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Integration of the *Kungkum Sinden* Tradition in Sendang Made for the Development of a Critical Thinking E-book

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Abstract: This research focuses on developing an integrated e-book that incorporates the local wisdom of the Kungkum Sinden tradition in Sendang Made into ecosystem learning to enhance junior high school students' critical thinking skills. The research addresses the limited availability of contextual teaching materials and the need for digital resources that support 21st-century learning, particularly critical thinking and technology integration. A Research and Development (R&D) method was employed using the ADDIE framework, consisting of analysis, design, development, implementation, and evaluation stages. Data were collected through expert validation involving science education lecturers and a science teacher, as well as readability testing. The e-book achieved high validation scores: 3.18 for presentation (valid), 3.32 for content feasibility (very valid), and 3.41 for language appropriateness (very valid), with an overall validity of 83% and a rating of very valid. The product integrates ecosystem concepts with local ecological values and interactive features designed to train interpretation, analysis, inference, evaluation, explanation, and self-regulation skills. In conclusion, the developed e-book is highly feasible and valid for supporting contextual science learning and improving students' critical thinking skills.

Keywords: Critical Thinking; E-book; Ecosystem; Local Wisdom; Sendang Made.

Introduction

Natural Science learning plays a crucial role in fostering critical thinking skills and understanding of ecosystem concepts in junior high school students. However, in practice, science learning in schools is often conceptual and teacher-centered, with learning resources lacking contextualization within the students' socio-cultural environments. As a result, students tend to memorize concepts without understanding their relevance to real life, particularly to environmental issues and local culture. This situation indicates the need to develop teaching materials that connect scientific concepts to socio-cultural realities, making learning more meaningful and strengthening students' critical thinking skills.

One approach relevant to this context is ethnoscience, which integrates local wisdom into science learning. This ethnoscience approach enables students to understand that science does not exist separately from culture but rather grows from human interactions with nature within specific social contexts. The integration of local wisdom into science learning has been shown to increase students' interest in learning, conceptual understanding, and environmental awareness, emphasizing contextual, exploratory, and project-based learning in accordance with local environmental characteristics [1], [2].

Indonesian local wisdom is highly diverse, with one example being the *Kungkum Sinden* tradition in Sendang Made, Jombang, East Java. This tradition is a traditional cultural practice involving ritual bathing in a spring (sendang) at specific times, particularly on the eve of Suro (the first day of the Islamic calendar), as a symbol of self-purification and respect for nature. The community's belief in the sanctity of the spring ensures that the area remains ecologically sound. Taboos against polluting the water, cutting down trees, or fishing in the spring area demonstrate the importance of conservation within the local community's traditional belief system. The *Kungkum Sinden* tradition represents not only a ritual practice but also an implicit ecological management system, where cultural norms regulate human interaction with natural resources, particularly water conservation and biodiversity preservation. These ecological values align with scientific concepts of ecosystem balance, biotic and abiotic interactions, and environmental conservation, making the kumkum tradition a meaningful context for science learning.

Several previous studies have demonstrated the significant potential of local wisdom in science learning. Research has shown that the Dawuhan tradition in Central Java embodies water conservation values that can be utilized as a resource for ecosystem learning in science subjects [3]. Furthermore, other studies reported that the development of local wisdom-based and ethno-STEAM-based e-books can effectively improve students' critical thinking skills [4], [5]. Despite the growing number of studies on local wisdom-based learning and the integration of ethnoscience, most existing research focuses on general cultural contexts or well-known traditions, with limited attention to specific local ecological practices that inherently reflect environmental conservation values. However, these studies primarily focus on learning effectiveness and have not explicitly linked cultural practices to specific scientific concepts or critical thinking indicators. In particular, no prior research has explored the integration of the *Kungkum Sinden* tradition in Sendang Made as a contextual framework for ecosystem learning at the junior high school level. This research gap

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shows the need for innovation in digital teaching materials that integrate cultural values and scientific concepts into a single learning unit. This study provides a novel contribution by systematically integrating the *Kungkum Sinden* tradition into an ecosystem e-book and explicitly mapping its features to critical thinking indicators, thereby bridging the gap between cultural knowledge and scientific learning.

