

## Validity and Effectiveness of Problem Based Learning E-Book Integrated with Indigenous Culture to Enhance Digital Literacy Skills in the Society 5.0 Era

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### Article History:

Received date: November 25 2024

Received in revised from: March 10 2025

Accepted date: March 18 2025

Available online: March 21 2025

### Citation:

Margalita, S., Susantini, E., Kuntjoro, S., & Ali, M. 2025. Validity and effectiveness of problem based learning e-book integrated with indigenous culture to enhance digital literacy skills in the society 5.0 era. *JUPI (Jurnal IPA dan Pembelajaran IPA)*, 9(1):154-169.

**Abstract.** 21st-Century Education in the society 5.0 Era emphasizes the development of skills relevant to modern demands, such as digital literacy. The skill can be enhanced through four key indicators: photo-visual skills, branching skills, reproductive skills, and information skills, which collectively support the ability to access and understand information from various digital sources. However, digital literacy levels in Indonesia remain relatively low. To address this, an e-book has been developed as a learning resource that integrates the indigenous culture of Sumur Panguripan in Surabaya with ecosystem-related topics. This study aims to produce a valid and effective problem-based learning e-book that integrates the indigenous culture of Sumur Panguripan to improve students' digital literacy skills. The research follows the ASSURE model, which includes the following stages: analyzing and utilizing students, stating goals, selecting methods, media and materials, requiring participation and evaluating and revising. Data analysis was conducted using descriptive quantitative methods. The findings indicate that the problem based learning e-book achieved a high Aiken's V validity index score across content feasibility, presentation, and language aspects, categorizing it as valid. Moreover, the e-book demonstrated high effectiveness in enhancing students' digital literacy. The results confirm that this problem based learning e-book, integrated with the indigenous culture of Sumur Panguripan, is capable of significantly improving digital literacy skills in the society 5.0 era.

**Keywords:** E-book, problem based learning Indigenous culture of Sumur panguripan, digital literacy.

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## Introduction

Education in the 21st century, particularly in the society 5.0 era, focuses on developing skills that align with modern challenges and needs. These include creativity, critical thinking, collaboration, and digital literacy. Digital literacy, as defined by Wu et al. (2024), involves the ability to evaluate, analyze, and effectively apply digital information in various contexts. Indonesia is currently navigating the society 5.0 era, a concept aimed at creating a smarter, technology-driven society where humans and technology work hand in hand to solve global challenges. According to Shiyamsyah et al. (2024), educational institutions play a crucial role in this transition by producing graduates who are not only competent but also capable of adapting to the rapid advancements of the modern age. In

this context, society is expected to leverage digital literacy to integrate technologies like the internet of things into everyday life (Hannoon & Mahmood, 2023).

Digital literacy plays a key role in enhancing education by helping students better understand lesson content and broaden their knowledge base. Naufal (2021) describes it as the ability to acquire information through digital media, while Destiana et al. (2023) highlight that it involves accessing, managing, comprehending, and critically evaluating learning materials using technology. While Indonesia ranks fourth globally in internet usage, with 202 million users (Kominfo, 2020), digital literacy among students remains low. Research by Raharjo et al. (2021) indicates that the digital literacy skills of teenagers, especially in Surabaya, are still underdeveloped. This disparity underscores the urgent need to strengthen digital literacy education to align with the country's technological advancements.

Digital literacy skills can be integrated into the educational world to help students achieve high-quality learning. According to Alkali and Amichai (2004), digital literacy skills can be enhanced through four key indicators. The first is photo-visual skills, which refers to the ability to interpret instructions from graphical displays or work guidelines and the student's ability to visualize information. The second is branching skills, which involves building knowledge using search engines and navigating non-linear, hypertextual content. The third is reproductive skills, which focuses on the ability to organize and synthesize information gathered from various sources. Lastly, information skills refer to the ability to evaluate and validate the information obtained from multiple sources concerning a specific concept.

Several factors contribute to the low digital literacy levels of students in Indonesia. Research by Oftika et al. (2020) reveals that only 30% of students use the internet for educational purposes, while the majority engage in non-educational activities. Although the government has introduced initiatives like electronic school books (elektronik or BSE), these resources are underutilized as digital learning tools, remaining largely indistinguishable from traditional printed textbooks in the eyes of many students (Aprilia et al., 2020). The widespread adoption of digital media is closely tied to technological advancements and the increasing availability of internet access. While this creates numerous opportunities, it also brings challenges. One significant drawback is the unrestricted access to vast amounts of information, which can lead to students encountering irrelevant or unverified content during the learning process (Susantini et al., 2021). Educators face the challenge of leveraging technology effectively while minimizing its negative impacts on students. E-books are an ideal resource for fostering digital literacy. These digital learning materials combine text, images, videos, and hyperlinks, making them accessible on devices such as computers, laptops, and smartphones (Pratama et al., 2024). When paired with the problem based learning (PBL) approach, e-books can significantly enhance digital literacy skills. Problem based learning encourages students to actively seek information from diverse digital sources to solve problems presented in the learning process (Sofyan et al., 2016). This method not only deepens student engagement with digital content but also improves their ability to critically evaluate and apply information effectively (Hursen & Fasli, 2021).

