

Validity of problem-based learning biodiversity e-book integrating Ruwat Petirtaan Jolotundo's local wisdom for science literacy

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Abstract: The problems faced in school textbooks and student worksheets are common problems globally and there are no daily problems that are in accordance with the surrounding environment and current problems so that they do not train students' scientific literacy skills. This research focuses on validity and readability of developing an integrated e-book that incorporates Jolotundo temple local wisdom into Biodiversity material to enhance high school students' Science Literacy skills. The study addresses the challenge of limited teaching materials due to the shortage of teachers capable of preparing suitable content for 21st-century learning, which emphasizes Science Literacy. The Research and Development (R&D) method was employed using the ADDIE framework, encompassing analysis, design, development, implementation, and evaluation stages. Data was collected through validation by two biology lecturers, material experts, and media experts, as well as a readability test. The e-book received high validation scores: 3.65 for presentation, 3.66 for content appropriateness, and 3.72 for language appropriateness. The readability test indicated a level 10, aligning with the cognitive level of grade X high school students, and was categorized as very positive and appropriate. In conclusion, the integrated e-book is highly feasible and valid for enhancing science literacy skills in grade X high school students, making it an effective tool for 21st-century learning.

Keywords: biodiversity; e-book; local wisdom; Jolotundo temple; science literacy

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Introduction

The implementation of student-centered learning approaches and 21st-century skills curricula faces several challenges. These include lack of teacher understanding, students' dependence on traditional methods, and limited common understanding of these skills among educators (Varas *et al.*, 2023; Yuhastina *et al.*, 2020). To overcome these challenges, learning strategies are developed to improve students' learning skills. Through this, it is hoped that students can develop the skills needed to face various challenges in the future, including science literacy skills, where scientific literacy is crucial for students to address global challenges, particularly environmental issues. It encompasses understanding scientific concepts and applying them in real-life situations (Tasquier *et al.*, 2022).

Science literacy is the skill in understanding scientific concepts and processes and the use of science in solving problems in everyday life (Sharon & Baram-Tsabari, 2020; Sutrisna, 2021). It encompasses understanding scientific practices, judging expertise, epistemic knowledge, and open-mindedness (Sharon & Baram-Tsabari, 2020). The concept of science is needed because it functions to understand science and is the basis for problem solving (Fausan *et al.*, 2021). The need to train students in science literacy is to keep up with the times, this is supported by the statement of Fuadi *et al.*, (2020) that science literacy skills are the main requirement for students in the 21st century. The results of the Program for International Student Assessment (PISA) survey show that the science literacy skills of Indonesian students are still lower than the international average score. Low science literacy is caused by many factors, including the learning methods used and the ineffective use of technology in learning, include textual teaching materials, misconceptions, and non-contextual learning (Hartono *et al.*, 2023).

Practicing scientific literacy can be taught through biology materials related to the environment. Biodiversity material is material in biology related to problems in the everyday environment (Setyaningsih et al., 2019). According to Tayyibah & Rachmadiarti (2022), this material can be used to practice scientific literacy because the material has objects of study of living things that can be observed in the environment around students. Material related to the everyday environment allows students to connect the material obtained with real world conditions so that it is suitable for use in practicing scientific literacy. To excel in scientific literacy skills in learning activities is to link scientific knowledge with topics in real life.

Recent studies highlight the importance of teaching scientific literacy through biodiversity and environmental topics in biology education. Developing biodiversity teaching materials based on socio-scientific issues has shown effectiveness in improving students' scientific literacy skills (Rohmah et al., 2022). Analysis of existing biology teaching materials revealed varying representation of scientific literacy categories, with method of investigation being the most prominent (Fadilah et al., 2020). Biodiversity literacy competence can be fostered through science education, leading to increased awareness and conservation efforts (Katili et al., 2021). Implementation of guided inquiry learning models utilizing the school environment has demonstrated positive effects on students' scientific literacy in biodiversity concepts (Wahyuni et al., 2022). These findings underscore the potential of integrating biodiversity and environmental topics into biology education to enhance scientific literacy. By employing appropriate teaching materials, learning models, and environmental connections, educators can effectively cultivate students' scientific literacy skills and environmental awareness. One of the learning models that can be combined is PBL because through this approach, students are invited to solve real problems that require them to think critically, conduct investigations, and make decisions based on data and evidence. PBL provides an opportunity for students to not only understand concepts theoretically, but also apply them in a more real and relevant context to their lives. In this case, biodiversity material taught through PBL can provide an in-depth learning experience, especially when associated with local problems and environmental issues around students.

