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INTERACTIVE E-BOOK INTEGRATING THE LOCAL POTENTIAL OF *ALOE VERA* AS FUNCTIONAL FOOD: FOSTERING SCIENTIFIC LITERACY AND CREATIVE THINKING SKILLS

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Abstract: This study aimed to develop a valid, practical, and readable web-based interactive e-book integrating the local potential of *Aloe vera* as a functional food within the Human Digestive System topic. Employing a Research and Development (R&D) design based on the 4D model (Define, Design, and Develop stages), storyboards and layout drafts were constructed using *Adobe InDesign* and compiled in *Flipbuilder* into an HTML5 web-based media. The e-book systematically incorporates specialized pedagogical modules, notably the "Literacy Science" section designed to support evidence evaluation and the "Creative's Corner" section intended to foster core creative thinking dimensions. Product feasibility was evaluated through material and media expert validation and limited field trials involving 3 science teachers and 21 Grade IX students. Quantitative evaluations revealed exceptional product quality: material validity reached 49.60/50.00, media validity reached 46.20/47.00, teacher practicality achieved 94.9% ("Highly Practical"), and student readability reached 88.5% ("Very Good"). These results demonstrate that the interactive e-book is a valid, practical, and readable instructional tool that holds strong pedagogical potential to support contextual science learning.

Keywords: Interactive E-Book, Local Potential, *Aloe Vera*, Scientific Literacy, Creative Thinking Skills

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INTRODUCTION

In the 21st-century educational landscape, scientific literacy and creative thinking skills have emerged as essential competencies for students navigating a technology-driven world. Scientific literacy enables individuals to comprehend complex natural phenomena, evaluate scientific evidence, and apply knowledge to real-world socio-scientific issues (OECD, 2023b; Sukiastini et al., 2025). Concurrently, creative thinking skills foster innovation, adaptability, and the capacity to propose novel solutions to unstructured problems (Pratama et al., 2025; Puspita et al., 2025).

Philosophically, these cognitive endeavors resonate deeply with the Quranic mandate for *tafakkur* (deep reflection), urging individuals to examine natural signs and biological mechanisms to cultivate higher-order reasoning:

يُنْبِتُ لَكُمْ بِهِ الزَّرْعَ وَالزَّيْتُونَ وَالنَّخِيلَ وَالْأَعْنَابَ وَمِنْ كُلِّ الثَّمَرَاتِ ۚ إِنَّ فِي ذَلِكَ لَآيَةً لِّقَوْمٍ يَتَفَكَّرُونَ

"He causes to grow for you thereby the crops, olives, palm trees, grapevines, and from all the fruits. Indeed in that is a sign for a people who give thought."

(QS. An-Nahl [16]: 11)

Recognizing their critical interplay, modern science curricula emphasize that mastering these higher-order thinking skills requires an immersive learning environment that bridges theoretical biology with authentic, contextual applications (Huda, et al., 2020a; Huda et al., 2026; Hardini et al., 2026).

However, achieving these ideal educational outcomes stands in stark contrast to current empirical realities. International assessments consistently highlight persistent challenges in science education, particularly in developing nations. According to the latest PISA results (OECD, 2023a), 15-year-old Indonesian students scored an average of 383 points in science, compared to an average of 485 points across OECD countries. This national trend is closely mirrored in specific domain-level competencies, particularly creative thinking in science. Empirical studies by Widiyaningsih et al. (2026) further demonstrate that students' creative thinking skills in biology are critically low, averaging only 37.85%, which is classified as "not creative." Specifically, students struggle most with flexibility, elaboration, and original thinking due to the dominance of convergent learning, closed questioning, and classroom passivity that inhibit divergent thinking potential (Nurulsari et al., 2020; Usman et al., 2025; Huda, et al., 2020b).

At the institutional level, biological topics requiring systemic understanding—such as the Human Digestive System are frequently reduced to passive, rote memorization. Pre-

intervention interviews with science teachers at SMPN 16 Pontianak confirmed this instructional gap, revealing a heavy reliance on conventional printed textbooks and a rare utilization of innovative digital media, particularly interactive e-books integrated with contextual themes like local potential.

