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Development of Interactive E-Modules Based on Canva in the Plant Morphology Course for Biology Education Students

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Abstrak: Penelitian ini dilatarbelakangi oleh rendahnya literasi botani dan tantangan visualisasi materi morfologi yang abstrak dalam pembelajaran pasca-pandemi. Penelitian ini bertujuan untuk mengembangkan e-modul interaktif berbasis Canva pada mata kuliah Morfologi Tumbuhan untuk mahasiswa Pendidikan Biologi. Metode penelitian yang digunakan adalah *Research and Development* (R&D) dengan model pengembangan ADDIE (*Analysis, Design, Development, Implementation, Evaluation*). Subjek penelitian terdiri dari ahli materi, media, dan desain intruksional, serta mahasiswa dan dosen untuk uji coba lapangan. Instrumen pengumpulan data berupa angket validasi ahli, angket respon mahasiswa. Data kelayakan dianalisis dengan menggunakan analisis validitas (Aiken's V) dan Analisis Kepraktisan data angket respons mahasiswa dan dosen menggunakan rumus persentase kepraktisan. Hasil validasi menunjukkan bahwa e-modul berada pada kategori "Sangat Valid" dengan perolehan nilai Aiken's V total rata-rata keseluruhan dari ahli 0,88. Uji praktikalitas oleh mahasiswa dan dosen memberikan respon positif secara keseluruhannya sebesar 90.12 % (Sangat Praktis). E-modul berbasis Canva ini terbukti valid dan praktis dalam pembelajaran morfologi tumbuhan.
Kata Kunci: E-Modul Interaktif; Canva; Morfologi Tumbuhan; Model ADDIE; Literasi Botani.

Abstract: This research is motivated by the low botanical literacy and the challenges of visualizing abstract plant morphology material in post-pandemic learning. This study aims to develop a Canva-based interactive e-module in the Plant Morphology course for Biology Education students. The research method employed is Research and Development (R&D) using the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). The research subjects consisted of material, media, and instructional design experts, as well as students and lecturers for field trials. Data collection instruments included expert validation questionnaires and student response questionnaires. Feasibility data were analyzed using Aiken's V validity analysis, while the practicality data from student and lecturer response questionnaires were analyzed using the percentage practicality formula. The validation results indicated that the e-module fell into the "Highly Valid" category, with an overall average Aiken's V value of 0.88 obtained from the experts. The practicality test conducted by students and lecturers yielded an overall positive response of 90.12% (Highly Practical). This Canva-based e-module has been proven to be valid and practical in plant morphology learning.
Keywords: ADDIE Model; Botanical Literacy; Canva; Interactive e-Module; Plant Morphology.

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1. Introduction

Education in the 21st century demands a paradigm transformation in learning, shifting from conventional methods toward the accelerative integration of digital technology [1], [2]. Biology Education students today are not only required to master academic content, but must also possess robust digital literacy and science literacy skills to remain competitive in the Industry 4.0 era [3], [2]. However, national data reveals significant challenges; according to PISA 2022, Indonesian students' science literacy scores remain at 385, far below the OECD average of 485 [4]. This disparity directly impacts students' ability to effectively comprehend, analyze, and communicate complex biological concepts [4].

One discipline within biology that exhibits a high level of abstraction is Plant Morphology [4], [5]. This course is fundamentally important as it serves as the foundation for understanding biodiversity and species identification [6]. However, field realities reveal a phenomenon of "plant blindness" among students, characterized by a tendency to overlook the presence of plants in their surroundings and a diminished interest in studying botany in depth [4]. Students' difficulties in mastering morphology are frequently attributed to the visual-descriptive nature of the material, which is nonetheless presented through static media [6], [7]. Needs analysis indicates that students often encounter difficulties in identifying the external structures of plants and classifying them using appropriate scientific terminology [7].

To date, the learning process in Plant Morphology has continued to be dominated by the use of conventional textbooks, monotonous student worksheets, and static PowerPoint presentations [8], [9], [3], [10], [5]. This reliance on traditional media has led to a predominantly educator-centered (teacher-centered) learning approach, triggering academic disengagement and failing to stimulate students' critical thinking abilities [9], [11], [12]. Despite Indonesia being a megabiodiversity country, the utilization of local potential as a learning resource within digital instructional media remains severely limited [8], [4], [13]. In fact, the integration of local content into interactive media has

the potential to create more contextual and meaningful learning experiences for students [8], [4], [14], [7].