Critical thinking is a key competence in 21st-century education, particularly in science learning, as it enables students to analyze information, evaluate evidence, and construct logical conclusions [6], [7]. This skill encompasses the ability to analyze information objectively, evaluate arguments, and make decisions based on logical reasoning [8]. Critical thinking is a skill in which students explore previously undiscovered knowledge, both concepts and facts, by conducting experiments or direct trials in the field, so that students learn beyond rote memorization. Critical thinking skills encompass six indicators: interpretation, inference, analysis, evaluation, explanation, and self-regulation [9].

An interview with a science teacher at Kudu Jombang Middle School revealed that most students have not yet fully mastered the learning materials. Consequently, students sometimes make errors when answering and solving application problems. The use of science teaching materials has also not been integrated with local wisdom values, leading to suboptimal learning due to insufficient contextualization. Furthermore, the teaching materials used are limited to textbooks and teacher-provided presentations. The limited number of teaching materials is also due to the limited number of teachers available to prepare them for classroom use.

As environmental education challenges become increasingly complex, teaching materials are needed that facilitate the development of critical thinking and problem-solving skills. Electronic textbooks (e-books) as a digital learning medium offer an effective and flexible solution to this goal. The use of e-books in environmental education has been shown to significantly improve students' cognition of the ecological environment[10],[11]. This is further enhanced when a problem-posing framework is integrated into the e-books, leading to improved learning outcomes, deeper critical thinking, and greater motivation. Similarly, the integration of everyday problems and solutions related to environmental pollution into e-books has been shown to enhance students' critical thinking [12]. Furthermore, e-books can be easily accessed by students anytime and anywhere, thus supporting independent and sustainable learning.

Based on the problem description above, the researcher aims to develop an e-book titled "Integrated Ecosystem Material with Local Wisdom Values in Sendang Made to Train the Critical Thinking Skills of Grade VII Students at SMP Negeri Kudu Jombang."

Research Methods

This study uses a Research and Development (R&D) approach to produce and refine educational products in accordance with identified research needs. The development process involved conducting a needs assessment to inform product design, followed by effectiveness testing to ensure its feasibility and impact [13]. The research conducted is development research, namely the development of an e-book integrating local wisdom values in Jombang Regency to train students' critical thinking skills in ecosystem materials.

Development procedure

The development model planned in this study was adapted namely ADDIE, which consists of five stages, namely Analyze, Design, Development, Implementation, and Evaluation [14]. The ADDIE model was selected due to its systematic, structured, and clearly defined stages, which facilitate an organized development process. The ADDIE model is illustrated in Figure 1. In the analysis stage, curriculum and concept analyzes were conducted. The design stage involved creating an e-book by connecting ecosystem materials and local wisdom values of the *Kungkum Sinden* Sendang Made tradition. The development stage was carried out by reviewing and revising the draft prepared by validator lecturers, media experts, and material experts, until expert validation. The implementation phase aims to empirically determine the effectiveness of the developed e-book. The evaluation phase will generate data and recommendations related to the developed e-book. The resulting data will then be analyzed, and the recommendations will be used to refine the developed test instrument.