Problem-Based Learning (PBL) has been shown to be an effective approach for enhancing students' scientific literacy across various educational levels. Studies have demonstrated that PBL, especially when combined with technology, can significantly improve scientific literacy and related skills. For instance, PBL supported by Prezi media positively impacted elementary students' scientific literacy (Kristiantari et al., 2022). PBL-STEM integration led to higher scientific literacy competencies compared to traditional PBL and conventional learning methods (Parno et al., 2020). Similarly, PBL in biology classes improved secondary school students' health literacy, a specific aspect of scientific literacy (Suwono et al., 2023). Furthermore, PBL enhanced scientific communication skills in middle school students, particularly when combined with video presentations at the beginning of lessons (Setyawan et al., 2020). These findings collectively support the effectiveness of PBL in fostering scientific literacy and related competencies across different educational contexts.

This research analysis highlights the integration of scientific literacy into biodiversity and environmental topics using local issues and Problem-Based Learning (PBL). While studies have underscored the benefits of socio-scientific issue-based learning and PBL in fostering scientific literacy, a critical gap remains in understanding the long-term impact and sustainability of these approaches, particularly when contextualized within students' local environments. The novelty of this research lies in its emphasis on a local wisdom approach within PBL. This research specifically integrates biodiversity topics with locally relevant socio-scientific issues, creating teaching materials that are both theoretically grounded and contextually relevant to students' immediate surroundings. Unlike traditional methods that may generalize environmental concepts, this approach situates learning within the socio-ecological realities students encounter, thus enhancing relevance and engagement. This model also addresses not only the cognitive but also the affective dimensions of learning, aiming to foster a deeper emotional connection to conservation and local biodiversity issues.

Local wisdom-based learning can effectively enhance students' understanding of biodiversity and conservation. Integrating local wisdom into biology education improves learning outcomes and critical thinking skills (Ramdiah et al., 2020). Problem-based student books incorporating local wisdom have been shown to empower students' conservation attitudes, particularly regarding endangered local species (Damopolii et al., 2024). Indigenous knowledge plays a crucial role in nature conservation, encompassing various aspects such as forest management, flora and fauna conservation, and land management (Abas et al., 2022). By incorporating local wisdom into biodiversity education, students can better relate to real-world problems and develop problem-solving skills. This approach not only enhances students' understanding of biodiversity but also fosters a sense of responsibility towards conservation efforts. Research has shown that incorporating local knowledge and cultural contexts into science curricula can significantly improve scientific literacy outcomes (Restiani et al., 2024; Verawati & Wahyudi, 2024). The integration of local wisdom not only enhances scientific literacy but also increases student engagement and provides culturally relevant learning experiences (Verawati & Wahyudi, 2024). One of the local wisdoms that can be integrated is the Ruwat Petirtaan Candi

Jolotundo. Integrating local wisdom values, especially the ruwatan tradition in the Petirtaan Jolotundo area, into biodiversity learning can enrich students' learning experiences. Local wisdom often contains practices and knowledge related to nature conservation and ecosystem balance. The ruwatan tradition at Petirtaan Jolotundo, which focuses on efforts to maintain balance between humans and the environment, provides a real example of how local communities have maintained biodiversity through cultural practices. The integration of local wisdom values not only enriches learning content, but also builds students' connectedness to their own culture and environment.

Based on the results of interviews with biology teachers at SMAN 1 Pacet Mojokerto, so far, the material on biodiversity has been explained through textbooks provided by the school and LKS only. The problems faced in school textbooks and LKS are common problems globally and there are no daily problems that are in accordance with the surrounding environment and current problems so that they do not train students' scientific literacy skills (Kusumawardhani & Indana, 2020). Therefore, there needs to be a learning resource that is able to train scientific literacy so that the level of scientific literacy continues to increase and is not left behind. One of the learning resources that can be used to train scientific literacy is e-books. Learning resources that support the development of scientific literacy and problem-solving skills are needed to address increasingly complex environmental education issues. For this reason, e-books as a digital learning platform provide an efficient and adaptive option. The development of PBL-based e-books integrated with the values of local wisdom of ruwatan at Petirtaan Jolotundo is an important step in presenting contextual and locally-based learning. This e-book not only provides biodiversity material, but also invites students to explore real problems in the Petirtaan Jolotundo area through interactive and multimedia features. Thus, students can learn about the importance of biodiversity while understanding how local wisdom can help preserve the environment.

