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Developing a Canva-Assisted PBL e-Worksheet to Enhance Elementary Students' Science Process Skills

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ABSTRACT

The effective implementation of Problem-Based Learning (PBL) in elementary classrooms remains constrained by the limited availability of digital instructional materials that systematically integrate PBL syntax, science process skills, and visual learning media aligned with the Merdeka Curriculum. This study aims to develop a PBL-based electronic student e-worksheet assisted by Canva and to examine its validity, practicality, and effectiveness in improving fourth-grade students' science process skills. This study employed a research and development (R&D) approach using the ADDIE model with a one-group pretest–posttest design. The participants consisted of 22 fourth-grade students (n = 22) at SD Negeri 05 Kepahiang, Indonesia. Data were collected through expert validation questionnaires, teacher and student response questionnaires, observations, interviews, and science process skills tests. Data analysis involved Aiken's V for content validity and N-Gain analysis to measure the effectiveness of the intervention. The findings indicate that the developed E-worksheet demonstrates high validity across content, language, and graphical aspects, with Aiken's V values ranging from 0.83 to 1.00. The effectiveness analysis shows a high improvement in students' science process skills, with an average N-Gain score of 0.90. In addition, positive responses from both teachers and students confirm the practicality and usability of the E-worksheet in classroom implementation. This study concludes that the PBL-based E-worksheet assisted by Canva is a valid, practical, and effective digital instructional tool for enhancing elementary students' science process skills.

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1. INTRODUCTION

The rapid development of information and communication technology in the 21st century has transformed learning paradigms from teacher-centered toward student-centered, which emphasizes active knowledge construction and skill development (Allayarova, 2025; Kavak, 2023). In primary education, especially in science learning, this shift is essential because elementary school serves as a foundational stage for cultivating students' scientific thinking. One of the key competencies that must be developed at this level is science process skills (SPS), which include observing, questioning, planning and conducting investigations, analyzing data, reflecting, and communicating results (Widyaningsih, 2020). These skills are essential for preparing students to meet the demands of 21st-century competencies.

Problem-Based Learning (PBL) is widely recognized as a relevant instructional model for fostering science process skills due to its position as a contextual problem for the starting point of learning and encourages students to think critically, collaboratively, and reflectively (Al-Thani & Ahmad, 2025). Previous studies have shown that PBL positively influences students' learning activities and science process skills (Sagala & Simanjuntak, 2017; Samsudin, Murniningsih, & Mustadi, 2021). However, despite the popularity of PBL, few studies have examined how digital instructional materials can systematically support each stage of the PBL syntax while simultaneously training all components of science process skills in elementary science learning (An, 2013; Saad & Zainudin, 2024). This limitation indicates that the effectiveness of PBL is not determined solely by the learning model but also by the availability of instructional materials that can meaningfully guide students throughout the learning process.

Student worksheets are an important instructional tool in facilitating PBL activities. In line with digital transformation in education, electronic worksheets offer greater potential than conventional worksheets because they allow the integration of text, images, and interactive elements in a single learning resource (Harini, Islamia, Kusumaningrum, & Kuncoro, 2023). One digital platform that has attracted attention is Canva, due to its user-friendly interface and strong visual design features. Several studies report that Canva-based learning media can enhance students' motivation and engagement (Saputra, Rahmawati, Andrew, & Amri, 2022). Nevertheless, existing research generally positions Canva only as a presentation or supplementary visual tool, rather than as an integral component in the systematic design of an e-worksheet that supports inquiry and science process skills development.

Furthermore, the literature reveals additional gaps. First, most PBL-based e- worksheet studies emphasize cognitive learning outcomes or learning motivation, while research focusing on the comprehensive development of science process skills remains limited. Second, studies that integrate Canva into PBL-based e-worksheet design for elementary science learning are still scarce, particularly those that align instructional materials with the Learning Outcomes of the Merdeka Curriculum Phase B. As a result, many instructional products are not optimally connected to current curriculum demands (Garay Abad & Hattie, 2025; Kjærgaard & Wahl, 2015).

