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Developing Canva-Assisted Problem-Based Learning Worksheets to Improve Fourth Graders' Cognitive Skills in Science

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Abstract

This study aims to develop a valid, practical, and effective Problem-Based Learning (PBL) worksheet assisted by the Canva application to improve fourth-grade students' cognitive learning outcomes. Using a Research and Development approach with the ADDIE model, this research was conducted involving a fourth-grade classroom teacher and students at Public Elementary School 41 Bengkulu city. Data were collected through needs analysis, observations, interviews, and cognitive tests, and subsequently analyzed using qualitative descriptive and quantitative methods. The development process resulted in a systematic worksheet design tailored to curriculum demands, emphasizing material relevance, clear instructions, and visual appeal. Expert validation indicated high feasibility, with material validity reaching 0.83, language validity at 1.00, and design validity at 1.00. Furthermore, the implementation revealed highly positive practical responses from both the teacher and students. The cognitive tests demonstrated a significant improvement, with average scores increasing from 75.50 (pretest) to 89.00 (posttest), yielding a moderate and statistically significant N-Gain score of 0.55 ($p < 0.05$). The findings suggest that Canva-assisted PBL digital worksheets serve as an effective, engaging instructional resource to foster active scientific inquiry and enhance cognitive outcomes in elementary education.

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1. Introduction

Elementary science education is fundamental for developing students' analytical and inquiry skills, yet instructional practices often struggle to translate abstract scientific phenomena into concrete, meaningful learning experiences. Although modern educational frameworks, such as Indonesia's Merdeka Curriculum, emphasize student-centered learning and critical thinking, classroom realities often fall short. International assessments, including TIMSS 2019 and PISA 2022, consistently highlight that Indonesian students face significant challenges in science, particularly concerning reasoning, information integration, and higher-order evaluative skills. These cognitive deficiencies are frequently exacerbated by a reliance on conventional instructional materials, such as static

Student Worksheets (LKPD), which tend to promote rote memorization rather than active conceptual understanding (Kahar et al., 2021; Prastowo, 2016; Syarifuddin et al., 2022). Consequently, improving the quality of human resources and educational outcomes relies heavily on the effectiveness of classroom learning processes and the strategic design of instructional materials (Al Faruq et al., 2024; Budiarto et al., 2024; Dröse et al., 2025).

Grounded in constructivist learning theory, effective science instruction must empower students to actively construct knowledge through systematic inquiry and interaction with their environment (Dagher & Erduran, 2016; Noperman, 2020; Rahmawati et al., 2021). Problem-Based Learning (PBL) emerges as a highly relevant pedagogical approach in this context, as it situates learning within authentic, real-world problems that stimulate collaborative problem-solving and critical thinking (Ali, 2019; Muktadir et al., 2024; Yu et al., 2015). By integrating PBL, students can systematically develop essential science process skills, such as observing, measuring, predicting, and drawing conclusions (Fitriani et al., 2020; Anbiya et al., 2023; et al., 2025), which are critical for scientific literacy. Furthermore, contemporary education is increasingly unconstrained by traditional temporal and spatial boundaries (Du et al., 2019; Lock et al., 2021), necessitating instructional tools that are visually engaging and highly accessible.

Despite the acknowledged pedagogical benefits of PBL, there remains a prominent research gap regarding the development of PBL-oriented Student Worksheets integrated with digital design platforms like Canva, particularly tailored for elementary science instruction. While previous studies have widely explored PBL as an instructional model, few have operationalized its syntax into visually stimulating, digitally assisted worksheets designed specifically to address the cognitive developmental needs of fourth-grade students. Canva, with its robust visual affordances, offers a strategic tool to transform monotonous worksheets into interactive, contextual, and aesthetically engaging learning media. This integration is hypothesized to reduce the cognitive load associated with abstract science topics, such as changes in the states of matter, thereby making the learning process more intuitive and aligned with the demands of the Merdeka Curriculum.

Therefore, this study aims to develop a valid, practical, and effective Problem-Based Learning-oriented Student Worksheet using the Canva application, specifically focusing on the topic of changes in the states of matter for fourth-grade students. By facilitating active student engagement through contextual problem-solving activities, this research seeks to improve students' cognitive learning outcomes. The findings are expected to contribute significantly to the academic literature on digital instructional material development in elementary science education and provide educators with an innovative, curriculum-aligned resource to foster conceptual mastery.

