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Validity of ESD-Oriented E-LKPD Using Liveworksheets to Improve Environmental Literacy of Elementary School Students

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Abstract

The low level of environmental literacy among elementary school students indicates the need to develop contextualized and ESD-oriented teaching materials. However, the integration of ESD content in science learning at the elementary school level remains limited. This study aims to test the validity of ESD-oriented E-LKPD developed using Liveworksheets platform to improve students' environmental literacy. This quantitative descriptive research focuses on the expert validation process. and forms part of a larger development process using the 4D model (Define, Design, Develop, Disseminate), which is limited to the develop stage. Validation was conducted by material and media experts using validation sheet instruments. The results showed that the E-LKPD obtained an average score of 96.88% from material experts and 96.25% from media experts, with a very valid category. Follow-up in the form of minor revisions was made to improve content accuracy, instructions, and interactive features of the media. These results indicate that the developed E-LKPD is feasible to use in science learning and has the potential to improve students' environmental literacy. This research contributes to the development of ESD-based interactive digital media at the elementary level, and lays the groundwork for testing the effectiveness of the product at a later stage.

Keywords: *E-LKPD, ESD, environmental literacy, liveworksheets, elementary school*

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INTRODUCTION

Education is one of the strategic efforts in achieving the Sustainable Development Goals (SDGs) that have been launched by the United Nations (UN). One important aspect of the SDGs is quality education that is able to shape individuals into agents of change for a sustainable future. In this context, the implementation of Education for Sustainable Development (ESD) becomes very relevant as an approach that instills values of sustainability, environmental awareness, and social responsibility from an early age. ESD is an approach designed in a structured way to understand and change the education system in order to be able to instill sustainability values in the mindset, attitudes, and behavior of future generations (Suratmi et al., 2022).

One of the strategic subjects in integrating ESD content is Natural Science. Science learning in elementary schools not only equips students with scientific concepts, but also develops critical thinking and curiosity about natural phenomena and their impact on human life and the environment (Khalida & Astawan, 2021). However, science learning often faces obstacles in conveying abstract concepts in a way that is interesting and easily understood by students. Conventional learning methods that are still

widely used are not fully able to meet the needs and characteristics of 21st century students who are close to technology and information.

These challenges encourage the importance of innovation in the delivery of science materials, especially in developing learning media that can integrate ESD content and support the achievement of environmental literacy. One form of innovation that can answer these challenges is the use of electronic-based Learner Worksheets (E-LKPD). E-LKPD is a digital version of conventional LKPD designed to be accessed through electronic devices such as laptops, tablets, or smart phones. This media allows the delivery of material that is more interactive, dynamic, and contextual according to student needs. The advantages of E-LKPD over printed LKPD include easy access, attractive visual design, and the potential for multimedia integration such as images, animations, audio, and learning videos. This not only increases student learning motivation, but also provides a more enjoyable and meaningful learning experience (Asri et al., 2023; Safitri et al., 2021). Digital platforms such as Liveworksheets can be utilized to develop interactive E-LKPDs. This platform provides various features that support active and independent learning. Several studies have shown that Liveworksheets-based E-LKPDs are effective in improving student competence (Zakirman & Aufiana, 2023) and helping students understand the material more easily (Firtsanianta & Khofifah, 2022)

However, despite the increasing number of studies on E-LKPD development, the integration of ESD content in science learning through E-LKPD for elementary school is still limited. Most studies focus more on developing E-LKPD based on certain learning models, such as problem solving or science literacy, without specifically linking them to sustainability principles. For example, research by Rohman et al. (2024) developed worksheets based on the Problem Based Learning (PBL) model, while research by Adawiyah et al. (2021) showed improved learning outcomes through E-LKPD, but did not explicitly integrate ESD values. Even in the research of Suratmi, Jaenudin, et al. (2025) which focuses on energy literacy, the connection with ESD principles has not been studied in depth.

Environmental literacy is one of the main components of ESD implementation. Environmental literacy includes knowledge about the environment, caring attitude, ability to apply knowledge in daily life, and active involvement in solutions to environmental problems (Nasution, 2021; Nuri et al., 2023). However, various studies reveal that the level of environmental literacy of students in Indonesia is still relatively low. Surveys show that many students do not fully understand important issues related to the environment, which has an impact on their attitudes and initiatives in implementing environmentally friendly behavior, both in the school environment and at home (Aini et al., 2021; Pangestu et al., 2023). Similar findings were presented by Suratmi, Jaenudin, et al. (2025) who explained that although students have a basic understanding of environmental issues, they do not fully understand them good and show high interest in environmental issues, they still have difficulty in understanding more complex topics, such as renewable energy, and show suboptimal awareness of problems such as plastic pollution. Therefore, it is important to strengthen environmental literacy through contextualized learning that is relevant to everyday life.

