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Validity of local wisdom-based e-modules for bio-landscaping course

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ABSTRACT

This study aims to develop an e-module for the Bio-landscaping and determine its validity as an interactive and contextual learning tools, in accordance with the need of 21st-century learning. The research employed the design and development research. The methodology encompasses three main phases: 1) need analysis involving students and lectures, 2) design and development of the e-module based on the findings of the needs analysis, and 3) product validation which involves expert validators. The Bio-landscaping e-module was validated by three experts covering biology concepts, linguistics, and media validators. The validation results showed an average feasibility score of 80,27%, categorized as good to very good, covering aspects of content feasibility, language, design, and presentation. In terms of content, the e-module was deemed consistent with the course learning outcomes and relevant to wetland ecological contexts, which are characteristic of Bio-landscaping. The linguistic aspect was rated good, with minor suggestions for making the sentences more concise and communicative. The design aspect achieved a very good category, supported by appealing visuals, color harmony, clear typography, and well-functioning video integration. The presentation aspect was found to be coherent and motivating for students to learn independently. Therefore, the Bio-landscaping e-module is declared feasible as a digital learning in biology education, particularly in fostering students' independent learning, critical thinking, and environmental literacy through a contextual approach based on local wisdom.

INTRODUCTION

The Bio-landscaping course is one of the innovations in Biology Education that integrates the principles of ecology, conservation, and sustainability in landscape design. Through this course, students are expected to understand the relationship between biodiversity, ecosystem functions, and environmental spatial planning, particularly in the context of local wisdom regarding wetlands. As a new course, Bio-landscaping still faces limitations in the availability of contextual and engaging teaching materials. The learning process is still dominated by the use of presentation media, while digital teaching materials that support independent learning have not been optimally provided. Therefore, the development of Bio-landscaping e-modules is essential to support a more effective and interactive learning process that aligns with the characteristics of Biology Education students. The developed e-module is expected to support the 21st-century skills that prospective biology teachers must possess.

Education in the 21st century requires both educators and students to possess digital literacy, critical thinking skills, and the ability to collaborate effectively. These competencies are crucial in supporting learning demands in the era of the Industrial Revolution 4.0. Digital literacy is an important competency in optimizing science learning and critical thinking skills (Mufidah, 2023). This highlights the importance of developing Bio-landscaping e-modules that not only deliver content but also facilitate activities that foster higher-order thinking and digital literacy.

In addition, recent studies highlight the relevance of integrating digital literacy with character education and local wisdom. Andriani et al. (2023) found that incorporating local wisdom-based digital media can increase students' engagement and foster positive character traits such as curiosity and discipline. The integration of local wisdom into character education promotes deeper cultural relevance, thereby fostering a sense of collective ownership over the educational environment and strengthening the social fabric within the community (Sakti et al., 2023). To optimize the instructional appeal of local wisdom values, their integration within a digital platform is essential for maximizing student learning motivation (Saripudin et al., 2022). Integrating cultural values with digital technology creates a relevant character education model that reinforces identity and adapts to modern times without sacrificing core principles (Asror et al., 2024). E-module based on local wisdom offers an innovative educational tool for cultural preservation and identity development (Asiah et al., 2025). The integration of technology in education enables the creation of flexible, collaborative, and learner-centered environments (Ministry of Education and Culture, 2021), making digital learning media particularly e-modules a strategic choice for enhancing learning access and encouraging active learning.

Technological advancements have also accelerated the development of digital teaching materials. E-modules, equipped with interactive features such as simulations, videos, and automated evaluations, have been shown to support deep conceptual understanding and promote critical and creative thinking (Herlina et al., 2023). The use of e-modules positively affects students' motivation and engagement in independent learning (Sidauruk et al., 2025). Several studies have demonstrated the effectiveness of e-module development across various scientific fields. Some research found that e-module to be valid, practical, and effective in improving students' digital literacy (e.g. Kurniasih et al., 2022; Dewi et al., 2022) and critical thinking (e.g. Koth et al., 2022; Pitorini & Suciati, 2025; Dermawan et al., 2025). To support all those skills, e-module for teaching should be feasible and relevant according to expert assessments and student responses (Wati et al., 2023). These findings support the potential of e-modules to enhance learning effectiveness.