The development of this e-module utilized Canva as the primary visual design platform, enabling the creation of visually appealing, professional displays that conform to the aesthetic standards of modern instructional materials [15], [11], [3]. Upon completion of the design, the content was converted to PDF format and uploaded to the Flip PDF platform to produce an interactive digital book featuring page animation effects, an easily navigable usage flow, and embedded videos integrated directly within the learning material [11], [10], [16]. The combination of these two platforms yields an e-module of high visual and interactive quality, while simultaneously remaining straightforward to create and update by lecturers without requiring complex programming expertise [17], [6], [3].

This is precisely where the research gap underlying the urgency of the present study becomes apparent. First, while Canva-based e-module development has attracted considerable scholarly attention, the bulk of existing studies remain narrowly focused on elementary education or general science subjects [3], [9], [11], leaving a conspicuous void in interactive media purposefully designed for advanced higher education content such as Plant Morphology [4], [15]. Second, many currently available e-modules do little more than digitize printed text into static PDF formats, falling short of incorporating interactive multimedia elements and game-based assessment features that are essential for alleviating students' cognitive load [15], [2]. Third, and perhaps most critically, there remains a striking absence of media that deliberately bridges Canva's aesthetic design principles with the systematic rigor of the ADDIE development model in ways that concurrently strengthen students' botanical literacy and scientific communication competencies [4], [2].

As a solution to these gaps, Canva for Education offers a compelling innovation through its intuitive visual design features, diverse template library, and seamless integration of videos, animations, and interactive graphics that effectively capture the interest of the millennial generation [3], [15], [6]. The

adoption of interactive e-modules further empowers students to engage in self-directed learning at their own pace while receiving immediate feedback throughout the learning process [18], [1], [7], [13].

Through a constructivist approach, students are encouraged to construct their own knowledge by actively engaging with digital content [16], [1], [19]. Accordingly, this study aims to develop and validate a Canva-based interactive e-module for the Plant Morphology course among Biology Education students. Beyond merely providing a valid and practical learning resource, this innovation is anticipated to serve as an effective instrument for overcoming barriers to material visualization and advancing students' botanical literacy in the digital age [4], [7], [10], [11].

2. Research Method

This study is a research and development (R&D) investigation aimed at producing a valid and practical Canva/Flip PDF-based interactive e-module for the Plant Morphology course [20], [19], [16], [21]. A mixed-methods approach was employed, wherein the qualitative component was utilized to describe the development process, analyze feedback from validators, and interpret student responses, while the quantitative component served to calculate Aiken's V validity index, practicality percentages, and descriptive statistics of the validation data [22], [21], [23], [24], [25].

The development process in this study followed the ADDIE model [3], which encompasses five sequential stages. This model was selected based on several key considerations: 1) it offers a structured and measurable procedure; 2) each stage yields clearly defined and verifiable outputs; 3) it accommodates ongoing evaluation at every phase, thereby enabling continuous revision throughout the development process; and 4) it has been widely adopted and demonstrated effectiveness in instructional material development within higher education settings [26], [20].

The research stages following the ADDIE syntax are as follows. The Analysis phase was carried out through three primary activities. First, a needs analysis was conducted through observation of the Plant Morphology lecture

process, interviews with the course lecturer, and review of the study program's academic documents to identify the gap between ideal and actual conditions. Second, student characteristic analysis was performed through a preliminary survey to map students' digital literacy abilities, device availability, and learning preferences. Third, content analysis was conducted through a review of the curriculum and course syllabus to determine the topics to be incorporated into the e-module [3], [24], [27].

The Design phase produced an e-module blueprint encompassing: 1) a content map containing the hierarchical structure of all Plant Morphology course material; 2) a storyboard representing the visual layout of each e-module page, including arrangement, color schemes, typography, and the positioning of multimedia elements; 3) a usage guide containing diagrams illustrating the relationships between pages and interactive features; and 4) research instruments comprising expert validation sheets for material, media, and instructional design, as well as response questionnaires for both students and lecturers [26].