Considering the important role of E-LKPD as a learning media, as well as the urgency of strengthening environmental literacy within the ESD framework, it is necessary to develop innovative learning media that can integrate ESD content into science learning. The media must not only be content and contextually relevant, but also scientifically, linguistically, presentation, and graphically feasible.

Therefore, the validation process by experts is an important step in development research to ensure the feasibility of the developed media. This validation aims to evaluate the extent to which the media developed meets quality standards and can be used effectively in the learning process. Therefore, this research was conducted as part of the development process of ESD-oriented E-LKPD using Liveworksheets to improve environmental literacy of elementary school students. This study specifically aims to determine the validity level of ESD-oriented E-LKPD using Liveworksheets based on experts' assessment of the material, language, design, and presentation aspects. This research is expected to contribute to enriching science learning innovation as well as expanding the scientific repertoire in the field of learning media development. It is also a strategic step that provides practical solutions in supporting the implementation of ESD at the elementary school level.

METHOD

This research is a quantitative descriptive research that systematically describes and analyzes the results of expert validation of ESD-oriented E-LKPD developed using the Liveworksheets platform. The flow of this research includes several stages: (1) designing E-LKPD based on needs analysis and ESD principles, (2) involving material and media experts to assess the product, and (3) collecting validation data using structured instruments. Validation was conducted to assess the feasibility of learning media from the aspects of content/material, language, presentation, and graphics before further use in learning. Quantitative data obtained from the experts' assessment were analyzed descriptively to determine the feasibility level of E-LKPD.

The validated E-LKPD products were previously developed based on the 4D development model (Define, Design, Develop, and Disseminate) proposed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn 1. Semmel in 1974 (Maku et al., 2023). However, it is limited only to the Develop stage, because the main focus is to develop and test the feasibility, practicality, and effectiveness of learning products not to disseminate. The E-LKPD developed is oriented towards education for sustainable development (ESD) and is intended to improve the environmental literacy of grade VI elementary school students. This product is prepared based on curriculum analysis, learner characteristics, and integration of ESD content in science learning, with an interactive format implemented through the Liveworksheets platform Therefore, this research was conducted as part of the validation process at the Develop stage.

The validation subjects consisted of two experts, namely material experts, and media experts. Material expert validation was conducted by experts in the field of Natural Science to assess the suitability of the content with the science curriculum, environmental literacy concepts, and ESD principles, as well as the relevance and difficulty level of the material presented Meanwhile, media expert validation was carried out by experts in the field of Technology Education to evaluate aspects of visual design, readability, interactivity of E-LKPD on the platform Liveworksheets, and media suitability.

The instrument used in the validation process is a validation sheet using a 4-point Likert scale with assessment categories, namely: very good (4), good (3), less good (2), and not good (1). The material expert validation sheet consists of 16 statements, covering aspects of content and material feasibility, language, and ESD content integration. Meanwhile, the media expert validation sheet includes 20 statements, covering aspects of display design, readability and understandability, interactivity, and media suitability with students' characteristics.

The data obtained from the validation results were analyzed quantitatively using the percentage formula. The percentage score obtained was then interpreted into five categories of validity level. The categories for determining product feasibility can be observed in Table 1 below.

Table 1. Criteria for Validity

No.	Interval	Criteria
1	81% - 100%	Very Valid
2	61% - 80%	Valid
3	41% - 60%	Fairly Valid
4	21% - 40%	Less Valid
5	0% – 20%	Invalid

(Adapted from Hulu & Dwiningsih, 2021)

Based on the validity criteria in Table 1 above, the development product will be used if it gets an assessment score from material experts and media experts in the very valid or valid category.

