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Integration of Merangin Local Wisdom in the Development of the E-Module of Basic Concepts of Elementary Biology

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ABSTRACT

Learning Basic Biology Concepts in the Primary School Teacher Education (PGSD) program is often delivered in a theoretical manner and remains insufficiently connected to students' ecological and cultural contexts. This study aimed to develop an e-module based on Merangin local wisdom, examine its feasibility and practicality, and analyze its potential as a contextual learning resource for elementary biology. The study applied a research and development design using the ADDIE framework, supported by qualitative exploration of local ecological knowledge. Data were collected through field observations, interviews with customary leaders and local environmental managers, analysis of curriculum documents, expert validation questionnaires, and student response questionnaires. The local wisdom integrated into the e-module comprised the Lubuk Larangan river conservation system, Rantau Kermas Customary Forest governance, and the Merangin Geopark, which were mapped onto ecosystem, environmental conservation, biodiversity, and evolution materials. Expert validation showed an overall feasibility score of 90.9%, categorized as highly feasible, while the limited practicality test with second-semester PGSD students produced a score of 89.4%, categorized as highly practical. These findings indicate that the e-module can bridge biological concepts with local ecological knowledge while strengthening cultural literacy and conservation awareness among pre-service elementary teachers.

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1. INTRODUCTION

Science education in teacher-preparation programs should connect conceptual knowledge with the sociocultural and ecological realities learners experience. In the Primary School Teacher Education (PGSD) program, mastery of Basic Biology Concepts is essential

because pre-service teachers will later introduce elementary pupils to organisms, ecosystems, biodiversity, and environmental responsibility. However, biology instruction often remains dependent on generic teaching materials that do not adequately reflect the local environment, creating a gap between formal scientific concepts and students' everyday experiences [1].

This problem is pedagogically significant because contemporary science education emphasizes integrating science, the environment, technology, and society. SETS- and STEM-oriented learning encourage lecturers to situate abstract scientific ideas within real-world social and environmental issues [1], [2]. In Indonesia, curriculum reform in science education also highlights the importance of embedding local wisdom and ethnoscience into formal learning so that scientific knowledge is not perceived as detached from students' cultural roots [3]. Contextual science learning grounded in local wisdom has been reported to support scientific literacy by enabling learners to interpret science through familiar phenomena [4].

The theoretical foundation of this study is ethnoconstructivism. Ethnoconstructivism positions local wisdom not merely as supplementary content but as a cultural and epistemic basis for learners to construct formal scientific understanding [5]. In this framework, students first encounter phenomena that are socially and culturally meaningful to them, then reconstruct those experiences into academic concepts such as ecosystems, food webs, conservation, biodiversity, and environmental carrying capacity. This approach is particularly relevant for PGSD students, who must not only understand biology but also learn to translate biological concepts into meaningful elementary learning experiences.

Merangin Regency, Jambi Province, provides a strong empirical context for ethnoscience-based biology learning. Jambi society has historically developed through plural social interactions, producing local value systems that regulate harmony among humans and between communities and the natural environment [6]. In Merangin, this ecological orientation appears in several forms of local wisdom, including the Lubuk Larangan river conservation system, the Rantau Kermas Customary Forest, and the Merangin Geopark. These practices contain biological concepts that can be translated into formal learning materials.

The Rantau Kermas Customary Forest illustrates community-based environmental governance. The Marga Serampas customary law community applies zoning, restrictions on forest exploitation, and customary sanctions to preserve forest functions [7]. Biologically, this practice is relevant to terrestrial ecosystem conservation, hydrological regulation, carbon storage, habitat protection, and biodiversity maintenance. The Merangin Geopark also offers scientific potential because its core area in Renah Pembarap contains geological heritage and fossil evidence that can support learning about biodiversity, adaptation, and evolutionary history [8], [9]. Meanwhile, Lubuk Larangan serves as a river conservation mechanism that temporarily restricts fishing to allow aquatic populations to reproduce and maintain ecosystem balance.

Transforming this local ecological knowledge into digital teaching materials is necessary because PGSD students increasingly require flexible, portable, and visually engaging learning resources. E-modules allow lecturers to combine text, images, video,

hyperlinks, concept maps, and formative evaluation into a single learning package [11]. Prior studies have also shown the pedagogical value of e-modules in local wisdom-based science learning, elementary learning, interactive multimedia learning, and the improvement of critical thinking [12]-[16]. Therefore, an e-module is a relevant medium for translating Merangin local wisdom into structured biology learning materials.