Problem based learning as proven to be an effective teaching model aligned with the key indicators of digital literacy. This approach requires students to actively search for information and facts using digital media to solve problems presented in the learning process. By engaging in tasks that involve searching, analyzing, and evaluating information from diverse digital sources, students naturally enhance their digital literacy skills. Hursen and Fasli (2021) found that using PBL with e-books not only boosts students' ability to learn independently but also improves their understanding of complex concepts, such as biology. The integration of e-books with the PBL model provides a relevant and practical solution for fostering digital literacy in modern educational contexts.

Education in the 21st century emphasizes not only skill development but also the integration of indigenous culture. Incorporating local cultural values into education is essential for fostering a sense of pride in one's heritage and strengthening national identity. Indigenous culture, which encompasses knowledge, skills, and values passed down through generations, can be integrated into digital learning materials like e-books. This approach not only preserves cultural heritage but also supports the understanding of scientific concepts, such as biology (Taufan et al., 2023). One example is the Sumur Panguripan ecosystem in Pesapen, Surabaya. This well-preserved natural site has significant potential as a teaching resource, particularly in lessons related to ecosystems within the Kurikulum Merdeka. By connecting the study of ecosystems with indigenous culture, digital learning media like e-books can serve as a tool to both enhance biological understanding and preserve cultural values. This integration of traditional knowledge and modern education creates a meaningful and contextually rich learning experience for students.

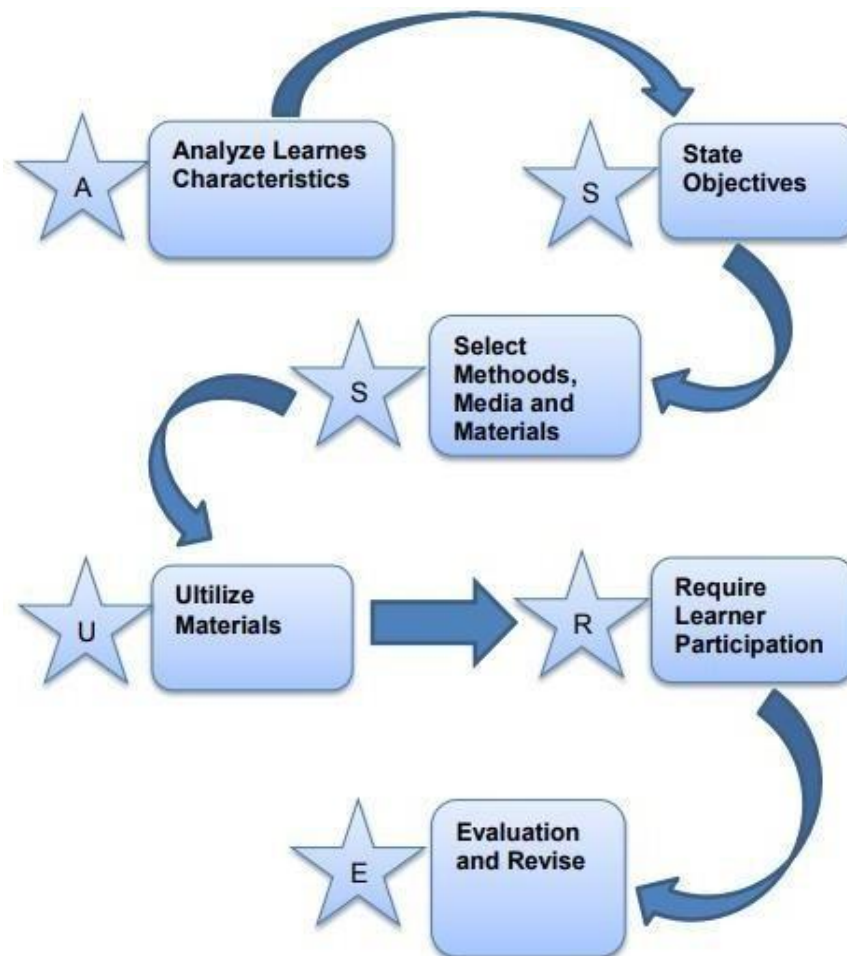
E-books that integrate indigenous culture, such as the Sumur Panguripan ecosystem in Surabaya, Indonesia, provide a unique opportunity to connect ecological concepts with preserved cultural values. The Sumur Panguripan, known for its consistent water quality even during dry seasons, exemplifies how traditional knowledge contributes to ecosystem conservation. In contrast, nearby community wells suffer from declining water quality—becoming murky and odorous—due to environmental degradation with research by Siahaan and sirait (2023). Studies underscore the importance of indigenous culture in preserving natural resources. For example, research on traditional practices for maintaining hot spring ecosystems in Karo Regency, Indonesia, demonstrates the significant role of local culture in safeguarding water quality (Hunaepi et al., 2018). This is highly relevant to Sumur Panguripan, where indigenous culture has sustained water quality despite environmental pressures. The use of e-books as educational tools aligns with current technological advancements, offering broader and more interactive access to information. Research by Rahmawati and Fitrihidajati (2023) highlights the practicality of e-books in teaching ecosystem topics and their significant impact on improving students' digital literacy. Similarly, Sonia and Yuliani (2023) found that e-books can enhance digital literacy skills by up to 96%, with an overwhelmingly positive response rate of 98.97%. Based on these findings, this research aims to evaluate the validity of problem based learning e-books integrated with the indigenous culture of Sumur Panguripan, Surabaya. The goal is to use this educational medium to effectively enhance students' digital literacy skills while fostering an appreciation for cultural and environmental heritage.