RESULTS AND DISCUSSION

Product Validation Results

The product validated in this study is an ESD-oriented interactive E-LKPD developed using the Liveworksheets platform. This E-LKPD is designed for grade VI science learning with a focus on renewable energy material. The development of this E-LKPD aims to improve students' environmental literacy through three main achievements, namely: (1) students can explain the concept of renewable energy, (2) students are able to identify the potential of renewable energy in the surrounding environment, and (3) students can develop energy saving plans in everyday life. Based on these objectives, the E-LKPD is organized into three main learning activities. Activity 1 is entitled Knowing Renewable Energy, which contains an explanation of the basic concepts of renewable energy, its types, differences with fossil energy, and the urgency of its use. The material is presented in the form of text, tables, and short videos, and is equipped with interactive exercises such as drag and drop and matching statements with types of energy. Activity 2 is titled Identifying Renewable Energy Potential, which invites students to explore the potential of renewable energy in Indonesia and in their surrounding environment through case studies based on regional maps and geographical conditions. Meanwhile, Activity 3 is titled Making Energy Saving Efforts, which contains practical steps and tasks that encourage students to implement energy-saving habits in everyday life. The product integrates material elements, explorative activities, as well as interactive features that support ESD values such as environmental awareness, sustainability, and responsible behavior. All three activities are designed to foster students' conceptual understanding and practical skills in an integrated manner.

Product validation was carried out by two experts, namely material experts and media experts, to assess the feasibility level of the product before it was implemented in the learning process. Validation by material experts covers three main aspects, namely: (1) content and material feasibility, (2) language, and (3) ESD content integration. Table 2 below presents the validation results from the material experts:

Table 2. Results of Material Expert Validation of ESD-Oriented Renewable Energy E-LKPDs

Assessment Aspect	Maximum Score	Acquisition Score	Percentage (%)	Category
Content and material feasibility	28	27	96,43	Very valid
Linguistics	12	11	91,67	Very valid
ESD Content	24	24	100	Very valid
Total	**64**	**62**	**96,88**	**Very valid**

Based on the results in Table 2, the E-LKPD was rated very good from the aspects of content and material feasibility (96.43%), the use of appropriate language and easy to understand (91.67%), and full integration with ESD content (100%). Overall, the results of validation by material experts showed that the product was in the "very valid" category with a total score of 96.88%. This assessment shows that the E-LKPD has fulfilled the principles of scientific accuracy and relevance of the learning context. The evaluation of scientific accuracy resulted in a high validation score, showing that there is consistency between the teaching materials developed with the applicable curriculum standards (Yulika & Hardeli, 2023). The importance of relevance in learning is also supported by the research of Riyanto et al. (2024) which states that through the connection of material with real environmental issues, science learning with an ESD-oriented STEAM approach can improve students' understanding of complex scientific concepts. Aspects of clarity of information and the use of language that is easy to understand show suitability with the characteristics of elementary school students. Learning that uses easy-to-understand language can improve students' overall communication skills (Repalena et al., 2024). In addition, the full integration of ESD values such as sustainability, responsibility, and environmental awareness confirms that this E-LKPD is not only a learning tool, but also a medium for character building and environmental care attitudes in students. This is in line with the research of Octaviana et al. (2022) which showed that the integration of environmental values in teaching materials can improve students' understanding of sustainability and social responsibility issues.

Meanwhile, validation by media experts covers four aspects, namely display design, readability and understandability, interactivity, and media suitability with the material. Based on the results obtained through the validation sheet, the percentage of assessment scores from media experts is presented in Table 3 below.

Table 3. Results of Media Expert Validation of ESD-Oriented Renewable Energy E-LKPDs

Assessment Aspect	Maximum Score	Acquisition Score	Percentage (%)	Category
Display Design	24	23	95,83	Very valid
Readability and Understandability	20	20	100	Very valid
Interactivity	20	20	100	Very valid
Media Suitability with Materials	16	14	87,5	Very valid
Total	**80**	**77**	**96,25**	**Very valid**

The results of validation by media experts showed that the E-LKPD has an attractive visual appearance (95.83%), is easy to read and understand (100%), has a high level of interactivity (100%), and is considered quite appropriate to the learning material (87.5%). The overall score of 96.25% places

