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DEVELOPMENT OF AN ECOLITERACY-BASED E-LKPD USING LIVEWORKSHEETS ON ENVIRONMENTAL CHANGE MATERIALS FOR GRADE X

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ABSTRACT

This study was motivated by the low utilization of contextual digital teaching materials in learning environmental change topics, resulting in environmental awareness and students' critical thinking skills not developing optimally. The study aimed to develop an ecoliteracy-based E-LKPD using Liveworksheets on environmental change materials for Grade X and to describe its validity and practicality levels. The research employed a Research and Development approach using the ADDIE model, limited to the analysis, design, and development stages. Data were obtained through teacher interviews, validation by subject-matter and media experts, and a small-group trial involving 15 students of SMA IT Fadhilah Pekanbaru using a Likert-scale questionnaire. The validation results showed an average score of 79% (valid category) for the material, media, and language aspects, while practitioner (teacher) validation reached 90% (very valid category). The student practicality trial produced an average of 91.5% in the very practical category, viewed from a systematic instructional design, ease of operation, and an attractive and contextual appearance. The integration of cognitive, attitudinal, and skills aspects within the ecoliteracy framework encourages students to analyze environmental problems, develop ecological empathy, and demonstrate responsibility toward the environment. It is concluded that the developed ecoliteracy-based E-LKPD is valid and highly practical for use as an alternative digital teaching material to support the implementation of the Merdeka Curriculum and the strengthening of the environmentally oriented Pancasila Student Profile.

Keywords: E-LKPD; Lcoliteracy; Liveworksheets; Environmental Change; Merdeka Curriculum.

INTRODUCTION

Biology learning holds a very strategic position in shaping students' ecological awareness through mastery of ecological concepts, sustainability principles, and an understanding of the interconnections between humans and the environment. Within the paradigm of 21st-century education, biology is not only viewed as a subject that demands mastery of scientific concepts, but also as a medium for fostering ecological character oriented toward the sustainability of life on Earth. Through biology learning, students are expected to understand natural processes holistically, think critically about environmental issues, and develop moral responsibility in maintaining ecosystem balance.

Environmental change is a Grade X biology learning topic that is directly related to global challenges such as global warming, pollution, deforestation, and the biodiversity crisis, which have become worldwide concerns (Dewi et al., 2024). Field realities indicate that learning on this topic is still dominated by lecture methods and the use of conventional teaching materials, such as government-issued textbooks and PowerPoint presentations. This pattern tends to be teacher-centered, causing students to play a passive role and experience difficulties in understanding the relationship between scientific theory and real environmental phenomena in their surroundings.

Based on interviews with biology teachers at SMA IT Fadhilah Pekanbaru, it was found that the Student Worksheets (LKPD) used are still in printed form and have not been able to foster students' interest, curiosity, or critical thinking skills regarding contextual and applicative environmental issues.

The rapid development of technology in the field of education opens opportunities for educators to develop interactive, adaptive learning innovations oriented toward students' needs. One such innovation is the E-LKPD (electronic student worksheet), a digital teaching material that combines text, images, audio, and video to create a richer and more engaging learning experience. E-LKPD functions not only as a learning resource but also as a medium for interaction between students and learning materials, allowing exploration through investigative and reflective learning activities. According to Prasetyo (2020), E-LKPD can create a dynamic and collaborative learning environment by positioning students as active participants in the learning process. Hidayati (2021) emphasizes that the integration of E-LKPD in biology learning plays a significant role in improving students' critical thinking skills, intrinsic motivation, and learning independence. E-LKPD also has the potential to be integrated with an ecoliteracy approach that functions to foster sustainable environmental care attitudes among students (Lestari & Rahman, 2022).

Ecoliteracy refers to an individual's ability to understand the basic principles of natural systems, think systemically, possess environmental care attitudes, and take action to protect the environment (Capra, 2021). In biology learning, ecoliteracy emphasizes aspects of knowledge, attitudes, and individual actions toward nature as manifested in real actions. According to Dewi and Rachmadiarti (2023), the application of ecoliteracy values in the learning process can enhance students' environmental empathy, strengthen ecological awareness, and foster responsible behavior toward nature.