Based on a preliminary study conducted in the odd semester of June 2025, questionnaire and interview data revealed that teaching materials for the Bio-landscaping course were still limited to simple presentation media without visual or interactive support such as integrated images or videos. Students therefore require more engaging and accessible digital learning resources. To date, no e-module specifically tailored to Bio-landscaping and wetland-based local

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wisdom has been developed, creating a significant gap in available learning materials for this new course. This study aims to develop a valid and effective Bio-landscaping e-module based on local wisdom to support learning and contribute to the advancement of technology-based instructional materials in Biology Education. Additionally, the e-module is expected to support students' learning independence, strengthen digital literacy, and facilitate interactive and contextual learning aligned with the characteristics of Bio-landscaping.

METHODS

This study uses a design and development research (DDR) approach aimed at producing a product and evaluating its validity. This methodology, due to its iterative nature organized into recurring research process, supports the development of research processes with strong practical applicability, enabling researchers to continuously improve products and processes and test new resources and educational approaches (Tinoca et al., 2022). The stages carried out include the analysis of student and lecturer needs, the design and development of the e-module based on the needs analysis results, and finally, validation of the e-module product involving expert validators. The types of validity examined in this study include content validity and face validity. Content validity refers to the suitability, accuracy, and usefulness of the material presented in the e-module in relation to the Bio-landscaping course learning outcomes. Face validity includes clarity of language, readability, visual design (color, layout, typography), clarity of illustrations and videos, and the quality of presentation structure.

The needs assessment was conducted involving respondents, comprising both students and lecturers from the Biology Education study program. Student needs regarding instructional materials were identified using a questionnaire consisting of seven (7) items, rated on a 5-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree). Concurrently, lecturers were administered a separate instrument containing five (5) questions focused on the material requirements for the Bio-Landscaping course, with responses collected using a binary (Yes/No) format. Data analysis was performed quantitatively by calculating the percentage derived from the ratio of the total accumulated response scores to the maximum possible score.

The design phase of the e-module was initiated based on the findings derived from the needs assessment. The resulting e-module was specifically oriented toward promoting ease of access, interactivity, and strong support for an active learning process, while also integrating engaging audio-visual components. The website editor Canva and Microsoft Word 2019 were utilized for the layout and formatting of the e-module. The design process comprised several sequential steps: 1) formulate learning objectives, 2) design the structure and content of the e-module, 3) determine the media and format, and 4) design evaluations.

During the development of the Bio-landscaping course e-module, product validity testing was carried out. The validity test involved three validators, all of whom were lecturers teaching the Bio-landscaping course. Three lecturers serving as validators. The object of this study was the Bio-landscaping e-module developed to support the learning process of the Bio-landscaping course. The aspects evaluated are the content suitability, language, design, and presentation.

The research was conducted over a period of three months, from June to August 2025. It was carried out at the Biology Education Study Program, Faculty of Teacher Training and Education, Lambung Mangkurat University. Quantitative descriptive analysis was used to interpret data from the results of expert reviews and assessments of the developed e-module products to determine their validity and suitability before implementation in learning. The student response questionnaires used a Likert scale, which consisted of five options: (a) Very Good (VG) = score 5, (b) Good (G) = score 4, (c) Fair (F) = score 3, (d) Poor (P) = score 2, and (e)

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Very Poor (VP) = score 1. The results of this analysis form the basis for revising the product and determining the validity and practicality of the developed e-module. Furthermore, the total assessment score can be calculated using the following formula:

$$P = \frac{Total\ score\ obtained\ from\ the\ questionnaire\ data}{Maximum\ score}\ x\ 100$$

Description:
P = Percentage of respondent scores obtained.

