

Project-based learning e-book with Indonesian local wisdom supporting SDGs to facilitate students' bioentrepreneurship skills

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Abstract: The 21st-century competency demands, namely creativity, critical thinking and problem solving, communication, and collaboration. The learning outcomes of the independent curriculum in Indonesia emphasize the importance of students adopting attitudes that support the Sustainable Development Goals (SDGs). Therefore, this research is necessary to produce a valid e-book for facilitating students' bioentrepreneurship skills by incorporating Bojonegoro's local wisdom and supporting SDG 15. The method used in developing the e-book was the 4D model (define, design, develop, and disseminate). Validation which covered content feasibility, presentation feasibility, and language feasibility was carried out by two expert lecturers in the fields of content and instructional media and one biology teacher. Reliability testing was conducted to ensure that the data is trustworthy and consistent. Data analysis was obtained quantitatively and descriptively. The result reveal that content and presentation feasibility are the same, with a score of 3.76 in the very valid category, and the reliability categories are very high at 95% and 93%, respectively. In addition, the language feasibility shows a score of 4, indicating a very valid category with 100% reliability. This result demonstrates that the developed e-book is highly valid for facilitating students' bioentrepreneurship skills.

Keywords: 21st-century competency; ecosystem; learning resources; e-book validity

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Introduction

The 21st-century learning paradigm often becomes an important topic discussed by organizations such as the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the Partnership for 21st Century Skills (P21), emphasizing that the main focus is preparing young generations to face the workforce and job opportunities in economic stability (González et al., 2020). Life skills and career skills, learning and innovation skills, and information, media, and technology skills are the competencies that need to be prepared for the younger generation to face global competition (P21, 2015). The learning process can be used to facilitate life skills so that the learning process is not only oriented towards theoretical concepts but also their application in real life (Shiyamsyah et al., 2024)

The learning outcomes for phase E in the Indonesia independent curriculum expect students to actively participate in providing solutions to problems, analyzing, planning, executing, as well as evaluating and reflecting on themselves as part of efforts to achieve the Sustainable Development Goals (SDGs). 21st-century skill frameworks do not usually address the most practical aspects of teaching methodologies (Riyadi & Rahayu, 2018). Teachers play a crucial role in guiding learning activities toward achieving the SDGs (Acs et al., 2016) especially SDGs-15 which is related to the conservation topic.

Entrepreneurship is the creative and innovative ability used as a foundation for strategies and resources to seek opportunities for success, which is highly aligned with the efforts of the SDGs (Shiyamsyah et al., 2024). In entrepreneurship, values, abilities, and behaviors are highlighted in how a person faces life's challenges to seize opportunities, despite the various risks they may encounter (Madjakusumah & Saripudin, 2020).

Bioentrepreneurship comes from the word "bio," meaning living organisms, and "entrepreneurship," meaning business ventures. It refers to everything related to the attitudes, actions, and processes carried out by entrepreneurs in starting, running, and developing businesses using living organisms that can be processed into products, marketed, and generate productive economic outcomes (Muliadi et al., 2021). Bioentrepreneurship is an empowerment approach that combines biological concepts with entrepreneurship (Wardhani et al., 2020). It is the integration of biology and entrepreneurship, involving the utilization of biological materials with market value to create products that can be sold (Bridge, 2017). Bioentrepreneurship is well-suited to improve academic performance, creativity, and entrepreneurial interest among high school students when applied in biology lessons (Shiyamsyah et al., 2024).

Generation Z students have a strong attachment to the use of modern technology and the internet in their activities (Fitrahmawati & Suhartini, 2021). Therefore, teachers need to innovate and be creative in developing the learning process by incorporating technological and internet advancements, then applying them to learning materials and real-life contexts (Susilawati et al., 2020) and up-to-date technology-based teaching materials are very much needed by Generation Z students.

E-books are one form of teaching material presented in a modern way with the advantages of being practical and flexible, and they can contain content such as videos, images, and articles that help students understand the concepts (Agustin & Razi, 2023). Therefore, e-books can aid in visualizing abstract material, which helps students understand and increases their interest in the learning process (Martha et al., 2018). E-books can be used as a learning medium that includes engaging content such as images, videos, and hyperlinks to make the learning process more interesting and enjoyable (Rosyidah & Rahayu, 2022).

Febriarti and Rahayu (2022) revealed that the use of e-books as teaching materials leads to better learning outcomes achievement compared to the use of traditional paper materials. This finding is consistent with the study conducted by Wahyuni and Rahayu (2021), which shows that the use of e-books, when aligned with the learning model, can enhance higher-order thinking skills and innovation in problem-solving through various activities or features, such as formulating problems, making arguments, and evaluating issues in the surrounding environment.