These gaps are reinforced by field findings in Grade IV at SD Negeri 05 Kepahiang. Observations and interviews indicate that teachers have not fully implemented the PBL syntax, science process skills are practiced only partially, and the worksheets used remain conventional and lack contextual problem-solving activities. Consequently, students' science process skills tend to be low, which aligns with Mahmudah (2022), finding that science process skills do not develop optimally without systematic training. In addition, students often experience difficulties in understanding and identifying problem contexts in PBL activities, highlighting the need for instructional media that can clearly and attractively visualize problems (Arsyad & Syakhrani, 2024).

Based on these conditions, this study offers novelty through the development of a Canva-assisted E-worksheet that integrates the PBL syntax, all components of science process skills, and the Learning Outcomes of the Merdeka Curriculum Phase B into a single instructional tool. Unlike previous studies, the developed E-worksheet functions not merely as an exercise sheet but as a structured problem-solving guide that facilitates students from problem identification to reflection and communication of results. Canva is employed as the main design platform to visually present contextual problems, thereby supporting students' understanding and engagement throughout the inquiry process.

Accordingly, this study aims to: 1) develop a Canva-assisted, PBL-based E-worksheet that is valid, practical, and feasible for elementary science learning; and 2) examine its effectiveness in improving fourth-grade students' science process skills. The findings of this study are expected to contribute theoretically to the development of PBL-based instructional materials for science process skills and practically to provide an innovative E-worksheet product that responds to the needs of elementary science learning in the digital era.

2. METHODS

2.1 Research Design

This study employed a Research and Development (R&D) approach aimed at developing, validating, and evaluating a Canva-assisted electronic student electronic worksheet based on the Problem-Based Learning (PBL) model to enhance fourth-grade students' science process skills. The development procedure followed the ADDIE model, consisting of five stages: analysis, design, development, implementation, and evaluation (Branch, 2009). To examine the effectiveness of the developed product, the study incorporated a one-group pretest–posttest design, in which students' science process skills were measured before and after the implementation of the E-worksheet.

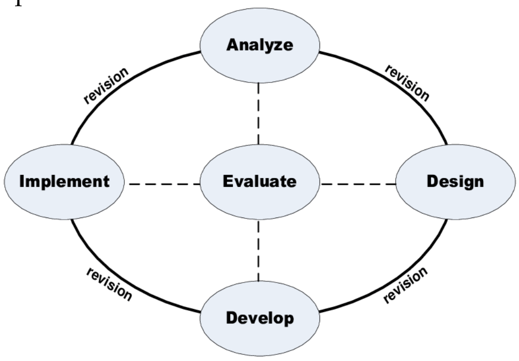

Figure 1. ADDIE Steps

The study was conducted in a public elementary school in Kepahiang Regency, Indonesia. Participants included Grade IV students selected through intact class sampling for limited and field trials, as well as classroom teachers and expert validators involved in product validation.

2.2 Data Collection and Analysis

Data on effectiveness were collected using a science process skills test administered as a pretest and posttest. Learning gains were analyzed using the Normalized Gain (N-Gain) formula, which measures the extent of improvement relative to the maximum possible gain. N-Gain values were interpreted using the following criteria: high (≥ 0.70), moderate (0.30–0.69), and low (< 0.30). Practicality data were obtained through teacher and student response questionnaires, analyzed descriptively to determine ease of use, clarity, and instructional usefulness. Together, Aiken's V and N-Gain provided evidence of the validity and effectiveness of the developed E-worksheet.

2.3 Participants and Sampling Technique

The participants consisted of one intact Grade IV class, selected using convenience (intact class) sampling due to school policy, which did not allow random assignment of students to different groups. This approach is commonly used in educational development research to ensure the feasibility and ecological validity of classroom implementation. The selected class participated in both the limited trial and field trial stages. In addition, classroom teachers were involved in practicality assessments, while expert validators participated in the validation process.