2. Methods

This study employed a Research and Development (R&D) approach aimed at developing and validating a Problem-Based Learning (PBL) oriented Student Worksheet (LKPD) designed using the Canva application. The development process systematically followed the ADDIE model, encompassing five sequential stages: analysis, design, development, implementation, and evaluation (Winarni, 2018). To evaluate the effectiveness of the developed product during the implementation stage, a one-group pretest-posttest pre-experimental design (O_1 $O_1 \rightarrow X \rightarrow O_2$) was applied, where O_1 represents the pretest, X denotes the treatment using the PBL-based Student Worksheet, and O_2 represents the posttest.

The research was conducted at Public School 41, Bengkulu City. The main subjects for the implementation phase consisted of 20 fourth-grade students and one classroom teacher. Prior to the main implementation, an empirical trial involving 20 fourth-grade students from a different class was conducted to rigorously establish the validity and reliability of the cognitive test instruments. Ethical considerations were strictly observed throughout the study to foster a safe, empathetic, and inclusive learning environment. Prior to any data collection, formal institutional approval was granted by the administration of Public School 41 Bengkulu City. Furthermore, written informed consent was obtained from the parents or legal guardians of all participating fourth-grade students. The consent forms transparently detailed the study's objectives, the voluntary nature of participation, and guaranteed the strict confidentiality and anonymization of all student data. Students were also provided with a supportive space and the agency to withdraw from the research activities at any time without any academic penalty, ensuring their well-being and comfort remained the utmost priority.

Data collection involved multiple instruments to ensure a comprehensive evaluation of the product: expert validation sheets, teacher and student response questionnaires, and cognitive tests. The expert validation sheets assessed the product's feasibility based on content, language, presentation, and graphical aspects. The teacher and student response questionnaires were constructed using a five-point Likert scale (ranging from strongly agree to strongly disagree) to capture practicality, ease of use, media presentation, and learning engagement. Furthermore, a cognitive test, administered as both a pretest and posttest, was utilized to measure students' cognitive learning outcomes specifically related to their understanding of changes in the states of matter.

Data were analyzed using descriptive qualitative and quantitative statistical techniques. Content validity was determined using Aiken's V formula, involving a panel of six expert validators: two subject-matter experts in Elementary Science Education, two language experts in Elementary Indonesian Language Education, and two graphic design experts (educational technology and fine arts). Aiken's V index was calculated using the following formula: $V = \frac{\sum s}{n(c-1)}$

In this formula, V represents Aiken's validity index, s refers to the score assigned by each rater minus the lowest score in the rating category ($s = r - l_o$), l_o denotes the lowest validity rating score (1), c indicates the highest validity rating score (4), and n represents the number of raters (Azwar, 2015). The V index ranges from 0 to 1, with $V \geq 0.8$ categorized as high validity.

Following implementation, learning effectiveness was measured to determine the improvement in students' cognitive learning outcomes. The normalized gain (N-Gain) score was calculated by comparing the pretest and posttest scores (Hake, 1999) using the following formula:

$$N\text{-}Gain = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Maximum Score} - \text{Pretest Score}}$$

The resulting N-Gain scores were classified into three categories: high (N-Gain > 70%), moderate (30% ≤ N-Gain ≤ 70%), and low (N-Gain < 30%).

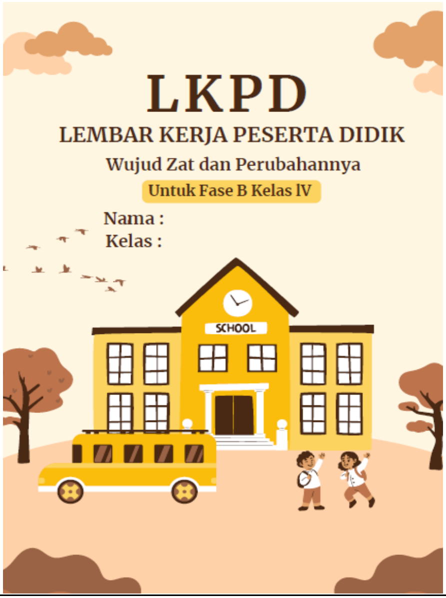
3. Results

3.1 Needs Analysis and Product Development

The development of the Problem-Based Learning (PBL) worksheet assisted by Canva was initiated based on a comprehensive needs analysis conducted at Elementary School 41, Bengkulu City. The curriculum analysis revealed that existing instructional materials, primarily government-issued textbooks on the topic of changes in the states of matter, lacked contextualization and failed to fully support students in achieving the targeted competencies. Furthermore, a preliminary cognitive assessment indicated a significant learning gap; the students' average score was 58, falling well below the Minimum Learning Mastery Criteria (KKM) of 70. Most students struggled with reasoning-based questions and applying scientific concepts to real-life phenomena.