Table 1. Category Criteria of Percentage Interpretation

Percentage Range (%)	Category/Criteria
81 – 100	Excellent
61 – 80	Good
41 – 60	Fair
21 – 40	Poor
0 – 20	Very Poor

RESULTS AND DISCUSSION

The Need for Bio-landscaping E-Module

The initial stage in the development process began with the identification of needs. The results of this identification became an important basis for the preparation and design of the e-module being developed. At this stage, an analysis of student characteristics was conducted and a questionnaire was distributed to explore learning needs, particularly among Biology Education students. A total of 17 respondents participated by completing the needs identification questionnaire.

Table 2. Results of Needs Identification Questionnaire on the Use of E-Modules in Bio-landscaping Courses

No.	Question	Total Score
1	Have Bio-landscaping lecturers used e-modules in the learning process?	65
2	Do you think e-module teaching materials will be easier to use in the classroom learning process?	70
3	Do you need e-module teaching materials in the learning process?	68
4	Will e-module teaching materials that contain audio-visuals make you more enthusiastic about the learning process?	69
5	Do e-module teaching materials that include audio-visual elements make the learning process more interesting?	71
6	Do you agree that the Bio-landscaping course should use e-module teaching materials?	66
7	Do you agree that the Bio-landscaping course should include evaluation questions?	67
	Total	**476**
	Percentage (%)	**80%**

The total score obtained from the responses was then compared with the maximum possible score, calculated as: Maximum score = Number of items × Number of respondents × Maximum Likert value = 7 items × 17 respondents × 5 = 595. Based on the results in Table 2, the total score obtained was 476. From the results of the assessment through the questionnaire, it

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can be seen that the identification of the needs of Biology students in the Bio-landscaping course obtained a percentage of 80%, which is considered good and needed by students. The needs analysis involved two lecturers. The two lecturers were asked about the urgency of preparing an e-module for the bio-landscaping course. The results of the analysis of the needs of lecturers teaching Bio-landscaping courses show that e-modules have been produced.

Table 3. Lecturer Responses to the Necessity of Developing an E-Module for the Bio-landscaping Course

N	Question	Freq.		
		Yes	Sometimes	No
1	Is it necessary to develop an e-module for the Bio-landscaping course?	2	-	-
2	Does the Bio-landscaping course require an e-module?	2	-	-
3	If you answered Yes, is it necessary to develop an e-module?	2	-	-
4	Will the e-module support learning activities?	2	-	-
5	Is the e-module necessary for lecturers to conduct learning activities?	2	-	-
Total		**10**		
Percentage (%)		**100%**		

According to the table above, which was presented to identify the needs for digital e-modules provided to lecturers teaching the Bio-landscaping course, the average percentage was 100%, which is considered excellent and therefore very much needed in the learning process. This percentage indicates an excellent level of necessity, showing that lecturers fully support the development of an e-module for the Bio-landscaping learning process. Therefore, these findings served as an important reference for the researchers in developing the Bio-landscaping e-module. Specifically, the identified needs guided the inclusion of features such as audio-visual explanations, evaluation questions, and materials that support independent learning within the final e-module design. In the digital era, learning resources in electronic format are a necessity for improving the quality of learning process (e.g. Budiarto et al., 2022; Usman et al., 2024).