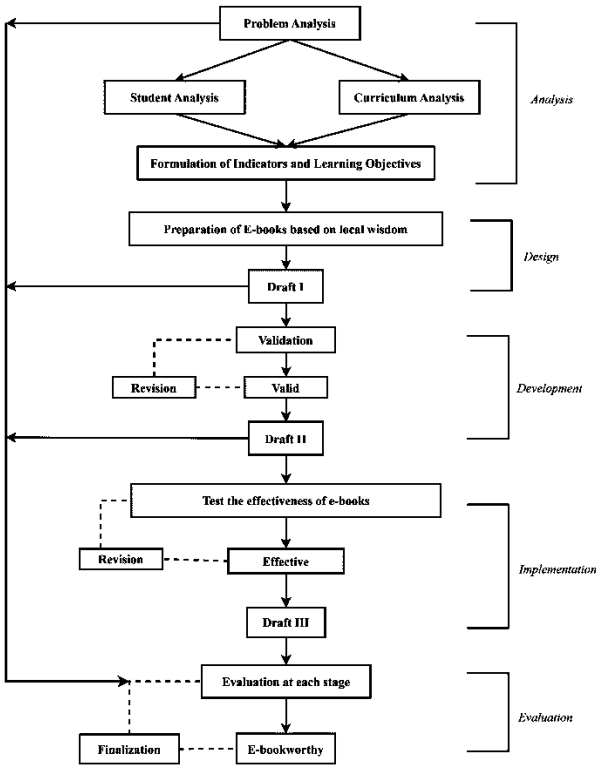


Figure 1. ADDIE development model

The instrument used to measure the e-book's feasibility is a teaching materials validation instrument. This feasibility encompasses the components of content, presentation, and language feasibility based on criteria adapted from. The validation process involves two validators. The validators are experts in science learning and in the development of learning media. The validator's assessment results were analyzed descriptively using the e-book's feasibility presentation. The scores were obtained using a Likert scale, as presented in Table 1.

Table 1. Likert Scale Criteria[15]

Scale Value	Evaluation
1	Not good
2	Pretty good
3	Good
4	Very good

The results of the validity calculation are used to determine the suitability of the e-book, as shown in Equation 1.

$$\text{Average Score (\%)} = \frac{\sum \text{Score of each criteria of all validators}}{\sum \text{validators}} \quad (1)$$

After the average score is obtained, to calculate the average criteria score, the following Equation 2 is used:

$$\text{P validation score (\%)} = \frac{\sum \text{score obtained}}{\sum \text{maximum score}} \times 100\% \quad (2)$$

The calculation results were then classified into four validity criteria, as shown in Table 2. An ebook is considered valid if it scores ≥ 62.75% [15].

Table 2. E-book Eligibility Criteria Based on Validation Results[15]

Precentage (%)	Criteria
0-20	Invalid
21-40	Less Valid
41-60	Fairly Valid
61-80	Valid
81-100	Very Valid

The e-book readability sheet is used to determine the practicality level of the e-book on the Integrated Local Wisdom of the Jombang Regency Ecosystem that is being developed. Readability tests are used to determine the e-book's readability level.

E-book effectiveness test

The study continued by testing the e-book's effectiveness. The researchers used a one-group pretest-posttest design to measure the effectiveness of the developed e-book in training students' critical thinking skills. The study subjects were 31 seventh-grade students from Kudu Jombang Public Junior High School, selected purposively based on their suitability for the research objectives. The effectiveness of the e-book was analyzed using a normality test and continued with the Wilcoxon Signed Rank Test because the data were not normally distributed. Furthermore, the increase in students' critical thinking skills was calculated using the N-gain formula:

$$\text{N-gain} = \frac{\text{Score post test} - \text{Score pre test}}{\text{Score maks} - \text{Score pre test}}$$

Once the N-gain is known, it will then be analyzed using the N-gain index interpretation category.

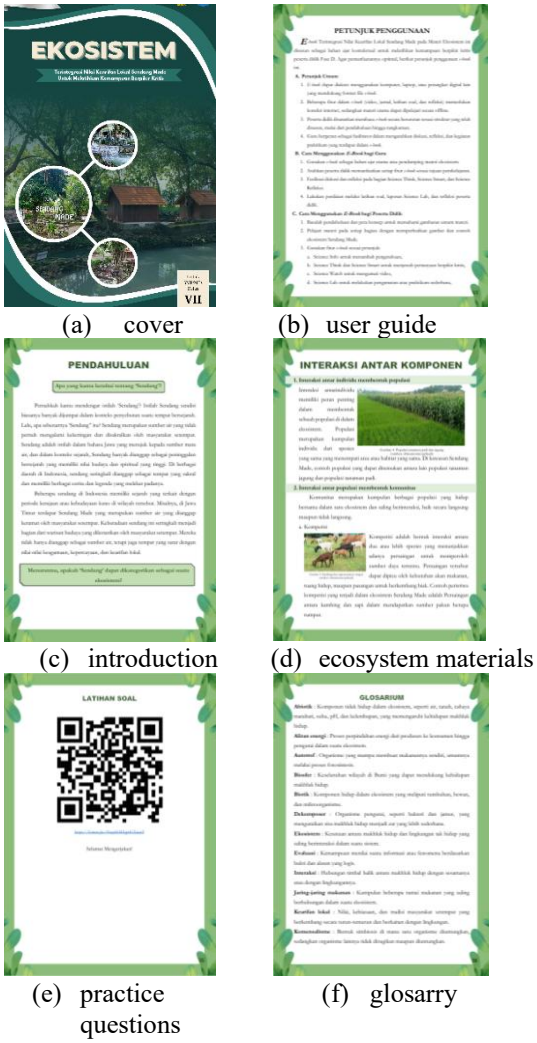
Table 3. N-gain index interpretation category