To address these empirical findings, the product development phase was systematically executed through several key steps: (1) analysis of learning outcomes, (2) formulation of learning objectives, (3) analysis of students' prior competencies, (4) instructional content analysis, and (5) product design and validation. The initial design of the worksheet underwent substantial revisions to align strictly with the PBL syntax. Revisions included redesigning the cover to feature contrasting colors and relevant imagery, refining the instructions to clearly reflect the PBL stages, and contextualizing the problem orientation phase with relatable scenarios (e.g., melting ice). The "Organizing for Learning" and "Investigation" syntaxes were enhanced by incorporating QR codes for interactive video resources and step-by-step experimental procedures. Finally, the "Developing Results" and "Evaluating" sections were restructured to include clear prompts that guided students in analyzing their findings and evaluating their problem-solving processes.

a. Cover



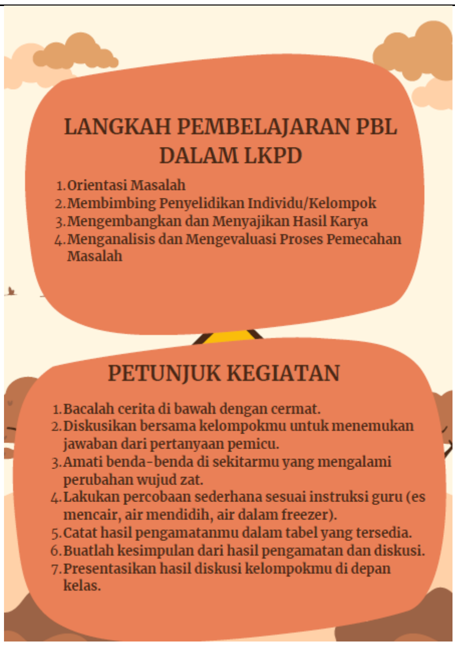
Before Revision

After Revision

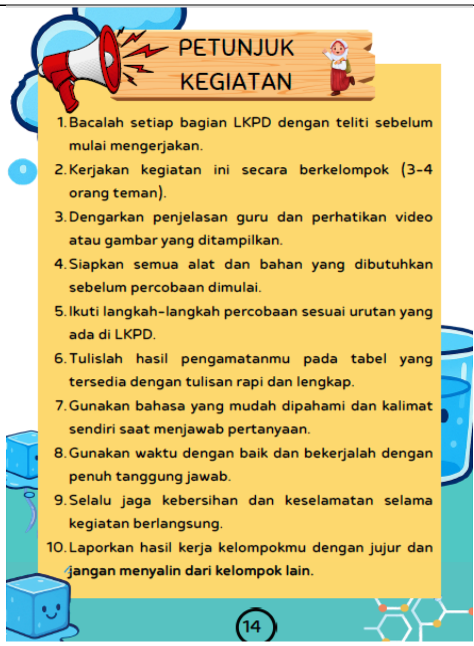
Fig. 1. Cover

The initial version of the student worksheet cover was considered less appealing, as the images and design did not correspond to the topic of changes in the states of matter. The color scheme lacked contrast and did not visually support the learning content. After revision, the cover was redesigned to better reflect the topic, incorporating more relevant imagery and a contrasting color palette, which enhanced its attractiveness and alignment with the instructional material.