The main objective of this study is to develop a PBL-based e-book that not only trains the scientific literacy of grade X high school students but also builds their awareness of the importance of protecting the environment through local contexts. This study is significant because it combines an innovative learning approach with relevant cultural and local contexts, providing a more meaningful and applicable learning experience for students. Through this e-book, it is hoped that students will be able to understand the concept of biodiversity in depth, as well as be trained in scientific literacy skills that will be useful for their future and understand the importance of maintaining the balance of biodiversity in real life and minimizing conceptual misunderstandings (Nurahman & Susantini, 2022).

Method

Research and development is the kind of research that is employed. A research approach called "research and development" as in Figure 1, is used to design or manufacture a specific product based on the needs of the research. Research is used for needs analysis and product efficacy testing in order to manufacture specific products (Umar et al., 2023).

Development research is being done, including creating an e-book in Jolotundo temple that incorporates local knowledge values to help strengthen students' scientific literacy abilities when studying biodiversity-related content. The development model that will be planned in this research is ADDIE consisting of five stages, namely Analyze, Design, Development, Implementation, and Evaluation. The reason researchers use the ADDIE model is because the steps used are systematic, clear and easy to understand. The following is a picture of the ADDIE model.

Curriculum analysis and idea analysis were done during the analysis phase. The Jolotundo Temple's local wisdom values and biodiversity materials were linked to create an electronic book during the design stage. Up until the new manuscript is expertly validated, validator lecturers, media professionals, and material specialists review and revise the development stage. The goal of the implementation stage is to test the validity and dependability of the e-book that is being built practically. The assessment phase will yield information and recommendations on the e-book that is being created. After that, the data is examined, and recommendations are made to improve the test instruments that were created.

The teaching material validation tool is used to assess the appropriateness of e-books. Based on standards modified from Syafruddin et al (2020); Tri and Wahdah (2023) the appropriateness components of language, presentation, and content are included in the question of feasibility. Then, two lecturers from Surabaya State University who specialize in biology teaching and in education in general evaluate the validation sheet for this textbook. An e-book feasibility presentation was used to conduct a descriptive analysis of the validator evaluation results. Values are obtained from Likert Scale calculations which are presented in Table 1.

