

Development of Problem Based Learning-Based Student Worksheets to Improve 4C Skills in Science Learning in Elementary Schools

Laura Lailatul Qodri^{1*}, Yeni Erita¹, Leni Zahara¹, Rayendra¹

¹Basic Education Study Program, Universitas Negeri Padang, Padang, Indonesia.

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Corresponding Author:

Sumiyem

2014070038.laurailatulqodri@gmail.com

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Abstract: Education in the 21st century requires a shift toward student-centered learning and the strengthening of 4C skills (*Creativity, Critical Thinking, Collaboration, and Communication*) as mandated by the Pancasila Student Profile and the Merdeka Curriculum. Needs analysis in elementary schools shows that existing LKPD are still traditional, lack problem-solving components, do not facilitate collaboration, and have not supported higher-order thinking. This condition indicates the urgency of developing contextual and interactive LKPD based on Problem-Based Learning (PBL) to reinforce students' 4C skills in grade IV IPAS lessons. This study aims to develop PBL-based LKPD to improve students' 4C skills using the ADDIE model. The research was conducted in SDN 02 Maek, SDN 06 Maek, and SDN 07 Maek involving 30 students and 3 teachers. The product's validity met the required standards, with media validation at 71.6% (valid), language validation at 80% (valid), and content validation at 66% (valid). Practicality testing showed scores of 86.3% from teachers (very practical) and 82.6% from students (very practical). The LKPD's effectiveness was demonstrated through an average N-Gain of 0.77 (high). Thus, the developed LKPD is categorized as valid, very practical, and effective in strengthening 4C skills in grade IV IPAS learning.

Keywords: Problem Based Learning; Student Worksheet (LKPD); 4C Skills

Introduction

The 21st century has brought a need for a change in how learning happens, shifting from a teacher-centered approach to one that puts students at the center of the learning process. There is a strong focus on strengthening 21st-century skills, especially the four C skills: Creativity, Critical Thinking, Collaboration, and Communication. These skills are a main point in many global education policies. The four skills are clearly shown in the Pancasila Student Profile and have been included in the implementation of the Merdeka Curriculum as a response to the changing and challenging educational environment (Trilling & Fadel, 2009; Kemendikbudristek, 2022). Article 3 of Law No. 20 of 2003 on the National Education System states: "National education aims to develop abilities and shape the character and civilization of a nation with dignity, in

order to enlighten the nation's life. Its goal is to develop the potential of students to become individuals who are religious and pious towards God Almighty, have good morals, are healthy, have knowledge, are capable, creative, independent, and become democratic citizens who are responsible." (UU No. 20 Year 2003, Article 3). This commitment is further reinforced in Regulation of the Minister of Education, Culture, Research, and Technology of the Republic of Indonesia No. 16 Year 2022 on Learning Process Standards, Article 4, which states: "The learning process is carried out interactively, inspiringly, enjoyably, challenging, and motivating students to actively participate, as well as providing enough space for initiative, creativity, and independence according to the students' talents, interests, and physical and psychological development." (Permendikbudristek No. 16 Year 2022, Article 4). Therefore, strengthening the 4C skills is not only relevant from a teaching perspective

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but also has legal backing as part of the holistic and sustainable goals of national education. These skills are important to develop starting from elementary school because they form the basis for building character, developing critical thinking, and enhancing students' social colaimpetencies.

The elementary school age is a significant phase of cognitive and social development, during which students begin to develop reflective thinking, build productive social relationships, and foster imagination and creative expression. Individuals who are used to thinking critically and creatively, as well as have good communication and collaboration skills from an early age, tend to be more adaptable to future educational and work challenges (Lai & Viering, 2012). Reports from national and international assessments show that Indonesian students' mastery of 21st-century skills, particularly the 4C skills, is still low. According to the PISA 2018 results released by OECD, Indonesian students' abilities in reading, mathematics, and science are far below the OECD average, reflecting weak analytical thinking, creative problem-solving abilities, and argumentative communication skills. The 2021 Competency Minimum Assessment (AKM) results also support these findings; around 66% of students are still in the basic literacy category and show limitations in their ability to interpret information, think logically, and express ideas both in writing and speaking (Pusmendik, 2022). Additionally, the lack of collaboration culture is evident from the low level of student participation in collaborative tasks. However, the World Economic Forum (2020) identified the four Cs as essential qualifications for addressing the complex challenges of the 21st century.

This situation calls for innovative learning approaches that can holistically, contextually, and practically develop the four Cs skills starting from the elementary school level.

According to the Basic Education Data (Dapodik) 2024, there are more than 26 million elementary school students in Indonesia spread across over 148,000 educational institutions. Flexible and contextual teaching materials, such as Student Worksheets (LKPD), have the potential to be a strategic medium in supporting deeper learning processes. The choice of LKPD as a focus for development is based on its simplicity, affordability, ease of distribution, and suitability for both individual and group learning. LKPD can also be adapted to local contexts and student abilities, making it more effective than digital or audiovisual media in schools with limited technological access. LKPD allows for the integration of reflective, exploratory, and collaborative elements through written formats, directly stimulating students' thinking processes.