b. Instructions for Using the LKPD



Before Revision

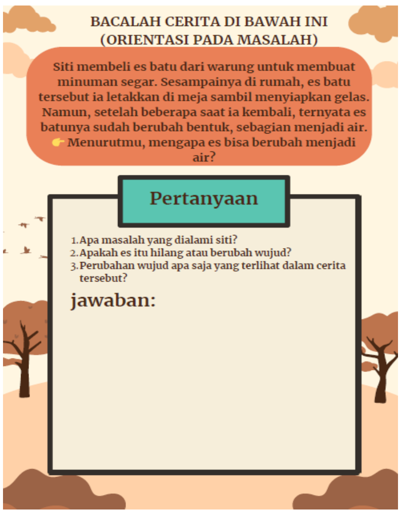


After Revision

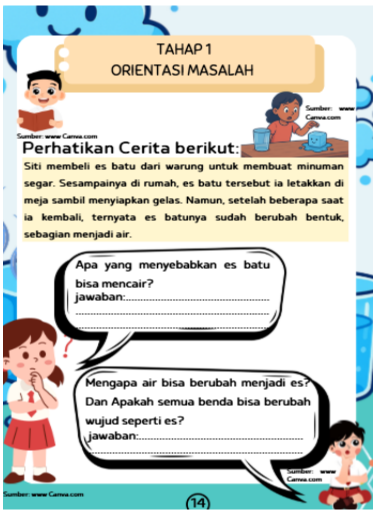
Fig. 2. Instructions for Using the LKPD

In the initial version, the instructions provided in the student worksheet were not fully aligned with the steps of the Problem-Based Learning (PBL) model. Activity guidance was unclear and did not adequately support the intended learning process. After revision, the instructions were revised to follow the PBL framework more closely, providing clearer guidance for each activity and facilitating students' engagement in problem-solving tasks as intended.

c. Problem Orientation Syntax



Before Revision

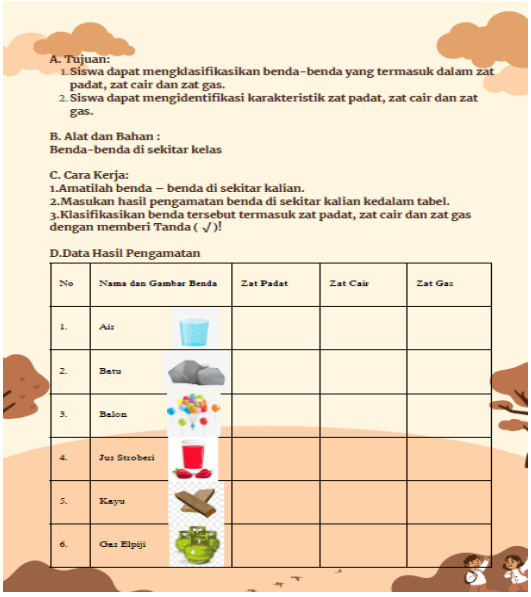


After Revision

Fig. 3. Problem Orientation Syntax

In the initial version of the student worksheet, the problem orientation step of the PBL model was not clearly represented, presenting only a simple case that lacked alignment with the topic of changes in the states of matter. After revision, the problem orientation was clearly defined, providing a more meaningful and contextually relevant problem scenario that directly aligned with the learning content, thereby facilitating students' engagement in identifying and understanding the scientific problem.

d. Organizing for Learning Syntax



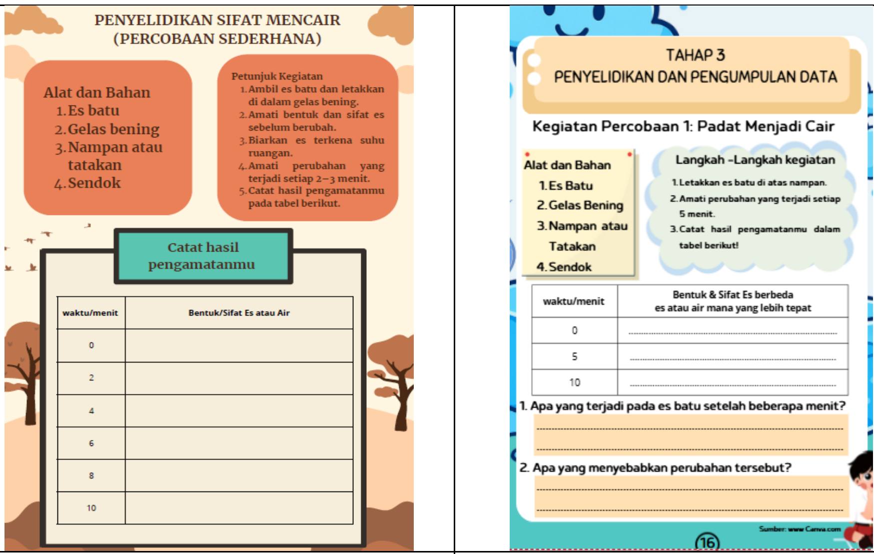
Before Revision

After Revision

Fig. 4. Organizing for Learning Syntax

In the initial version of the student worksheet, the "Organizing for Learning" step of the PBL model was not clearly represented and included only simple material on the classification of states of matter. After revision, this step was fully aligned with PBL principles, incorporating content that matched the learning objectives and including a QR code to provide students with interactive access to additional resources, thereby supporting more effective organization of learning activities.