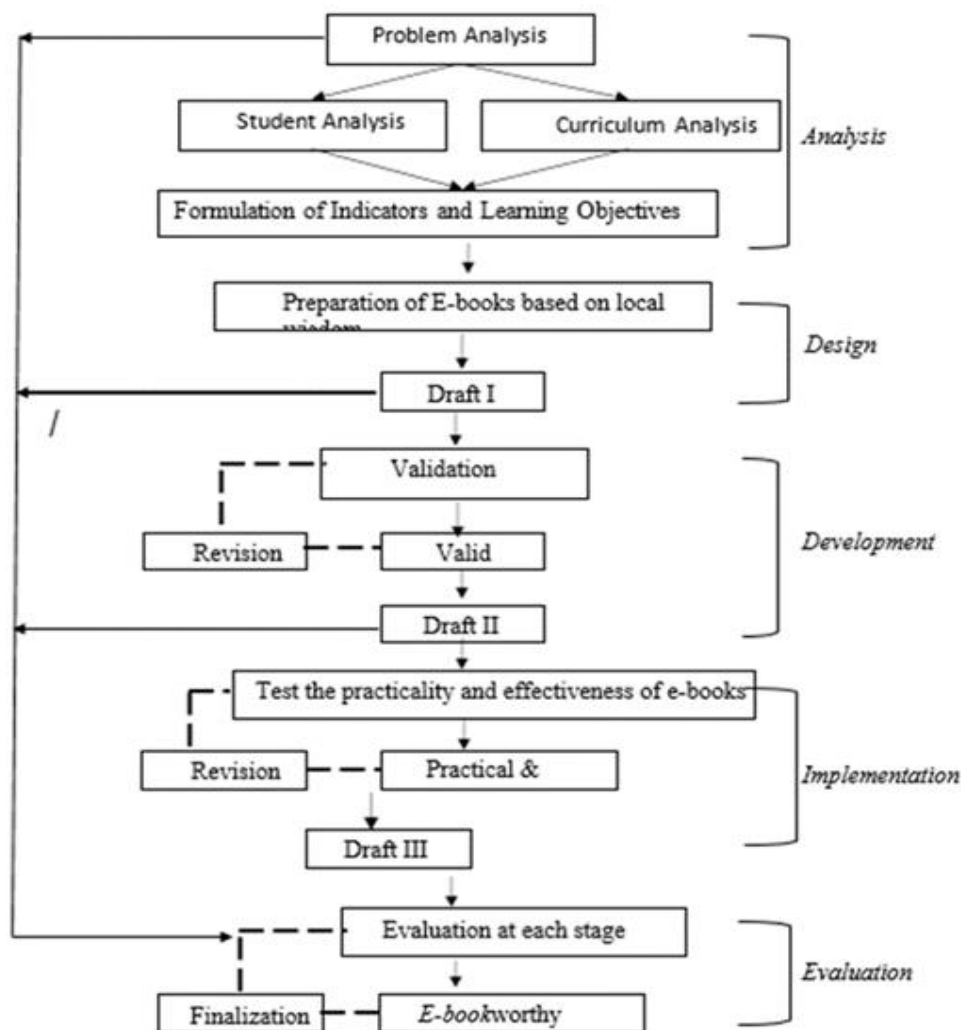


Figure 1. ADDIE Development Model

Table 1. Likert Scale Criteria

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

(Source: Riduwan & Akdon, 2008).

The results of the validity calculation are used to determine the suitability of the e-book, which is then calculated using the following [Formula 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 [Formula 2](#) is used.

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

The calculation results obtained are then classified into 4 validity criteria which can be seen in [Table 2](#). An e-book is said to be valid if it obtains a score $\geq 62.75\%$ (Riduwan & Akdon, 2008).

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

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

(Source: Riduwan & Akdon, 2008).

The level of practicality of the e-book Integrated local wisdom of Jolotundo Temple's Biodiversity content in development is assessed using the e-book readability sheet. To ascertain the readability level of the generated e-book, data collection approaches using the readability test method were employed. The readability approach is applied by choosing readings that span 100 words at the start, middle, and end of the e-book. Calculations were made to determine the number of sentences (Y-axis) and the number of syllables multiplied by 0.6 (X-axis). The intersection of the X and Y axes will be determined using the Fry Chart and then interpreted based on categories (Table 3). The e-module can be read by class X students if the meeting point is in the 9th-12th zone as a difficult category.

Table 3. Fry Chart Interpretation

Percentage (%)	Evaluation
1st – 6th zone	Easy (1st – 6th grade)
6th – 8th zone	Medium (6th – 8th grades)
9th – 12th zone	Difficult (9th – 12th grades)

(Source: Kinanti & Raharjo, 2021).

Results and Discussion

The e-book containing the local wisdom values of Ruwat Petirtaan Candi Jolotundo. Local wisdom of Ruwat Petirtaan Candi Jolotundo is located in Mojokerto Regency, East Java. Researchers interviewed several sources there to obtain information about ruwat petirtaan, its purpose and its relation to local wisdom in maintaining the environment and biodiversity in the area of the Jolotundo temple. There is a community group that is very firm in maintaining belief in the environment in the sustainability of life, especially the ruwatan ceremony held every 1 Suro which is still believed by the local community with a source of clean water so that it can help preserve the environment in the area around the Jolotundo petirtaan. Precisely in Seloliman Village, Trawas District, Mojokerto Regency. The community there maintains the Jolotundo water source well through the local wisdom of ruwat. This local wisdom is in the form of a ritual carried out in the Jolotundo Temple complex, with the aim of giving thanks for God's grace in the form of water that continues to flow from the water source in the Jolotundo temple (Lestari et al., 2021).