Previous studies have demonstrated that local wisdom-based learning can increase students' science competence [17], strengthen character education [18], and provide alternative contextual learning resources in social and cultural studies [19], [20]. Other studies have emphasized the role of ecotourism and natural environments as sources for environmental learning [21]. Nevertheless, these studies have not specifically developed an e-module that integrates the distinctive ecological wisdom of Merangin Regency into Basic Biology Concepts for undergraduate PGSD students. This indicates a clear research gap across locality, subject matter, learning medium, and target users.

Based on this gap, this study proposes the Development of a Merangin local wisdom-based e-module for Basic Biology Concepts in the PGSD program. The author's plan for problem-solving is to identify biological values embedded in local ecological practices, map them onto elementary biology materials, design them in a digital module format, and evaluate the product through expert validation and student practical testing. This study is expected to produce a learning resource that contextualizes biology, strengthens cultural literacy, and promotes conservation awareness among pre-service elementary teachers.

Accordingly, this study aims to: (1) identify forms of Merangin local wisdom relevant to biological science; (2) develop an e-module design for Basic Concepts of Elementary Biology integrated with Merangin local wisdom; (3) analyze the feasibility and practicality of the e-module; and (4) examine the contribution of the e-module as an alternative contextual learning resource for PGSD students.

2. METHOD

This study employed a research and development (R&D) design using the ADDIE framework, consisting of analysis, design, development, implementation, and evaluation stages. The R&D design was selected because the study sought not only to describe Merangin local wisdom but also to transform it into an educational product in the form of a Basic Biology Concepts e-module. The development procedure was supported by qualitative descriptive exploration and quantitative descriptive analysis of product feasibility and practicality [22].

The analysis stage focused on identifying local wisdom in Merangin Regency that was relevant to elementary biology materials. Data were collected through participatory field observations in the Rantau Kermas Customary Forest area, Lubuk Larangan river zones, and the core area of the Merangin Geopark. In-depth interviews were conducted with customary leaders, depati, village representatives, and local environmental managers to explore the philosophical, ecological, and pedagogical meanings of the local practices.

The design stage involved mapping local wisdom content onto the syllabus of Basic Concepts of Elementary Biology in the PGSD program. The mapping connected the Lubuk Larangan tradition with aquatic ecosystems, food webs, population dynamics, and

environmental carrying capacity; Rantau Kermas Customary Forest governance with terrestrial ecosystem conservation and hydrological functions; and Merangin Geopark with biodiversity, adaptation, fossilization, and evolutionary history.

The development stage produced an e-module prototype that included an introduction, learning outcomes, concept maps, contextual narratives, the special rubric "Jendela Merangin," a local terminology glossary, multimedia links, case-based activities, and formative evaluations. The prototype was validated by three expert groups: material experts, media design experts, and language experts. The validation instrument used a Likert-scale questionnaire supported by qualitative suggestions for revision.

The implementation stage was conducted through a limited practicality test involving second-semester students of the PGSD Study Program at Universitas Merangin. The practicality test examined students' responses to the clarity of content, ease of operation, attractiveness of presentation, relevance of local wisdom, and usefulness of the e-module for independent learning. Data were obtained through student response questionnaires and limited focus group discussions.

Qualitative data from observations, interviews, document analysis, and student responses were analyzed through data reduction, data display, and conclusion drawing. Quantitative data from validation and practicality questionnaires were converted into percentages and interpreted using feasibility and practicality categories. The combination of qualitative and quantitative descriptive analysis was used to ensure that the product was academically valid, contextually meaningful, and practically usable in PGSD biology learning.

3. RESULTS AND DISCUSSION

3.1. Identification of Merangin Local Wisdom Relevant to the Basic Concepts of Elementary Biology

The first essential step in developing this e-module is to deconstruct and reconstruct the traditional knowledge of the Merangin Regency community into academic scientific concepts. In line with the principles of Basic Science of Ethnoconstructivism Learning [5], local wisdom should not be viewed solely as a passive cultural heritage; its scientific content should be systematically explored. This exploration process aims to translate noble sociocultural values into a formal biological language that is measurable and applicable for learning.