To bridge this gap between abstract concept learning and real-world relevance, contextualizing science instruction through local potential offers a powerful pedagogical solution. From an epistemological perspective, this approach aligns closely with Islamic integrated science paradigms, which emphasize the empirical observation of nature and human physiology as pathways to higher-order thinking. This is explicitly highlighted in the Quran:

فَلْيَنْظُرِ الْإِنْسَانُ إِلَى طَعَامِهِ

"Then let man look at his food" (QS. Abasa [80]: 24)

This Quranic imperative is coherent with the Hadith of Prophet Muhammad ﷺ, which further underscores the physiological importance of digestive health and nutritional discipline:

مَا مَلَأَ آدَمِيَّ وَغَاءَ شَهْرًا مِنْ بَطْنٍ

"A human being fills no vessel worse than his stomach."

(Narrated by At-Tirmidhi no. 2380)

Together, these scriptural foundations frame the study of digestive mechanisms as a call for both scientific inquiry and health awareness.

A synthesis of recent empirical research demonstrates that integrating regional local potential into science learning significantly enhances essential 21st-century competencies, yielding its most marked improvements in students' conceptual understanding and overall learning outcomes (Kamila et al., 2024). Pontianak, West Kalimantan, exemplifies this local potential through its rich biological resources, notably the extensive cultivation of *Aloe vera* as a functional food that naturally supports digestive health (Mensah et al., 2025). Integrating this local context into the human digestive system curriculum transforms passive concept absorption into meaningful exploration, allowing students to examine the direct physiological benefits of local flora on human health (Munifah et al., 2019; Lestari et al., 2021; Saregar et al., 2025).

Complementing this contextual foundation, digital learning technologies serve as a powerful conduit to deliver interactive and visually engaging learning experiences, overcoming the static limitations of traditional printed textbooks. Interactive e-books can dynamically illustrate how the human digestive system functions by combining multimedia features such as animations, video demonstrations, and self-assessments to significantly enhance conceptual understanding (Yorganci, 2022). However, digital learning tools often fail to achieve their full

pedagogical impact due to a critical oversight: a lack of cultural and contextual relevance. As Sayed & Lucas (2025) highlights, many existing interactive e-books rely heavily on generic or Western educational models that disconnect learning from students' social and environmental realities, ultimately diminishing learner engagement (Huda et al., 2019; Yasin et al., 2020; Putra et al., 2024).

To address this limitation, integrating local potential into innovative educational technologies like interactive e-books offers a vital pedagogical strategy. Integrating local bio-resources, such as *Aloe vera*, into digital media transforms abstract biology into familiar real-world experiences, yielding culturally responsive, high-impact learning tools (Sriyati et al., 2026). While previous studies have explored interactive e-books (Merkle et al., 2022; Sujana et al., 2025) and local potential (Ningrum et al., 2023; Saptaningrum & Pritasari, 2023) either separately or in combination (Kamila et al., 2025; Yanarti et al., 2023), research integrating the functional food context of *Aloe vera* as a West Kalimantan local potential into an interactive e-book for junior high school biology remains notably lacking. Therefore, this study aims to develop a valid, practical, and feasible interactive e-book integrating the local potential of *Aloe vera* as a functional food on the Human Digestive System topic to support junior high school students' scientific literacy and creative thinking skills.

METHOD

Research Design

This study employed a Research and Development (R&D) design adapted from the 4D model proposed by Thiagarajan et al. (1974), which encompasses four stages: Define, Design, Develop, and Disseminate. In accordance with the study's scope, the development process was implemented through the first three stages (Define, Design, and Develop) to produce a valid, practical, and feasible interactive e-book integrating *Aloe vera* as a functional food on the Human Digestive System topic. The systematic workflow of these three development stages is illustrated in **Figure 1**.