The Ruwatan ceremony in the Jolotundo Petirtaan area is a mandatory annual agenda. If Ruwatan is not carried out, the water source in Jolotundo will dry up or stop producing water. One thing that the community can do to protect the environment is to continue to believe in myths as a form of local wisdom that can be a guideline for the community to be wise towards the environment and the variety of living things in the Jolotundo area. The developed module is expected to facilitate understanding of the material and increase insight related to local wisdom so that it is fun to use, has clear concepts and sources, and can achieve learning objectives (Lestari et al., 2019). According to Nadir et al., (2022) the module can be integrated with the right learning approach and linked to the context and scientific problems in everyday life so that students know the relevance of the material being studied to real life conditions. The teaching module developed by researchers uses independent curriculum guidelines with the PBL model. The description of the display of the e-book can be seen in Figure 2.

E-books can increase interaction between teachers and students. A number of studies have shown the potential of interactive e-books to enhance the learning experience by incorporating local knowledge and interesting features. Learning that utilizes local wisdom, especially in science lessons, can facilitate students' understanding because they can directly observe based on their surroundings (Setianingrum et al., 2023). Dewi & Agung, (2021); Mahfiroh & Muslim, (2023) found that e-books containing local wisdom, such as those based on Balinese values, were very feasible and practical, with positive feedback from educators and students. Cintamulya et al., (2023) emphasizes the need for e-books to be visually appealing and relevant to Generation Z's learning styles, while Nurmayanti et al., (2017) highlights the importance of expert validation and positive feedback from teachers and students in ensuring e-book quality. Instructional materials in the context of learning are one of the essential components because they are what will be analyzed, studied, and mastered by the students (Ramdoniati et al., 2018). This e-book contains various features mentioned above and can be used as teaching material that includes integration of local wisdom of Mojokerto district, Jolotundo temple

because it is close or contextual to students. In this e-book development stage, the e-book has been revised several times and reviewed to evaluate the e-book's shortcomings before being validated. Based on the results of the research that has been carried out, validation is used to determine the theoretical feasibility of the e-book that has been developed. The validation results were analyzed descriptively using the percentage of e-book suitability using a 1-4 Likert scale. Several aspects that are validated include aspects of appropriateness of presentation, aspects of content validity and aspects of language validity. The following are the results of the E-book validation Viewed from the aspect of feasibility of presentation, it can be seen in Table 4.



Figure 2. (a) cover of the e-book; (b) e-book usage instructions; (c) Feature of e-book; (d) Jolotundo local wisdom; (e) chapter 1 of the e-book; (f) bio concept; (g) Bio local wisdom; (h) Bio quiz; (i) Back cover of the e-book.

Table 4. The results of the E-book validation are reviewed from the aspect of feasibility of presentation

Aspects of Presentation Feasibility Assessment	Validation Result Score		Average Score
	Validator 1	Validator 2	
E-book Display Quality	3.75	3.25	3.5
Layout Quality	3.75	3.75	3.75
Text Quality	3.75	3.75	3.75
Image Quality	3.75	3.25	3.5
Video Quality	3.5	4.00	3.75
E-book quality	3.67	3.67	3.67
Average Score	3.7	3.61	3.65
Validity Score (%)	92.5%	90.25%	91.25%
Interpretation of Validity Scores		Very Valid	

The validity results are presented in [Table 4](#), showing a total average validity score of 3.65 which is interpreted as very valid. These results include aspects that must be considered in developing e-modules, namely self-instructional, self-contained, stand-alone, adaptive and user-friendly aspects according to the ([Erni, 2023](#)). These five aspects received scores ranging from 3.5-4, which indicates that they have been fulfilled and are declared very valid. Several aspects that are assessed on the appropriateness of presentation include the quality of the e-book display, the quality of the layout, the quality of the text, the quality of the images, the quality of the images and the quality of the e- book. Overall, the quality of the e-book is very good with features such as a table of contents that can be clicked to go to a specific page, as well as external links that provide access to additional resources on the internet. Easy operation of e-books also ensures that students can easily access and utilize all available content. This e-book can be accessed using a laptop or smartphone online or offline. The quality of e-books varies across studies. [Kandriasari et al., \(2023\)](#); [Susantini et al., \(2021\)](#) found that electronic books can be effective in training students' metacognitive skills and improving their analytical skills. However, [Korat & Falk, \(2019\)](#); [Cintamulya et al., \(2023\)](#) identified several areas that need improvement. [Cintamulya et al., \(2023\)](#) noted that e-books will have to better adapt to Generation Z's learning styles, meanwhile [Korat & Falk, \(2019\)](#) found that many children's e-books are overloaded with distracting multimedia effects. Despite these challenges, the potential of e-books in increasing digital literacy and supporting language and literacy development is clear. Taking all these indicators into account, this e-book is considered very worthy in terms of presentation. The display quality, layout, text, images and videos are all well integrated, providing an interactive, informative and fun learning experience for students.