The people of Jambi, and more specifically those of Merangin Regency, are known to have a long track record of maintaining the harmonious coexistence of a pluralistic social life while simultaneously preserving their natural environment [6]. The close relationship with the mountainous, forested terrain and swift river currents has fostered ecological sensitivity among the indigenous communities. This knowledge is passed down from generation to generation, not through written texts but through empirical practices and communal customary laws.

Based on observations and interviews with local customary figures, this study successfully identified three main pillars of local wisdom in Merangin Regency that are highly relevant to the Basic Concepts of Biology. These three practices include the

Customary Forest management system in Rantau Kermas, the presence of the Merangin Geopark, and the river conservation tradition through the *Lubuk Larangan* system. All three are complete representations of the ethnoscience approach, ready for integration into elementary-level learning materials.

The first focus is the existence of the Rantau Kermas Customary Forest, located in the Jangkat District. The Marga Serampas customary law community consistently manages and protects this forest area using traditional regulatory instruments [7]. This management includes proportional land-use zoning, restrictions on tree felling, and the enforcement of severe customary sanctions or fines against anyone proven to have damaged the forest's sustainability without the customary stakeholders' permission.

From a scientific perspective, safeguarding the Rantau Kermas Customary Forest embodies the fundamental principle of protecting terrestrial ecosystems. The untouched forest area functions optimally as a water catchment (hydrology), preventing erosion and flooding downstream. In addition, this forest acts as a guardian of biogeochemical cycles, specifically the carbon cycle, and serves as a natural habitat that protects the endemic species typical of the Sumatran mountains from the threat of extinction.

The community's obedience to customary law in Rantau Kermas often proves more effective than formal state law enforcement. This provides profound character education value for pre-service teacher students. Through this material, the concept of environmental conservation is no longer taught merely as a theory on paper, but is proven through the tangible success of the local community. This aligns with the legal anthropology study by Chandra [25], which asserts that customary law in Merangin Regency originated from the community's close interaction with nature, making its preservation a defining aspect of environmental order and harmony. Future teachers can instill in their future students the awareness that preserving nature is part of maintaining the dignity and legal order of their ancestors.

The second focus shifts to the aquatic region and geological history, namely the management of the Merangin Geopark area. The core area of this geopark stretches across the Renah Pembarap District and holds invaluable natural wealth [8]. This geopark is not merely an ecotourism destination; rather, it is an earth heritage site that documents the record of natural evolution, making it the most authentic open laboratory in Jambi Province.

The primary scientific value of the Merangin Geopark lies in the presence of ancient flora and fauna fossils, one of the most iconic being the Araucarixylon tree fossil, estimated to be hundreds of millions of years old. The fossil discoveries clearly imprinted in sedimentary rocks along the Batang Merangin River provide tangible evidence of continental drift dynamics and past climate changes [9]. This is highly relevant for explaining materials on the history of life, evolution, and the fossilization process of living organisms.

Besides ancient relics, the core zone of the Merangin Geopark is also home to immensely rich modern biodiversity. The interaction between the petrified ancient flora and the green vegetation currently inhabiting the riverbanks provides a perfect visual landscape for studying species adaptation and biodiversity at the genetic, species, and ecosystem levels. Therefore, integrating Geopark materials into the e-module will provide an extraordinary visual and cognitive experience that enhances students' understanding of biology.

The third, equally important focus is the *Lubuk Larangan* tradition. This tradition is a mechanism for protecting river aquatic ecosystems, collectively agreed upon by customary figures, the community, and the village government in various areas of Merangin. Under this system, residents are strictly prohibited from catching fish or from poisoning specific river areas (lubuk) for 1 to 2 years, after which they are finally "opened" en masse during a customary celebration.

The biological study behind the *Lubuk Larangan* tradition is a direct application of the carrying capacity theory and the population dynamics of aquatic organisms. The harvest hiatus period provides sufficient biological time for local endemic fish, such as the semah fish, to undergo spawning and reproduction without disturbance. This ensures the continuity of food chains and food webs in the freshwater ecosystem is not disrupted by overfishing.

The use of learning resources grounded in the natural and cultural environment significantly enriches the learning experience [23]. Learning that is usually confined by lecture hall walls is now expanded to encompass an empirical understanding of the complex interactions among humans, culture, and ecology. This fosters environmental awareness, a love for local culture, and the social skills desperately needed to manage environmental issues at the community level.

