literacy Posttest (Con)	.133	29	.200*	.938	29	.092

Furthermore, the digital literacy pretest and posttest results data went through a homogeneity test with a significance score greater than 0.05 (Sig > 0.05). The homogeneity test results can be seen in table 3.4

Table 3.4 Digital Literacy Homogeneity Test Results

	Levene Statistic	df1	df2	Say.
Based on Mean	2.187	3	96	.095
Based on Median	1.953	3	96	.126
Based on Median and with adjusted df	1.953	3	93.464	.126
Based on trimmed mean	2.145	3	96	.100

Based on the homogeneity test data in table 3.4, it can be seen that digital literacy data has a significance value of > 0.05. Next, the ANCOVA test was carried out as seen in table 3.5

Table 3.5 Digital Literacy ANCOVA Test Results

Source	Type III Sum of Squares	df	Mean Square	F	Say.
Corrected Model	1524.582[a]	2	762.291	213.976	.000
Intercept	3282.356	1	3282.356	921.360	.000
Pretest	**95.340**	**1**	**95.340**	**26.762**	**.000**
Class	**1524.061**	**1**	**1524.061**	**427.805**	**.000**
Error	167.438	47	3.563		
Corrected Total	1692.020	49			

Based on the ANCOVA test results table, a significance value of 0.000 is obtained, which means it is smaller than 0.05 (Sig < 0.05). This identifies significant differences between classes that use e-modules and those that do not use e-modules. Next, an N-gain test was carried out to determine the influence and effectiveness of using e-modules in learning. The N-Gain calculation table for the digital literacy test, with a pretest score of 56.4 and posttest with a score of 83.5, obtained an N-Gain of 0.62, which shows that the e-module is effective in empowering students' digital literacy. The calculation results can be seen in table 3.6

Table 3. 6 Digital Literacy N-Gain Test Results

S *preliminary test*	S *post test*	N gain	Information
56,4	83,5	0,62	Medium effectiveness

Based on a series of tests that have been carried out, it can be concluded that the e-module containing local advantages of East Nusa Tenggara has a significant and effective effect on empowering students' digital literacy skills. E-modules with local content have the opportunity to increase learning understanding because they contain local environmental phenomena (Rosalia et al. 2024). The use of e-modules has been proven to increase digital literacy scores (Dewi et al. (2020); Fitri and Aini 2021). Students are able to open their horizons of thinking by observing the resources and diversity around them through information obtained from e-modules. E-modules also allow students to get more in-depth information because they contain information from the internet which contains in-depth research related to the topic being studied. E-modules have succeeded in training digital literacy skills and maximizing the learning process independently (Mufidah et al. 2023; Putri, Permana, and Holiyani 2023). E-modules can effectively improve students' digital literacy in various educational contexts, from elementary to university level (Ibtidaiyah et al. 2024). Students can more easily access information from sources that are trusted and relevant to the required goals. Facilitate the learning process and maximize the use of technology in the digital era.

4. CONCLUSION

Based on the results of this research, it can be concluded that the e-module has proven to be valid, practical and effective for use by obtaining normal and homogeneous data which has a significance of > 0.05 with an Ancova test value having a significance of < 0.05. The e-module was proven to be effective with an N-gain score of 0.62. Therefore, the development of e-modules containing local advantages of East Nusa Tenggara has proven to be able to empower students' digital literacy during the learning process.

5. ACKNOWLEDGEMENT

The researcher would like to thank the Ministry of Education and Culture for accommodating the researcher's lecture process through the Superior Scholarship Program, thanks to the material validator Prof. Dr. Murni Sapta Sari, M.Pd. Validator of media and teaching materials Prof. Dr. Mimien Heni Irawati Al Muhdhar, M.Pd and Biology Education Practitioner Mrs. Dr. Andam S. Ardan who is willing

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