e. Investigation and Data Collection Syntax

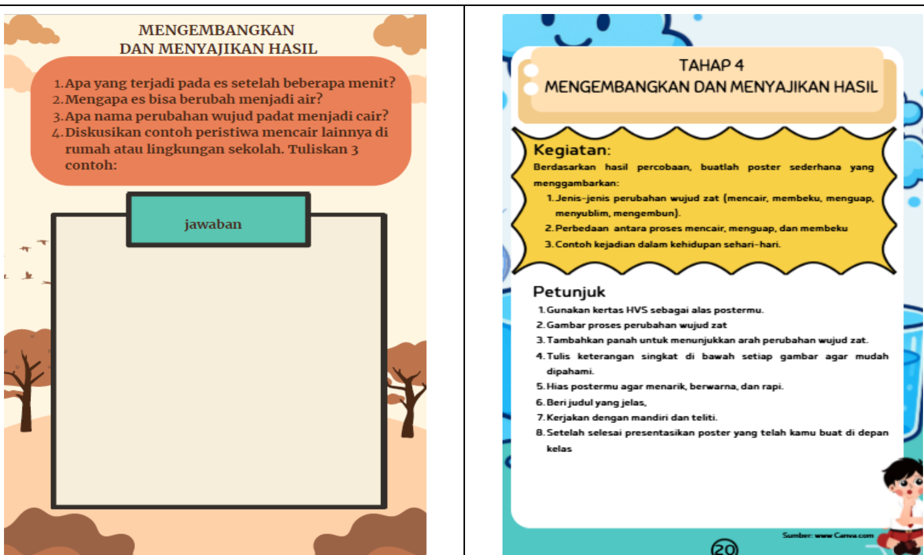


Before Revision	After Revision

Fig. 5. Investigation and Data Collection Syntax

In the initial version of the student worksheet, the investigation step involved a simple experiment listing the tools and materials, but the procedure for conducting the experiment was unclear. After revision, the investigation and data collection steps were clearly structured, providing detailed guidance aligned with the topic of changes in the states of matter, which enabled students to conduct experiments systematically and collect relevant data effectively.

f. Developing and Presenting Results Syntax



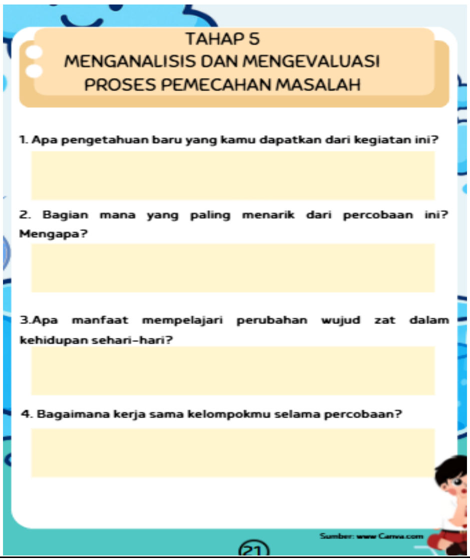
Before Revision	After Revision

Fig. 6. Developing and Presenting Results Syntax

In the initial version of the student worksheet, the "Developing and Presenting Results" step was very simple, containing only questions that were not entirely appropriate for guiding students' analysis. After revision, this step was fully aligned with the PBL framework, providing clear explanations of the activities and detailed instructions, which helped students systematically develop, analyze, and present their results in a structured manner.

g. Analyzing and Evaluating Syntax

Before Revision



After Revision

Fig. 7. Analyzing and Evaluating Syntax

In the initial version of the student worksheet, the “Analyzing and Evaluating” step was insufficiently developed and did not provide clear guidance for students to assess their understanding or the outcomes of their investigations. After revision, this step was enhanced to include structured activities and prompts that guided students in critically analyzing their findings and evaluating their learning process, fully aligning with the Problem-Based Learning framework and supporting higher-order thinking skills.