## Methods

This study is a developmental research aimed at improving product quality by utilizing the research and development methodology (Sugiyono, 2017). The research adopts the ASSURE model, which consists of six stages: 1) Analyze learner characteristics: Identifying the characteristics of the target learners. 2) State objectives: Determining the goals of the research. 3) Select, modify, or design media: Selecting, innovating, or designing and developing learning media. 4) Utilize media: Implementing the developed media in the learning process. 5) Require learner response: Gathering responses from learners after using the media to evaluate its effectiveness. 6) Evaluate: Assessing the developed media. This systematic approach ensures that the developed product aligns with learner needs and achieves its intended objectives effectively. This developmental research aimed to create a new product in the form of a problem based learning e-book integrated with the indigenous culture of Sumur Panguripan in Surabaya. The e-book's effectiveness was measured based on its ability to enhance students' digital literacy.

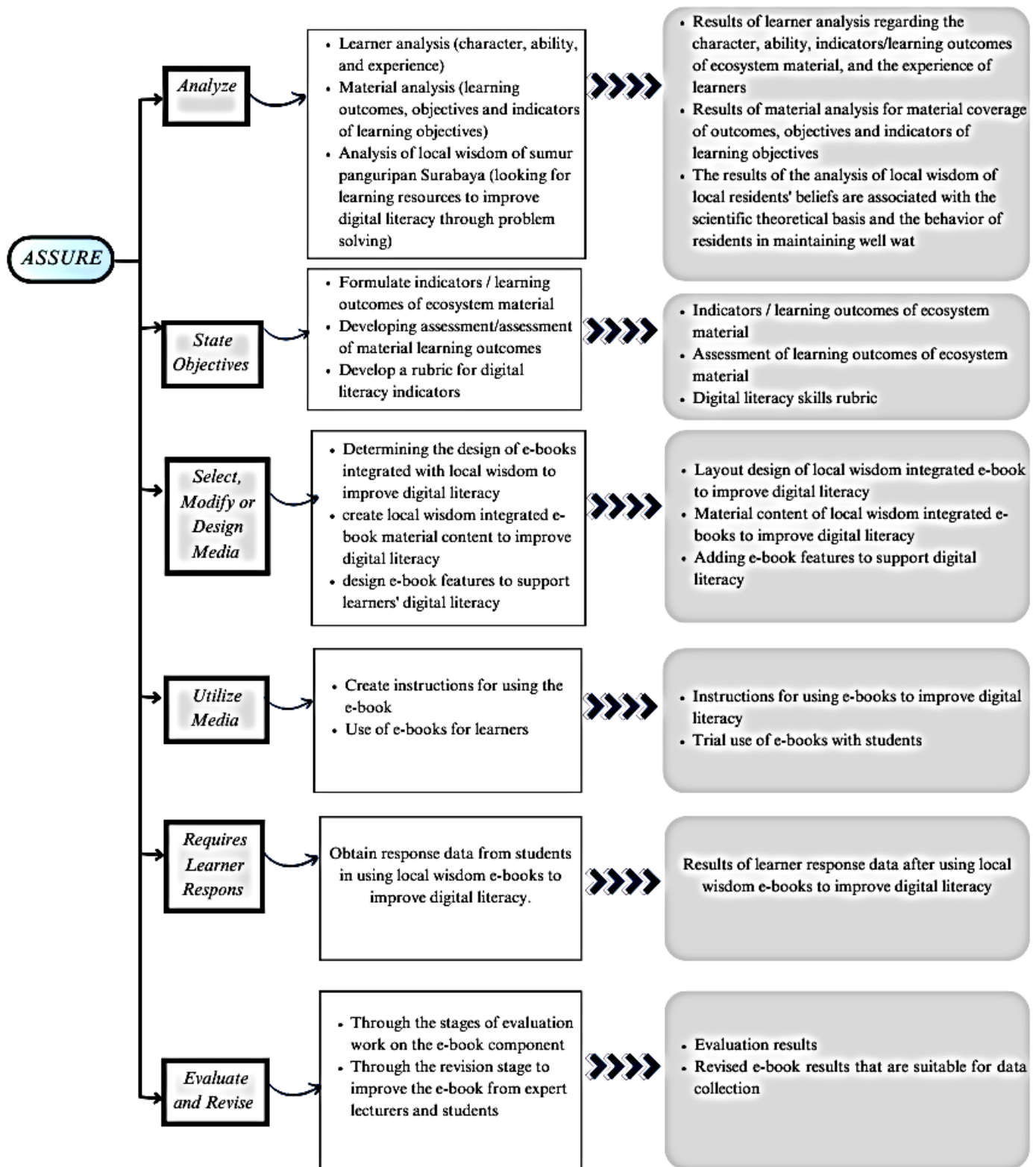
The study was conducted in the graduate program of biology education at Universitas Negeri Surabaya. The research process included several stages. The initial

analysis stage involved curriculum analysis, learner analysis, task analysis, material analysis, and the formulation of learning objectives. In the design stage, the focus was on selecting appropriate instruments, determining e-book content, deciding on the format, and drafting the initial design. The development stage followed, comprising expert validation and revisions based on feedback. finally, the implementation stage aimed to evaluate the effectiveness of the developed e-book. The study's sample consisted of 36 tenth-grade students from senior high school 13 surabaya. The research methodology, including its sequential steps, is illustrated in Figure 1.