E-Module Design for the Bio-landscaping Based on Local Wisdom

The data collected during the analysis stage, or the identification of student needs, course material, and instructors for the Bio-landscaping course, forms the basis for the next stage, which is the design of the e-module product being developed. The core objective of the E-Module is to establish specific, measurable, and clear learning outcomes defining what students must be able to achieve upon its completion. During the structural and content design phase, the topics and sub-topics of Bio-landscaping are determined. Content sequencing is logically structured, crucially incorporating the local wisdom of South Kalimantan. Given our location in the Banjarmasin area, the proximity to the Barito rivers emphasizes the close relationship between the Banjar community and the local wetland ecosystem. A prominent local wisdom relevant to this e-module is the adaptive architecture and settlement management along the riverbanks. Traditional housing, such as the *Rumah Lanting* (floating houses) and stilt houses (*rumah panggung*), are engineered to accommodate extreme river water fluctuations. This design reflects principles of hydro-ecological adaptation and sustainable structures that harmonize with the natural hydrological cycle. Furthermore, the communities possess profound knowledge regarding indigenous flora that effectively serves as riparian erosion control. Traditional fishing practices, which are strictly seasonal and species-specific, also demonstrate a deep understanding of resource conservation. Broadly, this e-module is designed to deliver digital

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literacy while simultaneously introducing this valuable local wisdom and fostering locally-oriented character education. The e-module design stages are as follows:

Table 4. Bio-landscaping E-Module Design Stages

Design Phase	Visual	Description
Cover		The cover of the Bio-landscaping e-module has a green leaf background with elements of the earth's surface landscape. The title "Bio-landscaping: Concepts and Applications in Local Wisdom" is written in bold font in the center. Below it are the names of the study program and university.
Table of Contents		The table of contents page uses a combination of white and light green colors. The display is neat and easily accessible via digital devices.
Module User Guide		This page explains how to use the e-module step by step: from reading the introduction, completing the pre-test, to participating in the formative evaluation.

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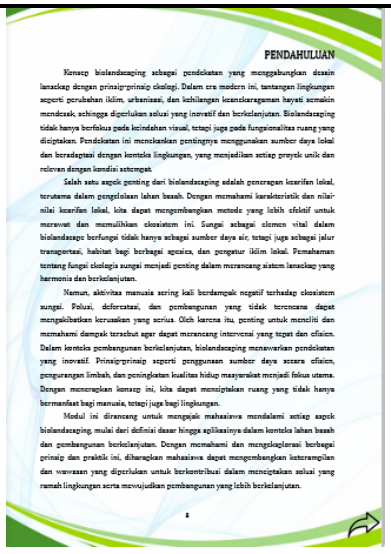
Design Phase	Visual	Description
E-Module Characteristics		Featuring characteristics of e-modules such as independent, interactive, and contextual learning.
Concept Map		Contains diagrams showing the relationships between topics in Bio-landscaping: basic concepts, sustainability principles, local wisdom, and wetland management.
Introduction		This section highlights the importance of Bio-landscaping in addressing the issues of climate change and urbanization.

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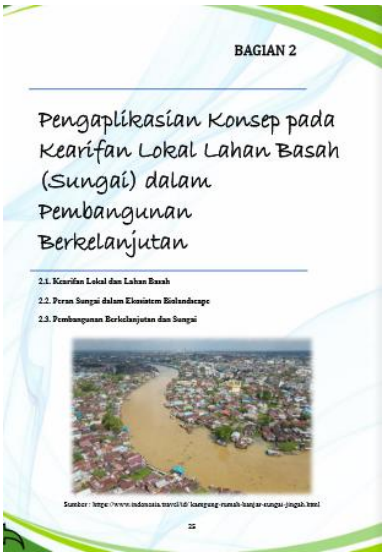
Design Phase	Visual	Description
Section 1: The Concept of Bio-landscape		Contains explanations of the definition, scope, and basic principles of Biolandscape. Each subchapter is accompanied by illustrations, exercises, and short quizzes.
Section 2: Application to Local Wisdom on Wetlands		This section links the concept of Bio-landscaping to the practices of the communities around the river. It is equipped with videos and case studies such as watershed management and Banjar river traditions.
Formative Practice and Evaluation		This section links the concept of Bio-landscaping with community practices around rivers. It includes videos and case studies such as watershed management and Banjar river traditions.