N-gain Score (g)	Category
$g > 0.7$	High
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

Results and Discussion

This research resulted in an e-book that combines the local wisdom values of Sendang Made, Jombang Regency, with ecosystem material in science learning. During the analysis phase, the researchers reviewed the applicable curriculum and conducted an in-depth study of the material concepts to identify learning needs for both students and teachers. This process aimed to ensure that the product development truly aligned with student characteristics, the school context, and the learning outcomes, thus ensuring a more focused and relevant development direction.

The design phase involved systematically developing the e-book's content framework, encompassing material organization, visual design, and the determination of learning support features. This stage also involved aligning the e-book design with critical thinking indicators.



(a) cover (b) user guide

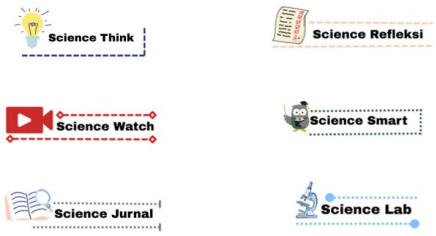
(c) introduction (d) ecosystem materials

(e) practice questions (f) glosarry

Figure 2. E-book design

In the developed phase, the e-book covers several topics related to ecosystems, including ecosystem components, interactions within ecosystems, energy flow, biogeochemical cycles, and ecosystem balance. The e-book consists of several main components: a cover page, a user manual, learning features, concept maps, learning outcomes, an introduction, main material, practice questions, and a glossary. Each component is designed to support the others:

the concept map and learning outcomes help students understand the material's structure, while the introduction links the concept of ecosystems to the local context of Sendang Made as a real environment with biotic and abiotic components. The main material is presented in an integrated manner alongside local wisdom values, and it is equipped with interactive features to practice critical thinking skills, while practice questions and a glossary strengthen conceptual understanding. With this structure, the e-book not only serves as a medium for delivering material but also as a contextual learning tool for developing students' critical thinking skills [16], [17].



Figures 3. E-book features

An e-book integrating local wisdom and ecosystem materials was developed, featuring several features. These features help students to enhance their learning experience, thus creating meaningful learning. The e-book to be developed includes material on ecosystems in Science subjects. The features contained in the developed e-book include Science Watch to train interpretive critical thinking indicators; Science Lab to train analytical critical thinking indicators; Science Think to train critical thinking skills with explanatory indicators; Science Journal to train inferential critical thinking skills indicators; Science Smart to train evaluation indicators; and Science Reflection to train critical thinking indicators for self-regulation. The e-book also contains not only text, but also images and videos that students can access independently. Mapping features to these critical thinking indicators shows that the e-book functions not only as a medium for delivering material, but also as a learning tool systematically designed to train students' critical thinking skills [18].

The use of interactive e-books has the potential to strengthen student engagement in learning, especially when linked to the local cultural context. Integrating local wisdom into science learning helps students understand concepts more concretely because they relate directly to their surroundings [19]. Previous research also shows that local wisdom-based e-books are deemed feasible, practical, and receive positive responses from both teachers and students [20], [21]. Furthermore, an attractive visual appearance and suitability to the characteristics of the digital generation are important factors in e-book development.

Before validation, the e-book was revised and reviewed to refine its content and presentation. Validity testing was conducted to assess the product's theoretical feasibility using a Likert scale from 1 to 4. Aspects evaluated included presentation feasibility, content feasibility, and language feasibility. The validation results for the presentation aspect are shown in Table 4.