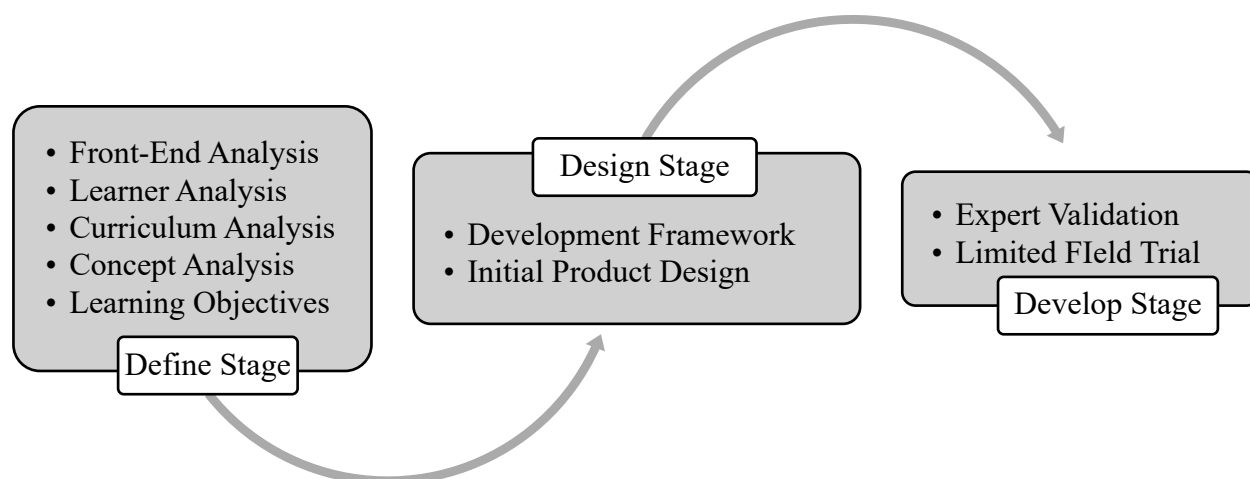


Figure 1. The three-stage development procedure of the interactive e-book (adapted from Thiagarajan et al., 1974)

Development Procedure

Define Stage

The definition phase aimed to establish and define instructional requirements through five primary analytical steps:

1. *Front-End Analysis*: Observed classroom activities and interviewed science teachers at SMPN 16 Pontianak to identify learning challenges and technology needs.
2. *Learner Analysis*: Assessed 9th-grade student characteristics and needs using a questionnaire.
3. *Curriculum Analysis*: Examined Grade IX *Kurikulum Merdeka* standards (Phase D), including Learning Achievements (*Capaian Pembelajaran* / CP) and Learning Objective Pathways (*Alur Tujuan Pembelajaran* / ATP) for the Human Digestive System.
4. *Concept Analysis*: Mapped biological concepts of human digestion alongside the integration of *Aloe vera* as a functional food.
5. *Learning Objectives*: Formulated Learning Objectives (*Tujuan Pembelajaran* / TP) and its indicator.

Design Stage

The design phase involved constructing the preliminary product and evaluation tools:

1. *Development Framework*: Formulated development guidelines synthesizing interactive multimedia principles, human digestion concepts, and *Aloe vera* functional food context.
2. *Initial Product Design*: Constructed storyboards, interface layouts, and multimedia elements to generate Draft I of the interactive e-book.

Develop Stage

The development phase focused on refining and testing the product through expert appraisal and small-group trials:

1. *Expert Validation*: Draft I was evaluated by material experts, media experts, and science teachers. Expert feedback was implemented in Revision I to produce Draft II.
2. *Limited Field Trial*: Draft II was tested with 21 Grade IX students (across low, medium, and high academic performance levels) for readability and 3 science teachers for instructional practicality. Revisions based on feedback yielded the final Draft III

Data Analysis

Data comprised qualitative feedback and quantitative ratings from validators, teachers, and students. Qualitative comments were analyzed descriptively to guide revisions.

Quantitative Validity Analysis

Expert ratings were averaged ($\bar{X}$) per indicator:

$$\bar{X} = \frac{\sum x}{n}$$

Where $\sum x$ is the sum of validator scores and n is the total number of validators. Scores were converted into four qualitative validity levels based on ideal mean (X_i) and ideal standard deviation (S_{bi}) criteria that showed in **Table 1**.

Table 1. Score Conversion to Validity Categories

Score Range	Value	Category
$X \geq X_i + 1.S_{bi}$	A	Very Valid
$X_i + 1.S_{bi} > X \geq X_i$	B	Valid
$X_i > X \geq X_i - 1.S_{bi}$	C	Fairly Valid
$X < X_i - 1.S_{bi}$	D	Less Valid

(source: Mardapi, 2018)

Note:

$$X_i : \frac{1}{2} (\text{Ideal Max Score} + \text{Ideal Min Score})$$

$$S_{bi} : \frac{1}{6} (\text{Ideal Max Score} - \text{Ideal Min Score})$$

Practicality and Readability Analysis

Teacher practicality and student readability ratings were converted into percentages (%) using the formula:

$$\% \text{ Score} = \frac{\Sigma \text{Response Score}}{\Sigma \text{Total Maximum Score}} \times 100\%$$

Percentage results were categorized according to five criterion levels adapted that showed in **Table 2**.

