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Analysis of the Development Needs for STEAM-PjBL Based Electronic Student Worksheets to Enhance Critical Thinking Skills among Elementary School Students

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Abstract: This study aims to analyze the needs for the development of Electronic Student Worksheets (E-LKPD) based on STEAM (Science, Technology, Engineering, Arts, and Mathematics) and Project-Based Learning (PjBL) to enhance the critical thinking skills of Elementary School (SD) students. Fostering 21st-century skills through active and relevant methods is crucial in contemporary education. The research employs a Research and Development (R&D) approach, specifically utilizing the Analysis stage of the ADDIE model. Data was collected through a survey (questionnaire) from 25 students in Class V C at SDN 09 Bengkulu City, focusing on their current learning experiences and specific E-LKPD requirements.The analysis results indicate a strong and urgent need for innovation in teaching materials. A majority of students (55%) expressed dislike for conventional LKPD, yet showed very high enthusiasm for project-based learning (85%) and the use of LKPD in a digital format (90%). Students explicitly require E-LKPD that is easily accessible on mobile devices (80%), equipped with videos/animations (95%), and presents tasks that challenge higher-order critical thinking skills, particularly in generating new ideas or solutions (85%).In conclusion, there is a significant gap between the currently available teaching tools and students' needs for active, digital, and project-oriented learning. The proposed development of STEAM-PjBL-based E-LKPD is highly relevant and urgent to create a more dynamic and effective learning environment for cultivating critical, creative, and collaborative thinking skills in elementary school students.

Keywords: E-LKPD, STEAM, Project-Based Learning (PjBL), Critical Thinking Skills, Needs Analysis.

Introduction

Education today garners significant attention within the context of globalization and an ever-changing era. Education does not only serve to transfer knowledge but must also be capable of shaping students' character and life skills, which are essential for facing the challenges of the 21st century. Along with the advancement of technology and information, the education system must be adaptive and relevant to meet the increasingly diverse needs of society (Suryaningsih & Nurlita, 2021; Arini & Sulistiyono, 2023). Therefore, it is important to implement educational approaches that are more interactive and actively engage students in the learning process (Sulistianingsih & Amir, 2021).

Critical thinking skills are one of the most sought-after competencies in the 21st-century context. Not only in school but also in the professional world, the ability to think critically, solve problems, and adapt to new situations is crucial (Yuliandari, 2025; Ritonga & Napitupulu, 2024). A good learning process must encourage students not only to receive information but also to analyze, evaluate, and create, all of which contribute to the development of critical thinking skills (Sulistianingsih & Amir, 2021; Andini & Muhammad, 2025). Student-centered education that encourages exploration and inquiry is therefore highly necessary to ensure students participate more actively in their learning.

The implementation of active learning methods, such as Project-Based Learning (PjBL), has proven

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effective in enhancing students' critical thinking skills. Numerous studies show that PjBL not only helps students understand theory but also encourages them to apply concepts practically through real-world projects (Ritonga & Napitupulu, 2024; Muslim et al., 2023; Antari et al., 2023). In this context, PjBL is a strategy capable of creating a dynamic and interactive learning environment, thereby forming students who are independent and responsive to problems in their surroundings (Zulva et al., 2025; Almarwah et al., 2025).

The STEAM (Science, Technology, Engineering, Arts, and Mathematics) concept in education is also gaining a strategic place. The integration of STEAM into the curriculum emphasizes not only the mastery of knowledge but also the enhancement of students' creativity and innovation (Saputri & Attalina, 2025; Erinna et al., 2022). This approach provides students with opportunities to collaborate on cross-disciplinary projects, supporting the development of their critical thinking and collaborative skills (Almarwah et al., 2025). Research results indicate that the combination of PjBL and STEAM has the potential to increase student engagement and critical thinking skills (Andini & Muhammad, 2025; Almarwah et al., 2025).