the product in the "very valid" category. The high level of interactivity confirms that this E-LKPD is able to provide an interesting and participatory learning experience. This interactive feature supports the principle of active learning and is in line with the constructivism approach which focuses on how students construct their knowledge through interaction and direct experience (Alafnan & Dishari, 2024). Attractive visuals are also an added attraction for elementary school students who tend to learn more effectively through visual displays and hands-on activities. This is supported by Piaget's cognitive development theory, which states that children at primary school age are at the concrete operational stage, making it easier to understand concepts through activities that involve physical and visual actions (Akbar et al., 2022). In line with this, Hasnaa & Sahronih's (2022) found that visually designed media, such as multimedia presentations or videos, can help students understand and remember material better. Research by Murdani et al. (2024) also showed that the use of Project Based Learning (PjBL) model assisted by learning video media significantly improved the creative thinking ability of elementary school students compared to conventional learning. This finding confirms that the integration of interactive and visual learning media not only improves concept understanding, but also contributes to the development of higher-order thinking skills. In the context of ESD learning, this is very important to form a complete environmental literacy, because students are required to think critically, reflectively, and be able to make sustainable decisions on environmental issues around them.

Validation in learning media development is a crucial step to ensure that the media produced is not only technically feasible, but also in accordance with the needs and characteristics of students as users. This process aims to produce effective, relevant, and high-quality learning products (Prasetyo & Zulherman, 2023; Rosiana et al., 2023). Based on the validation results from both experts, the ESD-oriented Renewable Energy E-LKPD was declared very feasible to be applied in learning activities, with all aspects of the assessment in the "very valid" category. Some minor revisions have been made in accordance with the suggestions given by the validators to improve the appearance and presentation of the product content.

Validation Follow-up

In addition to providing quantitative assessments, the validators also provided qualitative input related to product improvement, especially on aspects of material substance, activity instructions, readability, visual appearance, and interactive media features. The follow-up to this feedback was realized in the form of minor revisions that reflected the process of developing reflection-based E-LKPDs and was carried out iteratively. The principle of iterative design emphasizes that design does not only occur once, but through various cycles of evaluation and improvement (Sundari et al., 2024). This revision aims to improve the clarity of content, appearance, and effectiveness of presentation to be more in line with the characteristics of elementary school students and ESD-oriented learning principles.

In general, material experts provided suggestions for improvement on the clarity of scientific concepts, the preparation of instructions, and the suitability of activities with scientific principles and learning objectives. In the material aspect, improvements were made to the definition of energy to be in accordance with scientific concepts, refinement of instructions in the "Energy Detective" activity, and revision of the map analysis sentence to be clearer and more directed. These revisions show the application of instructional design principles that emphasize clarity of purpose, suitability of content to the level of cognitive development of students, and active involvement in the learning process, as confirmed by Sirait & Dewi (2024) that the development of learning technology needs to refer to established

instructional design principles, while taking into account the availability of technology and student abilities. This is very relevant in the context of elementary school students who are in the concrete operational stage, where concept understanding is strongly influenced by visualization and directed instructions, as explained by Sujana et al. (2021) that students at this stage tend to have difficulty understanding abstract concepts without the help of visual media. Research by Nisrina et al. (2024) which shows that concrete media such as Smart Ladders are effective in increasing student activity, independence, and learning outcomes, reinforces the importance of visual and interactive presentations in the learning process in elementary schools.

Meanwhile, media experts suggested improvements in terms of design, learning objectives, and the addition of interactive elements that enrich information and facilitate user navigation. Improvements were made to the formulation of learning objectives to use operational verbs that are measurable and in accordance with the cognitive domain, given that the selection of appropriate verbs plays an important role in creating clear, directed learning outcomes and facilitating more effective assessment (Rahmah & Zaim, 2021). This selection also refers to Bloom's taxonomy to ensure that learning objectives are systematically organized and reflect the desired cognitive level (Newton et al., 2020). In addition, a summary of the material is added before the evaluation to support the retention and integration of information, thus strengthening students' understanding of the concepts that have been learned. This is in line with the findings of Anggraeni & Handayaningrum (2021) which show that the use of strategies such as previewing or re-presenting material allows students to review learning, so they more easily understand the core of the material and are able to apply it in solving practice questions. Interactive features are also strengthened by adding buttons to load media descriptions, developer profiles, and teaching modules to improve understandability and completeness of information in E-LKPDs. Empirical studies support that integrating interactive elements in digital media can transform traditional learning into a more participatory process and stimulate students' interest in learning (Monika et al., 2023; Winarso et al., 2023). The following are two examples of screenshots of the product shown in Figure 1, to provide a clearer picture of the appearance and content in the ESD-oriented Renewable Energy E-LKPD.