The average overall validity score was 3.74, indicating validity. This value indicates that the e-book meets the criteria for developing digital teaching materials, including self-instructional, self-contained, stand-alone, adaptive, and user-friendly aspects, as outlined by the Directorate General of Primary and Secondary Education. All aspects received scores of 3-4, indicating that these components have been met satisfactorily. The presentation aspect was assessed for visual appearance, layout, text quality, illustrations, supporting media, and the e-book's overall performance.

Table 4. The Results of the E-book Validation are Reviewed from the Aspect of the Feasibility of Presentation

Aspects	Validation Result Score		Average Score
	Validator 1	Validator 2	
E-book Display Quality	3.75	3.75	3.75
Layout Quality	3.75	3.75	3.75
Text Quality	3.5	3.75	3.625
Image Quality	4	3.75	3.875
Video Quality	3.5	3.75	3.625
E-book quality	4	3.75	3.83
Average Score			3.74
Validity Score (%)			94%
Interpretation of Validity Scores			Very Valid

In terms of appearance, the e-book was deemed to present the material clearly and systematically. Navigation between pages was smooth, with visual markers for ease of use. The choice of color and contrast was considered to support reading comfort. The layout was also proportional, with text and images balanced to avoid distractions. The simple yet attractive design maintained the material's main focus without compromising visual appeal.

The language and typography also demonstrated good quality. The font type and size were chosen consistently for readability, and the text color supported clarity of information. The illustrations presented are relevant to the material and are accompanied by clear sources, thereby enhancing the content's credibility. Furthermore, the inclusion of high-quality interactive images and videos enriches the student learning experience.

Supporting features such as an interactive table of contents and external links also enhance the e-book's ease of use. This product can be accessed through various devices, both online and offline, providing flexibility in use. Consistent with previous research findings, interactive e-books have the potential to improve students' metacognitive and analytical skills [22], [23]. However, several studies also emphasize the importance of balancing multimedia use to avoid compromising learning focus. Overall, based on the indicators assessed, this e-book was deemed highly suitable in its presentation, as it harmoniously integrates visual, textual, and multimedia elements to support interactive and meaningful learning.

Based on Table 5, the average content validity score was 3.92, indicating high validity. This result indicates that the e-book material meets the content suitability standards. Content validity refers to the accuracy, precision, and consistency of the information presented, ensuring alignment with learning objectives and curriculum standards. Several studies confirm that material quality, conceptual novelty, and contextual relevance are key

indicators of e-book suitability [24], [25]. Furthermore, the development of digital teaching materials also needs to align with the applicable curriculum, integrate local wisdom values, and consider the characteristics of current learners. Content validity is also closely related to the measurement of scientific literacy and critical thinking skills, making the appropriateness of the material to the learning instruments and objectives essential. In this study, the aspects assessed included conceptual accuracy, alignment with the Independent Curriculum, novelty and context of the material, systematic presentation, comprehensiveness of discussion, integration of local wisdom, and achievement of critical thinking indicators.

Table 5. The Results of the E-book Validation are seen from the Aspect of Content Suitability

Aspects	Validation Result Score		Average Score
	V1	V2	
Quality of matter concept	4	4	4
Quality of material conformity with the Independent Curriculum	4	4	4
Recency and Contextuality of Concepts	4	4	4
E-book systematics	4	3.75	3.875
Completeness of ecosystem materials	4	4	4
Integration of Local Wisdom Values in Ecosystem Materials	3.5	3.66	3.583333
Achievement of Science Literacy Ability	4	4	4
Average Score			3.92
Validity Score (%)			98%
Interpretation of Validity Scores			Very Valid

Theoretically, a learning product is deemed appropriate if it is based on the applicable curriculum, supported by a relevant theoretical foundation, and presented in accordance with students' cognitive development levels. Previous research emphasizes the importance of alignment between material, learning strategies, and curriculum outcomes in e-book development. Appropriate strategies also contribute to strengthening students' metacognitive skills and managing cognitive conflict [22].