The development stage represents a crucial phase of this study, during which the Problem-Based Learning-based Student Worksheet using the Canva application was developed based on the design formulated in the previous stage. At this stage, the researcher transformed the Student Worksheet design into an initial product ready for feasibility testing. The development process was carried out by aligning the Student Worksheet with the learning outcomes, learning objectives, and students’ needs related to the topic of changes in the states of matter in fourth-grade elementary science learning. In this phase, Canva was used as the primary design platform to create a Student Worksheet with an attractive, interactive, and user-friendly visual appearance. Canva was selected due to its flexible design features, which allow the integration of visual elements such as images, icons, color schemes, and layouts suitable for elementary school students.

Each Student Worksheet page was designed according to Problem-Based Learning principles, guiding students to engage in critical thinking, collaboration, and concept discovery through exploratory activities. After the initial version of the LKPD was completed, expert validation was conducted to evaluate its feasibility. The validation aimed to assess the Student Worksheet from multiple perspectives, including content accuracy, language clarity, and visual design quality. The evaluation was carried out using validation instruments developed during the design stage, covering aspects such as material clarity, curriculum alignment, language readability, visual attractiveness, and consistency with Problem-Based Learning principles.

3.2 Product Feasibility (Expert Validation)

Prior to field implementation, the developed PBL-based worksheet was rigorously evaluated by a panel of six experts to ensure its feasibility across material, language, and design aspects. The content validity was calculated using Aiken's V formula.

The material validation results (Table 1) demonstrated that the worksheet's instructional content suitability and accuracy achieved a valid category (V = 0.67), while content relevance and its ability to stimulate curiosity were rated as very valid (V = 1.00 and V = 0.83$, respectively).

Table 1.
Results of material validation

Indicator	V-Index	Category
Suitability of instructional content	0.67	Valid
Accuracy of the material in the instructional content	0.67	Valid
Instructional material contains relevant content	1.00	Very Valid
Instructional material can stimulate students' curiosity	0.83	Very Valid
Overall Material Validity	**1.00**	**Very Valid**

The language validation results (Table 2) indicated that the worksheet met the highest standards of linguistic feasibility. All indicators, including language clarity, communicativeness, suitability to students' cognitive development, and compliance with linguistic rules, obtained perfect scores (V = 1.00), categorizing the language aspect as very valid.

Table 2.
Results of language validation

Indicator	V-Index	Category
Clarity of language	1.00	Very Valid
Communicativeness	1.00	Very Valid
Suitability to students' cognitive development	1.00	Very Valid
Compliance with linguistic rules	1.00	Very Valid
Overall Language Validity	**1.00**	**Very Valid**

Similarly, the design validation (Table 3) evaluated the worksheet's physical and visual attributes, such as material size, cover design, and layout organization. All design indicators achieved a maximum validity index (V = 1.00), confirming that the Canva-assisted visual elements were highly appropriate and categorized as very valid.

Table 3.
Results of Design Validation

Indicator	V-Index	Category
Instructional material size	1.00	Very Valid
Cover design	1.00	Very Valid
	1.00	Valid
Instructional material size	1.00	Valid
	1.00	Sangat Valid

The following figure shows the recapitulation of Student Worksheet validation results.

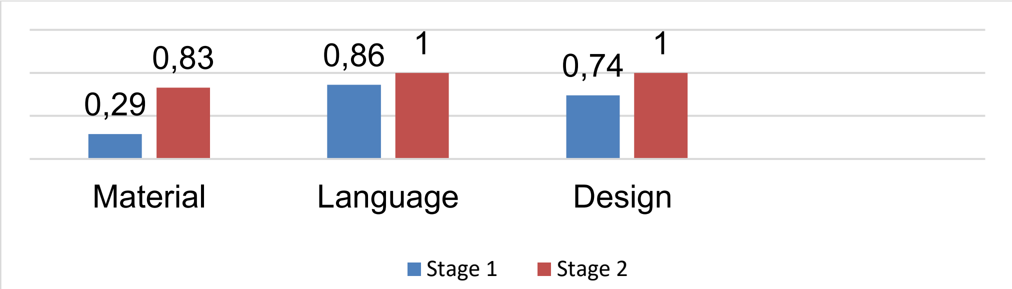


Fig. 8. Recapitulation of worksheet validation results

3.3 Product Practicality (Teacher and Student Responses)

The practicality of the developed worksheet was assessed during the implementation phase using response questionnaires administered to one classroom teacher and 20 fourth-grade students. The teacher's response regarding attractiveness, content, language, and PBL integration yielded a total score of 11 out of 14, which falls into the "Good" category, indicating high practical utility in a classroom setting (Table 4).