2.4 Validation Procedures and Instruments

The validity of the E-worksheet was evaluated through expert judgment involving three validators: (1) a science education expert, (2) an instructional media expert, and (3) a language expert. All validators held at least a master's degree in their respective fields and had professional experience in elementary education and instructional material development.

Validation instruments were structured questionnaires using a 4-point Likert, covering aspects of content appropriateness, PBL alignment, language clarity, and graphical design. Content validity was analyzed using Aiken's V, which measures the degree of agreement among experts regarding item relevance. An Aiken's V value greater than 0.80 was interpreted as indicating high validity.

2.5 Data Collection and Analysis

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Practicality data were obtained through teacher and student response questionnaires, analyzed descriptively to determine ease of use, clarity, and instructional usefulness. Together, Aiken's V and N-Gain provided evidence of the validity and effectiveness of the developed e-worksheet. Ethical approval for the study was obtained from the school authorities prior to data collection. Permission was granted by the school principal, and informed consent was obtained from classroom teachers, students, and students' parents or guardians. Participants were informed that their involvement was voluntary and that all data would be used solely for research purposes while maintaining confidentiality.

3 FINDINGS AND DISCUSSION

3.1 Research Result

This development study produced a Canva-assisted electronic student e-worksheet based on the Problem-Based Learning (PBL) model to enhance fourth-grade students' science process skills. The study was conducted in October 2025 using the ADDIE instructional design model, which includes analysis, design, development, implementation, and evaluation stages. The main results of each stage are summarized below.

3.1.1 Analysis

The analysis stage indicated that the Merdeka Curriculum emphasizes contextual learning and active student engagement to achieve learning outcomes. Based on curriculum mapping, the IPAS topics of frictional force and muscular force in Grade IV were identified as appropriate for PBL-based learning because they naturally involve inquiry, experimentation, and problem-solving activities related to science process skills.

However, interviews with ten fourth-grade students revealed that IPAS learning was still dominated by teacher-centered practices, such as listening to explanations and completing textbook-based tasks, with limited opportunities for investigation or hands-on activities. This condition was confirmed by interviews with the classroom teacher, who reported that PBL had not been consistently implemented, science process skills were trained only partially, and innovative digital instructional media were rarely used. In addition, an analysis of the existing worksheets showed that they lacked contextual problem scenarios, had incomplete learning structures, and did not explicitly support the development of science process skills. These findings highlight the need for a PBL-based e-worksheet that can facilitate systematic inquiry and active student participation.

3.1.2 Design

The design stage focused on developing a structured and pedagogically meaningful E-worksheet aligned with the characteristics of fourth-grade students. The e-worksheet was designed using Canva as the main platform to integrate learning content, instructions, and activities into a single digital worksheet.

The e-worksheet structure includes: (1) title and material identity, (2) learning instructions, (3) learning outcomes and objectives aligned with the Learning Outcomes and Learning Objectives Sequence (4) supporting navigation features, and (5) learning activities organized according to the PBL syntax. These components were designed to ensure clarity, ease of use, and instructional coherence.

The core learning activities were structured following the five stages of PBL. The problem orientation stage introduces contextual problems related to frictional force through short visual stimuli. The organizing students for learning stage provides access to learning resources via QR codes, supporting students' readiness for inquiry. The investigation stage engages students in observation and data collection activities to train key science process skills. In the developing and presenting results stage, students report and discuss their findings, promoting communication and reflection. Finally, the analyzing and evaluating stage reinforces conceptual understanding by connecting scientific concepts with real-life examples. Overall, the design of the E-worksheet emphasizes pedagogical functionality rather than visual complexity, with Canva serving as a tool to support clarity, contextualization, and student engagement within the PBL framework.

3.1.3 Development

At the development stage, the Canva-assisted PBL-based E-worksheet was validated to examine its content accuracy, language appropriateness, and graphical quality. Validation was conducted by two experts for each aspect using a Likert scale, and the results were analyzed using Aiken's V to determine content validity. Overall, the validation results indicate that all aspects of the E-worksheet achieved high validity, with Aiken's V coefficients ranging from 0.83 to 1.00, which fall within the highly valid category. This confirms that the learning content aligns with curriculum demands, the language is clear and appropriate for fourth-grade students, and the graphical design supports readability and engagement. A summary of the validity results is presented in the table below, while detailed item-level results are provided in the appendix.