Apart from the feasibility aspect of presentation, e-books are also validated from the aspect of content validity. The following are the results of the E-book validation from the content feasibility aspect, which can be seen in [Table 5](#).

Table 5. The results of the E-book validation are seen from the aspect of content suitability

Aspects of Presentation Feasibility Assessment	Validation Result Score		Average Score
	Validator 1	Validator 2	
Quality of matter concept	3.67	3.33	3.50
Quality of material conformity with the Independent Curriculum	3.67	4.00	3.84
Recency and Contextuality of Concepts	3.33	4.00	3.67
E-book systematics	3.50	3.67	3.59
Completeness of ecosystem materials	3.83	4.00	3.92
Integration of Local Wisdom Values in Ecosystem Materials	3.60	4.00	3.80
Achievement of Science Literacy Ability	3.60	3.00	3.30
Average Score	3.60	3.71	3.66
Validity Score (%)	90%	92.75%	91.5%
Interpretation of Validity Scores		Very Valid	

The validity results are presented in [Table 5](#), showing a total average validity score of 3.66 which is interpreted as very valid. Content validity in e-books refers to the validity and reliability of the information presented in the e-book content. It includes a number of factors that must be considered to ensure that the e-book content is trustworthy and conforms to established standards ([Kharisna & Amini, 2023](#); [Muamar et al., 2021](#)). The e-book content feasibility developed based on the indicators mentioned above shows that the material presented has integrated the local wisdom values of Ruwatan in the Petirtaan Jolotundo area with the topic of biodiversity in a relevant and contextual manner. The selection of local wisdom of Ruwatan as the focus of this topic is very appropriate because the Ruwatan ritual has ecological and spiritual meanings that are closely related to environmental conservation, including maintaining the clarity of water in Petirtaan Jolotundo ([Lestari](#)

et al., 2021). The integration of this ritual with biodiversity helps students understand how local wisdom can support the preservation of ecosystems in the area (Sriyati et al., 2022).

This e-book also contains examples of biodiversity components in Petirtaan Jolotundo, such as flora and fauna in the area. This material is presented in detail by connecting each species with its role in maintaining the balance of the ecosystem and its relationship to the traditions of the surrounding community. In addition, the benefits of biodiversity in the Petirtaan Jolotundo area are also explained in full, providing students with an understanding of the importance of conservation and sustainable use (Fahadah et al., 2023; Verawati & Wahyudi, 2024). Another aspect that is considered is the material on the classification of flora and fauna integrated with local wisdom values. Students can learn to identify certain species while understanding how community traditions, such as Ruwatan, contribute to their conservation efforts. Thus, this e-book not only provides an academic understanding of biodiversity but also presents real examples of how local traditions and cultures can maintain the balance of the ecosystem (Damopolii et al., 2024).

By integrating the role and efforts of the community in maintaining environmental balance, this e-book becomes more comprehensive in encouraging environmental awareness in students. The tradition of maintaining water clarity, which is part of the Ruwatan ritual, provides a strong context for connecting cultural values with scientific concepts in environmental conservation. Overall, the contents of this e-book are considered worthy because they are able to combine academic materials and local wisdom values in a relevant, practical, and contextual way, making it very effective in training students' scientific literacy skills.

Apart from aspects of suitability of presentation and content validity, e-books are also validated from the aspect of language validity. The following are the results of the E-book validation from the content feasibility aspect, which can be seen in Table 6.