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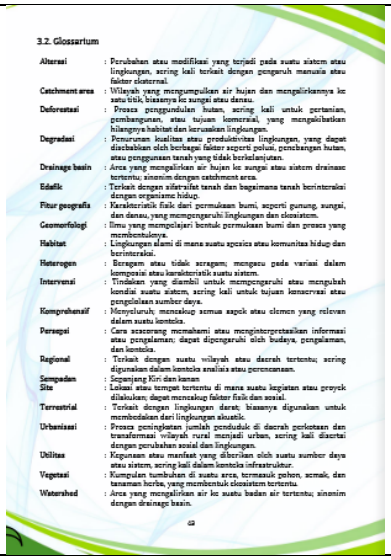
Closing & Glossary		Provides general conclusions and a glossary of important terms. The final design features shades of green and blue.

Based on the Bio-landscaping e-module design stages table, it can be concluded that the e-module design process is carried out systematically, starting from needs analysis to the finalization stage. Each stage is designed to ensure that the e-module is not only visually appealing, but also pedagogically and contextually relevant to the characteristics of Bio-landscaping learning. The resulting design combines scientific, aesthetic, and local wetland wisdom elements so that this e-module is expected to improve students' understanding, motivation, and independence in learning the concepts and application of Bio-landscaping in a sustainable manner. E-modules based on local wisdom to help improve cultural literacy and critical thinking skills (e.g. Wahyudi, et al., 2025; Makhrus et al., 2025). E-modules incorporating local wisdom are projected to enhance educational quality by simultaneously boosting material retention and solidifying students' character values (e.g. Sofyan et al., 2020; Masie et al., 2025)

The validity level of the e-module for the Bio-landscaping course

The validation process was carried out to assess the feasibility of the Bio-landscaping e-module that had been developed before being tested on students. This validation involved three lecturers who teach the Bio-landscaping course. The completed Bio-landscaping e-module product was submitted to the lecturers for assessment based on content, language, design, and presentation. The validation results are presented in the following table:

Table 5. Bio-landscaping E-Module Design Stages

Aspects Evaluated		Assessment Score		
		V1	V2	V3
A. Content Suitability				
1.	The suitability of the material in the Bio-landscaping e-module with the learning outcomes	4	4	4
2.	The accuracy of the substance of the learning material in the e-module.	4	4	4
3.	The material in the Bio-landscaping e-module is easy to understand	4	4	4
4.	The learning material in the Bio-landscaping e-module is useful for increasing knowledge about wetlands.	5	4	4
5.	The suitability of the illustrations (example images) in the Bio-landscaping e-module is in line with the learning material	5	4	4

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Aspects Evaluated		Assessment Score		
		V1	V2	V3
B. Linguistic				
7.	All information in the Bio-landscaping e-module is clearly legible.	4	4	4
8.	The language used in the Bio-landscaping e-module is easy to understand	4	4	4
9.	The clarity of information delivery in the Bio-landscaping e-module.	4	4	4
10.	Sentences are in accordance with the rules of correct Indonesian.	4	5	4
11.	The language used does not cause ambiguity.	4	4	4
12.	The language used is communicative.	4	5	4
C. Design				
13.	The use of colors in the Bio-landscaping e-module is appropriate and not excessive.	4	5	4
14.	The font size used is easy to read clearly.	4	4	4
15.	The font type used is easy to read clearly	4	4	4
16.	Illustrations/images used in the e- module are clear (not blurry).	5	5	5
17.	Videos in the E-Module run smoothly and can be viewed clearly.	5	5	5
D. Presentation				
18.	Clarity of the e-module's objectives.	4	5	4
19.	The sequence of material descriptions in the entire content of the e-module.	4	4	4
20.	The sequence of material explanations in the learning videos presented	4	4	4
21.	Appropriate motivation for students	4	4	4
22.	The content of the e-module is interesting and can motivate students to study harder	4	4	4
23.	Completeness of information in the e-module (summary of material, worksheets, practice questions)	4	4	4
24.	Interactivity of student learning using the e-module	4	5	4
Number		96	99	94
Percentage (%)		**80%**	**82,5%**	**78,3%**
		Good	**Very Good**	**Good**