Table 2. Practicality and Readability Score Conversion

Percentage (%)	Category for Practicality	Category for Readability
≥ 80	Highly Practical	Very Good
> 60 – 80	Practical	Good
> 40 – 60	Fairly Practical	Fair
> 20 – 40	Impractical	Poor
≤ 20	Very Impractical	Very Poor

(source: Riduwan, 2019)

FINDING AND DISCUSSION

Development of the Interactive E-Book

The interactive e-book integrating *Aloe vera* as a functional food was developed following three main stages of the 4D development model: Define, Design, and Develop.

Define Stage

The key findings, identified instructional gaps, and integration strategies established during the Define stage (front-end, learner, and curriculum analyses) are summarized in **Table 3**.

Table 3. Results of Front-End, Learner, and Curriculum Analyses Guiding E-Book Development

Analysis Component	Key Findings & Identified Gaps	Integration / Action Strategy
Front-End Analysis	1. Instruction relies primarily on static textbooks and presentation slides. 2. Contextual examples are limited to initial motivational steps rather than core learning activities.	Addressed teacher demand for interactive digital media that incorporate local contexts (<i>Aloe vera</i> as a functional food) to make abstract biological processes meaningful.
Learner Analysis	1. Grade IX students show a strong preference for visual, interactive digital media. 2. While familiar with <i>Aloe vera</i>, most students are unfamiliar with "functional foods" and prefer fast food over nutritionally beneficial options.	Targeted this educational gap by designing interactive e-book content that connects local plant resources directly to human digestive health.
Curriculum & Concept Analysis	Mapped to <i>Kurikulum Merdeka</i> Phase D standards for Grade IX science on the Human Digestive System.	Systematically integrated <i>Aloe vera</i> functional food concepts alongside core biological topics.

3.1.2. Design Stage

In the Design stage, storyboards and initial layout drafts were created using *Adobe InDesign* and compiled in *Flipbuilder* to produce Draft I. The interactive e-book was published as a web-based HTML5 interactive e-book accessible across devices via a URL link, allowing

students to navigate the content online seamlessly. The structural layout, visual design, and core pedagogical components implemented in Draft I of the interactive e-book are organized across nine distinct sections. The detailed descriptions, key features, and visual preview placeholders for each section are presented in Table 4.

Table 4. Structural Layout, Visual Previews, and Pedagogical Features of Interactive E-Book (Draft I)

E-Book Component	Visual Preview (Screenshot)	Description & Key Features
Front Cover		Displays the main title (<i>Aloe vera sebagai Functional Food dalam Sistem Pencernaan Manusia</i>), visual graphics, target grade level (SMP/MTs), and author identification.
User Instruction and E-Book Advantages		Provides operational guidelines for interactive navigation alongside an overview of the e-book's core pedagogical features designed to support autonomous, interactive learning.
Introduction		Introduces the section titled " <i>What is Aloe vera as a Functional Food?</i> ", connecting regional plant resources directly to human digestive health.
Table of Content		Features an interactive, hyperlinked list of chapters and subtopics for direct and effortless navigation throughout the e-book.
Concept Map		Presents a visual diagram mapping the systematic relationships among biological concepts within the Human Digestive System topic.

Core Instructional Content

Literacy Science Section

Creative's Corner



Presents core instructional materials on the human digestive system integrated with interactive multimedia elements, visual illustrations, embedded videos, and contextual real-world references.

Features contextual science information and real-world socio scientific issues designed to train students' scientific literacy competencies.

Presents open-ended, contextual problem scenarios that prompt students to apply divergent thinking and propose innovative solutions.

Develop Stage & Iterative Refinements

The Develop stage involved expert evaluation, limited field trials, and two rounds of iterative revisions that are summarized in **Table 5**.