**Figure 1.** ASSURE stages

The research procedure using the ASSURE development model was designed to refine and test the effectiveness of the developed e-book. The steps of research and development following the ASSURE model to enhance students' digital literacy through the e-book, based on the six stages shown in Figure 2.



**Figure 2.** The ASSURE Research Procedure

The development research on the e-book yielded validity results, which will be calculated using a specific formula. The scores obtained are analyzed to determine the feasibility of the e-book based on the indigenous culture of Sumur Panguripan, Surabaya, in enhancing digital literacy by employing the following formula (Aiken, 1999).

$$V = \frac{\sum s}{n(c-1)} \quad (1)$$

Explanation:

- V : The index of agreement among experts or raters
- S : The difference between the score given by the experts and the lowest score
- C : The highest score on the rating scale
- N : Number of experts

The Aiken's V validity score ranges from 1 to 0, with the validity interpretation presented in Table 1.

**Table 1.** Aiken's V validity interpretation criteria

Score	Category
$0.75 \leq V < 1.00$	Valid
$0.50 \leq V < 0.75$	Moderate Validity
$0.25 \leq V < 0.50$	Low Validity
$0 \leq V < 0.25$	Very Low Validity

(Source: Retnawati, 2016)

The validity criteria in this analysis refer to the Aiken's V table. Using 2 experts, the required V value for a choice to be considered valid is 0.75. Learning mastery of students can be measured after they use the e-book and take a test. This mastery will be analyzed to determine the effectiveness of the problem based learning e-book on the ecosystem material integrated with the indigenous culture of Sumur Panguripan Surabaya in improving students' digital literacy. The effectiveness of the e-book is determined by the percentage of students who pass the knowledge test, reflecting the improvement in their digital literacy. The scores obtained are then calculated using the following formula.

$$\text{Value} = \frac{\sum \text{Obtained test score}}{\text{maximum score}} \times 100\% \quad (2)$$

The results analyzed from the calculations will be aligned with the minimum score criteria set by the school. Students are considered to have achieved learning mastery if their test score is  $\geq 75$ . The results from the calculation using the following formula will then be interpreted according to the criteria in the Table 2.

**Table 2.** The interpreting criteria of students learning mastery

Average score (%)	Category
0 - 40	Very Low
41 - 55	Low
56 - 70	Moderate
71 - 85	Good/Effective
86 - 100	Very good/Very effective

In a classical classroom setting, achievement is considered mastery if 75% of the students score above 75. Furthermore, the mastery of digital literacy indicators from the test results after using the e-book can be calculated using the following formula.

$$\text{Value} = \frac{\Sigma \text{ total score of spesific indicator}}{\Sigma \text{ maximum score of spesific indicator}} \times 100\% \quad (3)$$

To analyze the digital literacy achievement of students, the analysis is performed by assessing the completion of each digital literacy indicator, namely photo-visual skills, branching skills, reproductive skills, and information skills, through the pre-test and post-test items. The data is then processed using the N-Gain formula to determine whether there was any effect from the implemented learning. The percentage of completion for each indicator will subsequently be categorized as follows:

$$N - \text{gain} = \frac{\text{Posttest score} - \text{pretest score}}{\text{Maximum score} - \text{pretest score}} \quad (4)$$

Explanation :

- g : Normalized gain score
- S posttest : Post-test score
- S pretest : Pre-test score
- S max : Maximum score

N-Gain, then, will be presented in the Table 3.

**Table 3.** The interpreting criteria of students learning mastery

Average score (%)	Category
$(g) > 0.7$	High
$0.30 > (g) > 0.7$	Moderate
$(g) < 0.3$	Low

(Source: Hake, 1999)