Integrating ecoliteracy concepts into E-LKPD makes learning activities more meaningful by balancing cognitive, attitudinal, and skills or action aspects. In this study, the Liveworksheets platform was used as the development medium because it provides interactive features such as digital quizzes, video uploads, and direct input worksheets that can be accessed through online devices. Canva was also used as a medium for editing E-LKPD content to make it more engaging and contextual for students.

Based on these theoretical and empirical foundations, this study aims to develop an ecoliteracy-based E-LKPD using Liveworksheets on environmental change materials for Grade X as an alternative digital teaching material that is valid, practical, and aligned with the demands of 21st-century learning.

RESEARCH METHODS

This study employed a Research and Development approach, focusing on the development of a product in the form of an E-LKPD used by students in learning activities. The development process utilized the ADDIE model, which was limited to three stages: analysis, design, and development.

The E-LKPD on environmental change materials was developed using an ecoliteracy approach as its conceptual foundation. The aspects and indicators of ecoliteracy embedded in the Environmental Change E-LKPD are presented in Table 1.

Table 1. Ecoliteracy Aspects and Indicators

No	Ecoliteracy Aspect	Ecoliteracy Indicators
1.	Cognitive	1. Ability to analyze environmental problems 2. ability to propose solutions to environmental problems
2.	Attitudinal	1. Possessing empathy and environmental awareness 2. fostering respect for the environment and its components
3.	Skills	1. Demonstrating responsibility toward the environment 2. utilizing available resources and maintaining environmental sustainability properly

(Source: Modified from Tyas et al., 2022)

The scope of this study included validation activities conducted at the Biology Education Study Program, Faculty of Teacher Training and Education, Universitas Riau, and a limited trial at SMA IT Fadhilah Pekanbaru involving Grade X students. Data were collected through semi-structured interviews with teachers, expert validation questionnaires, and small-scale student response questionnaires. The main variables examined in this study were product validity and product practicality. Product validity covered content, language, and media appropriateness as assessed by experts, while practicality was measured based on teacher and student responses regarding the ease of use of the developed E-LKPD (Sugiyono, 2022).

Data collection techniques used to obtain information related to performance gaps and student analysis included interviews, questionnaire distribution, and literature studies. Meanwhile, data for assessing product validity were obtained through validation by subject-matter and media experts.

Data analysis was conducted using descriptive quantitative techniques, focusing on the validity results of the E-LKPD evaluated by experts and the practicality results assessed by teachers and students. Validity and practicality data were analyzed using a Likert scale with predetermined scoring criteria to obtain an objective overview of the levels of validity and practicality of the E-LKPD. In the validity stage, assessments were conducted by two validators, namely subject-matter and media experts. The validity scores were then analyzed to determine the level of E-LKPD validity using a 4-point Likert scale with the following formula:

$$\text{Validity Percentage} = \frac{£}{N}\ X\ 100\%$$

where:

Σx = Total score obtained from validators

N = Maximum possible score

After obtaining the overall percentage score for each statement, the product validity was interpreted based on the categories shown in Table 2.

Table 2. Product Validity Categories

Percentage (%)	Category
81-100%	Very Valid
61-80%	Valid
41-60%	Moderately Valid
21-40%	Less Valid
0-20%	Not Valid

(Source: Fraenkel, J. R et al., 2019)

Practicality was reviewed based on teacher and student response results. Each activity was measured using a 4-point Likert scale. The scores obtained were calculated using the following formula:

$$\text{Practicality Percentage} = \frac{£}{N}\ X\ 100\%$$

After the percentage data were obtained, the level of practicality was interpreted according to the practicality criteria presented in Table 3.

Table 3. Product Practicality Categories

Percentage (%)	Category
81-100%	Very Practical
61-80%	Practical
41-60%	Moderately Practical
21-40%	Less Practical
0-20%	Not Practical

RESULTS AND DISCUSSION

Analysis Stage

The analysis stage was conducted to identify possible causes of performance gaps and to determine solutions that could be used to address these issues. Performance analysis was carried out through interviews with Grade X biology teachers at SMA IT Fadhilah Pekanbaru to identify obstacles and difficulties experienced by students in understanding environmental change material. The interview results indicated that students had difficulty analyzing environmental problems that emerged during learning. This was caused by instruction that was still dominated by lecture methods and conventional teaching materials in the form of government-issued textbooks and monotonous presentation slides. Teachers stated that learning had not yet been directed toward problem-based or analytical models, which are crucial for environmental change topics (Setiawan, 2020).