Project-based learning (PjBL) is a project-based approach that effectively trains or facilitates students' entrepreneurial skills or bioentrepreneurship (Shiyamsyah et al., 2024). Project-based learning involves students in acquiring information and demonstrating their knowledge, which is then implemented in real-world scenarios (Maharani & Efendi, 2023). The project-based learning model guides students in designing, organizing, and formulating solutions or alternatives to problems specified in project tasks, so e-books can be developed into teaching tools that include activities to train or facilitate entrepreneurship skills and implement concepts from real-life situations (Ridha et al., 2024).

E-books can be developed by incorporating local wisdom or the potential of a particular region and then linking it to the learning material being taught as a concrete example, so that students can connect theoretical concepts with real-life implementation. Local wisdom can help students develop creativity and imagination as well as enhance their sense of nationalism (Masihu & Augustyn, 2021). The use of local wisdom in learning can assist students in understanding and appreciating the cultural richness and natural potential of the region (Jacinda et al., 2024).

The local wisdom of the Bojonegoro community in Ngringinrejo Village, East Java, Indonesia, is related to the cultivation of starfruit. Additionally, in Wedi Village, East Java, Indonesia, there is also local wisdom in the cultivation of salak (snake fruit). Planting and management of starfruit and salak wedi are carried out traditionally by the community. Almost every family in the area has land planted either with starfruit or salak. The natural potential in the region presents significant opportunities for development and supports SDG-15 (Sary et al., 2023).

Ecosystems are a topic in biology that is closely related to achieving the SDGs-15. Ecosystems are the study of interactions between living organisms within a particular area and their environment (Masihu & Augustyn, 2021). Ecosystem topics can stimulate students to think analytically, encouraging contextual thinking related to the environment (Rosyidah & Rahayu, 2022). Additionally, understanding ecosystems requires a complex comprehension, which necessitates contextual learning with the environment (Susilawati et al., 2020).

In relation to the challenges of studying the topic of ecosystems, several previous studies have applied the PjBL model to improve students' competence in this topic (Kricsfalusy et al., 2018). Several studies reported its impact on improving students' thinking skills (Khafah et al., 2023; Savitri & Susanti, 2024), while other studies reported its positive impact on improving students' environmental (Carlina & Djukri, 2018) and eco-literacy (Park & Kim, 2024). However, studies that develop PjBL model modules with an orientation towards developing SDGs-based competencies are still difficult to find.

Research on developing e-books as teaching materials based on a PjBL approach and local wisdom, which includes activities in the form of features aligned with learning outcomes in the Merdeka curriculum to foster bioentrepreneurship indicators, particularly those highlighting the local wisdom values of Bojonegoro Regency, such as starfruit and salak wedi, has not yet been found (Shiyamsyah et al., 2024). Meanwhile, the Bojonegoro district government has established and developed agrotourism for starfruit and salak wedi as part of its efforts to support the SDGs. Therefore, this e-book, which is expected to be

valid, practical, and effective as a result of development, aims to foster students' bioentrepreneurship skills through a PjBL approach infused with Bojonegoro's local wisdom values and can be used to facilitate students according to the demands of 21st Century Education and the SDGs. This article will discuss the results of the validation of the developed e-book. In addition, through this e-book also aims to prepare the younger generation to face global competition in economic stability and serves as an alternative effort to achieve SDG-15.

Method

This development research is the development of e-books as teaching materials on ecosystem topics using the 4D development model to enhance students' bioentrepreneurship skills (Shiyamsyah et al., 2024). This stage includes define, design, develop, and disseminate. Define; this includes activities to analyze the fundamental problems in learning and resolve them, analyze student characteristics, analyze materials, analyze tasks, and formulate learning objectives to set the direction for e-book development. Design; this involves designing the e-book based on the analysis results from the define stage, including Media Selection, Format Selection, Content and Feature Arrangement, and the development of evaluation questions for pre-test and post-test needs, which is then called Draft I. Internal review is conducted on Draft I, which then becomes Draft II. Develop; this activity consists of e-book validation and revisions based on feedback from validators, resulting in Draft III. This is followed by testing the e-book to assess its practicality and any revisions, which results in Draft IV. Draft IV will undergo effectiveness testing for use in training bioentrepreneurship skills, and the results of this analysis will be used for refinement and finalization, producing the final e-book. Disseminate; the final version of the e-book, which is ready for distribution, is disseminated, including through article publication.