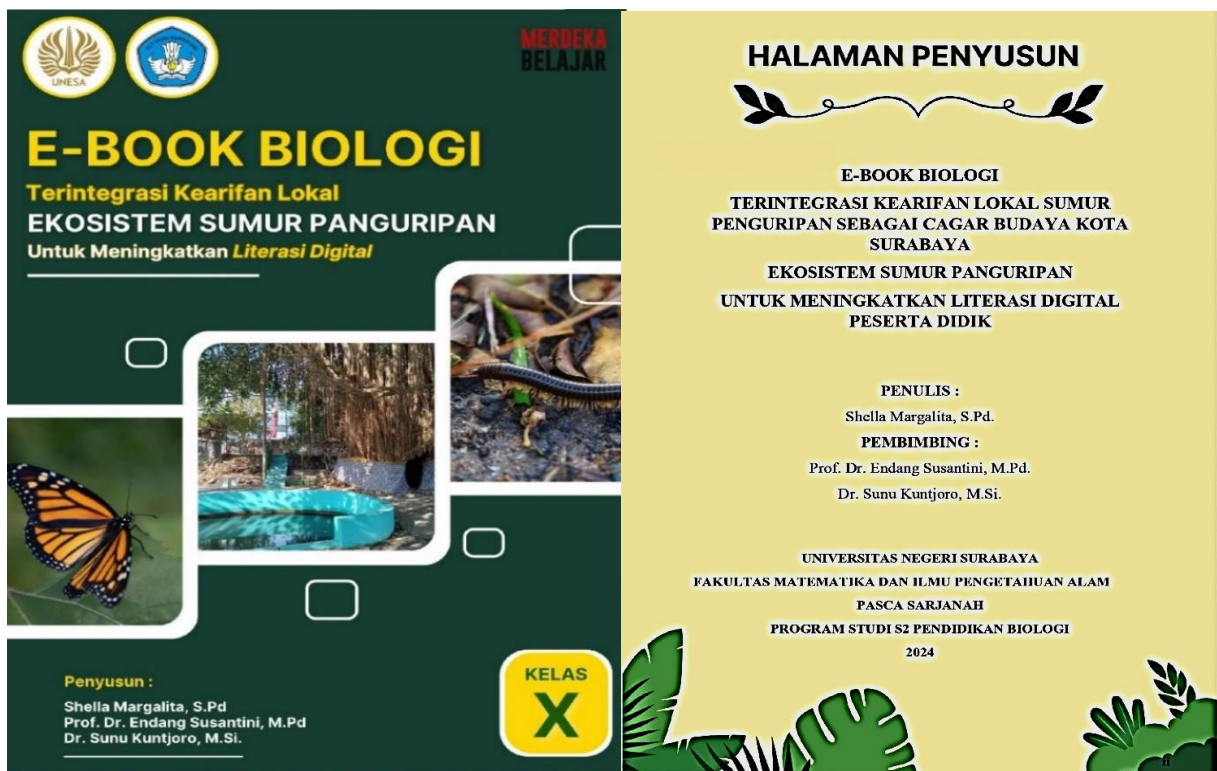
The percentage data of digital literacy mastery is obtained from the assessment of each indicator of skills that can be improved. The results are then analyzed using descriptive quantitative methods. The mastery of each indicator is analyzed using the following formula.

$$\text{Digital literasi (\%)} = \frac{\text{The scores per indicator obtained by all students}}{\text{The maximum scores per indicator from all students}} \quad (5)$$

Students are considered to have experienced an improvement in digital literacy if their test scores show progress, even if they achieve the minimum learning mastery criteria, which is the minimum benchmark set by the school as the threshold for students to meet learning objectives.