In the context of modern cultural literacy, this e-module facilitates what is referred to as Learning Cultural Literacy through Creative Practices [24]. Through its multimedia elements and interactivity, the e-module enables students to engage critically and creatively with local wisdom. They are not merely passive consumers of cultural narratives; rather, they are invited to interpret the meaning behind these traditional conservation practices and reflect upon them in the context of contemporary environmental challenges.

The initial step in this research was to identify and map the sociocultural practices of the Merangin Regency community that contain elements of nature conservation. Through an ethnographic review and interviews with local customary stakeholders, it was found that the Merangin community has long practiced empirical environmental management. Three primary forms of local wisdom successfully identified and bearing strong relevance to basic biology are:

a. Rantau Kermas Customary Forest Management System
   Located in Jangkat District, the Serampas Clan customary law community has a very strict communal forest management system. Based on the observations, this practice includes proportional land-use zoning and the prohibition of indiscriminate tree felling. There are strict customary sanctions and social fines for anyone who damages forest areas without the permission of *the depati* (traditional leader).
b. Lubuk Larangan River Conservation System
   This is a communal agreement between residents, indigenous leaders, and village officials to prohibit the exploitation of river biota in certain water zones (*lubuk*). This fishing ban applies for a set period (generally 1 to 2 years). After the ban period ends, the river will be "opened" and harvested en masse during traditional celebrations.
c. Merangin Geopark Natural History Site
   The ecotourism area that spans Renah Pembarap District is identified not only as a recreational area but also as a natural laboratory. This geopark holds prehistoric relics in

the form of fossils of ancient flora and fauna, with the most iconic being the *Araucarixylon tree* that petrified along the flow of the Batang Merangin River.

Overall, the in-depth identification of the Rantau Kermas Customary Forest, the Merangin Geopark, and the Lubuk Larangan system demonstrates that the Merangin people have long practiced empirical biological science. These facts solidify the foundation that local wisdom in this region is highly valuable and valid as the primary scientific basis. These concepts are then synthesized and mapped into the Basic Concepts of Elementary Biology syllabus, so that they are ready to be fully accommodated into the interactive e-module format that has been developed.

3.2. Analysis of the Relationship of Merangin Local Wisdom with Elementary Biology Materials

The integration of local wisdom into formal education products, especially in higher education such as PGSD study programs, cannot be done superficially or as a gimmick. In the context of the Development of modern teaching materials, the integration process must be precisely mapped to align fully with the applicable curriculum and Graduate Learning Outcomes (CPL) [2]. This process requires caution so that the content of local culture does not obscure the concept of pure science, but rather clarifies and strengthens students' understanding of basic biological material.

Winangun et al. [12] emphasized that the Development of case-based science basic concept e-modules in the context of local wisdom is an urgency and current academic need. Winangun et al. highlight that this kind of integration has proven successful in breaking down the barrier between rigid scientific theory and the dynamics of people's lives, making e-modules not only a tool for transferring material but also a reflection of the socio-ecological wealth in which students live and develop.

The Development of teaching materials in the form of e-modules was strategically chosen because this instrument offers flexibility and interactive capacity that goes far beyond conventional printed textbooks. In the current era of information disclosure, e-modules facilitate a harmonious blend of Science, Environment, Technology, and Society (SETS) approaches with local wisdom in real-time [1]. E-modules enable the presentation of natural data in text, dynamic visuals, and self-evaluation, all consolidated in a single, portable platform, allowing students to access learning spaces anytime, anywhere.

The main pedagogical foundation that frames the integration in the design of this e-module is the learning principle of ethnoconstructivism. As emphasized by Asrial et al. [5], ethnoconstructivism requires students to build their own knowledge by borrowing their cultural experiences as an initial foundation. Therefore, this e-module does not begin the explanation by presenting an abstract definition of biological theory. On the contrary, each chapter in the e-module begins with an explanation of specific natural phenomena in Merangin, which is then slowly reconstructed towards the discovery of deductive scientific concepts.

Structurally, this elementary biology e-module is designed with a scalable, user-friendly interface. The content design includes an introduction page, a concept map, a description of the material inserted with the rubric "Jendela Merangin", a glossary of regional languages, and an evaluation rubric. This "Merangin Window" rubric serves as a cognitive

bridge, a place where local cultural narratives are presented, complete with multimedia documentation relevant to the biology sub-topics under discussion.