The validation covered content feasibility, presentation feasibility, and language feasibility and was carried out by two expert lecturers in the fields of content and instructional media and one biology teacher. The obtained data was analyzed using descriptive quantitative methods. Validation data interpretation criteria can be seen in Table 1 with the formula (1) (Thiagarajan et al., 1974).

Table 1. Validation data interpretation criteria

Scale Value	Criteria
3,26-4,00	Highly Valid
2,51-3,25	Valid
1-76-2,50	Quite Valid
1,00-1,75	Less Valid

$$\text{Average Score} = \frac{\text{The sum of the scores for each criteria from all validators}}{\text{Number of Validators}} \quad (1)$$

The reliability of the results of validity scores is calculated by the formula and presented in percentage scores. The agreement formula is presented in formula (2).

$$R = 1 \frac{A-B}{A+B} \times 100\% \quad (2)$$

Description: R= Reliability coefficient, A= Assesment of validator who give high scores, B= Assesment of validator who give low scores. The results said to be reliable if the reliability value is $\geq 75\%$ (Fitri & Rahayu, 2021).

Results and Discussion

The development of the PjBL-based e-book with local wisdom from Bojonegoro is carried out through several stages of analysis and data collection. One of the collected and analyzed data is about the local wisdom of the Bojonegoro community in Ngringinrejo Village regarding starfruit cultivation. The proper planting and management practices, while preserving the values of local wisdom passed down through generations with an emphasis on environmental sustainability, have positively impacted the region, leading to it becoming known for producing high-quality starfruit. Additionally, Wedi Village also possesses local wisdom in the cultivation of salak (snake fruit). 'SalakWedi' has become a local commodity known for its distinctive taste, which is sweet with a slight tanginess. Planting and management are carried out traditionally by the community. Almost every family in the area has land planted with salak. These two regions are evidence that the passing down of knowledge on plant and environmental management through generations has created local wisdom values that positively influence the development of promising local potentials.

The Bojonegoro government, recognizing this potential, has collaborated with the community and village organizations to develop the area into an agrotourism destination. This natural potential has had a positive impact on the local community and government. However, its use has not yet been widely integrated as a learning resource and topic in schools. It could be utilized to raise students' awareness of local potential and train or facilitate them in positive utilization by exploring business opportunities while still considering environmental values. Additionally, despite its development into an ecotourism area, the abundance of starfruit and salak in Bojonegoro is not well-utilized. Most of the harvest is sold as fresh fruit, often leading to some of it spoiling and decreasing in economic value. Therefore, there is a need for awareness and skills to process these abundant natural resources—namely, starfruit and salak—into innovative, economically valuable, and environmentally friendly products, which should be taught to students through the learning process in schools.

In the development of the e-book, the researchers incorporated several features that include activities based on PjBL syntax to enhance bioentrepreneurship skills. The features and their connections to PjBL syntax and bioentrepreneurship skill indicators are shown in Table 2.

Table 2. Feature relation with PjBL syntax and bioentrepreneurship indicators

Syntax of PjBL	Feature	Bioentrepreneurship Indicator
Start with a driving question (problem analysis and project determination)	Ayo Meneliti	Problem observation
Designing plan for the project	Mari Rencanakan	Product Innovation
Creating schedule	Mari Rencanakan	Product Innovation
Monitoring the project progress	Ayo Lakukan	Product Innovation
Assessing the outcome	Mari Menghitung	Sales result analysis

The e-book consists of materials and activities organized into several features, namely 'Let's Research,' 'Let's Plan,' 'Let's Do,' 'Let's Calculate,' and 'Bio Evaluation.' These five features were developed and aligned with PjBL syntax to enhance bioentrepreneurship skills by incorporating four indicators: problem analysis, product innovation, sales analysis, and reflection. The developed e-book is shown in Figure 1.