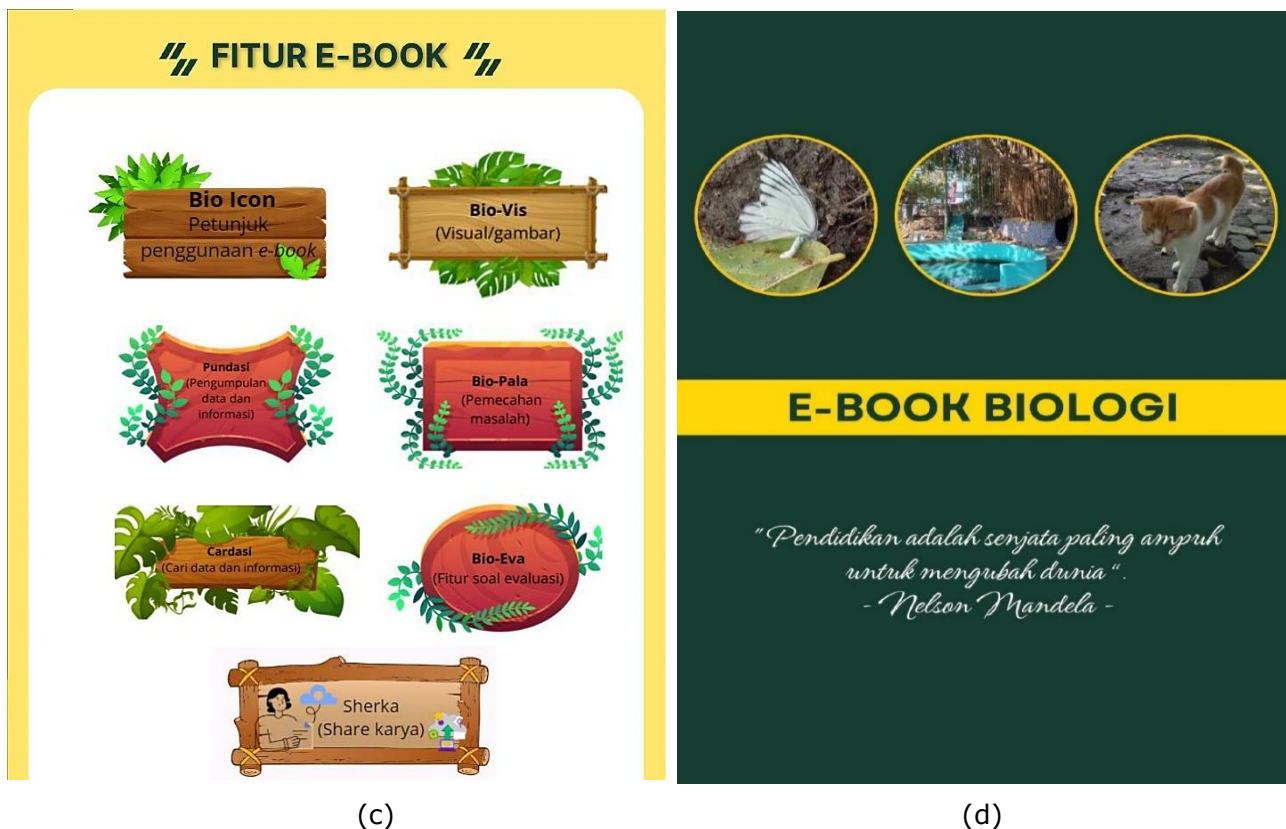
## Results and Discussion

The development research produced components of the e-book material integrated with the indigenous culture of Sumur Panguripan Surabaya, connected to the ecosystem content of the independent curriculum. Each stage of the e-book's content, related to indigenous culture, follows the steps of the PBL model, with a focus on the ecosystem issues of the indigenous culture of Sumur Panguripan, Surabaya. Currently, the well remains a vital source of daily life for local residents, providing both water supply and clean water. This contrasts with the declining quality of water sources from both the local wells and Surabaya's PDAM (Regional Drinking Water Company). This phenomenon is reflected in the problem-solving questions presented at the end of the e-book. The e-book design is created to showcase indigenous culture as a means of applying real-life phenomena from the ecosystem material being studied, allowing students to integrate these lessons into their daily lives, particularly in fostering wise and responsible attitudes towards their surrounding environment. The design of the e-book, which integrates the indigenous culture of Sumur Panguripan Surabaya to enhance students' digital literacy, is as follows.



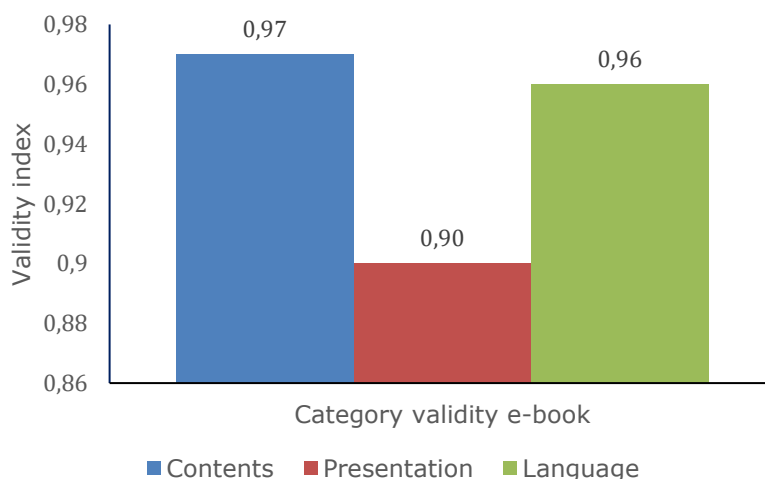
(a)

(b)



**Figure 3.** E-book view: (a) e-book front page, (b) e-book composer page, (c) e-book feature page, (d) the back cover page.

The validity test results from the two expert lecturers are presented as follows.



**Figure 4.** Diagram illustrating the recap of the e-book validation result

Based on Figure 4, the validation of the e-book by two expert lecturers shows that the average Aiken's V validity scores for the content feasibility, presentation, and language aspects were 0.97, 0.90, and 0.96, respectively, all categorized as valid according to

Retnawati (2016). The average validation scores from Rater I for the content feasibility, presentation, and language aspects were 3.96, 3.58, and 4, respectively. Meanwhile, Rater II gave average scores of 3.88, 3.83, and 3.75 for these same aspects. The overall average validity score for all aspects, based on Aiken's V, was 1%, falling within the valid category. This indicates that the e-book is not only relevant and beneficial but also presented in a way that is easy to understand and adheres to proper language standards. Such validation is crucial to ensure that the e-book is academically sound and effective in enhancing students skills (Lim et al., 2020). The validity of the content and presentation allows the e-book to be confidently implemented in classrooms, particularly to strengthen students' digital literacy in the context of ecosystem material linked to indigenous culture. The integration of indigenous culture in this e-book provides significant added value. By connecting ecosystem material with the indigenous culture of Sumur Panguripan, students can see the real-world application of the concepts they learn in their daily lives (Hunaepi et al., 2018). This approach not only enhances their understanding of the material but also cultivates wise and responsible attitudes toward their environment. This aligns with the goals of the kurikulum merdeka, which emphasizes contextual and real-life-relevant learning (Hunaepi et al., 2020).