Table 4.
Teacher response results to the student worksheet (Class IVA)

Indicator	Item No.	Score	Mean	Category
Attractiveness	1	1	3	Good
	2	1		
	3	0		
	4	1		
Content	5	1	2	Good
	6	1		
Language	7	1	2	Good
	8	1		
PBL-Based Student Worksheet	9	1	4	Good
	10	1		
	11	1		
	12	1		
	13	0		
	14	0		
Total	14	11	11	Good

Based on the teacher response results presented in Table 4, the PBL-based Student Worksheet developed using the Canva application received an overall score of 11 out of 14, which falls into the good category. The aspects of attractiveness, content, language, and PBL integration were all rated as good, indicating that the worksheet is practical and suitable for use in the learning process.

The student responses (Table 5) corroborated the teacher's positive assessment. Students rated the worksheet favorably across all indicators, resulting in an overall mean score of 0.80, which is also categorized as "Good". This indicates that the Canva-assisted PBL worksheet was engaging, understandable, and practically applicable for the students.

Table 5.
Student Response Results to the Student Worksheet (Class IVA)

Indicator	Item No.	Score	Mean	Category
Attractiveness	1	0.7	0.75	Good
	2	0.85		
	3	0.65		
	4	0.8		
Content	5	0.8	0.80	Good
	6	0.8		
Language	7	0.75	0.85	Good
	8	0.95		
PBL-Based Student Worksheet	9	0.75	0.83	Good
	10	0.8		
	11	0.75		
	12	0.9		
	13	0.95		
	14	0.85		
Total	14	11.30	0.80	Good

Based on the student response results presented in Table 5, the PBL-based Student Worksheet developed using the Canva application obtained an overall mean score of 0.80 and was categorized as good. The indicators of attractiveness, content, language, and PBL-based worksheet characteristics were positively evaluated by students, indicating that the worksheet is practical, engaging, and suitable for use in learning activities.

3.4 Product Effectiveness on Cognitive Learning Outcomes

To determine the effectiveness of the PBL-based worksheet, a one-group pretest-posttest design was utilized to measure improvements in students' cognitive learning outcomes regarding changes in the states of matter. The results (Table 6) demonstrate a substantial increase in student performance.

Table 6.
Summary of Pretest and Posttest Scores of Cognitive Learning Outcomes

Class	Mean Score		Gain	Category
	Pretest	*Postest*		
Experimental	75.50	89.00	0.55	Moderate

As detailed in Table 6, the students' average score improved significantly from 75.50 in the pretest to 89.00 in the posttest. The calculated N-Gain score was 0.55, which falls within the "Moderate" category. These quantitative findings confirm that the Canva-assisted PBL worksheet is effective in enhancing fourth-grade students' cognitive learning outcomes in science.

4. Discussion

The findings of this study indicate that the Canva-based electronic Problem-Based Learning (PBL) worksheet significantly improved fourth-grade students' cognitive learning outcomes on changes in the states of matter. This finding is consistent with previous studies showing that interactive digital learning media promote creative and critical thinking through active, student-centered learning (Hinchcliff & Mehmet, 2023; Dalifa et al., 2024; Muktadir et al., 2024; Habibah et al., 2025). Similarly, accessible electronic reading platforms and leveled digital books enhance elementary students' literacy and learning performance by supporting flexible digital learning environments (Muktadir et al., 2025; Müller & Mildenberger, 2021; Huda, 2024). Moreover, visual learning materials have been shown to improve academic achievement and self-regulated learning (Liao et al., 2024), while Canva integration enriches both students' learning experiences and teachers' instructional practices (Erfiana & Rohmah, 2025). Canva-assisted learning also promotes critical thinking, communication, collaboration, and creativity through the design of higher-quality learning tasks (Awaliyah et al., 2026).