Student Worksheets (LKPD) that are innovatively designed can also facilitate better learning. With STEAM and PjBL-based LKPD, students can be given tasks relevant to their everyday life context, thereby increasing their motivation and engagement in learning (Suryaningsih & Nurlita, 2021; Akbar et al., 2022). These worksheets do not only function as learning aids but also as a guide for student exploration and creativity in investigating complex topics.

However, despite significant strides in integrating active methods and using LKPD, challenges remain. Many educators may still be entrenched in traditional teaching practices that focus more on lectures and one-way information delivery, which can hinder the development of students' critical thinking skills (Sulistianingsih & Amir, 2021; Agusta, 2021). Therefore, training programs for teachers are necessary to implement more interactive and adaptive teaching methods (Yuliandari, 2025).

In the context of primary education, the issue of critical thinking skills becomes increasingly urgent, given the need to prepare a future generation that is not only capable of academic competition but also possesses good problem-solving skills. Methods that emphasize projects and collaboration, such as PjBL and STEAM, are crucial in addressing this need (Erinna et al., 2022; Afandi et al., 2024). This is particularly relevant for elementary school students who are in the foundational stage of developing their thought processes (Ritonga & Napitupulu, 2024; Almarwah et al., 2025).

To achieve this goal, a needs analysis for the development of STEAM-PjBL based LKPD is expected to contribute positively to enhancing critical thinking skills among elementary school students. This study aims to assess the effectiveness of LKPD designed to actively engage students in tasks that test not only knowledge but also their ability to apply that knowledge in complex, real-world situations (Putri, 2025; Nanna et al., 2024). With systematically researched and developed LKPD, it is hoped that every student can experience a significant improvement in their critical thinking ability.

Education oriented towards the development of critical thinking skills through project-based learning and STEAM integration is relevant in the context of increasingly diverse fields of knowledge. This opens opportunities for students to explore and understand the world around them in a more comprehensive and enjoyable way. Therefore, the development of STEAM-PjBL based LKPD for enhancing elementary school students' critical thinking skills is not just necessary but vital in creating a resilient, creative, and innovative generation (Saputri & Attalina, 2025; Almarwah et al., 2025).

Methods

The method employed in this study is the Research and Development (R&D) approach, integrating the ADDIE model (Analyze, Design, Develop,

Implement, Evaluate). This model allows the researcher to systematically analyze needs before designing and developing the instructional product. In this context, the Analysis stage is crucial for identifying students' specific needs regarding the STEAM-PjBL based Student Worksheets (LKPD) (Damayanti et al., 2023; Mardiana & Ahmatika, 2023). This aligns with research indicating that many schools still face difficulties in providing appropriate materials for active and critical learning (H.S & Haeruddin, 2025).

Data collection in this research can be conducted using questionnaires (or surveys) to gather necessary information from students about their requirements for the STEAM-PjBL based LKPD. The use of questionnaires is recognized as an effective method for obtaining direct feedback from students regarding the most effective learning methods for them, including how they interact with existing materials (Fitriani & Hidayat, 2024). Additionally, interviews with teachers can be carried out to gain an added perspective on the constraints in implementing this learning model, as well as their preferences concerning the material to be developed (Ningsih et al., 2023; Izzania, 2021).

Following the analysis stage, the results from the questionnaires and interviews will be utilized to design the LKPD. The design must not only meet the students' academic needs but also foster the development of their critical thinking skills. Previous research indicates that LKPD designed with student feedback in mind can significantly enhance their concept mastery and collaboration skills (Maharani & Zulyusri, 2024). For example, the use of a STEAM-integrated PjBL approach has been proven effective in increasing student engagement and conceptual understanding across various subject matters (Ramadhana et al., 2022; H.S & Haeruddin, 2025).

Results and Discussion

This study was conducted among the student population of Class V C at SDN 09 Bengkulu City, where a total of 25 students participated as respondents. Based on the collected data, the results of the needs analysis for the development of the STEAM-PjBL-based Electronic Student Worksheets (E-LKPD) are detailed in the following section.