The effectiveness of LKPD in enhancing the four Cs skills can be further improved through the integration of learning models aligned with constructivist and authentic orientations. Problem-Based Learning (PBL) was chosen because it has both theoretical and practical support for developing reflective thinking, group collaboration, creative solution exploration, and argumentative communication. This model is better than others like Discovery Learning or Project Based Learning, which often require more time and complex resources to implement in elementary classrooms. PBL focuses on understanding concepts through realistic problem-solving processes that can be guided systematically using LKPD, allowing the 4C skills to be developed at the same time. Based on observations at four elementary schools in Bukik Barisan Subdistrict – SDN 02 Maek, SDN 06 Maek and SDN 07 Maek – it was found that most teachers still use LKPD copied from textbooks or online sources without any modification. Learning activities mainly focus on achieving quantitative scores, without including life skills values or higher-order thinking abilities. There was no evidence of group exploration scenarios, teamwork activities, meaning discovery, or learning reflection that were clearly structured in the LKPD.

The LKPD used did not meet the criteria for being valid in content, practical in implementation, and effective in achieving learning goals. Despite this, two of the four schools observed have started incorporating elements of 4C (Creativity, Critical Thinking, Collaboration, Communication) through activities like group discussions, teamwork, and problem-solving. However, these practices are not yet systematically documented in written teaching materials such as LKPD. Below is a table listing the names of schools that have begun applying 4C skills in IPAS learning.

The traditional LKPD found in schools is prepared in the form of a Student Worksheet (LKS). This type of LKS does not include exploration stages, contextual problem presentation, or group discussion activities. As a result, the learning process lacks deep cognitive interaction and does not encourage students to think critically, creatively, collaboratively, or communicatively, but rather focuses only on developing the ability to remember facts. An ideal LKPD is not just a set of instructions or questions. It is designed using a problem-based approach that actively engages students in analytical and reflective thinking. Within the framework of the Merdeka Curriculum, LKPD development is based on Learning Outcomes (CP), which includes essential content or materials. These are then broken down into Learning Objectives (IP) as the direction for the competencies students are expected to achieve. Next, the Learning Objective Flow (ATP) is systematically and integratively structured using the syntax of the Problem Based Learning (PBL) model. This

supports the gradual and contextual development of critical thinking skills. The presentation of LKPD should encourage students to examine problems from different perspectives and support the strengthening of 21st-century skills, especially the 4C skills: Creativity, Critical Thinking, Collaboration, and Communication. Research conducted by Nasution et al. (2024) found that applying problem-based LKPD significantly improves critical thinking abilities in elementary school students.

The research results show that the developed LKPD is very suitable, with material validity of 89%, design validity of 87%, practicality of 90%, and high effectiveness in improving students' critical thinking abilities. This is proven by the average test score of 90. Then, the research by Savery and Duffy (2023) titled "Enhancing 21st Century Skills through Problem-Based Learning in Primary Education" shows that applying PBL supported by structured LKPD has a significant impact on improving students' critical thinking and collaboration skills. The results show an increase of 18% in critical thinking scores and 21% in collaboration abilities after six weeks of learning intervention. The main focus of this study is on two 4C skills: critical thinking and teamwork. Meanwhile, the research by Zhang and Li (2022) titled "Designing Problem-Based Learning Worksheets to Foster Critical Thinking and Communication Skills in Elementary Science" shows content validity of 91%, practicality of 88%, and effectiveness in improving critical thinking and communication skills. The data shows that after using the LKPD for one semester, critical thinking scores increased by an average of 20 points and communication skills scores increased by 17 points on a 100-point scale. This study emphasizes the importance of contextual problem-based tasks that encourage discussion, but it does not integrate creativity and collaboration into the LKPD design.

The novelty of this research design lies in its approach of combining all four 4C skills into one structured learning design, rather than separating them as in previous studies. The developed LKPD is not only aimed at building students' understanding of IPAS material but also directly aims to develop their critical thinking, creativity, communication, and collaboration abilities through integrated activities. In addition, the design of this LKPD was created based on the results of needs analysis from teachers and students in the field, making it more relevant and contextual. The context of IPAS learning was chosen because it supports the integration of multiple competencies and aligns with the direction of strengthening the Pancasila Student Profile in the Merdeka Curriculum. The solution proposed by the author is the development of LKPD based on Problem-Based Learning that integrates all four 4C skills. This design is prepared to address the weaknesses of conventional LKPD, which have not promoted 4C

skills and have not been relevant to contextual learning needs. This research design is titled "Developing Problem-Based Learning LKPD to Improve 4C Skills in IPAS Learning for Fourth Grade Students in Elementary Schools," with the aim of developing teaching materials that are valid, practical, and effective in shaping students who are critical thinkers, creative, cooperative, and communicative in an integrated and aligned manner with learning objectives.