Table 1. Validity Results

Aspect Evaluated	Range of Aiken's V	Interpretation
Content validity	0.83–1.00	Highly valid
Language validity	0.83–1.00	Highly valid
Graphical quality	0.83–1.00	Highly valid

In addition to quantitative validation, experts provided qualitative feedback, which was used to revise and improve the e-worksheet. Revisions primarily addressed clarity of instructions, consistency of terminology, and optimization of visual layout to better support the learning flow. Examples of revisions before and after improvement are illustrated in Figures 12 and 13.

3.1.4 Implementation

The implementation stage examined the extent to which the learning process followed the PBL syntax and supported the development of students' science process skills (SPS). Classroom observations showed that all stages of PBL were implemented effectively, with Canva functioning as a pedagogical support tool for problem visualization, investigation, documentation, and presentation of learning outcomes.

Overall, students demonstrated active participation across all PBL stages, and the achievement levels of SPS indicators exceeded the Minimum Competency Achievement Criteria (KKTP) of 70. Mastery levels ranged from 87.5% to 93%, indicating high instructional fidelity and effective learning implementation.

Learning effectiveness was further analyzed using N-Gain to measure improvements in students' learning outcomes. The results showed a mean N-Gain value of 0.90, which falls into the high improvement category according to Hake's criteria ($g > 0.70$). This indicates that the implementation of the Canva-assisted PBL-based e-worksheet resulted in substantial learning gains. A summary of the N-Gain analysis is presented in Table 2.

Table 2. N-Gain Score

Indicator	Value
Number of Students	22
Average Pretest Score	50.0
Average Posttest Score	90.6
Average Score Gain	61.9
Average N-Gain	0.90
Average N-Gain (%)	86.3
N-Gain Category	High

These findings demonstrate that the structured integration of PBL syntax with digital visual support effectively enhanced students' science process skills and learning outcomes.

3.1.5 Evaluation

The evaluation stage was conducted based on student and teacher responses to assess the practicality and acceptability of the developed E-worksheet. Student responses indicated high levels of agreement across aspects of display, material clarity, and language use, with percentages ranging from 80% to 90%. Teacher responses also showed positive perceptions, with agreement levels between 67% and 100%, indicating that the E-worksheet was considered suitable and feasible for classroom use. Overall, these results suggest that the Canva-assisted PBL-based E-worksheet is practical, well-received, and appropriate for elementary science learning, supporting both instructional implementation and student engagement.

3.2 Discussion

3.2.1 Feasibility of the PBL-Based E-worksheet Assisted by Canva Media

The PBL-based e-worskheet assisted by Canva media was developed by considering three feasibility aspects: content, language, and graphics, in accordance with the standards established by the National Education Standards Board (BSNP, 2016). Beyond demonstrating feasibility, these aspects collectively explain why the developed e-worksheet functioned effectively as a learning scaffold. The needs analysis conducted in Grade IV at SD Negeri 05 Kepahiang revealed that the previously used E-worksheets were limited to routine practice questions, lacked authentic problem-solving activities, and did not follow standardized e-worksheet structures. Consequently, students were rarely engaged in inquiry-oriented learning processes, and teachers experienced difficulties aligning instructional materials with the competency demands of the Merdeka Curriculum.

This condition reflects a broader pedagogical challenge in curriculum implementation, particularly when teachers are required to shift from teacher-centered instruction toward student-centered and inquiry-based learning (Tang, 2023). The findings align with Ndari & Mahmudah (2023), who reported that teachers encounter substantial difficulties in Learning Outcomes and Learning Objectives Sequence, as well as in selecting appropriate instructional strategies and integrating technology meaningfully. From a constructivist perspective, such challenges may limit opportunities for students to actively construct knowledge through exploration and problem-solving, thereby hindering the development of higher-order thinking and science process skills.