The developed e-book has been adapted to the learning outcomes of the Independent Curriculum and utilizes the Sendang Made context as a learning resource. The integration of local traditions and ecological conditions provides a more meaningful learning experience, as students can connect ecosystem concepts to the realities of their surroundings. Material on ecosystem components, interactions between living things, energy flow, and Science-geochemical cycles is explained through examples relevant to the ecological conditions and practices of the Sendang Made community. This approach allows students to understand concepts more concretely while fostering awareness of the importance of maintaining environmental balance in line with local wisdom.

Cultural values related to environmental sustainability are systematically integrated into the e-book. Practices such as prohibitions on forest destruction and customary rules for nature conservation serve as concrete illustrations of local communities' contributions to ecosystem sustainability. This integration not only enriches the learning context but also strengthens the material's relevance to students' lives.

The e-book is also designed to accommodate all indicators of critical thinking skills. Interpretation skills are facilitated through the Science Watch feature, which presents contextual videos about the ecosystem and local wisdom of Sendang Made, enabling students to identify and relate information to scientific concepts. Analytical aspects are practised through the Science Lab, where students observe and describe the relationships between ecosystem components. Explanatory skills are developed through Science Think, which encourages students to construct coherent scientific arguments based on the phenomena they are studying.

Furthermore, inference skills are honed through the Science Journal, which includes evidence-based conclusion-drawing activities. Evaluation in Science Smart is developed through authentic questions that require students to assess the accuracy and relevance of information. Meanwhile, self-regulation is facilitated through Science Reflection, which helps students reflect on their thinking processes and understanding after studying the material.

Overall, this e-book demonstrates high feasibility, as it comprehensively integrates local knowledge with the development of critical thinking skills. This finding aligns with previous research that suggests local wisdom-based teaching materials are effective in enhancing critical thinking skills, particularly in problem-solving [26]. Furthermore, interactive e-learning materials have been reported to have a stronger impact than conventional textbooks, and the integration of innovative approaches such as STEM and augmented reality also strengthens students' critical thinking skills [27].

Table 6. The Results of the E-book Validation are Seen from the Language Feasibility Aspect

Aspects	Validation Result Score		Average Score
	V1	V2	
Use of Language	4	3.75	3.87
Language Structure	4	3.75	3.87
Use of Terms	4	3.66	3.83
Average Score			3.86
Validity Score (%)			98%
Interpretation of Validity Scores			Very Valid

Language validity in e-books refers to the accuracy, precision, and clarity of language used in the e-book's content. Language validity encompasses several aspects that must be considered to ensure the language used complies with established standards and is easy for readers to understand. Some aspects assessed in language validity include language usage, language structure, and terminology. The developed e-book demonstrated strong language suitability across a range of assessment indicators. First, in terms of language use, this e-book was deemed quite

communicative with a score of 3.87. The sentences are easy for students to understand, so the intended message is clear. The language is straightforward and informative, helping students quickly grasp the concepts without confusion.

The language structure in this e-book complies with the General Guidelines for Indonesian Language Spelling (PUEBI), receiving a score of 3.87. This indicates that the e-book's writing follows correct grammar and spelling rules, thus minimizing errors that can interfere with understanding. The sentences in this e-book are designed to avoid double meanings, ensuring the information conveyed does not confuse readers. Each sentence delivers clear content, and the integration between paragraphs is well maintained, ensuring an easy-to-understand flow. The terminology used in this e-book also demonstrates excellent quality. The biological terms used are appropriate to the context and material discussed, earning it a score of 3.83. These terms are used consistently throughout the e-book, supporting more effective conceptual delivery. Consistent use of these terms is crucial for helping students understand and retain terminology relevant to the topic of ecosystems and local wisdom in Sendang Made.

This e-book demonstrates high language suitability. The use of communicative language, easy-to-understand, straightforward, and informative sentences, and a language structure that aligns with PUEBI (Indonesian Language and Education Standards) and avoids ambiguity ensures that students understand the material well. The use of appropriate and consistent terminology supports clear conceptual delivery, helping students master ecosystem material integrated with local wisdom values. Language can motivate by increasing reading interest, and the presentation of material in the features presented can train students' literacy [28].

