

Analysis Of The Design Needs For E-LKPD On Renewable Energy Integrated With Problem Based Learning and Local Wisdom, Assisted By Canva Ai to Make It Easier For Students To Develop Creative Thinking Skills

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ABSTRACT

Creative thinking skills are one of the 21st century competencies that students need to have to produce original ideas, explore alternative solutions, and adapt to increasingly complex global challenges. This article presents the results of a needs analysis (defined stage) in the development of renewable energy E-LKPD integrated with Problem Based Learning (PBL) models and Canva AI-assisted local wisdom. The needs analysis was carried out through five steps, namely end-to-end analysis, student analysis, task analysis, concept analysis, and formulation of learning objectives, involving 35 students of class X Phase E and 3 physics teachers of SMAN 15 Padang. The results of the study showed that the average initial test score of students' creative thinking skills was only 34.29% (very low category), the teaching materials used were still in the form of simple printed LKPD that had not fully integrated local wisdom and PBL syntax, and there was a gap between the demands of the Independent Curriculum and learning conditions in the field. On the other hand, the needs questionnaire shows that the response of students to the development of E-LKPD is very high (average above 81%). These findings confirm the need to develop E-LKPD renewable energy integrated with PBL and local wisdom assisted by Canva AI as a contextual teaching material solution that is able to facilitate students' creative thinking skills.

Keywords :Need Analysis,E-LKPD,Renewable Energy,Problem Based Learning,Local Wisdom,Creative Thinking.



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I. INTRODUCTION

Twenty-first-century learning requires students to develop competencies that enable them to respond to the rapid advancement of science and technology. One of the most essential competencies is creative thinking, which is recognized as one of the 4C skills (*Critical Thinking, Creativity, Collaboration, and Communication*). Creative thinking enables students to generate diverse ideas, propose alternative solutions, and solve problems innovatively [1], [2]. Therefore, learning should be designed to provide students with opportunities to actively construct knowledge and develop creativity through meaningful learning experiences.

Physics is one of the subjects that has considerable potential to foster creative thinking because it involves investigating natural phenomena closely related to everyday life [3]. However, physics instruction in schools is still frequently dominated by teacher-centered approaches, where students mainly receive information rather than actively constructing their own understanding. As a result, students have limited opportunities to develop creative thinking skills, such as generating original ideas, exploring multiple problem-solving strategies, and elaborating on their reasoning [4]. In contrast, the Merdeka Curriculum emphasizes student-centered learning that promotes the development of twenty-first-century competencies through active participation and authentic learning experiences.

Renewable energy is one of the physics topics that is particularly suitable for developing students' creative thinking skills. This topic requires students not only to understand scientific concepts but also to analyze real-world energy issues, evaluate alternative renewable energy resources, and propose innovative solutions based on environmental conditions. Learning about renewable energy becomes more meaningful when it is connected to

students' local environment and daily experiences, allowing them to relate scientific concepts to real-life situations [5].

To support such learning, appropriate instructional materials are needed to facilitate active student engagement and improve conceptual understanding [6], [7]. One promising learning resource is the Electronic Student Worksheet (E-LKPD). E-LKPD is a digital version of conventional student worksheets that integrates multimedia elements such as text, images, videos, animations, and interactive learning activities, thereby increasing students' motivation and engagement [8], [9]. The effectiveness of E-LKPD can be further enhanced by integrating it with the PBL model. PBL uses authentic problems as the starting point of learning, encouraging students to identify problems, gather information, analyze possible solutions, and collaboratively construct knowledge [10], [11]. Previous research also indicates that PBL provides opportunities for students to develop higher-order thinking skills by engaging them in inquiry processes, problem investigation, and solution evaluation [12]. These characteristics make PBL a suitable approach for developing creative thinking because students are encouraged to generate ideas, explore alternative solutions, and construct meaningful explanations through problem-solving activities [13].

In addition to instructional models, integrating local wisdom into learning materials is essential for creating contextual learning experiences. Local wisdom enables students to connect physics concepts with local culture, environmental resources, and community practices, making learning more meaningful while fostering environmental awareness and appreciation of local culture [14], [15]. Furthermore, recent advances in Artificial Intelligence (AI) have created new opportunities for developing innovative digital learning materials. AI technology can support teachers in designing interactive learning resources and improving educational practices through innovative digital solutions [16]. One platform that has gained increasing attention is Canva AI, which provides AI-assisted design features to support the development of attractive, interactive, and efficient instructional media [17].