1. **Current Learning Experience**

No.	Question	Yes	No
1.	I like using the Student Worksheets (LKPD) provided by the teacher.	45%	55%
2.	School assignments are often related to everyday life problems (at home/in the environment).	50%	50%
3.	I am often encouraged to find many different ways to solve a problem in class.	70%	30%
4.	I feel that the current LKPD is adequate for making me think hard (critically).	60%	40%
5.	I prefer learning by creating projects/models rather than just taking notes and memorizing.	85%	15%
6.	I feel more enthusiastic about learning if the LKPD is packaged in a digital/electronic format.	90%	10%

The survey results regarding the current learning experience show diverse student perspectives on the various methods and learning tools implemented by the teacher. The aspects revealed in this survey include the use of Student Worksheets (LKPD), the relevance of school assignments to daily life, collaborative learning approaches, and preferences for digital learning. Firstly, student interest in using the LKPD is varied, with **45%** liking the worksheets provided by the teacher, while **55%** disagree. This indicates that not all students feel engaged with this learning tool. According to Masruri and Misbah (2023), implementing a Project-Based Learning (PjBL) model can increase student engagement and learning outcomes, suggesting the need for more interactive learning approaches to support effective teaching.

Furthermore, regarding the connection of school assignments to everyday problems, **50%** of students feel the tasks are relevant. Research by Zahroh and Yuliani (2021) suggests that the application of science literacy-based E-LKPD can

train students' critical thinking skills, which can be integrated with contextual learning to enhance the relevance of subject matter to students' lives. This supports the argument that real-world context in school assignments can help students better understand and apply their knowledge. Concerning collaboration and the development of critical thinking skills, **70%** of students stated they are often encouraged to find multiple ways to solve a single problem in class. Research by Suriaman et al. (2024) shows that team-based project methods positively impact communication, collaboration, and critical thinking skills, highlighting the importance of collaboration in the learning process. Problem-based learning models also indicate that active participation in problem-solving can stimulate students' critical thinking skills (SURTIKA & U.S, 2024; Ayunda et al., 2023).

In terms of developing critical thinking ability, the survey shows that **60%** of students feel the current LKPD is adequate for this purpose. Jayadiningrat et al. (2022) and Dewi et al. (2018) mention that utilizing the Science Technology Society (STS) Learning Model shows a significant positive influence on students' critical thinking skill development. Innovative and interactive learning approaches are essential in creating a learning environment that supports the development of critical thinking skills. A very high level of interest is seen in the project-based learning method, where **85%** of students prefer creating projects or models over learning through note-taking and memorization. Findings by Handayani et al. (2021) demonstrate that integrating the PjBL model with LKPD can enhance mathematical creative thinking ability, supporting more active and engaged learning behaviors in the classroom.

Finally, student preference for LKPD in a digital format, with **90%** of students feeling more enthusiastic about learning with digital LKPD, indicates a clear need for innovation in instruction. The development of interactive digital-based LKPD, as studied by Mulu et al. (2022) and Dewi & Agustika (2022), can increase student motivation and empowerment in learning. Digitalization in learning can enhance critical thinking skills and students' understanding of subject matter by enabling easier and more interactive access (Sukiastini et al., 2024).Overall, there are many insights from the survey indicating that more varied and innovative learning approaches, including the use of modern technology, can help students feel more engaged and motivated in learning.