To provide a more concrete picture of the integration structure, here is a mapping matrix that summarizes the correlation between the curriculum material of the Basic Concept of Elementary Biology and the sociocultural reality in Merangin Regency, which is accommodated in the e-module:

Table 1. Integration of Merangin Local Potential in Learning Materials

Elementary Biology Materials	Sub-Material	Merangin Local Context in e-module	Objectives for PGSD Students
Ecosystem	Abiotic/biotic components, Food webs	The ecosystem of the Batang Merangin River and the practice of Lubuk Larangan.	Understand the population dynamics of local aquatic organisms and the impact of human interventions.
Environmental Conservation	Environmental Damage & Solutions (Conservation)	Customary law of the Rantau Kermas Customary Forest [7].	Realize the importance of community norms in preserving the lungs of the ecosystem.
Biodiversity	Species Grouping & Conservation	Flora and fauna endemic to the Merangin Geopark core zone area [8].	Examining adaptation and local genetic richness for primary school teaching materials.

The implementation of mapping in Table 1 is most prominent in the Ecosystem chapter, where the *Lubuk Larangan tradition* is fully integrated. When discussing the biotic and abiotic components of flowing waters, the e-module dissects the physical parameters of the Batang Merangin River, such as water discharge, temperature, and acidity, as well as its interactions with local biota, including the Semah fish. This phenomenon is presented to replace generic textbook examples (such as lake ecosystems in a four-season country) that are often less relevant to Jambi students' imagination.

Furthermore, in discussing the material of the aquatic food chain, the concept of Lubuk Larangan is presented not only through descriptive texts but also supported by interactive multimedia elements [11]. This e-module includes a hyperlink or a short video showing the opening procession in Lubuk Larangan, led by local traditional leaders. This visualization prompts students to observe firsthand how harvest restrictions affect fish size, variety, and health, thereby scientifically demonstrating the restoration of environmental carrying capacity.

In the Environmental Conservation chapter, the focus of integration is a case study of the Rantau Kermas Customary Forest. Referring to the study by Tamami [7], the e-module specifically explains how customary fines or social sanctions are applied to individuals who engage in illegal logging without the depati's (traditional leader's) permission. Land conservation material is taught by analyzing the often blunt, positive state laws and customary laws that have proven sharp at protecting water catchment areas and ecosystem lungs.

This integration related to Customary Forests is also designed to stimulate students' Higher Order Thinking Skills (HOTS). At the end of the forest conservation material, the e-module presents the Problem-Based Learning (PBL) rubric. Students were asked to analyze a fictitious case study on the threat of deforestation in their area and to formulate prevention

solutions that combine government regulations and the moral value of local wisdom. This aims to form empathy and the sharpness of students' reasoning in solving real environmental problems. The implementation of these values into the conservation-based science curriculum not only deepens understanding of ecological concepts but also fosters a caring attitude towards the sustainability of nature in real terms [26].

The third implementation focuses on the Biodiversity chapter by leveraging the richness of the Merangin Geopark core zone. This ecotourism area, rich in geological heritage, provides abundant material on the processes of species adaptation and natural selection [9]. The e-module explores the comparison between the conditions of ancient floras petrified by volcanic activity millions of years ago and the diversity of today's epiphytic flora that dominates the riverbank area.

To strengthen the visual understanding of space and time, the multimedia feature in the e-module presents an interactive gallery featuring high-resolution cross-sections of Araucarixylon fossils and other prehistoric biological traces from the Merangin Geopark [8]. Students can zoom in on images on their screens to observe the structure of ancient plant tissues, facilitating the learning of evolutionary biology that feels very close to being in their own provincial administrative area.

The formative evaluation and assessment design inserted at the end of each chapter in this e-module is also recalibrated to align with the ethnoconstructivist approach. The interactive multiple-choice questions and quizzes provided are no longer *rote learning*, but *case-based*. For example, an evaluation question might read, "If the duration of *Lubuk Larangan* is shortened from one year to three months, what is the most likely biological impact on the trophic level of the Merangin river ecosystem?". This assessment ensures that students truly master the blend of academic theory and local reality.

For PGSD students, the experience of interacting with the e-module structure like this actually provides dual benefits, both substantive and pedagogical. Substantively, they master the material of the Basic Concepts of Biology empirically and meaningfully. Nevertheless, pedagogically, what is much more important is that they directly exemplify *how to teach* contextual biology. This methodological provision will be duplicated and adjusted when they actually become classroom teachers in elementary schools throughout Jambi Province.