A summary of the validation results of the developed e-book can be seen in the following table 7:

Table 7. Results of E-book Validation by Material Expert Lecturers and Media Expert Lecturers

Aspects	Validation Result Score		Average Score	Category
	V1	V 2		
Feasibility of Presentation	93%	93 %	93%	Very Valid
Content Validity	98%	97 %	97%	Very Valid
Language Validity	100%	95 %	98%	Very Valid
Average			96%	Very Valid

The Validation conducted by two validators indicated that the developed interactive e-book on ecosystem material achieved an overall average score of 96%, which falls into the very valid category and confirms its feasibility for use [15]. Therefore, the interactive e-book can be categorized as highly valid and feasible for implementation, as it fulfills the criteria of presentation quality, content appropriateness, and language suitability. These findings indicate that integrating local wisdom into digital teaching materials not only improves conceptual understanding but also develops students' critical thinking skills and environmental awareness.

The implementation stage was carried out through classroom application to evaluate the effectiveness of the developed e-book.

Table 8. Result of Normality Test (Shapiro-Wilk)

			Shapiro-Wilk
Group	Statistic	df	Sig.
Pretest	.943	31	.099
Postest	.894	31	.005

During the implementation phase, the effectiveness of the e-book was tested analyzed using the Wilcoxon Signed Rank Test because the data were not normally distributed.

Table 9. Result of the Wilcoxon Signed Rank Test

Test Statistics[a]	
	Posttest - Pretest
Z	-4.888[b]
Asymp. Sig. (2-tailed)	.000

The Wilcoxon test showed a p-value of < 0.05, indicating a significant difference between the pretest and posttest results.

Table 10. Results of descriptive analysis of pretest-posttest

Group		N	Mean Rank	Sum of Ranks
Posttest - Pretest	Negative Ranks	0[a]	.00	.00
	Positive Ranks	31[b]	16.00	496.00
	Ties	0[c]		
	Total	31		

This finding provides empirical evidence that the use of e-books significantly improves students' critical thinking skills.

Table 11. Result of N-Gain Score Pretest-Posttest

Data	Score	N-gain Score	Category
Mean Pretest Score	41.23	0.71	High
Mean Posttest Score	82.90		

The increase in average scores from pretest to posttest indicates that students' critical thinking skills improved after using the e-book. Prior to the study, students had a limited understanding of ecosystem concepts, as reflected in their relatively low pretest scores. After implementing the e-book, posttest scores increased significantly, indicating that it helped students understand ecosystem concepts. This improvement demonstrates that the developed e-book met the research objective of developing students' critical thinking skills through contextual learning. The integration of local wisdom in the e-book enabled students to connect ecosystem concepts to the real environment, making the learning process more meaningful and not simply memorizing concepts [29], [30].

The evaluation stage was conducted to assess and refine the developed e-book based on validation and effectiveness testing results. The findings from these stages served as a basis for improving the e-book's quality, particularly in terms of content clarity, feature functionality, and alignment with critical thinking indicators. This process

ensures that the developed e-book is not only valid and effective but also continuously improved to support meaningful, contextually relevant science learning.

These results align with the ethnoscience approach, which emphasizes the integration of local knowledge in science learning. The context of local wisdom allows students to build understanding through real-life experiences, making the concepts learned more meaningful. The use of interactive digital media, such as e-books, also supports constructivist-based learning, where students actively construct their own knowledge [31]. These findings align with previous research showing that local wisdom-based teaching materials and digital learning media can improve students' critical thinking skills.

Conclusion

The developed e-book was declared valid for use as an open-access learning material, with an average overall validity score of 96%, which is categorized as highly valid. Furthermore, the e-book proved effective in improving students' critical thinking skills. This was demonstrated by the Wilcoxon test, which yielded a p-value of 0.000 (< 0.05), indicating a significant difference between the pretest and posttest scores. This improvement was further reinforced by the N-gain value of 0.71, which is in the high category.

Author's Contribution

W. Wulandari contributed to the development of the research concept and design, data collection, data analysis, and manuscript writing. A.R. Purnomo supervised the overall research process, provided theoretical and academic input, and reviewed and refined the manuscript until the final version

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