The use of an e-book integrated with the indigenous culture of Sumur Panguripan Surabaya is designed to align with problem based learning. This approach is highly relevant to the concept of society 5.0, where technology and indigenous culture collaborate to create innovative learning solutions. The PBL model incorporated into the e-book provides students with opportunities to think critically and solve problems related to the local ecosystem—an essential skill in the digital era. This is supported by research from Hebebcı (2022), which found that PBL integrated with technology can enhance students abilities to access, manage, and process information using technological tools.

The integration of indigenous culture also serves as a platform to promote sustainable education, encouraging students to act responsibly in preserving their environment. This aligns with one of the objectives of the pancasila student profile strengthening project in the independent curriculum. Each stage of the e-book is designed to actively involve students in accessing features and hyperlinks, thinking critically, and solving problems. These processes ultimately aim to enhance students skills in addressing challenges in the Society 5.0 era. The e-book incorporates digital literacy indicators into its features to support student learning. The bio icon feature provides instructions for navigating icons and e-book functions, enhancing photo visual skills. Similarly, bio-vis resents images and videos of the Sumur Panguripan ecosystem, reinforcing these skills. The Cardasi feature (search for data and information) enables students to use digital tools to build nonlinear, hypertextual, and navigational knowledge, aligning with the branching skills indicator. The pundasi feature (data and information collection) introduces students to factual information about the Sumur Panguripan ecosystem, encouraging them to evaluate and compare data, which corresponds to the reproductive skills indicator. The Bio-Pala feature (problem-solving) engages students in practical activities to compare, validate, and adopt information, addressing information skills. Additionally, the Bio-Sherka feature (share work) allows students to present their problem-solving results, while the bio-eva feature (evaluation) includes questions to deepen conceptual understanding, further supporting information skills. These integrated features allow students to operate the e-book to acquire information and concepts while indirectly improving their digital literacy skills. This aligns with research by Shiyamsyah and Yuliani (2022), which found that the implementation of interactive e-books effectively enhances students' digital literacy. This improvement is driven by problem-based learning, which encourages students to explore and solve problems independently through the use of technology.

Furthermore, the study by Lim et al. (2020) highlights that the use of e-books as a learning medium not only aids students in understanding the material but also enhances

their digital skills, particularly in navigating digital information and utilizing digital media effectively. This research demonstrates that incorporating hyperlinks, videos, and images in e-books enables students to better develop visual, navigational, and information management skills. Overall, the findings indicate that the problem based learning e-book integrated with indigenous culture from Sumur Panguripan, Surabaya, is not only valid in terms of content, presentation, and language but also effective in improving students' digital literacy and critical thinking skills. As such, this e-book serves as an excellent model for developing other teaching materials that integrate indigenous culture with digital technology in education. Students' learning mastery was evaluated using four pre-test and post-test questions designed to measure specific indicators of digital literacy, including photo visual skills, branching skills, reproductive skills, and information skills. The data were analyzed using the n-gain score formula to assess the effectiveness of the e-book. Students were considered to have achieved learning mastery if their scores exceeded the school's minimum learning mastery criteria set at 75. The results, including students' test scores after utilizing the PBL e-book integrated with Sumur Panguripan's indigenous culture to enhance their digital literacy, are presented in Table 4.

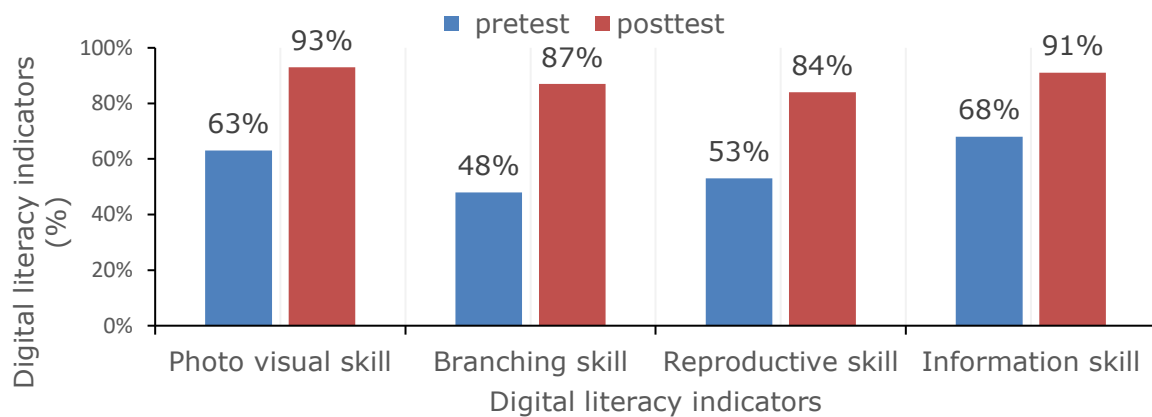
**Table 4.** The learning mastery results of students using a PBL E-book Integrated with indigenous culture from Sumur Panguripan Surabaya to Enhance Digital Literacy

	Pre-test	Post-test	N-gain
Average	58.3	89.0	0.73
Student mastery	0%	100%	
Criteria	Severely insufficient	Very Effective	High

The improvement in test results following the implementation of the PBL learning model and the e-book integrated with the indigenous culture of Sumur Panguripan, Surabaya, highlights the effectiveness of this approach in enhancing students' digital literacy. The pre-test results showed a lowest percentage score of 40%, categorized as "poor," and a highest score of 70%, categorized as "fair." In contrast, the post-test results revealed significant progress, with the lowest percentage score rising to 80%, categorized as "good," and the highest score reaching 100%, categorized as "excellent." These findings underscore the positive impact of integrating indigenous culture and PBL in e-books on students' learning outcomes and digital literacy development.