2. **Needs for STEAM-PjBL Based E-LKPD and Critical Thinking**

No.	Question	Yes	No
7.	I want the E-LKPD to be accessible and usable on my phone or tablet.	80%	20%
8.	I want the E-LKPD to be equipped with videos or animations to make the material easier to understand.	95%	5%
9.	The E-LKPD should have a place for me to upload photos or the results of my group's work.	70%	30%
10.	I like assignments that require me to plan and create a simple object/tool (Project).	80%	20%
11.	I want the project assignments in the LKPD to involve the simultaneous use of Mathematics, Science, and Technology.	75%	25%
12.	I like assignments that require me to work together with friends (collaboration).	85%	15%
13.	I want the LKPD to have tasks that require me to compare and choose the most correct solution.	75%	25%
14.	I want the LKPD to have tasks that ask me to draw conclusions from the data/facts I collect.	65%	35%
15.	I want the LKPD to challenge me to create entirely new ideas or solutions.	85%	15%

The survey results regarding the needs for STEAM-PjBL based E-LKPD and critical thinking reveal various expectations from students concerning the desired format, content, and skills. The majority of students desire E-LKPD that is accessible via mobile devices such as phones or tablets, with **80%** of respondents giving a positive answer. This demand aligns with the developmental trend in education that prioritizes the use of technology to enhance educational accessibility, especially as many schools currently implement distance learning (Hatala & Hudzaly, 2025; Maisarah et al., 2024).

Students also wish for E-LKPD equipped with visual media like videos or animations to facilitate material comprehension, which garnered **95%** support. This reflects the need for a multimodal approach in instruction, which has been proven effective in boosting student engagement and understanding of the material (Suryaningsih & Nurlita, 2021). Research shows that combining text with visual elements can aid the learning process and facilitate better mastery of the material (Wahono et al., 2022).

In connection with STEAM-PjBL content, students show high interest in tasks requiring them to plan and create simple objects or tools (**80%**), as well as tasks involving the simultaneous use of mathematics, science, and technology (**75%**). This indicates students' understanding and desire to engage in collaborative and creative learning, producing projects that are not only theoretical but also practical (Putri et al., 2025; Munawaroh et al., 2023). Engagement in meaningful collaboration with peers, with **85%** of students liking assignments involving teamwork, reflects the importance of social and team skills in the context of modern learning (Aisyah et al., 2024).

From the perspective of critical thinking skills, the results show that **75%** of students want tasks that require them to compare and select the best solution, and **85%** want challenges to generate innovative ideas or solutions. This indicates students' readiness to think analytically and explore their critical abilities in making decisions based on available facts (Aqila et al., 2025; Rahardhian, 2022). Furthermore, students' desire to draw conclusions from the data or information they collect (**65%**) shows that they value a learning process based on data and analysis, which is a key component in the development of critical thinking skills (Wirawan et al., 2023).

Integrating these elements into the E-LKPD will create a dynamic learning environment, supporting students in developing the essential skills needed in the modern world. By applying the principles of STEAM and PjBL, and prioritizing critical thinking, the E-LKPD can become an effective tool in meeting the learning needs of 21st-century students who face continuously evolving technological and informational challenges (Maisarah et al., 2024; Puspitasari et al., 2025).

Discussion

An analysis of the needs for the development of electronic Student Worksheets (LKPD) based on STEAM-Project-Based Learning (PjBL) is crucial for enhancing the critical thinking skills of Elementary School (SD) students. STEAM, which encompasses Science, Technology, Engineering, Arts, and Mathematics, provides a comprehensive educational approach that focuses not only on academic aspects but also on creativity and real-life relevance (Hikmah & Zulyusri, 2025; Rachmawati et al., 2023). Research indicates that integrating STEAM with the Project-Based Learning (PjBL) model can significantly improve students' critical thinking skills (Indahwati et al., 2023; Wirahandayani et al., 2024). In this context, the LKPD serves as an instrument to support the learning process and encourages students to take initiative in their education (Iramahdewi et al., 2025; Muslimah & Hardini, 2023).