The validation process was conducted to assess the feasibility of the Bio-landscaping e-module based on content, language, design, and presentation aspects. The assessment was carried out by three validators (V1, V2, and V3) using an instrument containing 24 assessment items with a five-point scale (1–5), where a score of 5 indicates excellent criteria and a score of 1 indicates poor criteria. Based on the assessment results from three validators, the Bio-landscaping e-module obtained an average percentage of 80,27%, which is classified as good to very good, and is therefore declared suitable for use as digital teaching material for the Bio-landscaping course. These results show that the e-module has met the criteria for content, language, design, and presentation.

The development process of the Bio-landscaping e-module began with an analysis of student needs as the basis for compiling digital teaching materials, which showed that the module for the Bio-landscaping course was of the required standard (good). Furthermore, after

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the needs analysis, the researchers designed the material to be included in the e-module, systematically forming the structure and components of the teaching materials. This statement emphasizes that in order for the resulting e-module product to be of high quality, the components of the teaching materials must be developed through regular, harmonious, consistent, and balanced procedures or stages, thereby forming a functional and effective module.

This approach is in line with systematic instructional design models which is widely used in digital module development (e.g. Ramanda et al., 2023, Suratnu, 2023). In addition, design-based research is considered a comprehensive and flexible instructional design framework for developing digital materials systematically (Adeoye, 2024). Therefore, the development of the Bio-landscaping e-module must follow a structured process so that the module does not merely contain material, but is also integrated with pedagogical, media, interactivity, and evaluation aspects that support the success of the learning process.

In addition to conducting a needs analysis of students, the researchers also conducted a needs analysis of lecturers teaching the Bio-landscaping course. The results of the analysis showed that in the learning process for this course, there were no teaching materials in the form of e-modules that could be used independently by students. The availability of e-modules is considered important because they can serve as additional learning resources and flexible learning guides, allowing students to access the material anytime and anywhere (Holisoh et al., 2025) in line with Akbari et al. (2023) who stated that the development of e-modules can increase student learning independence through the presentation of interactive and easily accessible material. Thus, the development of Bio-landscaping e-modules is expected to support a more efficient, contextual, and student-centered learning process.

In the process of developing the Bio-landscaping e-module, researchers also utilized supporting software and applications such as Canva for module cover design and Microsoft Word for text material compilation. The main components of the module include text, images, videos, and evaluation questions, which are harmoniously combined in accordance with the module design stages. This is in line with the findings that in order to produce interesting and effective teaching materials in digital format, it is necessary to integrate various media elements such as text, audio, video, and animation (Handoyo, 2025)

After going through the e-module product development stage, the researchers then validated the Bio-landscaping e-module. The validity test of the developed product was submitted to the lecturer in charge of the Bio-landscaping course for assessment. The results obtained from the assessments of the three validators showed that the Bio-landscaping e-module received an average percentage of 80.27%, which falls into the category of good to very good. These results indicate that, in general, the Bio-landscaping e-module has met the criteria for suitability as digital teaching material that can be used in the learning process.

First, in terms of content feasibility, the e-module has been assessed as being in line with the learning outcomes of the Bio-landscaping course. The material presented covers relevant scientific substance, is easy to understand, and contributes to the development of students' knowledge of wetland-based landscape management. In addition, the illustrations and case studies included are also assessed as being in line with the material taught, thereby strengthening students' conceptual understanding. This is in line with research conducted by Meldrawati et al. (2024), which also found that content is the most decisive component in the feasibility of environmental learning e-modules. Media and design feasibility constitutes a critical indicator for evaluating the e-module's potential to adequately support learning process (Rasyid et al., 2024). Feasibility is one of the main factors for an e-module to be accepted and utilized by students (Bhat et al., 2022).