This process of cognitive attribution and cultural reflection is crucial in creating meaningful learning. Bang [27] emphasizes that learners' understanding of the natural environment is significantly shaped by the specific cultural lens of their community. By using the lens of Merangin's local culture, students are no longer required to memorize biological concepts that are far removed from their reality—such as the characteristics of taiga or tundra ecosystems—but are invited to dissect authentic flora and fauna phenomena they can witness firsthand in their hometowns.

Once identified, the local wisdom is deconstructed to find its common thread with the concept of formal science. Qualitative analysis shows that the three traditions are not just myths, but pure applications of ethnoscience that are in line with the curriculum of the Basic Concepts of Elementary Biology:

a. The Relationship of Kermas Region's Customary Forest with Environmental Conservation Materials

   The practice of caring for customary forests is scientifically highly relevant to the conservation material of terrestrial ecosystems. The forest that the Serampas Clan closely guards acts as a water catchment area (hydrology) that prevents ecological disasters such as landslides and floods. Biologically, this forest absorbs carbon emissions (biogeochemical cycle) and protects the germplasm of Sumatran endemic species. This concept provides a new perspective for students: that environmental conservation can be enforced through communal moral compliance rather than just state regulations.

b. The Relationship *of Lubuk Larangan* with Ecosystem Materials and Food Nets

   The analysis of *Lubuk Larangan* found a direct correlation with aquatic ecosystem material, population dynamics, and environmental carrying *capacity*. The harvest pause period provides biological time (the spawning period) for endemic fish such as the Semah fish to reproduce. This understanding teaches students about efforts to prevent *overfishing* to maintain food webs and the trophic balance of rivers.

c. The Relationship of Merangin Geoparks with Biodiversity and Evolution Materials

   The existence of *Araucarixylon* fossils provides empirical evidence of the dynamics of past climate change on earth. Biodiversity is associated with adaptation. The interaction between primitive petrified flora and modern epiphytic vegetation on riverbanks provides the perfect comparative material for studying the diversity of genes, types, and ecosystems in context.

In the end, the pattern of integration that is manifested in the Development of this e-module represents a harmonious synthesis between the past and the future. The wisdom of the Merangin ancestors in preserving the earth is not allowed to become extinct with the times, but is resuscitated and repackaged using 21st-century digital technology. This strategic step strengthens higher education's position as an agent of cultural conservation and a pioneer of educational reform, firmly rooted in the nation's identity.

As part of a broader educational framework, this integration highlights the urgency of addressing the so-called 'human disconnection from nature' [28]. Students who are preoccupied with modern routines daily are prone to ecological alienation, which, in turn, can erode their sensitivity to conservation issues. These e-modules serve as bridges, reconnecting students' cognitive consciousness with the reality of the physical environment around them and reaffirming that they are an integral part of the ecosystem.

3.3. Analysis of the Form of Local Wisdom Integration in the Development of e-modules

The Basic Concept of Elementary Biology Elementary School Concept e-module, based on Merangin local wisdom, has been developed and is not yet ready for use in the lecture process until it undergoes a rigorous quality assurance stage. Referring to the research and development (R&D) procedure proposed by Sugiyono [22], an innovative educational product must be evaluated through two main test stages: validity test (feasibility) by experts or experts in their field, and practicality test through direct implementation to the user

subject, in this case, PGSD students. These two tests are crucial tools for ensuring that the teaching materials produced are not only visually appealing but also academically valid.

The feasibility test stage is conducted by submitting the final draft of the e-module to a team of expert validators comprising biological material experts, interactive learning media design experts, and Indonesian linguistics experts. This validation process uses a quantitative assessment instrument in the form of a questionnaire with a Likert scale, where each expert is asked to provide an assessment score against a set of indicators. In addition to providing numerical scores, validators are also required to provide qualitative notes in the form of criticism, suggestions, and recommendations for improvement so that the e-module becomes more perfect.

The first aspect that is validated is the feasibility of the material or content, which occupies the most central position in the Development of teaching materials. The assessment on this aspect focuses on the depth of explanation of biological concepts, the accuracy of mapping Merangin local wisdom (such as Customary Forests and Geoparks) with modern ecological theories, and the suitability of the material's difficulty level to the cognitive capacity of PGSD S1 students [1]. The results of the accumulated assessments from subject matter experts showed a very encouraging feasibility percentage, which reached 91.5%. This number puts e-module materials in the "Very Feasible" category.