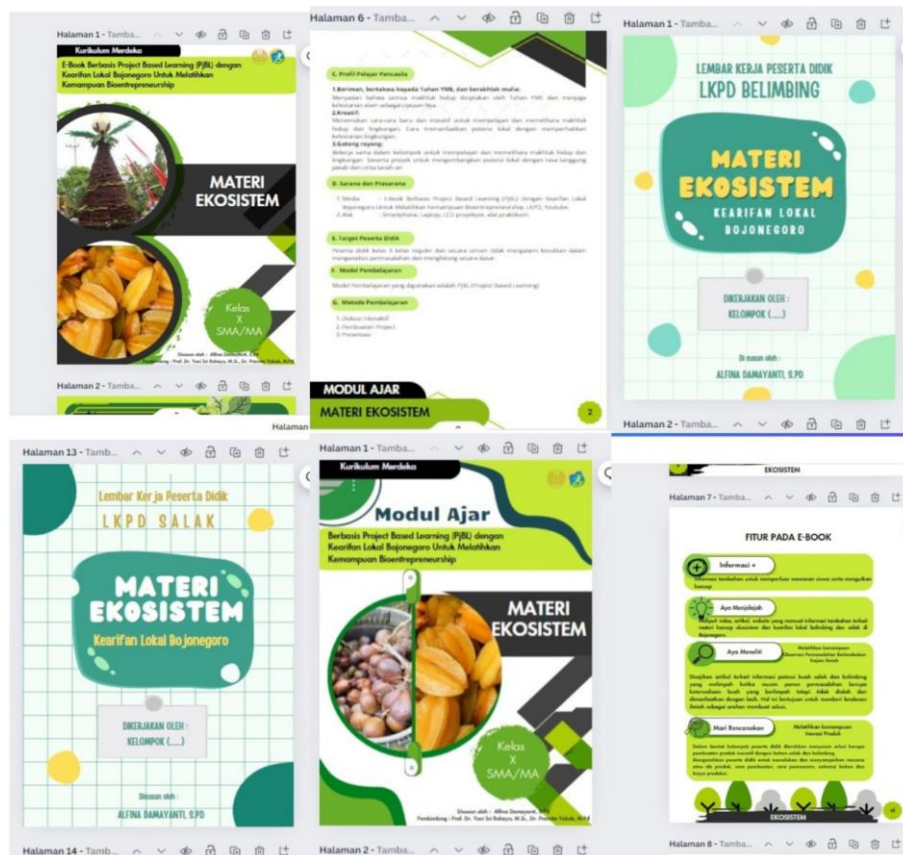


Figure 1 Developed of e-book

Validation was carried out on three aspects: content feasibility, presentation feasibility, and language feasibility. The overall content feasibility is presented in [Table 3](#).

Table 3. Results of content feasibility

Aspects of the Contents	Result	Criteria	Reliability
Alignment of materials with learning outcomes and learning objectives	3.83	Highly Valid	95%
Relevancy of the ecosystem concept and glossary	3.83	Highly Valid	95%
Alignment of features with the PjBL syntax	3.67	Highly Valid	95%
Alignment of materials with local wisdom	4.00	Highly Valid	95%
Alignment of features with bioentrepreneurship indicators	4.00	Highly Valid	95%
Relevancy of features. PjBL syntax and bioentrepreneurship indicators	3.71	Highly Valid	95%
Average	3.76	Highly Valid	95%

Generally, the content feasibility for the e-book shows an average score of 3.76, which can be interpreted as very valid with a reliability level of 95%, indicating high reliability. Some comments and suggestions from the validators include adding indicators for ecosystem material and linking them with bioentrepreneurship skill indicators, as the point on the alignment of CP (Competency Profile) and learning objectives indicators received a score of 3.83. The concept map received a score of 3.83, with a note that it needs to be better aligned between the material and its organization within the e-book. The alignment of features with PjBL syntax received a score of 3.67, categorized as highly valid, with comments suggesting that the project activities are not explained in detail, and that a more efficient monitoring mechanism is needed, such as creating a social media group to facilitate communication and monitoring of student project progress. There should also be an emphasis on reflection, specifically evaluating personal experiences, understanding of the material, and the entrepreneurial skills acquired by students after completing the project activities. The scores, comments, and suggestions are also related to the features within the e-book, such as placing more emphasis on project activities and clarifying problems in the 'Let's Research' feature to ensure students can easily understand the connection between the problems and solutions facilitated through the project activities. Explanations related to the PjBL learning model sequence need to be clarified, such as by adding details on 'schedule' and 'monitoring.' The alignment of the material with local wisdom received a score of 4, categorized as highly valid. The alignment of features with bioentrepreneurship skill indicators also received a score of 4, categorized as highly valid, while the alignment and connection between features, PjBL syntax, and bioentrepreneurship indicators received a score of 3.71. The reliability level is very high, with a score of 95%, indicating consistency and trustworthy results from the validators.

Activities within the e-book play a crucial role in achieving the intended learning objectives. The developed e-book uses a PjBL-based learning model, so the activities or features within it must clearly reflect the syntax leading to project-based learning. Clearly designed learning related to the type of learning model and media used will enhance students' ability to understand the material and provide better learning outcomes achievement (Dewi et al., 2018). Validation of teaching materials must consider content feasibility (Damayanti & Yuliani, 2023). An e-book can be considered valid if it has been validated by several experts in the fields of media and content (Wijaya et al., 2018). Teaching materials are of higher quality when they involve real-life experiences and examples from the students' environment. An e-book that aligns with the model, content, and provides real-life experiences or examples will improve students' understanding (Agustin & Razi, 2023). The use of local wisdom as a learning tool linked with the material will enhance students' contextual understanding. Therefore, with the content feasibility test results showing highly valid criteria and a high reliability value, it can be concluded that the developed e-book is suitable for use. Furthermore, the second component is presentation feasibility, as shown in [Table 4](#).