The findings indicate that the use of a PBL e-book integrated with the indigenous culture of Sumur Panguripan, Surabaya, is effective in enhancing students' digital literacy. This improvement is evidenced by an average n-gain score of 0.73, with the majority of students falling into the "moderate" improvement category and some in the "high" category. These results suggest that a project-based learning approach within a local context helps students achieve a deeper understanding of concepts. This aligns with the study by Idris (2020), which found that integrating PBL with technology significantly enhances student engagement and learning outcomes. Furthermore, this study recorded a remarkable increase in student learning mastery, rising from 0% in the pre-test to 100% in the post-test. This indicates that all students successfully met the criteria for learning objective achievement. These results align with the findings of Mahadi & Ariska (2022), who emphasized that problem-based learning encourages students to engage in solving complex problems, thereby enhancing their digital skills and strengthening their digital literacy through the use of e-book features. The average improvement achieved also reflects the effectiveness of the PBL approach in facilitating digital literacy, particularly in skills such as photo visual skills, branching skills, reproductive skills, and information skills. According to Setyaningsih et al. (2021), these skills are essential for digital literacy

development, especially when students are provided with opportunities to directly interact with locally relevant digital content. This interaction not only deepens their conceptual understanding but also fosters practical application skills. Overall, there was a significant improvement in students' digital literacy skills, as evidenced by the results of the pre-test and post-test. The achievement of digital literacy indicators through the e-book integrated with the indigenous culture of Sumur Panguripan, Surabaya, is presented.



**Figure 5.** Results of improving students digital literacy

Based on Figure 5, the competency test results of 36 students reveal significant improvements across four digital literacy indicators after using the PBL e-book integrated with the indigenous culture of Sumur Panguripan, Surabaya. The average scores for each indicator are as follows: photo visual skill at 93%, branching skill at 87%, reproductive skill at 84%, and information skill at 91%. These findings, supported by the data in Table 4 and Figure 4, demonstrate the effectiveness of the e-book in enhancing students' digital literacy. The photo visual skill indicator, with an average score of 93%, shows students' excellent ability to interpret and comprehend visual information. This aligns with the findings of Hafizah et al. (2022), which highlight that visual media can significantly enhance understanding and engagement in digital learning through relevant contextual visual enrichment. Meanwhile, the branching skill indicator, scoring an average of 87%, reflects students' strong ability to navigate and select appropriate information pathways. Akayoglu (2020) emphasize that this skill is crucial in digital environments, enabling students to explore diverse information sources and choose effective learning paths. This not only broadens their perspectives but also enhances their ability to gather relevant information aligned with the studied phenomena. Overall, these results affirm the value of integrating indigenous culture with PBL strategies in e-books to develop students' digital literacy comprehensively.

The digital literacy indicator for reproductive skills, with an average score of 84%, reflects students' strong ability to process and reproduce received information. However, the challenge lies in understanding diverse pieces of information and connecting them, which requires advanced critical thinking. According to Aesaert et al. (2014), reproductive skills are crucial in digital learning as they enable students to comprehend and apply information in relevant contexts based on previously acquired knowledge. The indicator for information skills reached an impressive 91%, indicating students' excellent ability to search for, evaluate, and utilize relevant information effectively. This aligns with the findings of Ng et al. (2020), which emphasize that information skills play a critical role in fostering students' digital literacy success.

Overall, this study demonstrates that PBL e-books integrating elements of indigenous culture can effectively enhance digital literacy. These findings align with previous research on the effectiveness of the PBL approach in digital education, which highlights the importance of collaboration, problem-solving, and local context relevance in deepening students' understanding of the material.

## Conclusion

The development of a PBL e-book integrated with the indigenous culture of Sumur Panguripan, Surabaya, has been validated as highly effective. Validity testing by two expert lecturers yielded average scores for content feasibility, presentation, and language aspects of 0.97, 0.90, and 0.96, respectively, with an Aiken's V validity score of 1%, categorized as highly valid. The e-book was also shown to be effective in improving digital literacy skills, as evidenced by an average post-test score of 89 and an n-gain score of 0.73, which falls into the high criteria. The integration of indigenous culture within the e-book not only enhances students' digital literacy skills but also deepens their understanding of local context and culture. This fosters an appreciation for and commitment to preserving indigenous culture, while simultaneously developing critical and creative thinking skills to address real-life problems. This e-book can serve as a valuable resource for teachers aiming to enhance students' digital literacy skills, aligning with the demands of 21st-century education and preparing students to thrive in the society 5.0 era.

## Acknowledgement

The author extends heartfelt gratitude to Dr. Sifak Indana, M.Pd., and Dr. Tarzan Purnomo, M.Si., as the validating experts and examiner for the e-book development research.

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