Table 6. The results of the E-book validation are seen from the language feasibility aspect

Aspects of Presentation Feasibility Assessment	Validation Result Score		Average Score
	Validator 1	Validator 2	
Use of Language	4.00	3.75	3.88
Language Structure	3.50	3.75	3.63
Use of Terms	3.33	4.00	3.67
Average Score	3.61	3.83	3.72
Validity Score (%)	90.25%	95.75%	93%
Interpretation of Validity Scores		Very Valid	

The aspect of language feasibility is an important component in e-book development to ensure that the content delivered can be accepted and understood well by students. Based on the indicators mentioned, the use of language in this e-book is considered communicative, which means that the language used is able to bridge messages effectively between the writer and the reader. The sentences used are easy for students to understand, without excessive complexity, thus helping them to master the material more quickly and efficiently. (Diana & Wisanti, 2020; Rahmah & Susilowibowo, 2021). The use of clear language is also a major concern in this e-book. Each sentence is structured simply and to the point, thus minimizing confusion. The clear delivery of information allows students to focus on the core concepts presented without being distracted by complicated language styles (Schaller et al., 2020). In addition, the informative aspect is highly prioritized by providing clear and in-depth explanations of the biological concepts discussed, ensuring that students receive accurate and relevant information.

In terms of language structure, this e-book is structured according to the General Guidelines for Indonesian Spelling (PUEBI), which ensures the accuracy of grammar and spelling in each sentence. This is important to maintain consistency and clarity of the language used, as well as to prevent misinterpretation. The sentences in the e-book are also designed not to cause double meanings, so that the message conveyed is clear and unambiguous (Almunawaroh, 2021). These sentences also represent the content to be conveyed, ensuring that every main point of the material can be well received by students. In addition, there is good integration between sentences in each paragraph. The logical relationship between ideas in one paragraph to the next paragraph is well created, helping students follow the flow of explanations in a coherent and easy-to-understand manner. This is important so that students do not feel lost in the material, but instead feel the continuity of the information conveyed.

The use of biological terms in this e-book is also well considered. The terms used are in accordance with relevant biological concepts and are understood by high school students. Not only that, the terms are also used consistently throughout the e-book, which helps students recognize and remember biological concepts better. The consistency of the use of these terms supports the delivery of concepts more clearly, without causing confusion or misinterpretation. Overall, the language suitability aspect of this e-book has met the standards required for effective learning, both in terms of communication, structure, and use of terms. Results, can be seen in Table 7.

Table 7. Results of e-book validation by material expert lecturers and media expert lecturers

Aspects of Presentation Feasibility Assessment	Validation Result Score		Average Score (%)	Category
	Validator 1	Validator 2		
Feasibility of Presentation	92.5	90.25	91.25	Very Valid
Content Validity	90	92.75	91.5	Very Valid
Language Validity	90.25	95.75	93	Very Valid
Average			91.92	Very Valid

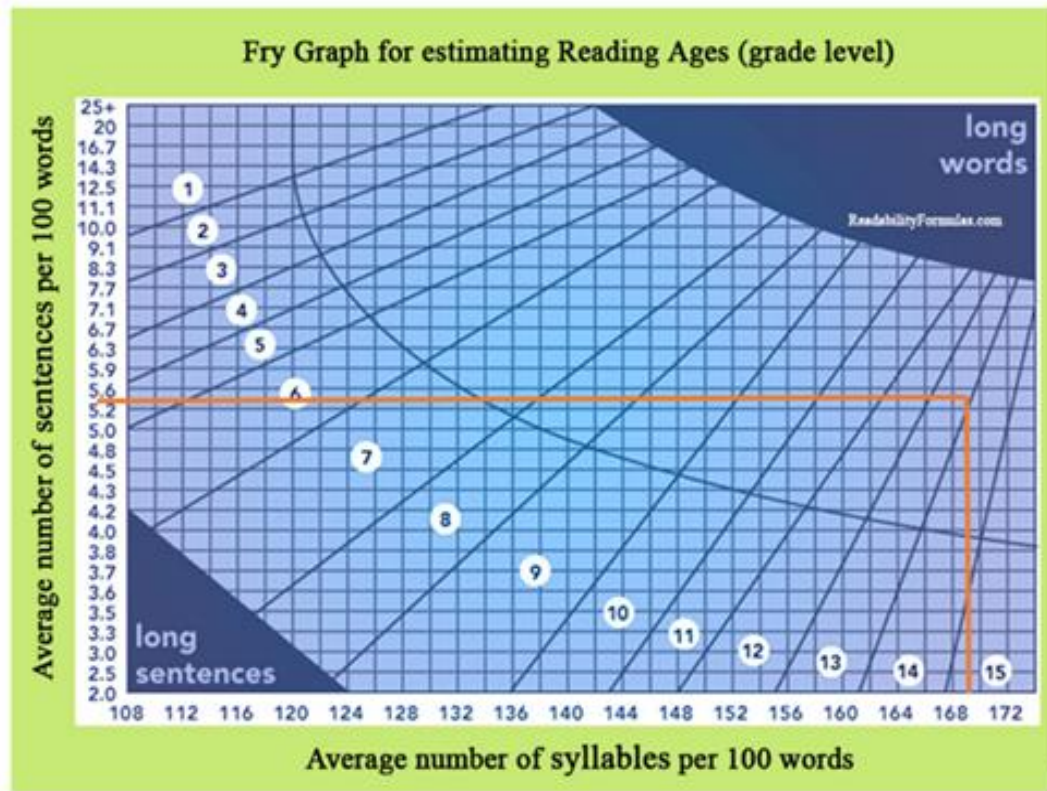
Based on the three validators of the interactive e-book on the biodiversity material developed, an average percentage of 91.92% was obtained with a very valid and feasible interpretation (Riduwan & Akdon, 2008). Thus, this interactive e-book is declared valid and suitable for use and meets the aspects of suitability of presentation, content and language.