Table 5. Summary of Product Revisions and Refinements During the Develop Stage

Revision Phase	Evaluator	Qualitative Feedback	Revisions Implemented
Revision I (Draft 1)	Material expert	1. Inconsistent scientific name formatting (italics, capitalization, authors). 2. Excessive use of foreign terms. 3. Key functional food compounds of <i>Aloe vera</i> were not clearly distinguished	1. Standardized all scientific nomenclature 2. Replaced foreign terms with standard Indonesian equivalents 3. Highlighted key functional food compounds using bold text
	Media expert	1. Missing direct shortcuts to Table of Contents, Concept Map and User Guide. 2. Poor contrast and layout of navigation buttons	1. Added direct navigation buttons to key sections 2. Repositioned buttons and enhanced color contrast

Revision II (Draft II)	Science teachers and Grade IX students	1. Ambiguous phrasing and complex language leading to potential misinterpretation.	1. Simplified sentence structure for target readability.
		2. Text blocks were too dense/lengthy.	2. Condensed long text blocks into concise sections.
		3. Insufficient visual illustrations to support conceptual understanding.	3. Embedded additional visual and relevant images.

Expert Validity Analysis

The validity of the interactive e-book was evaluated by a panel of 5 experts (2 university expert lecturers and 3 experienced science teachers) across 50 material indicators and 47 media indicators. Ratings were converted to a 4-point qualitative scale based on ideal mean ($\bar{X}_i$) and standard deviation (S_{bi}) criteria.

Table 6. Expert Validation Results for the Interactive E-Book

Evaluator Category	Evaluators (n)	Aspect	Max Score	Mean Score ($\bar{X}$)	Category
Expert Lecturers & Teachers	5	Material / Content	50.00	49.60	Very Valid
Expert Lecturers & Teachers	5	Media / Design	47.00	46.20	Very Valid

As presented in Table 6, the material aspect achieved a mean score of 49.60 out of 50.00, surpassing the threshold for the "Very Valid" category ($\bar{X} \geq 33.33$). Evaluators noted high accuracy in scientific content, strong alignment with *Kurikulum Merdeka* learning objectives, and effective integration of *Aloe vera* functional food concepts.

The media aspect achieved a mean score of 46.20 out of 47.00, well above the threshold for "Very Valid" ($\bar{X} \geq 31.33$). High ratings were attributed to clear graphical layouts, intuitive navigation buttons, and adherence to interactive multimedia design principles.

Practicality and Readability Evaluation

Following expert validation, Draft II underwent usability testing through limited field trials to establish teacher practicality and student readability.

Teacher Practicality Assessment

Three science teachers evaluated the instructional usability of the e-book across 25 indicators covering Content, Language, Presentation, and Graphics.

Table 7. Teacher Practicality Evaluation Results

Evaluation Aspect	Evaluated Indicators	Average Score (%)	Practicality Category
Content Appropriateness	10	95.0%	Highly Practical
Linguistic Clarity	3	93.3%	Highly Practical
Presentation Quality	7	95.2%	Highly Practical
Graphics & Multimedia	5	96.0%	Highly Practical
Overall Mean Score	25	94.9%	Highly Practical

As shown in Table 7, science teachers rated the e-book at an overall mean score of 94.9%, placing it firmly in the "Highly Practical" category. Teachers highlighted that the integrated multimedia features provided a practical, easy-to-use solution for conducting contextual science instruction without demanding excessive preparation time.

Student Readability Evaluation

Readability testing was conducted with 21 Grade IX students at SMPN 16 Pontianak representing diverse cognitive performance levels (low, medium, and high).

Table 8. Student Readability Evaluation Results

Evaluation Aspect	Indicators	Mean Score per Item	Percentage Score (%)	Readability Category
Content Clarity	13	4.44	88.0%	Very Good
Linguistic Ease	2	4.30	86.0%	Very Good
Presentation Flow	3	4.50	90.0%	Very Good
Graphical Interaction	7	4.51	90.2%	Very Good
Overall Mean	25	4.44	88.5%	Very Good

The student readability trial yielded an overall percentage score of 88.5% ("Very Good"). Students noted that animated digestive pathways, video experiments, and local *Aloe vera* context made learning engaging and easy to navigate independently. Collectively, these high feasibility, practicality, and readability ratings confirm that the interactive e-book provides a structurally sound and user-friendly platform for classroom instruction. More importantly, this overall usability serves as the pedagogical foundation needed to address the baseline challenges identified during the Define stage, particularly the over-reliance on static print textbooks, passive learning habits, and a lack of contextual science applications (Huda et al., 2019; Yasin et al., 2020; Putra et al., 2024). By embedding *Aloe vera* as a functional food directly into the Human Digestive System curriculum, the e-book transforms abstract physiological concepts into interactive, contextual learning experiences that drive scientific literacy and creative thinking skills.