Overall, the presentation feasibility validation received an average score of 3.76, which falls into the very valid category, with a reliability level of 93%, indicating that the data is highly reliable. The color selection received a score of 3.67, with comments suggesting that more attention should be given to the background color in relation to the text to improve visibility. Regarding the layout, it received a score of 3.76, with comments recommending better attention to the positioning of images and clear descriptions to match the images. The writing score received 3.67, with comments suggesting that font sizes could be reduced and images enlarged for clarity and appeal. The font choice for titles or subtitles should be

distinct from the font used for descriptions, and font sizes should be adjusted to make them more prominent and engaging for readers. The reliability score of 93% indicates a very high category, demonstrating that the reliability of the presentation validation results is consistent and trustworthy.

Table 4. Results of presentation feasibility

Aspects of the Presentation	Result	Criteria	Reliability
Cover reflecting the contents	4.00	Highly Valid	93%
Color choices	3.67	Highly Valid	93%
Displaying images and videos of local wisdom relate to the material	4.00	Highly Valid	93%
Proportional alignment of layout (text and image placement)	3.67	Highly Valid	93%
Font size easy to read	3.67	Highly Valid	93%
Text color	3.67	Highly Valid	93%
Average	3.76	Highly Valid	95%

Presentation feasibility includes several points related to the layout of text and images, as well as overall readability of the content. Good presentation media will make students more interested in learning, thus increasing their motivation and leading to better learning outcomes achievement (Mahmudah & Rahayu, 2024). It is well known that It is important to use clear images and content descriptions, as well as a neat layout, to produce high-quality teaching materials (Adom et al., 2020).

The presentation and layout of e-book were created by using the Canva with the aim of producing an engaging e-book that motivates students in their learning. This is consistent with the research by (Damayanti & Yuliani, 2023) which found that teaching media developed with Canva can enhance students' enthusiasm for learning and make them more active in the learning activities. The third component evaluated in the e-book validity test is language feasibility, as presented in Table 5.

Table 5. Results of language feasibility

Aspects of the Language	Result	Criteria	Reliability
Sentences are easy to understand and communicative	4.00	Highly Valid	100%
Language arrangement is appropriate to PUEBI	4.00	Highly Valid	100%
Sentences are clear (not lead to ambiguous interpretations)	4.00	Highly Valid	100%
Operational language (not local language)	4.00	Highly Valid	100%
Average	4.00	Highly Valid	100%

The language feasibility test shows an average score of 4.00, indicating that the language feasibility is in the very valid category with a reliability level of 100%. This suggests that the linguistic aspects of the e-book adhere to appropriate rules and word choices. A minor suggestion is to pay more attention to species names, which should be printed in italic font. The validity of teaching materials and learning media can be assessed from aspects such as display design, ease of operation, image and video quality, and the use of clear and understandable language which is supported by other researchers (Syahdia et al., 2024; Wahyuni & Rahayu, 2021)

Additionally, the reliability test in this study shows high results in content feasibility, presentation feasibility, and language feasibility. It is well-known that stability in evaluation needs to be considered in research, necessitating a reliability test. This is supported by other research on the development of media, teaching materials, or assessments in various fields such as chemistry, biology, and mathematics (Feng et al., 2021; Korpershoek et al., 2020; Munadzir, 2022)

Conclusion

The results reveal that the e-book based on PjBL with local wisdom of Bojonegoro-East Java, Indonesia supporting SDGs-15 to facilitate students' bioentrepreneurship skills is valid for use in learning activities, with validation scores for content, presentation, and language being 3.76, 3.76, and 4, respectively. This is supported by the validation results indicating that the validity of content, presentation, and language are each categorized as 'highly valid'. Further research is needed to test the practicality and effectiveness of the developed e-book in facilitating students' bioentrepreneurship skills

supporting SDGs-15. Based on the research findings, the author recommends using local wisdom in learning, as it not only provides contextual or real-life examples but also increase a sense of love for the region and care for the environment. It is necessary to conduct trials on the developed e-book before it is implemented in school learning activities.

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Conflicts of Interest

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

Author Contributions

A. Damayanti: investigation, data analysis, writing-original, draft preparation and editing. **Y. S. Rahayu:** Conceptualizing research, methodology, supervision **P. Yakub:** writing-review and editing, project administration, investigation.

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