Method

This study will use the Research and Development (R&D) method, which aims to develop and test the feasibility of a learning product. This approach involves steps based on a proven model to create a product that is valid, practical, and effective (Mulyani, 2022). As a method, R&D includes gathering empirical data to identify user needs, designing solutions in the form of a product such as learning media, and testing it on the target group. In the context of education, this method is often used to develop technology-based or specific approach-based learning media, such as electronic worksheets or modules based on 21st-century skills (Jaya et al., 2022). In this research design, the model used is ADDIE, which consists of five main steps: analysis, design or planning, development, implementation, and evaluation.

Prosedure

Analysis

This stage aims to analyze learning needs, student characteristics, and expected competencies. The analysis is conducted through observation and literature study to formulate appropriate learning objectives (Elpina et al., 2022). The analysis includes:

Needs Analysis

Needs analysis is carried out through interviews to understand the current condition of the school conducted with educators. In this stage, an analysis of suitable teaching materials is also performed according to the development of students. Student development analysis is done by understanding what teaching materials are preferred by students and assisting educators in teaching.

Curriculum Analysis

Curriculum analysis is conducted by considering the characteristics of the curriculum. This is done to ensure that the development carried out aligns with the applicable curriculum. Afterward, the writer determines and finalizes the CP and TP.

Student Character Analysis

This analysis is conducted to observe students' attitudes towards the learning process. This is done to

ensure that the development carried out is in line with the characteristics of the students.

Design

This stage involves designing learning media or instructional products, such as Problem-Based Learning (PBL)-based student worksheets (LKPD), while considering aspects of validity, practicality, and attractiveness. The initial product is designed in accordance with the needs of both students and teachers (Mulyani, 2022). At this stage, the initial product prototype is developed based on findings from the previous phase. Activities include drafting the product design, such as developing a PBL-based LKPD aimed at enhancing students' 4C skills—critical thinking, creativity, collaboration, and communication. The design emphasizes validity, practicality, and attractiveness to ensure its relevance and usability. The initial product is developed based on design principles that take into account students' characteristics, fostering creativity, critical thinking, collaboration, and communication (Elpina et al., 2022).

Development

The development stage includes expert validation of both content and media, limited trials, and product revisions based on feedback from experts and users. The product is tested in classroom settings to assess its effectiveness in improving students' 4C skills (Jaya et al., 2022). This stage consists of expert validation and subsequent revisions based on input. The process involves: Expert validation: Conducted by subject matter and media experts to evaluate the feasibility and quality of the product. Product revision: Implemented based on feedback from validators and trial outcomes to enhance product quality. For instance, Jaya et al. (2022) emphasize that expert validation of content and media is essential to ensure that learning products, such as educational games, are relevant to students' needs and aligned with curriculum standards.

Implementation

Following the validation stage, the product is revised and subsequently tested to determine its level of practicality. After the practicality testing is conducted, the next phase focuses on evaluating the effectiveness of the PBL-based LKPD.

Evaluation

The evaluation stage serves as the final phase of the development process. Each preceding phase incorporates both formative and summative evaluations. Formative evaluation involves the collection of data at each stage of the ADDIE model to refine and improve the product continuously. Meanwhile, summative evaluation focuses on gathering final data at the conclusion of the research to determine

students' responses and the overall effectiveness of the developed product.

Research Subject School

The subjects of this study were fourth-grade students from SDN 02 Maek, SDN 06 Maek, and SDN 07 Maek, located in Bukik Barisan District. The total number of participating students was as follows:

Table 2. Research Subject

School Name	Number Of Students
SDN 02 Maek	9 Students
SDN 06 Maek	15 Students
SDN 07 Maek	11 Students
Amount	30 Students

Data Collection Instruments

A research instrument is a measurement tool used by researchers to conduct their study (Lase et al., 2024). Such instruments may include tests, questionnaires, interview guides, and observation sheets, which are employed to collect data relevant to the research objectives (Pranata, 2024). Therefore, it can be concluded that research instruments serve as tools that assist researchers in obtaining factual information and gathering data to ensure the research process proceeds effectively. In this study, the researcher employed several instruments to collect the required data, namely:

Validity Instrument

The validity instrument consists of validation sheets used to collect data regarding the validity of the developed media. The validation process involves media experts, material experts, and language experts (Putri & Erita, 2023). The media expert evaluates the technical and presentation aspects of the media, including visual design, readability, and interactivity, to ensure that the media is both effective and engaging. The material expert assesses the accuracy and relevance of the content, ensuring that the information presented aligns with and supports the learning objectives. The language expert ensures the appropriateness and clarity of the language used, evaluating grammar, vocabulary, and writing style to guarantee that the text is understandable for students and free from linguistic errors. The following table presents the specifications of each validation instrument and the list of validators involved in the study.