Before developing an instructional product, a needs analysis should be conducted to identify the gap between existing learning conditions and the expected learning outcomes. Needs analysis represents the initial stage of research and development because it provides essential information for determining product characteristics that meet students' needs, teachers' expectations, and curriculum requirements [18]. Moreover, the development of instructional materials should begin with identifying learning needs, learner characteristics, curriculum demands, and classroom problems to ensure that the resulting product effectively addresses actual educational needs [19]. Consequently, the resulting product is expected to address actual classroom problems and improve learning quality.

The preliminary needs analysis conducted at SMAN 15 Padang revealed several problems in physics learning, particularly in the renewable energy topic. The creative thinking test showed that students achieved an average score of only 34.29%, which falls into the very low category. The scores for each creative thinking indicator were 38.21% for fluency, 32.86% for flexibility, 34.64% for originality, and 31.43% for elaboration. Questionnaire results also indicated that many students still experienced difficulties in understanding physics concepts and preferred interactive digital learning materials. Interviews with physics teachers further revealed that the existing instructional materials mainly consisted of textbooks and printed worksheets, which had not integrated Problem-Based Learning, local wisdom, or digital technology. These findings demonstrate a considerable gap between the instructional materials currently available and the learning needs required to support creative thinking skills.

Previous studies have reported that Problem Based Learning-based E-LKPD can support students' active engagement during learning [10], and several studies have also integrated local wisdom into PBL based instructional materials to strengthen contextual meaning [14], [15]. However, these studies were generally limited to combining PBL and local wisdom without incorporating AI-assisted design tools, and did not specifically target the four indicators of creative thinking (fluency, flexibility, originality, and elaboration) as the primary outcome measure. Meanwhile, studies employing Canva AI in instructional media development have largely focused on visual attractiveness and student motivation [17], without integrating problem-based learning stages or local cultural contexts. The present study addresses this gap by simultaneously integrating three elements PBL syntax, local wisdom of rice husks, traditional Minangkabau house, and rice field irrigation, and Canva AI-assisted design within a single E-LKPD on renewable energy [20], specifically designed to facilitate all four indicators of creative thinking among grade 10 students. This combination has not been examined in prior research, thereby constituting the scientific novelty of this study.

Although previous studies have demonstrated that Problem-Based Learning (PBL)-based E-LKPD can improve students' engagement and learning outcomes [21], [22], while the integration of local wisdom enhances contextual learning experiences and environmental awareness [23], [24], most of these studies have only combined one or two instructional approaches. Likewise, studies employing Artificial Intelligence (AI), particularly Canva AI, have primarily focused on improving the visual quality of learning media and increasing students' motivation and engagement [25], [26], without integrating pedagogical strategies and contextual

cultural values into a single instructional product. Moreover, previous studies have rarely developed E-LKPD specifically to facilitate the four dimensions of creative thinking proposed by Torrance, namely fluency, flexibility, originality, and elaboration [26].

Therefore, the present study offers a scientific contribution by simultaneously integrating four essential components within a single Electronic Student Worksheet (E-LKPD), namely renewable energy content, Problem-Based Learning (PBL), local wisdom of West Sumatra, and Canva AI-assisted instructional design. Renewable energy learning is contextualized through local wisdom, including the utilization of rice husks as biomass, the architectural concepts of the traditional Minangkabau house, and local irrigation systems, allowing students to connect scientific concepts with authentic environmental issues in their surrounding communities [27]. Furthermore, Canva AI is employed not merely as a design tool but as an instructional support platform for developing interactive digital learning materials aligned with the stages of Problem-Based Learning and the characteristics of the Merdeka Curriculum [25], [28].

Accordingly, the novelty of this study lies not only in combining pedagogical, technological, and cultural approaches within a single instructional material but also in developing an E-LKPD specifically intended to facilitate the four indicators of creative thinking in renewable energy learning. The findings of this needs analysis provide an empirical foundation for the subsequent development and validation of the proposed E-LKPD and contribute to the growing body of research on AI-assisted, context-based physics learning materials [26], [16].

II. METHOD

This study employed a descriptive research design as the preliminary stage of a Research and Development (R&D) study using the 4-D development model proposed by [18], consisting of Define, Design, Develop, and Disseminate stages. The present study focused on the Define stage to identify learning problems, students' characteristics, instructional material needs, and teachers' expectations as the basis for developing an Electronic Student Worksheet (E-LKPD) integrated with Problem-Based Learning (PBL), local wisdom, and Canva AI. The research was conducted at SMAN 15 Padang, Indonesia, involving 35 Grade X students in Phase E and three physics teacher. The participants were selected using purposive sampling because the school had implemented the Merdeka Curriculum and provided a relevant context for identifying the needs of renewable energy learning materials. Grade X students were selected because renewable energy is included in the physics learning content at this level. The selection of one school was considered appropriate because this study represented the initial needs analysis stage of an R&D process, which aimed to identify specific learning conditions and instructional requirements before the development and validation of the proposed product.