The implementation of e-books is seen from the e-book readability test. The readability test results are seen by counting the number of sentences and the number of syllables, then multiplying them by 0.6 out of 100 words at the beginning, middle and end of the e-book, then the results are converted to a fry graph. The following is a recapitulation table of the e-book readability test results, which can be seen in Table 8.

Table 8. Recapitulation Table of Readability Test Results

Reading Samples	Page	Number of Sentences	Number of Syllables x 0.6	Levels
Text 1 (Initial part)	19	7	187.2	10
Text 2 (Middle part)	41	6.4	142.8	10
Text 3 (Final part)	57	2.8	178.8	10
Average Amount		5.4	169.6	10

The results of calculating the number of sentences and syllables that have been averaged are then converted into the fry graph presented in Figure 3.


Figures 2. Readability Conversion Results on Fry Charts

These findings demonstrate that, in accordance with Kinanti & Raharjo (2021), every track sample is considered as challenging (Table 3). Because language use affects comprehension, the readability level must be acceptable for the target reader (Susantini et al., 2021). This relates to the level of student development. High school kids are thought to be well-developed intellectually and emotionally, according to Kaitlyn & J., (2021) therefore they must be able to comprehend information from any work

that uses a challenging or sophisticated language. The readability findings are in the correct readability category because class X students are the intended readers for the problem-based learning e-module that is being produced. The higher the readability level of a discourse, the easier it is to understand, and conversely, the lower the readability level, the more difficult it is to understand. This shows that discourse with a low readability level is not suitable to be presented at the target level (Nuryani, 2017). The data was obtained in the form of e-book descriptions, theoretical feasibility of e-books as seen from the results of validity through aspects of presentation, content, and language, and empirical feasibility of e-books as seen from the readability test. The development of teaching materials in the form of an e-book on environmental change based on problem-based learning integrated with local wisdom in Jolotundo temple. If e-books satisfy the theoretical and empirical feasibility standards, they can be deemed practical (Ristanti & Rachmadiarti, 2018). The creation of an environmental change e-book based on problem-based learning combined with local wisdom in Jolotundo temple has been deemed both theoretically and empirically possible based on all the descriptions of the data analysis results collected.

Conclusion

The integrated e-book of Jolotundo Temple's local wisdom in biodiversity materials is stated to be very feasible theoretically and empirically. This can be seen from the validation score obtained in the very valid category. Readability at level 10 corresponds to the level of thinking of class X high school students. In conclusion, the integrated e-book is highly feasible and valid for enhancing science literacy skills in grade X high school students, making it an effective tool for 21st-century learning.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

Y. E. Ivaningtias: conceptualized the research idea, designed the methodology, management and coordination responsibilities, analyzed data, carried out the research process and investigations must be limited to those who have contributed substantially to the work reported. **S. Indana** and **N. K. Indah:** conducted literature review and provided critical feedback on the manuscript

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