These findings are in line with Rahmawati (2021), who stated that indicators of environmental change, such as increasing pollution, are difficult for students to understand without the application of real-world concepts. Therefore, innovation is needed to interactively visualize environmental problems.

Curriculum analysis was conducted to ensure that the developed product aligned with the curriculum implemented at the school. Based on interview results, it was found that Grade X at SMA IT Fadhilah had implemented the Merdeka Curriculum. Accordingly, the developed E-LKPD was designed based on Phase E learning outcomes and the Learning Objectives Flow for environmental change material. Capra (2021) defines ecoliteracy as the ability to understand the relationship between humans and the environment as implemented through action, while the Ministry of Education and Culture (2021) emphasizes that environmental change material must be contextual and support the environmentally oriented Pancasila Student Profile. The formulated learning objectives encompassed cognitive aspects related to analyzing environmental problems, attitudinal aspects related to developing empathy and environmental awareness, and skills aspects related to environmental responsibility and the effective use of resources.

The analysis of student needs showed that 93.3% of students liked biology as a subject, yet 66.7% of students experienced difficulties in understanding contextual biology material. These results indicate that students possess visual learning characteristics and require interactive and contextual media that align with real-world conditions.

Design Stage

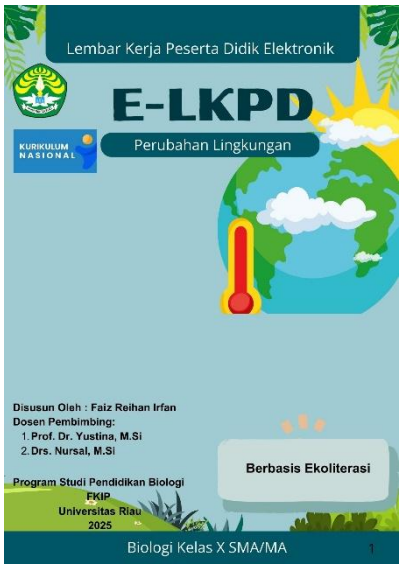
The design stage was a follow-up to the analysis stage. The researcher designed the Electronic Student Worksheet (E-LKPD) using Canva. The E-LKPD featured varied displays containing material in the form of literacy-based reading texts, images, videos, and question items using an ecoliteracy approach integrated with various formats such as multiple choice, listening, and check boxes (Asiri, A., 2022). These various formats were intended to make students feel as though they were playing a game, thereby increasing their interest during environmental change learning. The E-LKPD was created in PDF format and integrated through the Liveworksheets website, allowing access via smartphones and laptops.

The E-LKPD consisted of several components: (1) cover; (2) indicators and learning objectives; (3) instructional videos using an ecoliteracy approach to address environmental change problems; and (4) case-based questions to be answered by students.

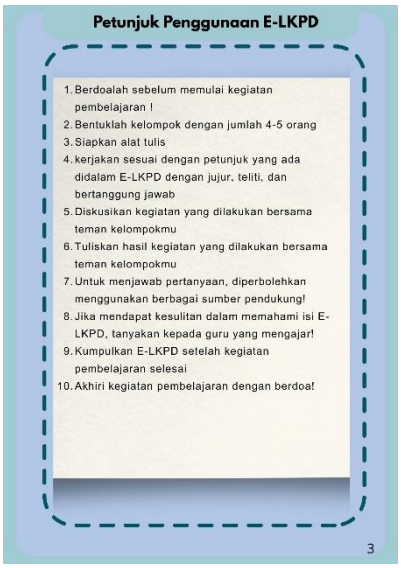
Furthermore, the assessment strategy embedded in the E-LKPD encompassed cognitive, attitudinal, and skills domains measured through questions integrated with ecoliteracy indicators.