The effectiveness of the developed e-worksheet can be interpreted through the lens of constructivist learning theory, which emphasizes that knowledge is actively constructed when learners engage with meaningful problems in authentic contexts (Romdhon, Masrifah, Shiyama, & Suharyati, 2024). The content feasibility of the E-worksheet ensured alignment with learning outcomes, material accuracy, and relevance to students' real-life experiences. This alignment is critical because well-structured content enables students to connect prior knowledge with new concepts, supporting conceptual change and deeper understanding (Krajcik & Shin, 2023). In addition, the explicit integration of problem scenarios stimulated students' curiosity and inquiry, which are essential conditions for meaningful learning in science education.

In terms of presentation and organization, the clarity of learning instructions, coherence among materials, and consistency of visual elements contributed to reducing students' cognitive load (Serki & Bolkan, 2024). From the perspective of multimedia learning theory from (Mayer, 2014), the combination of verbal explanations and visual representations when designed coherently can enhance students' understanding by supporting dual-channel processing. The Canva-assisted design allowed information to be presented in an organized and visually meaningful way, enabling students to focus on essential learning processes rather than navigating confusing or fragmented materials.

The feasibility of the e-worksheet in facilitating problem-solving processes further explains its effectiveness. Each stage of the Problem-Based Learning syntax duet o problem orientation, organizing learning activities, guided investigation, development of results, and evaluation were embedded systematically within the worksheet. This structure functioned as a form of instructional scaffolding, guiding students through complex inquiry tasks while gradually fostering independence. As a result, students were not merely completing tasks but actively engaging in observing, investigating, analyzing data, and communicating findings, which are core components of science process skills (Idul & Caro, 2022).

Language feasibility from e-worksheet also played a crucial role in supporting learning effectiveness. Clear, communicative, and developmentally appropriate language ensured that students could understand instructions and learning content without unnecessary ambiguity (Fitria & Afdaleni, 2024). This finding supports the notion that linguistic clarity is essential for inquiry-based learning, as unclear instructions may hinder students' ability to engage in scientific reasoning and investigation (Morris, 2025). The use of standardized terminology and grammatically accurate sentences further contributed to instructional clarity and learning efficiency.

Furthermore, the graphical feasibility of the e-worksheet supported learning by creating an engaging and accessible learning environment. Rather than serving merely aesthetic purposes, the visual elements facilitated comprehension, guided attention, and supported students in organizing and presenting information. This finding reinforces the idea that visual design, when aligned with pedagogical goals, can enhance learning engagement and conceptual understanding, particularly for elementary students who benefit from concrete and visually supported representations.

Overall, the feasibility findings align with (Anbiya & Khaldun, 2023), who demonstrated that inquiry-based LKPDs oriented toward science process skills meet validity standards and are suitable for classroom use. However, this study extends previous research by integrating digital media and visual scaffolding within a PBL framework, highlighting how instructional design choices contribute to learning effectiveness rather than merely confirming feasibility.

3.2.2 The Role of PBL-Based E-worksheet Assisted by Canva in Enhancing Students' Science Process Skills

The findings of this study indicate that the implementation of an E-worksheet based on the Problem-Based Learning (PBL) model and assisted by Canva media effectively enhances the science process skills (SPS) of Grade IV elementary school students. This improvement can be attributed to the integration of structured problem-solving activities, interactive digital worksheets, and visually engaging media that actively involve students in scientific inquiry processes.

Problem-Based Learning emphasizes learning through authentic problems, encouraging students to observe, question, investigate, analyze data, draw conclusions, and communicate findings (Wijnia, Noordzij, Arends, Rikers, & Loyens, 2024). These stages align directly with the core components of science process skills. In this study, the E-worskheet was designed to systematically guide students through each PBL syntax, including problem orientation, investigation, data analysis, and evaluation. As a result, students were not only exposed to scientific concepts but were also trained to apply scientific reasoning through hands-on and inquiry-based activities.