The integration of authentic, problem-based tasks into the digital worksheets effectively transitioned students from passive recipients of information to active investigators. This active involvement promoted deeper conceptual understanding, as students were able to connect abstract phenomena, such as melting and evaporation, with tangible everyday experiences. These results strongly corroborate PBL theory, which posits that learning becomes substantially more meaningful when students confront real-world challenges that necessitate sustained inquiry, critical reasoning, and peer collaboration (Gusman, 2023; Hmelo-Silver, 2004; Miller & Krajcik, 2019; Cong & Ironsi, 2025).

Beyond purely cognitive gains, the collaborative nature of the PBL syntax—particularly during the investigation and data presentation phases—cultivated a highly inclusive learning environment. By engaging in shared problem-solving, students were encouraged to listen to diverse perspectives, thereby exercising empathy and mutual respect. This aligns with the fundamental principles of constructivist approaches, where knowledge is actively co-constructed through meaningful social interactions and engagement with the environment (Piaget, 1970; Vygotsky, 1978). The PBL-based worksheet allowed students to take ownership of their learning by analyzing problems, generating solutions, and reflecting on their understanding, which inherently fosters higher-order thinking skills (Rivas et al., 2022).

Crucially, the utilization of Canva in designing the instructional material played an instrumental role in bridging the cognitive gap often experienced by elementary students when facing abstract scientific concepts. Visual media help learners process multiple streams of information simultaneously (Evagorou et al., 2015; Sari et al., 2026). The Canva-based visuals, which included vibrant diagrams, interactive layouts, and structured aesthetic guidance, effectively scaffolded the students' cognitive load. Interactive visuals simplify abstract ideas, making them considerably more concrete and comprehensible (Ryoo & Bedell, 2017). Consequently, the high feasibility scores obtained during expert validation directly translated into high practicality in the classroom; the visual design maintained students' attention, enhanced engagement, and provided intuitive navigation for independent and collaborative learning. This confirms the assertion that the effectiveness of learning media is deeply intertwined with its design quality, including clarity, usability, and visual appeal (Adi et al., 2023; du Preez & Jacobs, 2026).

The positive responses from both the teacher and the students further underscore the practical implications of this study. From a pedagogical standpoint, language that is developmentally appropriate and well-structured enables students to focus on problem-solving processes rather than struggling to interpret instructions. This significantly reduces the teacher's instructional burden, allowing educators to transition seamlessly into the role of facilitators within the PBL framework (Al-Bahadli et al., 2023; Martínez, 2022). Furthermore, the moderate N-Gain score (0.55) achieved in this study confirms that well-designed digital worksheets can elevate learning motivation and participation, translating into measurable cognitive improvements (Rehman et al., 2024; Šliogerienė et al., 2025).

While this study offers robust evidence supporting the efficacy of Canva-assisted PBL worksheets, several limitations must be acknowledged. The implementation was conducted within a relatively limited sample and localized context, which may restrict the broad generalizability of the findings. Additionally, the effectiveness analysis was primarily confined to short-term cognitive learning outcomes. Future research should aim to involve larger, more diverse student populations over extended implementation periods, and broaden the scope of assessment to encompass long-term retention as well as affective and psychomotor domains. Despite these limitations, the present study contributes a highly feasible, curriculum-aligned instructional resource that fundamentally supports meaningful and student-centered science learning at the elementary level.

5. Conclusion

This study concludes that the Canva-assisted Problem-Based Learning (PBL) worksheet is a valid, practical, and highly effective instructional resource for improving fourth-grade students' cognitive learning outcomes in science. By integrating contextual scientific problems with visually engaging designs, the worksheet successfully translates abstract concepts, such as changes in the states of matter, into accessible, real-world applications. The findings confirm that this digital integration not only enhances conceptual mastery and critical thinking but also cultivates a more inclusive, empathetic, and collaborative learning environment among young learners. Practically, educators can adopt this curriculum-aligned tool to reduce students' cognitive load and transition toward meaningful, student-centered science instruction. Theoretically, this research extends the application of constructivist PBL frameworks by demonstrating the critical pedagogical role of digital visual scaffolding in elementary education. While this study is limited by its relatively small sample size and short-term evaluation scope, the positive empirical results provide a strong foundation for scaling such innovations. Future studies should explore the longitudinal impact of digitally enhanced PBL across diverse educational settings and assess its influence on broader affective domains. Ultimately, synergizing pedagogical innovation with accessible digital design offers a promising pathway to elevate both the quality and equity of elementary science education.

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