This assessment was designed to guide students toward ecoliteracy indicators, thereby training students' environmental care attitudes (ecoliteracy).

a. Cover Display

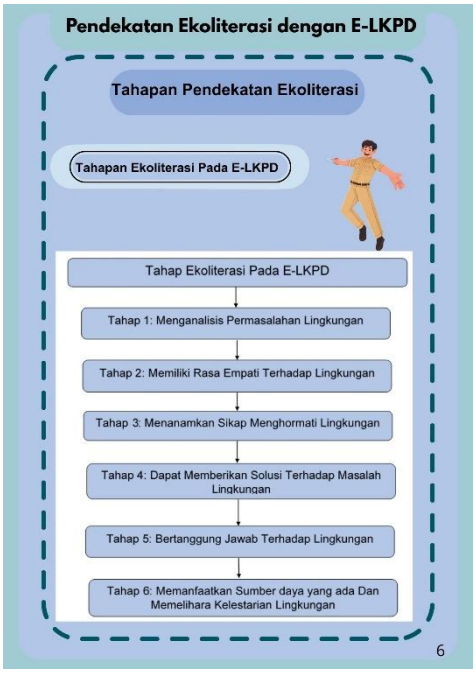


b. User Guide

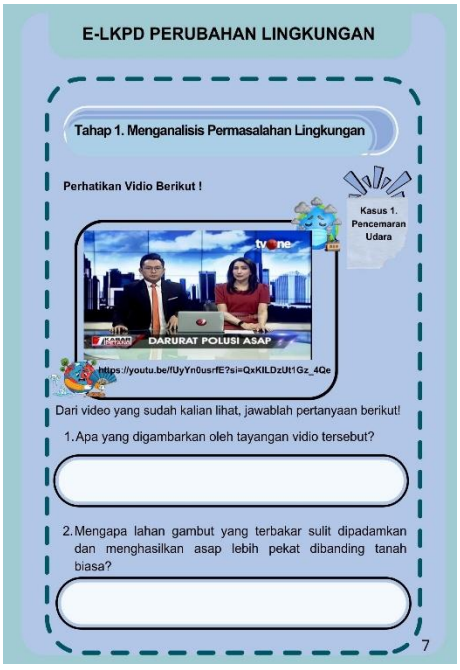


c. Learning Indicators and Objectives

d. Ecoliteracy Stages



e. Content Display of the Ecoliteracy-Based E-LKPD



f. Content Display of the Ecoliteracy-Based E-LKPD

Figure 1. Design of the Ecoliteracy-Based E-LKPD

Development Stage

The development stage involved the realization of the product design based on the previously prepared design, which was then validated by subject-matter experts, media experts, and a practitioner (teacher) before being tested on students. The development of the E-LKPD was carried out through several systematic steps, including the preparation of environmental change content aligned with Phase E learning outcomes and the Learning Objectives Flow; visual design using the Canva application by considering aesthetic aspects, layout balance, attractive color selection, and the use of images and videos relevant to the material; and conversion of the document to the

Liveworksheets platform to add interactive features such as drag-and-drop questions and short-answer items that allow students to interact directly with the learning content. QR codes were incorporated into several sections of the material to facilitate direct interaction with learning content, as well as to enable quick and practical access to the E-LKPD via smartphones or laptops.

After development was completed, the E-LKPD underwent formative evaluation through expert validation, teacher responses, and a small-scale trial with students to assess its validity and practicality based on user feedback for product refinement. Validation was conducted by three validators: two university lecturers as subject-matter and media experts, and one biology teacher from SMA IT Fadhilah as a practitioner validator. The validation results indicated that the material aspect received scores of 84% from Validator 1 and 76% from Validator 2; the media aspect received scores of 82% from Validator 1 and 78% from Validator 2; and the language aspect received scores of 82.5% from Validator 1 and 75% from Validator 2. Overall, the average validation score from the two expert validators was 79.5%, indicating a valid category and suitability for use.