Critical thinking skills are one of the main objectives of 21st-century education. Addressing this, the development of STEAM-PjBL-based LKPD is designed to stimulate more active student engagement. By utilizing this method, students are expected to experience a more in-depth learning process and be directly involved in projects relevant to their life context (Erinna et al., 2022; Mardiana & Ahmatika, 2023). Moreover, PjBL encourages students to think collaboratively and creatively through real-life experiences, equipping them with essential skills needed outside of school (Widyaningsih & Yusuf, 2019; Rahayu et al., 2023). Various studies demonstrate that the use of well-designed LKPD can optimize active student learning. Research conducted by Widiarti et al. mentions that systematically developed LKPD can help students better understand the material and increase their motivation and learning efficacy (Widiarti et al., 2025). This aligns with the findings of Iramahdewi et al., who emphasize that LKPD tailored to students' needs will improve the learning process and the achieved outcomes (Iramahdewi et al., 2025).

However, despite the numerous benefits offered, challenges exist in the implementation of the STEAM-PjBL-based curriculum, particularly concerning teacher training and the provision of adequate resources. The results of the study by Atana and Ansori indicate that the alignment between the independent curriculum (*Kurikulum Merdeka*) and the PjBL method is often not yet optimal (Atana & Ansori, 2025). Therefore, an in-depth needs analysis is necessary to identify aspects that must be improved so that the LKPD can be more effective and positively impact students' critical thinking skills.

The implementation of STEAM-PjBL-based LKPD is also expected to create an inclusive learning environment that supports the diversity of students' learning styles. Based on the research by Hikmah and Zulyusri, LKPD integrated with STEAM not only enhances conceptual understanding but also facilitates cooperation among students through creative projects (Hikmah & Zulyusri, 2025; Rachmawati et al., 2023). Developing LKPD that is responsive to the local environment and situation, as shown in the research by Agnafia and Anfa, suggests that integrating local wisdom can foster a sense of environmental care and strengthen interdisciplinary understanding (Agnafia & Anfa, 2025). Ultimately, the development of LKPD based on appropriate needs analysis and consideration of the unique local context is crucial for the successful implementation of STEAM-PjBL learning in improving the critical thinking skills of Elementary School students. Educators and curriculum developers must collaborate in this development process to ensure that the teaching materials are not only relevant but also capable of enhancing the quality and effectiveness of learning in the modern era (Indahwati et al., 2023; Riyana, 2025). Thus, students can be prepared to become critical, creative, and adaptive individuals in the future.

Conclusions

Based on the needs analysis conducted among 25 students in class v c at sdn 09 bengkulu city, there is a strong indication of an urgent need to develop steam-pjbl-based electronic student worksheets (e-lkpd) as a more effective tool for enhancing students' critical thinking skills. A majority of students (55%) expressed dislike for the conventional lkpd, and while interest in critical thinking is present, there is a highly dominant preference for project-based learning (85%) and the use of lkpd in a digital format (90%). This need for digitalization is reinforced by students' desire for e-lkpd that is easily accessible on mobile devices (80%) and rich in visual content such as videos and animations (95%). Furthermore, students explicitly requested tasks that challenge higher-order critical thinking skills, including comparing solutions, drawing conclusions from data, and especially, generating new ideas (85%), all of which validate the relevance and urgency of developing teaching materials integrated with steam-pjbl to support the achievement of 21st-century skills.

To ensure the successful and impactful development of the steam-pjbl-based e-lkpd, it is recommended that developers focus efforts on interactive and multimodal features, such as integrating videos and animations and ensuring mobile-responsive accessibility. In terms of content, the e-lkpd structure must explicitly reinforce steam and pjbl aspects by guiding students through project steps and requiring the integration of at least three steam disciplines in every task. Crucially, task design must be enhanced to consistently challenge students' higher-order critical thinking abilities—including analysis, evaluation, and idea creation. Finally, successful implementation requires the empowerment of teachers through comprehensive training, not only in the technical aspects of using the e-lkpd platform but also in the pedagogical methodology for effectively integrating pjbl and steam principles in the classroom.

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