Developing Scientific Literacy Competencies

The high overall evaluation scores comprising material validity (49.60/50.00), media validity (46.20/47.00), teacher practicality (94.9%), and student readability (88.5%) empirically confirm that the interactive e-book provides a scientifically sound and user-friendly platform to support scientific literacy. In traditional secondary classrooms, scientific literacy is frequently compromised when biological concepts are taught as isolated, abstract definitions detached from real-world relevance (Setyowati et al., 2026; Taib et al., 2025). The quantitative ratings across all evaluators confirm that the e-book's structured content and digital features successfully align with educational frameworks requiring students to recognize scientific contexts, evaluate evidence, and apply knowledge to socio-scientific issues (Meyer et al., 2025).

Specifically, the high material accuracy and clear presentation flow directly validate the pedagogical design of the "Literacy Science" feature. This section operationalizes core scientific literacy dimensions by presenting real-world health topics such as diabetes prevention and the digestive benefits of bioactive compounds in *Aloe vera* as central learning vehicles. Embedding dynamic animations of peristalsis, interactive video labs, and readable text blocks (supported by an 88.0% content clarity rating from students) allows learners to construct mental models independently. Combining contextual socio-scientific scenarios with interactive visual representations is designed to support conceptual retention and facilitate critical evaluation skills (Mani et al., 2026; Morris, 2025).

These evaluation results align with previous R&D studies demonstrating that valid and highly readable digital tools effectively support students' ability to interpret scientific evidence and apply reasoning to personal health choices (Li & Wu, 2025). This aligns with findings by Kamila et al. (2025), who demonstrated that integrating local potential specifically the traditional process of *petis* making into interactive science e-books positively influences students' scientific literacy skills, particularly in explaining scientific phenomena. Thus, integrating local potential through these interactive features presents a promising approach to bridging the gap between abstract biological theories and practical scientific literacy in classroom instruction.

Cultivating Creative Thinking Skills

Similarly, the combined validity, practicality, and readability metrics provide strong empirical support for the e-book's capacity to facilitate creative thinking. While traditional science instruction often prioritizes convergent thinking and single-correct-answer memorization, modern frameworks emphasize that scientific inquiry requires creative problem-solving (Tang et al., 2025). Evaluators confirmed that the high media quality (46.20/47.00) and

student interaction ease (90.2% for graphical interaction) remove technical barriers, allowing students to focus their cognitive effort on open-ended problem-solving tasks.

The pedagogical value of the "Creative's Corner" feature lies in its intended design to shift learning from passive content consumption to active innovation. In science education, domain-specific knowledge serves as the necessary foundation upon which creative thinking operates (Permana et al., 2023; Sun et al., 2020). By prompting students to analyze biological issues and engineer functional food solutions using *Aloe vera*, the e-book is structured to target four core creative dimensions: fluency, flexibility, originality, and elaboration. Teachers noted in the practicality trial (Linguistic Clarity = 93.3% and Presentation Quality = 95.2%) that the creative tasks were presented with sufficient clarity for Grade IX students to generate diverse solutions autonomously.

This integrated design resonates with research indicating that scenario-based prompts in accessible digital media encourage active knowledge synthesis over rote recall (Fadhlurahman et al., 2026). These results corroborate earlier empirical findings by Oo et al. (2024), who demonstrated that learning integrated with design principles significantly enhances students' creative performance and problem-solving skills compared to traditional instruction. Consequently, the empirical feasibility of the "Creative's Corner" module confirms that integrating local bio-resources within clear, well-validated design tasks represents a well-aligned strategy for supporting creative thinking in lower-secondary biology.

Dual-Variable Integration in Biology Instruction

Integrating scientific literacy and creative thinking skills within a single digital platform is designed to create a mutually reinforcing educational synergy that can enhance middle school biology instruction. Historically, educational interventions have often treated scientific literacy and creative thinking as distinct, unrelated learning objectives. However, modern instructional design theory suggests that attempting to foster creative thinking in isolation risks producing ungrounded, scientifically inaccurate ideas, whereas focusing solely on scientific literacy can lead to rigid, passive learning (Rios-Atehortua et al., 2024; Skjelstad Fredagsvik, 2022). The high overall teacher practicality (94.9%) and student readability (88.5%) demonstrate that unifying both competencies into one media layout is practically viable for classroom implementation.