Data were collected through three instruments: (1) a creative thinking skills test, (2) a student needs questionnaire, and (3) a semi-structured interview with a physics teacher. The creative thinking test was developed based on four indicators of creative thinking, namely fluency, flexibility, originality, and elaboration [25]. The test consisted of open-ended questions related to renewable energy concepts designed to measure students' ability to generate ideas, propose alternative solutions, develop original responses, and provide detailed scientific explanations. Before implementation, the creative thinking test was reviewed by experts in physics education to evaluate content validity, clarity, and suitability with the research objectives. The validity analysis was conducted to ensure that each item represented the indicators of creative thinking being measured. Furthermore, the reliability analysis was performed to determine the consistency of the instrument in assessing students' creative thinking skills.

The student needs questionnaire was developed to identify students' learning difficulties, preferences for digital learning materials, and their expectations regarding renewable energy learning. The questionnaire consisted of Likert-scale statements covering learning conditions, availability of instructional materials, digital learning needs, and students' perceptions of E-LKPD development. Before being administered, the questionnaire was validated by experts to evaluate the relevance of the statements, language clarity, and suitability with the research objectives. A semi-structured interview was conducted with the physics teacher to obtain information regarding current instructional practices, available learning materials, difficulties in teaching renewable energy concepts, implementation of Problem-Based Learning, integration of local wisdom, and teachers' expectations toward innovative digital learning materials.

The interview protocol consisted of guiding questions related to these aspects, allowing the researcher to obtain comprehensive information regarding existing learning conditions. Quantitative data obtained from the creative thinking test and questionnaires were analyzed descriptively using percentage analysis. The percentage score for each indicator was calculated using the following equation:

$$NP = \frac{R}{SM} \times 100$$

Where :

NP = percentage score

R = total score obtained

SM = maximum possible score

The percentage scores were then interpreted according to the creative thinking criteria presented in Table 1.

Table 1. Criteria for Creative Thinking Skills

Percentage (%)	Category
80-100	Very High
75-78	High
60-74	Moderate
55-59	Low
≤ 54	Very Low

(Source : Ref[29])

III. RESULTS AND DISCUSSION

The creative thinking skills test was administered to 35 tenth-grade students at SMAN 15 Padang, West Sumatra, Indonesia, to identify their initial level of creative thinking before developing the Electronic Student Worksheet (E-LKPD). The assessment measured four indicators of creative thinking proposed by [30], namely fluency, flexibility, originality, and elaboration . The results of the test are presented in Table 2.

Table 2. Students' Creative Thinking Skills Test Results

Indicator	Percentage (%)	Category
Fluency	38.21	Very Low
Flexibility	32.86	Very Low
Originality	34.64	Very Low
Elaboration	31.43	Very Low
Average	34.29	Very Low

Table 2 indicates that the average creative thinking score of students was 34.29%, which was categorized as very low. This finding demonstrates that students had not yet developed sufficient abilities to generate ideas, construct alternative solutions, and provide detailed explanations when dealing with contextual physics problems. The low achievement across all indicators indicates that students' learning experiences have not fully supported the development of higher-order thinking skills, particularly creative thinking. Among the four indicators, fluency obtained the highest percentage (38.21%), although it was still categorized as very low. This result suggests that students showed a limited ability to generate ideas when responding to open-ended questions. Students tended to provide a small number of responses and relied on previously learned concepts rather than exploring various possible solutions. Similarly, the originality score of 34.64% indicates that students experienced difficulties in producing unique and innovative ideas. Most responses reflected conventional thinking patterns and were closely related to examples previously provided by teachers.

The flexibility indicator obtained a score of 32.86%, indicating that students had difficulties viewing problems from different perspectives and applying various strategies to solve physics problems. Meanwhile, elaboration obtained the lowest score (31.43%), suggesting that students had limited ability to develop, explain, and justify their ideas using scientific reasoning. This condition indicates that students were not sufficiently

accustomed to activities requiring explanation, argumentation, and refinement of ideas. The low level of creative thinking skills identified in this study may be associated with the characteristics of physics learning currently implemented in the classroom. Based on teacher interviews and preliminary observations, learning activities were still dominated by teacher explanations and routine exercises. Such learning practices provide limited opportunities for students to investigate authentic problems, discuss alternative solutions, and construct their own understanding. Previous studies have emphasized that creative thinking develops through learning environments that involve inquiry, collaboration, problem solving, and opportunities for students to express and evaluate their ideas [4], [11].