In terms of language, the validator gave a good assessment, noting that the language used was communicative, clear, and in accordance with the rules of Indonesian. However, there were several minor suggestions that the sentences in certain parts should be more concise and

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easier to understand in order to minimize ambiguity in the delivery of learning messages. It is important to emphasize that the language in e-modules must meet the aspects of readability, clarity, and conformity with language rules so that students can more easily understand the learning content (Rusmansyah et al., 2023). Readability is a factor that indicates students can easily use the e-module independently because it is not difficult to operate (Purba et al., 2024).

Furthermore, in terms of design, the e-module received high scores, with an average score in the excellent category. The choice of colors, font size, and typeface was considered harmonious and easy to read. The illustrations and videos included were also considered attractive, clear, and functional, thereby enhancing the visual appeal of the e-module. This is reinforced by the findings of Putra et al. (2022), which explain that the visual design aspect of e-modules has a significant influence on students' interest in learning, as an attractive appearance can increase attention and motivation to learn. Effective visual design is crucial for heightening student engagement and improving the accessibility and ease of use of the e-module (Sintawati & Margunyasa, 2022).

In terms of presentation, the validators assessed that the sequence of concepts presentation was coherent, the learning objectives were clearly conveyed, and the content was able to motivate students. However, there were several suggestions that the formative evaluation and student worksheets should be developed to be more varied in order to increase interactivity in digital learning. This statement is supported by Handoyo's (2025) research, which states that a coherent presentation of material accompanied by interactive exercises can increase the effectiveness of e-module-based learning.

As a result, the Bio-landscaping e-module is deemed suitable for use in the learning process, with some minor improvements needed in terms of language and presentation to optimize its quality before it is tested on students. The Bio-landscaping e-module that has been developed has several advantages that support the effectiveness and independence of student learning. The e-module is equipped with student worksheets, practice questions, and answer keys that facilitate students to learn independently without always having to be accompanied by a lecturer. Each learning activity is designed to help students understand the concept of Bio-landscaping through a project-based and contextual approach to wetland ecosystems, supplemented with learning videos, illustrative images, and interactive concept maps that correspond to the material, such as the application of Bio-landscaping principles in river areas and wetland environments. Integrating Indonesian local wisdom into digital learning modules is a scalable model for culturally grounded educational innovation that simultaneously enhances students' academic achievement, strengthens their character development (Anas et al., 2025), students' scientific attitudes (Setiaji et al., 2025) and motivation (Sofyan et al., 2020). E-modules rooted in local wisdom not only cultivate an interactive learning experience but also significantly contribute to cultural preservation and biodiversity conservation (Sirojjuddin et al., 2025)

The development of the Bio-landscaping e-learning module took quite a long time, as the content had to be adapted to the curriculum, supported by relevant references, and designed with easily accessible interactive features. Nevertheless, the final product proved to be interesting, informative, and effective in supporting students' understanding of the concept of Bio-landscaping and its application in sustainable development. Further validation results show that the e-module has achieved the main objective of the study, which is to produce valid and feasible digital teaching materials that meet the required standards in terms of content, language, design, and presentation. Following this validation stage, the next step is to conduct a pilot test with students to assess the feasibility and effectiveness of the module in a real classroom environment. The study does not empirically verify whether the resulting Bio-landscaping e-module product demonstrably enhances students' digital literacy, character development, and critical thinking within the higher education context. Consequently, further research is required to thoroughly investigate and determine its effectiveness in learning implementation.

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CONCLUSION

This study produced an e-module on Bio-landscaping with a focus on product design and validation. Based on the assessment results from three validators covering content, language, design, and presentation aspects, the e-module obtained an average validity score of 80,27% with a rating of good to very good. These results indicate that the e-module has met the eligibility criteria as interactive, communicative, and relevant digital teaching material for course learning outcomes. It is considered capable of being a flexible learning resource that supports independent learning, increases motivation and critical thinking skills.

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