The Development phase consisted of two primary stages. First, e-module production, wherein the visual design was created using Canva, encompassing layout, typography, illustrations, and the integration of multimedia elements. The completed design was subsequently converted to PDF format and uploaded to Flip PDF to generate an interactive flipbook featuring page animation effects and embedded video content. Second, expert validation was conducted, whereby the completed product was reviewed by three validators, and the assessment data were subsequently analyzed using the Aiken's V index. Product revisions were carried out based on feedback and recommendations provided by the validators [28], [21].

The Implementation phase was carried out in two successive stages. The first stage consisted of a small group trial involving 10–15 Biology Education students who were currently enrolled in or had previously completed the Plant Morphology course. This trial aimed to assess the readability, ease of use, and initial responses to the e-module's appearance and content. The second stage

comprised a field trial conducted within a single lecture class of approximately 25–30 students, with the purpose of evaluating the e-module's practicality within an authentic instructional context [11], [25], [29].

The Evaluation phase in this study was both formative and summative in nature. Formative evaluation was conducted at the conclusion of each stage to ensure the quality of outputs prior to advancing to the subsequent phase. Upon completion of the entire development process, summative evaluation was performed, encompassing the recapitulation of validation data through Aiken's V index, practicality data analysis, and the compilation of the final e-module version ready for implementation [15], [28], [29].

The research subjects comprised three lecturers serving as material, media, and instructional design experts responsible for evaluating the content, media, and instructional design of the e-module; 10–15 Biology Education students in their 3rd or 5th semester participating in the small group trial to assess readability and initial responses to the e-module; and 25–30 students currently enrolled in the Plant Morphology course participating in the field trial to evaluate the e-module's practicality within an authentic learning context [30], [26]. The research instruments employed for data collection consisted of expert validation questionnaires and response questionnaires administered to both students and lecturers [31], [8], [22]. Data analysis was conducted using validity analysis through Aiken's V index:

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

Description:

Σs= The weighted score total (validator score minus minimum score),
n = the number of validators,
c = the score range (highest score minus lowest score) [6], [32], [28].

The calculation results were interpreted based on the criteria presented in Table 1 [29], [28]:

Table 1. Aiken's V Value Criteria

Aiken's V Value	Category	Description
0.81 – 1.00	Highly Valid	No revision required
0.70 – 0.80	Valid	Minor revision
0.60 – 0.69	Moderately Valid	Moderate revision
< 0,60	Invalid	Major revision

Practicality Analysis. Student and lecturer response questionnaire data were analyzed using the practicality percentage formula [27], [33]:

$$P = \frac{\Sigma \text{obtained score}}{\Sigma \text{maximum score}} \times 100\%.$$

The results were interpreted based on the criteria:

< 55% = Not Practical
55–69% = Moderately Practical
70–84% = Practical
≥ 85% = Highly Practical.

The e-module is considered to meet the practicality criteria if it obtains a percentage of ≥ 70% (Practical or Highly Practical category).

3. Results and Discussion

The development of the Canva-based interactive e-module for the Plant Morphology course has undergone the systematic procedures of the ADDIE model, yielding the following validity and practicality data [26].

1. **Description of the Interactive E-Module Product.** The resulting product takes the form of an interactive digital learning medium accessible through a Canva for Education platform link [9]. The e-module structure consists of: (a) an aesthetically designed cover page; (b) a preface and table of contents; (c) usage instructions; (d) an interactive concept map; (e) learning outcomes; (f) core material covering roots, stems, leaves, and flowers, integrating realistic images and tutorial videos; (g) game-based learning interactive quizzes; and (h) a glossary and reference list [26]. The primary innovation of this medium lies in its hyperlink navigation and multimedia integration, which facilitate self-directed learning and independent exploration [9].

2. **E-Module Validity (Aiken's V Analysis).** The feasibility of the e-module was assessed by three experts comprising material, media, and instructional design specialists, using a Likert scale instrument ranging from 1 to 5 [31]. Content validity was calculated using the Aiken's V Index to examine inter-rater agreement. The recapitulation of validation results is presented in Table 2.