The high validation score for this material indicates that the researchers successfully translated the principles of ethnoconstructivism [5] into a structured scientific language. The material expert validator specifically appreciated how this e-module elaborated complex ecosystem concepts into simpler, contextually relevant terms through the case study of Lubuk Larangan. The integration of the narrative of local traditions with the discipline of biological sciences is not forced but rather complements and strengthens the learner's substantive understanding.

The second aspect, which is no less crucial, is the feasibility of language and the presentation of the material. The evaluation in this aspect highlights the clarity of instructions, ease of sentence comprehension (readability), appropriateness of spelling and standard grammar, and the effectiveness of integrating a glossary of Merangin local-language terms into the narrative flow [11]. Based on the linguist validators' assessment, a feasibility percentage of 88.0% was obtained, which falls within the "Very Feasible" category. This assessment confirms that the language style used is communicative and consistent with the age-appropriate goals of college students.

Even though it achieved a highly feasible category, the language validators still provided some constructive feedback for product improvement. One minor suggestion was to bold or italicize specific biological terms and Merangin traditional vocabulary so that students could more easily distinguish foreign terminology from the main language of instruction. The researcher immediately implemented this revision, resulting in a much more optimal level of readability in the e-module.

The third aspect, as well as the hallmark of the e-module, is the feasibility of media design and graphics. Validation at this stage evaluates various visual and interactive elements, ranging from cover design, typography, and color palette combinations to embedded image and video resolutions to cross-page hyperlink navigation (user interface

design). Learning media experts gave the highest score among the three validation aspects, which was 93.2%, which means that the e-module design is categorized as "Very Feasible" and has very good presentation quality [2].

The success of this media design is largely due to a visual approach that consistently presents a portrait of the natural landscape of Merangin Regency. The use of high-resolution Araucarixylon fossil documentation in the Merangin Geopark [8] and audio-visual recordings from the Rantau Kermas Customary Forest area can provide an immersive learning experience for gadget users. Media validators only highlighted slight improvements in font size in certain paragraphs to keep them eye-catching even on a small smartphone screen.

In aggregate, if the values of the three experts (material, language, and media) are summed and averaged, then the e-module of Basic Concepts of Elementary Biology based on Merangin local wisdom obtains an overall ideality percentage of 90.9%. Referring to the feasibility conversion criteria stated by Sugiyono [22], the attainment of a value above the 80% limit confirms that the developed product is at the "Very Feasible" level. Therefore, the e-module has been declared to have passed the expert validation stage and is ready to proceed to the next stage, namely, practical field tests.

Table 2. Recapitulation of Expert Validation Results

Assessment Aspects	Feasibility Percentage (%)	Feasibility Category
Material/Content Feasibility	91.5%	Highly Feasible
Language and Presentation Feasibility	88.0%	Highly Feasible
Media/Design Feasibility	93.2%	Highly Feasible
Overall Average	90.9%	Highly Feasible

After validation, the next stage is to test the e-module's practicality through a limited trial. This practicality test was carried out by involving second-semester students from the Elementary School Teacher Education Study Program (PGSD) of Universitas Merangin. The selection of second-semester students is based on the distribution of basic science courses in the curriculum at the beginning of higher education. The response questionnaire was designed to capture students' subjective opinions on the effectiveness of e-modules in facilitating their independent learning style, ease of use, and the attractiveness of the material.

Based on the results of the questionnaire recapitulation collected from the limited trial, the responses of second-semester students at Universitas Merangin showed very positive appreciation, with an average score of 89.4%. This figure puts e-module products on the "Very Practical" eligibility criteria. The majority of PGSD students responded enthusiastically to the interactive features of the e-module, especially because they could access learning materials that were portable on their devices without being tied to a thick stack of printed reference books.