Table 4. Results of Subject-Matter and Media Expert Validation

No	Assessed Aspect	Validator 1	Validator 2	Average
1	Material Aspect	84%	76%	80%
2	Media Aspect	82%	78%	80%
3	Language Aspect	82,5%	75%	78,75%
	Overall Average	82,8%	76,3%	79,5%

The small-group trial results showed that the ecoliteracy-based E-LKPD received very positive responses from students. The trial involved 15 Grade X students of SMA IT Fadhilah who had studied environmental change material. The instructional design aspect obtained a score of 93% in the very practical category, indicating that students perceived the activity structure in the E-LKPD as systematic and relevant to their lives because the material was linked to real phenomena such as air, soil, and water pollution. The operational aspect obtained a score of 90% in the very practical category, indicating that students considered the product easy to use and access due to clear usage instructions, communicative language, attractive media display, and ease of access via smartphones and laptops (Hali & Rawal, 2021). Overall, the average practicality score of the E-LKPD was 91.5%, which falls into the very practical category, indicating that the product can be used in biology learning without revision.

Table 5. Results of Student Response Questionnaire in Small-Group Trial

No	Assessed Aspect	Score	Category
1	Instructional Design	93%	Very Practical
2	Operational	90%	Very Practical
	Average	**91,5%**	**Very Practical**

Teacher responses to the developed E-LKPD indicated very positive evaluations of the product's practicality in learning. The teacher assessed the cover display aspect with a score of 87.5% in the very valid category due to attractive layout, balanced text, and appropriate environmental-themed visuals. The E-LKPD content display aspect also obtained a score of 87.5% in the very valid category because of coherent text, clear visuals, understandable sentences, and consistent layout that was easy for students to follow.

The material aspect received a score of 95% in the very valid category due to alignment with Learning Outcomes, conceptual accuracy, material relevance and novelty, and the product's strong capacity to enhance student competencies. Overall, the average teacher validation score was 90%, which falls into the very valid category, indicating that the ecoliteracy-based E-LKPD is highly suitable for use in biology learning to improve conceptual understanding and foster students' environmental care attitudes (Fraenkel et al., 2019).

Table 6. Results of Practitioner (Teacher) Validation

No	Assessed Aspect	Score	Category
1	Instructional Design	93%	Very Practical
2	Operational	90%	Very Practical

Average	**91,5%**	**Very Practical**

The results indicate that the developed ecoliteracy-based E-LKPD meets the validity criteria based on subject-matter and media expert assessments with a score of 79.5%, is very valid based on practitioner (teacher) assessment with a score of 90%, and is very practical based on small-group trial responses with a score of 91.5%. The strength of this product lies in the integration of three ecoliteracy aspects—head, heart, and hands which enables students not only to understand environmental change concepts cognitively but also to develop environmental care attitudes and practical skills for real actions in environmental conservation.

This product also offers flexible access through the Liveworksheets platform, allowing learning to be conducted both online and offline, making it relevant to the demands of 21st-century learning that emphasize the use of information and communication technology in education (Dewi & Rachmadiarti, 2023). The study by Sutiana et al. (2024) demonstrated the development of effective and engaging learning media for students, which aligns with this study that also employed the ADDIE model and the Canva application in developing the E-LKPD.

The main advantages of the E-LKPD in this study include interactivity, accessibility, and multimedia integration. Interactivity is reflected in the presence of question features that can be directly answered digitally by students and provide instant feedback. Accessibility is demonstrated by the ability of the E-LKPD to be accessed via smartphones and laptops without requiring additional application installation. These advantages are consistent with the findings of Putri and Sari (2023), who stated that E-LKPD encourages independent learning, increases active student participation, and facilitates digital collaboration in the learning process.

Thus, the ecoliteracy-based E-LKPD can serve as an innovative alternative teaching material that supports the achievement of the environmentally oriented Pancasila Student Profile in accordance with the Merdeka Curriculum.

CONCLUSION

The development research on an ecoliteracy-based E-LKPD for Grade X environmental change material resulted in a digital learning product that meets quality standards. Validation by subject-matter and media experts showed an average score of 79.5% in the valid category, indicating that the product is suitable for use. The small-group trial produced an average practicality score of 91.5% in the very practical category, demonstrating that the product is easy to use and effective in learning activities. The integration of the three ecoliteracy aspects—cognitive, attitudinal, and skills—was proven to enhance students' understanding of environmental change concepts while simultaneously fostering ecological awareness. The ecoliteracy-based E-LKPD can serve as an innovative alternative teaching material that supports interactive and contextual biology learning, in line with the mandate of the Merdeka Curriculum to develop environmentally literate students.

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