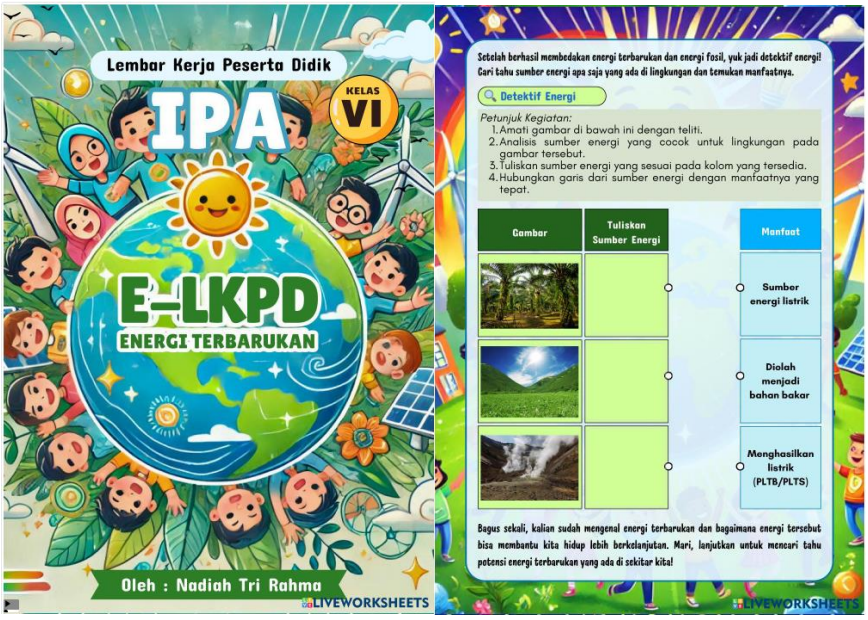

Figure 1. Initial Display and Activity of "Energy Detective" in E-LKPD

A few minor revisions were made while maintaining the main structure of the E-LKPD that had been validated by the experts. These revisions aim to improve pedagogical and technical aspects, including correcting conceptual errors and clarifying the flow of material delivery. These Improvements allow students to build knowledge progressively, in accordance with the principles of continuous learning as described by Pegalajar-Palomino et al. (2021). Thus, the revisions made not only strengthen content validity, but also improve the integration between learning components in the E-LKPD

These improvements directly contribute to the success of E-LKPD in improving students' environmental literacy through understanding the concept of renewable energy, strengthening environmental care attitudes, and encouraging critical and reflective thinking on energy issues. Previous research has shown that learning materials designed with ESD principles have a significant impact on increasing students' environmental literacy levels, so that they can identify and respond critically to environmental challenges (Saraswati & Suhartini, 2024; Tahmid et al., 2024). This finding is in line with the opinion of Adriyanto et al. (2020), who stated that ESD can enrich the learning process through strengthening the practical component and applying sustainability values in every teaching and learning activity. Therefore, the revised E-LKPD is considered feasible to be implemented in grade VI science learning, especially on the topic of renewable energy that supports the integration of sustainability values. Despite the promising results from expert validation, this study has several limitations. First, the validation was limited to expert judgment without field trials involving actual students and teachers, so its practical effectiveness in real classroom settings remains untested. Second, the number of experts involved was limited, which may influence the generalizability of the findings. Lastly, the study focused only on the feasibility aspects of the E-LKPD and did not evaluate student learning outcomes or environmental literacy improvements through implementation. Future research should include classroom trials and impact analysis to provide a more comprehensive evaluation.

CONCLUSION

This study shows that the ESD-oriented E-LKPD developed using the Liveworksheets platform has met the criteria of being very valid in terms of material and media. The validity of the product is reflected in the high assessment scores by material experts (96.88%) and media experts (96.25%), as well as from qualitative revisions that improve the clarity of scientific concepts, learning instructions, and digital display. These findings advance the development of science learning media in elementary schools by integrating the principles of Education for Sustainable Development (ESD) into a digital interactive format that suits the characteristics of students. The use of Liveworksheets enables interactive and reflective presentation of content, which can increase student engagement and foster early environmental literacy. This innovation contributes to the literature on the development of educational digital media to support contextual and sustainable learning at the primary education level. In the future, this research can be further developed through effectiveness testing on improving learning outcomes and environmentally friendly behavior of students more broadly. It is also recommended to develop similar E-LKPD on other ESD themes and explore the utilization of other digital technologies that support students' active and critical involvement in environment-based learning.

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