The use of Canva as a supporting medium further strengthened the effectiveness of the E-worksheet. This visual and interactive approach helped students document observations, organize data, and Canva enabled the presentation of problems through infographics, animations, diagrams, and digital tables, making abstract scientific concepts more concrete and accessible for elementary students (Ristanti & Isdaryanti, 2024). present investigation results clearly, thereby strengthening key science process skills such as observing, classifying, interpreting, and communicating. Similar findings were reported by Noormiati et al. (2023), who found that interactive E-worksheet increased student engagement, understanding, and active participation in science learning.

The results of this study are consistent with previous research demonstrating the positive impact of PBL-based instructional materials on science process skills Demirçalı & Selvi (2022); Gizaw & Sota (2023) found that the PBL model significantly improved students' science process skills, regardless of students' background differences. Furthermore, Sari, Utomo, & Astina (2021) reported that problem-based learning significantly enhanced students' scientific problem-solving abilities, which are closely related to SPS development.

In addition, research by Mutlu (2020) showed that LKPDs supported by digital tools effectively improved students' science process skills by facilitating experimentation and inquiry activities. Similarly, Wazni & Fatmawati (2022) confirmed that LKPDs designed with a science process skills approach met validity criteria and were effective in supporting students' scientific inquiry abilities.

The effectiveness of the e-worksheet in this study is also aligned with findings from Dwiningsih et al. (2024), who reported that STEM-based instructional modules were valid, practical, and effective in fostering science process skills. Although the learning approach differed, both studies emphasize the importance of student-centered, inquiry-driven learning materials in developing SPS. Moreover, Purtadi, Suyanta, & Rohaeti (2023) demonstrated that inquiry-based strategies at the elementary level significantly improved students' science process skills and learning motivation, supporting the suitability of inquiry-oriented models such as PBL for young learners.

Compared to previous studies, this research offers novelty by integrating three key components simultaneously: a PBL instructional model, an e-worksheet digital format, and Canva as a visual learning medium within the context of Grade IV science learning. Unlike earlier studies that focused on LKPD development, PBL implementation, or SPS improvement separately, this study highlights the interconnected role of learning media, learning model, and targeted skills within a single instructional framework. Overall, the findings suggest that the PBL-based e-worksheet assisted by Canva creates a learning environment that actively engages students in scientific inquiry, encourages critical and analytical thinking, and systematically trains science process skills. Supported by previous research, this study reinforces the conclusion that well-designed digital worksheets combined with problem-based learning and visual media are highly effective in enhancing elementary students' science process skills in accordance with the demands of 21st-century science education and the Merdeka Curriculum.

4 CONCLUSION

This study achieved its first objective by successfully developing a Canva-assisted, Problem-Based Learning (PBL)-based E-worksheet that is valid, practical, and feasible for elementary science learning. The development process followed the ADDIE model and resulted in an instructional product that met high validity standards across content, language, and graphical aspects, as indicated by expert judgment results (Aiken's V = 0.83–1.00). Practicality findings further demonstrated that the E-worksheet was easy to use and well received by both teachers and students. The integration of PBL syntax with Canva's visual and interactive features effectively supported structured inquiry activities and student engagement, ensuring alignment with the Learning Outcomes of the Merdeka Curriculum. These results indicate that the developed E-worksheet is pedagogically sound and suitable for classroom implementation.

In relation to the second objective, the findings confirm that the developed E-worksheet is effective in improving fourth-grade students' science process skills, as evidenced by a high N-Gain score (N-Gain = 0.90), which reflects substantial learning improvement. This effectiveness suggests that Canva-assisted PBL E-worksheets can serve as a powerful instructional resource for fostering student-centered and inquiry-based science learning. From a practical perspective, the E-worksheet may be integrated into teacher professional development programs and curriculum design initiatives to strengthen teachers' capacity to implement digital, inquiry-oriented learning materials. However, to strengthen causal inferences, future studies should employ quasi-experimental or experimental designs with control groups and involve larger, more diverse samples. Further research should also critically explore the incorporation of advanced digital features, such as adaptive feedback and learning analytics, to enhance students' inquiry depth and reflective learning processes.

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