The interactive e-book proposes a balanced pedagogical pipeline: the "Literacy Science" section builds essential scientific literacy by establishing the scientific context, evidence, and conceptual knowledge base regarding human digestion and functional foods. Immediately following this conceptual foundation, the "Creative's Corner" section acts as an application

engine, challenging students to utilize that literacy to engineer creative, practical health solutions.

This harmonious fusion of theoretical knowledge and practical innovation reflects the broader Islamic educational ideal of *Hikmah* (wisdom) where deep scientific understanding is successfully translated into practical, beneficial solutions for humanity:

يُؤْتِي الْحِكْمَةَ مَنْ يَشَاءُ ۚ وَمَنْ يُؤْتَ الْحِكْمَةَ فَقَدْ أُوتِيَ خَيْرًا كَثِيرًا

"He gives wisdom to whom He wills, and whoever has been given wisdom has certainly been given much good." (QS. Al-Baqarah [2: 269])

Bridging scientific literacy with creative design through this lens offers promising pedagogical advantages for secondary science education:

1. *Enhanced Knowledge Transfer*: By immediately applying scientific literacy concepts to creative design tasks, students are encouraged to transfer abstract biological knowledge into concrete, real-world applications.
2. *Sustained Student Engagement*: High graphical interaction (90.2%) and presentation flow (90.0%) confirm that alternating between reading and creative problem-solving maintains learner focus and prevents cognitive fatigue.
3. *Instructional Efficiency*: Combining both target competencies into a single interactive software application allows teachers to fulfill complex *Kurikulum Merdeka* learning goals simultaneously, maximizing classroom time efficiency.

This integrated approach expands upon previous interactive e-book research by Yanarti et al. (2023), who emphasized that teachers and students strongly require interactive digital media integrated with regional local potential to overcome passive learning habits and support conceptual understanding. By demonstrating that local bio-resources can serve as a unified thematic anchor for multiple 21st-century competencies, the current study directly addresses these identified instructional needs. Ultimately, the evaluation results demonstrate that the interactive e-book is a valid, practical, and highly coherent instructional medium that holds strong potential to harmonize scientific literacy and creative thinking skills within junior high school science education.

However, several methodological limitations must be acknowledged. This study strictly focuses on the Develop stage of the 4D model, restricting its scope to expert validity, teacher practicality, and student readability. Consequently, while the findings confirm high pedagogical suitability and media quality, the actual cognitive gains in scientific literacy and creative thinking were not empirically measured through a quasi-experimental pre-test/post-test design (e.g., N-gain analysis). The pedagogical benefits discussed herein represent projected outcomes

grounded in validated instructional frameworks. To empirically validate these projected outcomes, future research should proceed to the Dissemination stage by conducting controlled experimental interventions in real classroom settings.

CONCLUSION

This study successfully developed a web-based interactive e-book integrating the local potential of *Aloe vera* as a functional food to support lower-secondary biology education. Guided by the Define, Design, and Develop stages of the 4D model, the finalized e-book operationalizes dual educational objectives through specialized 'Literacy Science' and 'Creative's Corner' modules. Evaluator and user assessments confirmed high content accuracy, alignment with *Kurikulum Merdeka* Phase D competencies, and strong digital usability, establishing the e-book as a pedagogical sound instructional tool.

Conceptually, the e-book bridges abstract biological principles with real-world applications by embedding West Kalimantan's local potential into contextual socio-scientific issues. The 'Literacy Science' feature provides a structured cognitive base for evaluating everyday health claims and nutrient functions, while the 'Creative's Corner' feature leverages this foundational knowledge to target four core creative dimensions: fluency, flexibility, originality, and elaboration. Practically, integrating these dual competencies into a single digital platform offers middle school teachers an efficient, culturally responsive medium that transforms passive reading into active, scenario-based problem-solving.

To advance this instructional model and validate its empirical efficacy, future research should execute the Dissemination stage by conducting quasi-experimental field effectiveness trials (measuring N-gain scores) to evaluate actual improvements in students' scientific literacy and creative thinking skills across broader, diverse educational settings.

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