Table 3. Validator Name

Validators	Pecifications
Dr. Ulfia Rahmi, M.Pd	Media Expert Lecturer
Dr. Yuli Tiarina, S.Pd., M.Pd	Language Expert Lecturer
Dr. Desri Nora, S.Pd., M.Pd	Conten Expert Lecture

Product Practicality

Product practicality refers to the extent to which the developed product—in this case, the Problem-Based

Learning (PBL)-based Student Worksheet (LKPD) – can be used easily and efficiently by users within a learning context. To obtain data on the level of practicality of the PBL-based LKPD, a questionnaire was used as the primary instrument and distributed to both teachers and students as respondents. The questionnaire was designed to gather information regarding users’ experiences while utilizing the LKPD, including aspects such as ease of use, clarity of instructions, appropriateness of activities in relation to the allotted time, and the extent to which the PBL-based LKPD can enhance students’ 4C skills: critical thinking, creativity, collaboration, and communication.

Effectiveness Instrument

Learning effectiveness refers to the level of success achieved in accordance with predetermined objectives. In the context of instructional media, a learning medium is considered effective if it meets certain criteria, such as achieving the intended learning outcomes, producing positive impacts, generating meaningful changes, optimizing time use, utilizing resources efficiently, and being easy to apply in the learning process. The effectiveness of the Problem Based Learning (PBL) based Student Worksheet (LKPD) was evaluated using a systematically designed test instrument aimed at measuring 21st century skills, which include Critical Thinking, Creative Thinking, Collaboration, and Communication (4C). This test functioned as a quantitative measurement tool to determine the extent to which the development of the PBL based LKPD could enhance students’ 4C skills in the Science, Environment, and Social Studies (IPAS) subject for fourth grade elementary school students.

Data Analysis Techniques

Data Analysis and Processing Techniques for Product Validity

The validity of the Problem Based Learning (PBL) based Student Worksheet (LKPD) was determined from the questionnaires completed by the validators. The weighting of the questionnaire items was conducted using the Likert scale developed by Rensis Likert. The Likert scale was structured with positive categories, in which positive statements received the highest score. The scoring criteria are described as follows:

Table 4. Validation Statement Scores of the Validity Instrumen

Statement	Weight of statements
Strongly Agree	5
Agree	4
Neutral	3
Disagree	2
Strongly Disagree	1

Source: (Sugiyono, 2019)

Technique for calculating the final validation data of the Student Worksheet (LKPD) developed through the Problem Based Learning (PBL) model was analyzed using a scale of 0 to 100. The calculation was carried out using Formula 1.

$$V = \frac{x}{y} \times 100\% \tag{1}$$

Description:

V = Validation Value

X = Score obtained

Y = Maximum score

Validity Score Criteria of the LKPD Developed through the Problem Based Learning Model

Table 5. Percentage of the Validity Instrument

Numerical Score	Classification
81-100	Very Valid
61-80	Valid
41-60	Fairy Valid
21-40	Less Valid
0-20	Invalid

Source : (Sugiyono, 2019)

Data Analysis and Processing Techniques for Product Practicality

The final practicality data were analyzed using a scale ranging from 0 to 100. The calculation was conducted using Formula 2.

$$P = \frac{x}{y} \times 100\% \tag{2}$$

Description:

P = Practicality Value

X = Score obtained

Y = Maximum score

Table 6. Percentage Scores of the Practicality of the Student Worksheet (LKPD)

Numerical Score	Classification
81-100	Very Practical
61-80	Practical
41-60	Fairy Practical
21-40	Less Practical
0-20	Not Practical

Source : (Sugiyono, 2019)

The Problem Based Learning (PBL) based Student Worksheet (LKPD) is considered practical when the practicality score falls within the range of 61 to 80, and it can then proceed to the effectiveness stage.

Data Analysis and Processing Techniques for Product Effectiveness

The effectiveness of the Problem Based Learning (PBL) based Student Worksheet (LKPD) was determined

through a post-test administered to students. The assessment followed the scoring guidelines outlined below: Each correct answer was given a score of 10, while each incorrect answer received a score of 0. The maximum total score was 100, obtained when all answers were correct. The total score was calculated using Formula 3.

$$Score = \frac{B}{N} \times 100 \% \tag{3}$$

Description:

B = Number of correctly answered items.

N = Total number of test items

Score Criteria:

0–25 : Very Poor

26–45 : Poor

46–65 : Fair

66–85 : Good

86–100 : Excellent

The LKPD was considered effective when the effectiveness score was within the range of 66 to 85.

Result and Discussion

Result

This study produced a Problem Based Learning (PBL) based Student Worksheet (LKPD) developed through the stages of the ADDIE model, namely Analysis, Design, Development, Implementation, and Evaluation. In the Analysis stage, the needs of students and the characteristics of the Science, Environment, and Social Studies (IPAS) material were identified. The Design stage involved structuring and planning the LKPD activities, while the Development stage focused on creating the LKPD and its validation instruments. A limited trial was conducted during the Implementation stage to obtain feedback from both students and teachers, and the Evaluation stage was carried out to assess the validity, practicality, and effectiveness of the LKPD. The following section presents a series of research findings from the development of the Problem Based Learning (PBL) based Student Worksheet (LKPD) aimed at enhancing 4C skills in Science, Environment, and Social Studies (IPAS) learning for fourth grade elementary school students.