These findings also indicate a gap between the competencies expected in the Merdeka Curriculum and actual classroom practices. The curriculum emphasizes student-centered learning that develops creativity, critical thinking, collaboration, and communication skills. However, the instructional materials currently used at the research site were mainly printed textbooks and conventional worksheets that focused on conceptual explanations and routine problem exercises. These materials have not fully facilitated students to engage in contextual investigations, formulate solutions, or develop creative ideas. Therefore, learning materials need to be redesigned to provide more meaningful learning experiences that encourage active knowledge construction. The findings are consistent with previous research showing that Problem-Based Learning can improve students' higher-order thinking skills by involving them in identifying problems, collecting information, analyzing solutions, and presenting arguments [10], [11]. Through PBL activities, students are encouraged to explore various solution alternatives and develop reasoning processes, which are important components of creative thinking. Therefore, integrating PBL into E-LKPD is expected to provide students with structured opportunities to practice fluency, flexibility, originality, and elaboration.

In addition to the learning model, the integration of local wisdom is considered important for creating contextual physics learning. Renewable energy concepts are closely related to environmental resources and community practices surrounding students. Connecting renewable energy concepts with local contexts, such as biomass utilization from rice husks, traditional Minangkabau architecture, and local irrigation systems, can help students understand the relevance of physics concepts in everyday life. Contextual learning based on local wisdom may encourage students to develop creative solutions that are appropriate to their environmental conditions while strengthening their appreciation of local resources [15]. Furthermore, the development of digital learning materials supported by artificial intelligence provides new opportunities to improve the quality of instructional resources. Canva AI can assist teachers in designing attractive and interactive digital worksheets by integrating visual elements, structured layouts, and engaging learning designs [17],[27]. However, technology integration should not only focus on visual presentation but also support meaningful learning processes. Therefore, combining Canva AI with PBL and local wisdom provides a comprehensive approach that integrates technological, pedagogical, and contextual aspects of physics learning [26].

Overall, the results of the needs analysis reveal a significant gap between students' current creative thinking abilities and the competencies required in twenty-first-century learning. The findings indicate that students require instructional materials that provide authentic problems, contextual learning experiences, and interactive digital environments. Therefore, the development of an E-LKPD integrated with Problem-Based Learning, local wisdom, and Canva AI is considered a relevant solution to support creative thinking development and strengthen the implementation of the Merdeka Curriculum.

IV. CONCLUSION

This study analyzed the needs for developing an Electronic Student Worksheet (E-LKPD) on renewable energy integrated with Problem-Based Learning (PBL), local wisdom, and Canva AI to facilitate students' creative thinking skills. The needs analysis results showed that the creative thinking skills of tenth-grade students at SMAN 15 Padang remained at a very low level, with an average achievement of 34.29% across the four indicators of creative thinking: fluency, flexibility, originality, and elaboration. Furthermore, the analysis of instructional conditions revealed that the learning materials currently used were mainly conventional textbooks and printed worksheets, which provided limited opportunities for students to engage in authentic problem-solving activities, explore multiple solutions, and relate physics concepts to real-life contexts.

The findings from student questionnaires and teacher interviews confirmed the necessity of developing interactive digital learning materials that support contextual, student-centered, and meaningful learning experiences in accordance with the principles of the Merdeka Curriculum. The integration of PBL, local wisdom, and Canva AI in E-LKPD development is considered a relevant approach to overcome the identified learning gaps by combining pedagogical, technological, and contextual elements in renewable energy learning.

Theoretically, this study contributes to physics education research by providing empirical evidence that the development of instructional materials should not only emphasize digitalization but also integrate appropriate learning models and contextual environments to foster higher-order thinking skills, particularly creative thinking. The findings reinforce the importance of designing learning resources that enable students to investigate authentic problems, generate diverse ideas, develop alternative solutions, and communicate their scientific reasoning.

Practically, this study provides an initial foundation for teachers and researchers in developing innovative renewable energy learning materials. The proposed E-LKPD design can serve as an alternative instructional resource to support the implementation of the Merdeka Curriculum by facilitating active learning, contextual understanding, and creative thinking development. Furthermore, the results of this needs analysis become an empirical basis for the subsequent stages of the Research and Development process, including product design, expert validation, implementation, and evaluation of the effectiveness of the developed E-LKPD.

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