The integration of traditional knowledge into the Basic Concepts of Elementary Biology e-module is analyzed using the pedagogical foundation of ethnoconstructivism. In a qualitative framework, this e-module is not designed simply to move text from a book to a screen, but rather to reconstruct students' cultural experiences into academic science

knowledge. This form of integration is realized through the following instructional design strategies:

1. Case-Based *Narrative Approach*
   Instead of starting the chapter with an abstract definition (e.g., a general definition of an ecosystem), the e-module begins with a descriptive narrative of the condition of the Batang Merangin River. Students are first invited to analyze local phenomena, then directed to identify the biological concepts underlying them deductively.
2. Special Rubric "Jendela Merangin" and Local Glossary
   Cultural integration is accommodated specifically through the "Jendela Merangin" feature. This rubric presents an anthropological narrative of the applicable customary law. To ensure readability, the e-module includes a special glossary that defines the terms of the Merangin regional language in the context of Indonesian and biological terminology (e.g., the alignment of the term *lubuk* with the lentic/lotic ecosystem zone).
3. Interactive Multimedia Exploration
   The limitations of the text are overcome by integrating multimedia functions that evoke the visual imagination. In the Geopark material, the e-module integrates zoomable high-resolution images of prehistoric fossils, allowing students to observe the network structure of ancient plants from a device screen. In the ecosystem material, a documentary video link for the opening of *Lubuk Larangan is embedded*, so that students can directly observe the health and variation in fish population size as evidence of ecosystem recovery.
4. Evaluation Based on Ecological Problem Solving (*Problem-Based Learning*)
   Assessments in the e-module are integrated to trigger *Higher Order Thinking Skills* (HOTS). The form of evaluation integration is in the form of a hypothesis case study. For example, students are given a qualitative discussion question: *"If the duration of Lubuk Larangan is shortened from one year to three months due to economic pressure, formulate the biological impact that will occur on the river's food chain!"*.

Through limited open interviews during the implementation stage, this form of integration was confirmed to reduce student boredom during learning. The qualitative elaboration concludes that this e-module succeeds in making science material feel more "grounded", does not alienate students from their physical environment, and fosters ecocentric awareness that is vital for the formation of the character of prospective elementary school teachers in the future.

Qualitative analysis of students' open answers revealed that elements of ethnoconstructivism, such as narratives about Lubuk Larangan and Geoparks, have been proven effective in reducing boredom (fatigue when studying biology [1]). Students feel that the material feels more "grounded" and relevant to their home environment in Jambi. In the end, the high feasibility rate among experts (90.9%) and the high practicality rate among students (89.4%) provide strong scientific legitimacy for the production and dissemination of this e-module as a major alternative learning resource in the PGSD study program.

The use of these e-modules in the PGSD academic environment provides an essential epistemological foundation, where science is no longer seen as a sterile cognitive entity within culture. This approach emphatically situates culture and nature as central footholds

for students to construct their biological understanding. Packaging the Merangin local tradition into a multimedia digital format, as developed in this e-module, is a strategic step that goes beyond the boundaries of pedagogical innovation alone [2]. It also represents a dual preservation effort. On the one hand, he revitalized biology learning for PGSD students, making it more relevant and interesting and proving it to spark critical thinking and deepen understanding of the material. On the other hand, it documents, protects, and celebrates Merangin's cultural heritage, ensuring it remains alive and relevant as a source of ecological wisdom in the current and future era of digital disruption.

4. CONCLUSION

This study shows that Merangin local wisdom contains biological knowledge that can be systematically integrated into Basic Concepts of Elementary Biology. The Lubuk Larangan tradition represents aquatic ecosystem conservation and population regulation, the Rantau Kermas Customary Forest reflects community-based terrestrial conservation, and the Merangin Geopark provides authentic material for biodiversity, adaptation, and evolutionary learning. The developed e-module was judged highly feasible by experts and highly practical by PGSD students, indicating that integrating local ecological knowledge into digital teaching materials is academically and pedagogically acceptable.

This study suggests that biology instruction for pre-service elementary teachers can be more meaningful when scientific concepts are connected to local cultural and ecological realities. The e-module contributes to teacher education by providing a model of contextual biology instruction that simultaneously strengthens science understanding, cultural literacy, environmental awareness, and appreciation of local heritage. For the wider community, the product also contributes to documenting and disseminating Merangin ecological wisdom, thereby supporting cultural preservation and conservation-oriented public awareness.

This study is limited to the Development, expert validation, and limited practicality testing of the e-module in one PGSD institutional context. It has not yet measured learning effectiveness through experimental comparison, long-term retention, or the transfer of pedagogical competence into actual elementary classroom practice. Future research should therefore test the e-module using a broader sample, employ quasi-experimental or mixed-method designs, examine its effect on students' scientific literacy and environmental attitudes, and expand the model to other local wisdom contexts in Jambi and other regions.

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