Validity of the Problem-Based Learning (PBL)-Based Student Worksheet (LKPD) to Enhance 4C Skills in Fourth Grade IPAS Learning

The validity test aimed to evaluate the feasibility of the Problem-Based Learning (PBL)-based Student Worksheet (LKPD) before classroom implementation. The validation involved three experts media, language, and material who assessed the LKPD based on its content accuracy, linguistic clarity, and visual design. Each expert provided evaluations using a four-point

Likert scale covering the categories *Very Valid*, *Valid*, *Fairly Valid*, and *Less Valid*. The validation results are summarized in the following table 7.

Table 7. Validators test results

Expert Validators	Assesment Period	Average Score	Category
Media Expert	August 8–18, 2025	71.6	Valid
Language Expert	August 8–14, 2025	80.0	Valid
Material Expert	August 7, 2025	66	Valid

Source: Primary Data (2025)

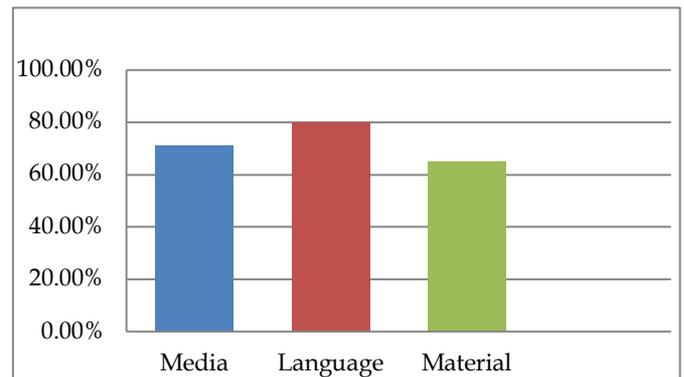


Figure 1. Validators Test Results

Based on the Diagram above, the PBL-based Student Worksheet (LKPD) obtained an overall mean validity score of **72.3%**, which falls within the “Valid” category. This indicates that the LKPD fulfills the necessary requirements in terms of content, language, and design, and is therefore feasible for use as a learning tool to enhance students’ 4C skills—Critical Thinking, Creativity, Collaboration, and Communication in fourth grade IPAS learning.

Practicality of Problem Based Learning (PBL)-Based Student Worksheet (LKPD) by Teachers

The practicality test by teachers aimed to assess the level of ease, clarity, and usability of the *Problem Based Learning (PBL)-based Student Worksheet (LKPD)* in teaching Natural and Social Sciences (IPAS) for fourth-grade students. This assessment was conducted to ensure that the LKPD could be effectively used as a guide for implementing problem-based learning and to support the development of 21st-century skills (4C): *Creativity, Critical Thinking, Collaboration, and Communication*. The practicality testing was carried out in two stages: a limited trial at SDN 02 Maek (September 1–3, 2025) and a wider scale implementation at SDN 06 Maek (September 4–8, 2025) and SDN 07 Maek (September 11–15, 2025). The instrument used was a questionnaire consisting of 11 statements, evaluated using a Likert scale of 1–5 and converted into percentages to determine the level of practicality.

Table 8. Results of the Practicality Test by Teachers

Name School	Implementation Period	Validator	(%)	Category
SDN 02 Maek (Limited Trial)	Sept 1-3, 2025	Yel Afrida, S.Pd.SD	90.0	Highly Practical
SDN 06 Maek	Sept 4-8, 2025	Tika Sumartin, S.Pd.	89.0	Highly Practical
SDN 07 Maek	Sept 11-15, 2025	Halimah Nurhasana, S.Pd.SD	80.0	Practical

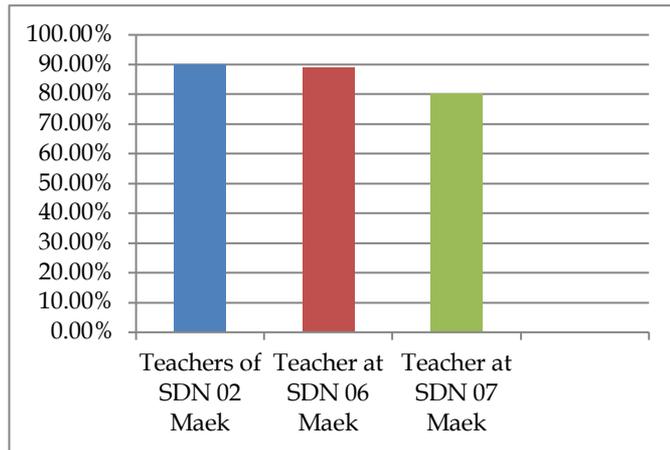


Figure 2. Teacher practical test results (Source: Primary Data (2025))

Based on the table above, the results of the practicality test conducted by teachers indicate that the PBL-based Student Worksheet (LKPD) is classified as highly practical for classroom use. The overall average score reached 86.33%, which falls under the *Highly Practical* category. These findings demonstrate that the LKPD is easy to use, provides clear instructions, and aligns well with the PBL syntax, making it suitable for broader implementation in IPAS learning at the elementary school level.