Table 2. Expert Validation Results of the Canva-Based Interactive E-Module Using Aiken's V

No	Assessment Aspect	Σs	$n(c-1)$	Aiken's V Value	Category
1	Material/Content Feasibility of the E-Module	14	16	0.88	Highly Valid
2	Media / Visual Quality and Interactivity of the E-Module	15	16	0.94	Highly Valid
3	Instructional Design / Quality of Learning Design	13	16	0.81	Highly Valid
Rata-rata Total				0.88	Highly Valid

Based on Table 2, the obtained V values of ≥ 0.80 indicate that the e-module possesses exceptionally strong content validity [2], [29], [28]. The experts also provided qualitative recommendations, including typography size adjustments for improved mobile-friendliness and the addition of video content in the flower morphology section [3], [22]. The application of Aiken's V in the validation process yielded a remarkably high validity level of 0.88, demonstrating that the content, design, and language of the e-module are well-aligned with the learning needs of Plant Morphology at the higher education level [25], [28], [4]. The obtained Aiken's V values can be seen in Figure 1.

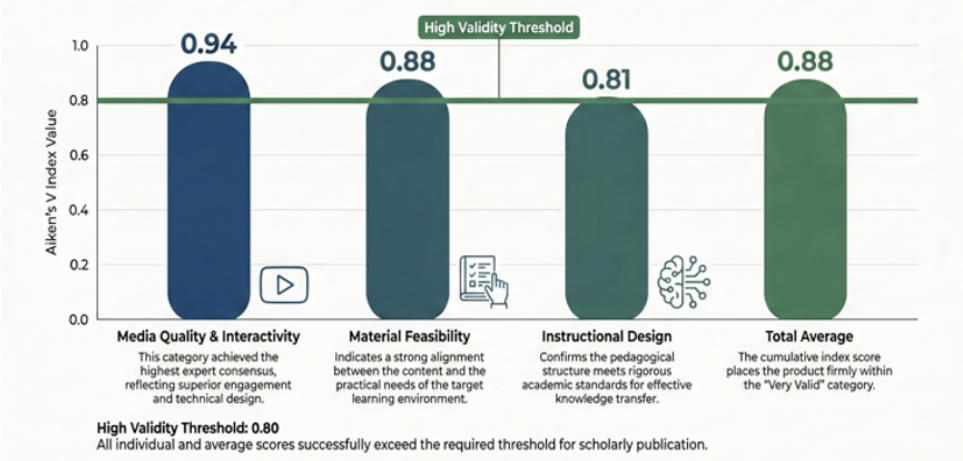


Figure 1. Expert Validation Results Based on Aiken's V Values

3. **Media Practicality (Lecturer and Student Responses).** The practicality test was conducted through the completion of response questionnaires by the course lecturer and Biology Education students [24], [4], [13]. The results of the practicality analysis are presented in Table 3.

Table 3. Practicality Analysis Results of the Canva-Based Interactive E-Module.

No	Respondent	Mean Score (%)	Category
1	Course Lecturer (User/Facilitator)	92.30%	Highly Practical
2	Students (Small Group, n=10)	89.70%	Highly Practical
3	Students (Field Trial, n=32)	88.35%	Highly Practical
Overall Practicality Mean		**90.12%**	**Highly Practical**

Lecturers responded positively, particularly regarding time efficiency and the ease of accessing the media from any location [4], [8], [17]. Students reported that Canva's visual and interactive interface effectively reduced academic disengagement when studying abstract botanical terminology [9], [26], [3]. These research findings demonstrate that the Canva-based interactive e-module is significantly capable of overcoming visualization barriers in Plant Morphology material. The practicality data of the Canva-Based Interactive E-Module can be presented in the form of a chart in Figure 2.