Practicality of Problem Based Learning (PBL)-Based Student Worksheet (LKPD) by Students

The practicality test by students was conducted to determine how easy, engaging, and helpful the *Problem Based Learning* (PBL)-based Student Worksheet (LKPD) was in supporting learning activities. The test involved fourth-grade students from three elementary schools: SDN 02 Maek, SDN 06 Maek, and SDN 07 Maek. A limited trial was carried out at SDN 02 Maek with 9 students, while the large-scale implementation was conducted at SDN 06 Maek with 15 students and SDN 07 Maek with 11 students. Students were selected to represent different learning ability levels high, medium, and low so that the results could comprehensively reflect student responses to the developed LKPD.

Table 9. Practicality Test Results by Students

Name School	Number of Students	Implementation Period	Average (%)	Category
SDN 02 Maek (Limited Trial)	9	Sept 1-3, 2025	85.0	Highly Practical
SDN 06 Maek	15	Sept 4-8, 2025	87.0	Highly Practical
SDN 07 Maek	11	Sept 11-15, 2025	76.0	Practical

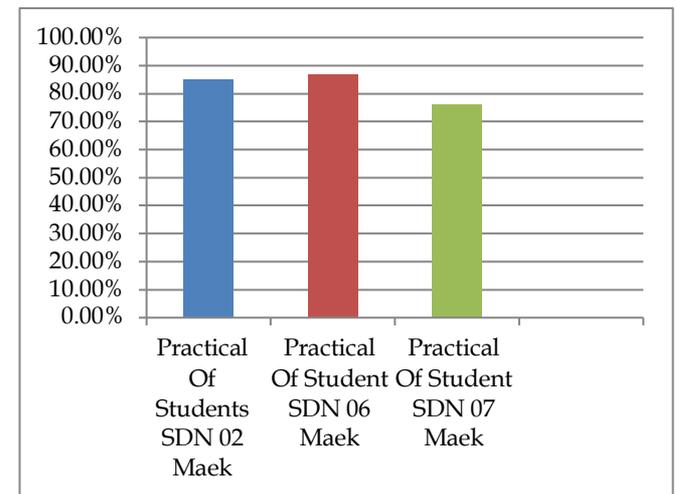


Figure 3. Results of students practical tests Source

Based on the table above, the practicality results show that the *Problem Based Learning* (PBL)-based Student Worksheet (LKPD) is considered highly practical by students. The limited trial at SDN 02 Maek achieved a score of 85%, while SDN 06 Maek obtained 87%, both categorized as *Highly Practical*. Meanwhile, SDN 07 Maek scored 76%, categorized as *Practical*. The overall average practicality score is 82.6%, indicating that the developed LKPD is very practical and effectively supports learning activities. This demonstrates that the LKPD is engaging, easy to understand, and facilitates active learning and 4C skill development (*Critical Thinking, Creativity, Collaboration, and Communication*) among fourth-grade students in elementary schools.

Effectiveness of Problem Based Learning (PBL)-Based Student Worksheet (LKPD) in Enhancing 4C

Skills in Science, Environment, Technology, and Society (IPAS) Learning for Fourth-Grade Students After the practicality test, the study proceeded to the effectiveness testing stage, which aimed to determine the extent to which the *Problem Based Learning* (PBL)-based Student Worksheet (LKPD) improved students' 4C skills (*Critical Thinking, Creativity, Collaboration, and Communication*) in IPAS learning. The effectiveness data were obtained through pretest and posttest assessments

conducted before and after the learning process. The testing procedure consisted of three stages: (1) administering the pretest to measure students' initial abilities, (2) conducting learning activities using the developed LKPD, and (3) administering the posttest to evaluate learning outcomes. All activities were carried out face-to-face in the classroom.

Table 10. N-Gain Effectiveness Test Results

School Name	Number Of Students	Average N-Gain	Average (%)	Category
SDN 02 Maek (Limited Trial)	9	0.75	75%	High
SDN 06 Maek	15	0.79	79%	High
SDN 07 Maek	11	0.76	76%	High

Source: Primary Data (2025)

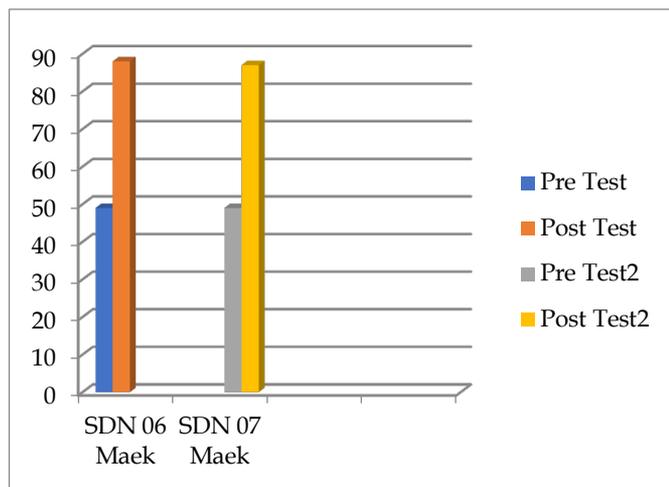


Figure 4. Score Pre Test and Post Test

Based on the N-Gain analysis results, all three schools showed a significant increase in students' 4C skills after using the developed LKPD. At SDN 06 Maek obtained 0.79 (79%), and SDN 07 Maek achieved 0.76 (76%), both within the *High* category. These results indicate that the *Problem Based Learning*-based Student Worksheet (LKPD) is effective in enhancing students' 4C skills, particularly in fostering critical thinking, creativity, collaboration, and communication abilities. Therefore, the developed LKPD is not only valid and practical but also proven to be effective in improving the quality of IPAS learning for fourth-grade students in elementary schools.

Discussion

Validity of Problem-Based Learning (PBL)-Based Student Worksheet (LKPD) to Enhance 4C Skills in IPAS Learning for Fourth-Grade Elementary Students

The validity of the Problem-Based Learning (PBL)-based Student Worksheet (LKPD) for IPAS learning in fourth-grade elementary school focused on perfecting

the product before its actual implementation. The researcher developed the LKPD and tested its feasibility through validation by three experts: a media expert, a material expert, and a language expert. The media expert assessed the visual aspects, layout, and illustrations of the LKPD; the material expert evaluated the accuracy and relevance of the content to the *Kurikulum Merdeka*; while the language expert assessed readability, clarity of terminology, and linguistic appropriateness. Based on the validation results, the obtained validity percentages for each aspect were: media aspect 71.6%, language aspect 80%, and material aspect 66%. Overall, these values fall into the "valid" category, indicating that the LKPD is suitable for use as instructional material. These percentages are consistent with Arikunto (2013) and Riduwan (2018), who stated that values above 60% are categorized as valid, thereby supporting the use of LKPD as a medium to develop 4C skills (Creativity, Critical Thinking, Collaboration, and Communication) in learning.

In the media aspect, initial evaluations indicated several elements requiring improvement, such as the cover color being less vibrant, making it less attractive; the full phrase "Problem-Based Learning" on the cover being considered unnecessary for student focus; the absence of the LKPD acronym expansion; and the lack of clear separation between two images on one page. After revisions, the cover color was brightened, the "Problem-Based Learning" phrase was removed, the acronym expansion was added, and separators between images were included, resulting in a more appealing and readable visual design. These revisions align with instructional design principles emphasizing color contrast, clear typography, and contextual visualization to enhance comprehension and learner engagement (Ulfa, 2020; Ali et al., 2024; Kurniawan & Putra, 2021).

In the language aspect, the initial LKPD contained some terms that were contextually inappropriate and table structures that were not neatly aligned, making some words unclear. Revisions included replacing ambiguous terms with "demonstrate responsibility," improving table alignment, and correcting misspelled words. Such linguistic refinement is crucial to ensure that students can clearly understand the instructions, terms, and activities in the LKPD, thus enabling effective learning (Putri et al., 2023).

The material validation emphasized the relevance of LKPD content to the *Kurikulum Merdeka* and the learning objectives of IPAS for fourth grade. Before revision, several parts were deemed irrelevant, such as point F, which did not align with the main topic, and inconsistent capitalization in the term "Table." After revision, irrelevant parts were removed, and the writing of "Table" was standardized according to academic conventions. This ensured that the LKPD contained only relevant materials aligned with curriculum standards,

thereby supporting the structured development of students' 4C skills (Ramadhan, 2022). Considering the results and revisions in all three aspects, it can be concluded that the developed PBL-based LKPD is categorized as valid, with validity percentages of 71.6% (media), 80% (language), and 66% (material). The improvements in visual, linguistic, and content aspects not only enhanced the overall quality of the LKPD but also ensured its readiness for use in IPAS learning for fourth-grade students to effectively foster 4C skills.

Practicality of Problem-Based Learning (PBL)-Based LKPD to Enhance 4C Skills in IPAS Learning for Fourth-Grade Elementary Students.