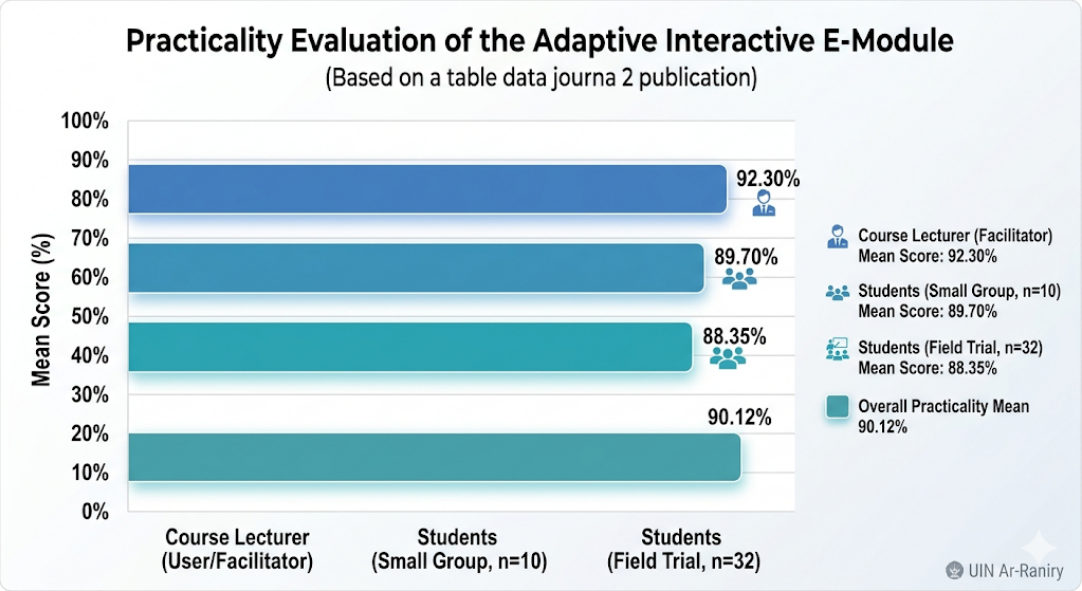


Figure 2. Practicality Score Chart of the Canva-Based Interactive E-Module in the Plant Morphology Course.

This success was driven by several fundamental factors, including the Integration of Multimedia Theory and Cognitive Load. The e-module consistently applied multimedia principles, wherein the combination of text, realistic images, and tutorial videos proved more effective in building students' mental representations [4], [24]. The harmonious visual presentation within Canva effectively reduced students' cognitive load when studying complex plant structures, thereby optimizing the information retention process [4], [7], [15]. This is further supported by findings indicating that aesthetically designed interactive media enhances students' emotional and cognitive engagement [26], [3].

Application of Constructivism in Botany Learning. Through a constructivist approach, the e-module facilitates students in actively constructing their own knowledge through interaction with multimedia features and reflective quizzes [3], [1]. Students are no longer passive recipients of information, but rather the primary agents in exploring morphological material [1], [31]. The application of Aiken's V Index in the validation process provides empirical evidence that the compiled content is well-aligned with the targeted learning outcomes [2], [29], [28].

Utilization of Local Potential and Botanical Literacy. Another distinguishing strength of this e-module is the integration of local plant specimens as objects of study [3], [19], [31]. This strategy creates a more contextual and meaningful learning experience, which has been empirically proven to enhance botanical literacy and mitigate the phenomenon of "plant blindness" among students [4], [3].

Overall, the development of this e-module makes an innovative contribution to the digitalization of higher education [3], [9], [26]. These findings corroborate previous studies asserting that visual design platforms such as Canva, when integrated with the systematic ADDIE development model, constitute an effective solution for enhancing the quality of biology learning in the digital era [9], [4], [3].

4. Conclusion

Based on the research findings and discussion, it can be concluded that the Canva-based interactive e-module for the Plant Morphology course is deemed highly valid (0.88) and highly practical (90,12%) for use in Biology Education student learning. The feasibility of this media is evidenced by an Aiken's V value of 0.88 obtained from all experts across material, media, and instructional design domains, reflecting an overall average percentage within the "Highly Valid" category. The practicality aspect likewise achieved exceptionally high criteria, as reflected in the positive responses from both students and lecturers who found the medium instrumental in visualizing abstract plant structures through its interactive multimedia features.

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