The practicality assessment of the PBL-based LKPD in IPAS learning for fourth-grade elementary school showed that the instructional material was highly practical for both teachers and students. Based on the practicality tests conducted by teachers, the LKPD received varied scores across schools. At the limited trial school (SDN 02), teachers rated the LKPD with a percentage of 90% (very practical), SDN 06 obtained 89% (very practical), while SDN 07 received 80% (practical). The average practicality score from the three schools was 86.33%, indicating that the LKPD meets the criteria of being very practical and feasible for classroom use. Similarly, practicality questionnaires completed by students reflected ease of use and engagement during learning. At SDN 02 (limited trial), students rated the LKPD at 85% (very practical), SDN 06 achieved 87% (very practical), and SDN 07 received 76% (practical). The combined percentage from all three schools was 82.6%, suggesting that students found the PBL-based LKPD very practical and easy to use.

These findings confirm that the developed instructional material effectively supports student engagement in discussion, problem-solving, and the enhancement of 4C skills. This aligns with Amelia & Iklimatuzzahra (2024), who found that systematically developed learning materials help students understand concepts more easily and enjoyably, especially when accompanied by relevant illustrations and activities. Furthermore, Putera et al. (2024) asserted that instructional materials tested for practicality are suitable for continuous implementation since both teachers and students can use them effectively without major difficulties. Similarly, Wulandari & Santoso (2023) emphasized that PBL-based materials enhance students' active participation and comprehension of IPAS concepts through exploration, discussion, and collaborative problem-solving. Based on these findings and supporting literature, it can be concluded that the developed PBL-based LKPD is both practical and effective in supporting the IPAS learning process for fourth-grade students. The material is user-friendly, promotes active engagement, and effectively supports

4C skill development. Therefore, the developed LKPD demonstrates a very high level of practicality from both teacher and student perspectives and is ready for broader implementation in elementary learning activities.

Effectiveness of Problem-Based Learning (PBL)-Based LKPD to Enhance 4C Skills in IPAS Learning for Fourth-Grade Elementary Students

The effectiveness of the PBL-based LKPD in improving 4C skills in IPAS learning for fourth-grade students was analyzed using the N-Gain score across three schools. The analysis showed a significant improvement in students' performance after using the developed LKPD. Specifically at SDN 06 achieved 0.79 (79%), and SDN 07 achieved 0.76 (76%), all of which fall under the "high" category according to Hake (1999). These results indicate that implementing the PBL-based LKPD made a significant contribution to developing students' Creativity, Critical Thinking, Collaboration, and Communication skills.

This finding is consistent with Setiawan et al. (2022), who reported that PBL-based worksheets significantly enhance students' critical thinking and collaboration skills in science learning. Similarly, Santoso & Wijaya (2021) emphasized that instructional materials promoting exploration, discussion, and reflection can stimulate creativity and effective communication among students. Ramadhan (2022) also supported these findings, showing that academically validated and contextually implemented learning products are more effective in achieving learning goals and 21st-century skills. Moreover, this study reinforces previous findings by Asri & Nugraheni (2024), who demonstrated that interactive instructional materials effectively improved students' learning outcomes, as evidenced by N-Gain scores categorized as moderately to highly effective. These results are also aligned with Edray and Hamimah (2023), who found that highly valid learning media can be effectively utilized in the classroom. Thus, it can be concluded that the developed PBL-based LKPD is not only valid and practical but also proven to be effective in enhancing students' 4C skills in IPAS learning for fourth-grade elementary school.

Conclusion

Based on the research and discussion, the following conclusions can be drawn: The product's validity was categorized as valid according to the results of evaluations by experts, which included media validation at 71.6% (valid), language validation at 80% (valid), and content validation at 66% (valid). These results indicate that the LKPD is suitable in terms of content, language, and appearance, so it is ready to be used after undergoing revisions based on the validators' feedback.

The product's practicality shows that the PBL-based LKPD falls into the practical to very practical category. Practicality was tested through limited trials at SDN 02 Maek and then implemented on a larger scale at SDN 06 Maek and SDN 07 Maek. Teacher evaluations showed percentages of 90% at SDN 02 Maek, 89% at SDN 06 Maek, and 80% at SDN 07 Maek. Student evaluations resulted in an average percentage of 82.6%, which is classified as very practical. This indicates that the LKPD is easy to use, engaging, and able to motivate students to actively participate in learning. The product's effectiveness is reflected in the improvement of students' learning outcomes and 4C skills, analyzed using the N-Gain test. Effectiveness was tested during at SDN 06 Maek and SDN 07 Maek. The calculated results showed N-Gain scores of 0.79 (79%) at SDN 06 Maek, and 0.76 (76%) at SDN 07 Maek, all falling into the high category. This proves that using PBL-based LKPD is effective in improving students' critical thinking, creativity, communication, and collaboration skills in IPAS lessons. In conclusion, the PBL-based LKPD developed is considered valid, practical, and effective, making it suitable as an innovative teaching material for fourth-grade elementary school IPAS lessons to strengthen 4C skills in line with the Merdeka Curriculum requirements.

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Author Contributions

Conceptualization, methodology, formal analysis, investigation, resources, L.L.Q. and Y.E.; data curation, preparation of the initial draft of the manuscript, validation, review and editing of the manuscript, visualization, L.Z. and R. All authors have read and approved the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest

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