BITNET
Jurnal Pendidikan Teknologi Informasi
Vol. 11 No. 3, September 2026, pp.101-111
https://journal.umpr.ac.id/index.php/bitnet/issue/
DOI: https://doi.org/

Development of Central Kalimantan Local Wisdom-Based IPAS Module on Disaster Mitigation for Grade IV Elementary Students

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ABSTRACT

This study aimed to develop an IPAS teaching module based on Central Kalimantan local wisdom on the theme of Disaster Mitigation and Preparedness for elementary students. The research employed the Research and Development (R&D) method using the ADDIE model. The module integrated four common disasters in Central Kalimantan forest and land fires, floods, extreme heat, and landslides with local wisdom practices, namely Saka/Handil water management, Rumah Lanting floating houses, Huma Betang/Kaleka architecture, and riparian vegetation planting. Learning activities were designed using the PBL approach. A limited trial was conducted with 32 Grade IV students of SDN 3 Sidorejo, Pangkalan Bun, using a pre-test and post-test design. Data were collected through interviews, expert validation and readability questionnaires, classroom observations, and conceptual understanding tests. Data analysis included feasibility percentages, N-gain analysis, and the Wilcoxon Signed-Rank Test. The results indicated that the module was highly feasible, with validation scores of 87.5% from content experts, 83.2% from media experts, and 91.4% from students. Statistical analysis showed a significant improvement in students' conceptual understanding ($p < 0.001$), with an average N-gain score of 0.69. Therefore, the local wisdom-based IPAS module is effective as a supplementary teaching material for the Merdeka Curriculum in elementary schools.

Keywords: *IPAS teaching module, Central Kalimantan local wisdom, disaster mitigation, Dayak tribe, ADDIE model*

Article history

Received:	*Revised:*	*Accepted:*	*Published:*
10 July 2026	*8 August 2026*	*21 September 2026*	*30 September 2026*

INTRODUCTION

Education serves as the fundamental foundation for developing the character and life skills of future generations. Within the implementation of the Merdeka Curriculum, the Natural and Social Science (IPAS) subject has become a strategic instrument for equipping elementary school students with critical thinking skills, scientific literacy, and environmental awareness in an integrated manner (Titin et al., 2025). In Phase B (Grades III–IV), the IPAS Learning Outcomes emphasize students' understanding and analysis of issues related to natural resource conservation as an effort to mitigate climate change (Sari et al., 2025), reflecting the orientation of 21st-century education toward developing students' competencies for real-world action.

Central Kalimantan is a province that is geographically and ecologically vulnerable to four major types of disasters: forest and land fires, floods, extreme heat, and landslides. Data from the Central Kalimantan Regional Disaster Management Agency (BPBD) indicate that forest and land fires and floods are the most persistent threats, directly

affecting educational activities and community life (Frida Alfiana et al., 2026). Unfortunately, these critical local conditions are not adequately represented in elementary school teaching materials. Most textbooks tend to employ examples from Java or generic national contexts, creating cognitive alienation among students from learning materials that should be directly relevant to their daily lives (Elmi et al., 2023).

The Dayak people, as the indigenous community of Central Kalimantan, possess a rich body of local wisdom that has been empirically proven to support adaptation to environmental conditions for centuries. Traditional water management systems such as Saka and Handil help maintain peatland moisture; Rumah Lanting floating houses are designed to adapt to fluctuations in river water levels; Huma Betang architecture incorporates cross-ventilation systems suitable for tropical climates; and the planting of riparian vegetation along riverbanks contributes to environmental conservation and disaster risk reduction. These practices represent the ecological intelligence of Dayak ancestors and remain highly relevant to contemporary disaster-related challenges (Dwi Kaputri et al., 2024). Local wisdom is defined as a set of local ideas and values that are considered wise, beneficial, and widely practiced within a community (Haerunnisa et al., 2020). The integration of local wisdom into IPAS learning has been shown to significantly improve students' learning motivation and cognitive achievement, with an N-gain score of 0.71 compared to learning without local wisdom integration (Retnaningsih & Khairiyah, 2022). This finding is consistent with the principles of Contextual Teaching and Learning (CTL), which emphasize the importance of connecting learning experiences with students' real-life contexts (Pertiwi, 2023).

Problem-Based Learning (PBL) utilizes authentic problems as the starting point of the learning process through five stages: (1) problem orientation; (2) organizing students for learning; (3) guiding investigations; (4) developing and presenting solutions; and (5) evaluating the problem-solving process (Yunsi, 2022). A meta-analysis conducted by Mustofa & Handini (2020) involving 42 PBL studies in Indonesian elementary schools reported an effect size of 0.82 on students' cognitive learning outcomes. When combined with authentic local contexts, PBL has strong potential to promote meaningful learning, enabling students not only to understand abstract concepts but also to connect them with practical actions in their surrounding environment (Wati & Misbah, 2020).

The Merdeka Curriculum defines a teaching module as a comprehensive instructional document that includes module identity, learning objectives, teaching materials, learning activities, assessments, and reflection components (Rahmawati & Margunayasa, 2022). A high-quality teaching module should meet three essential criteria: validity, practicality, and effectiveness (Mansur & Kartini, 2021). Research by Misbah et al. (2020) demonstrated that local wisdom-based modules developed in Kalimantan were both valid and effective in fostering students' character development and enhancing scientific literacy. Similarly, Sa'adah (2023) found that local wisdom-based digital teaching materials developed using the ADDIE model achieved excellent feasibility ratings in both content and media aspects.

A needs analysis conducted through interviews with Grade IV teachers at SDN 3 Sidorejo revealed that all teachers experienced difficulties in finding teaching modules that comprehensively integrate disaster mitigation content with the cultural context of

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Central Kalimantan. Based on this gap, the present study aims to: (1) develop a Central Kalimantan local wisdom-based IPAS teaching module on the theme of Disaster Mitigation and Preparedness for Grade IV students in Phase B; (2) evaluate the module's feasibility in terms of content, media, and readability; and (3) analyze its effectiveness in improving students' understanding of disaster mitigation concepts, measured using the N-gain index and statistically verified through the Wilcoxon Signed-Rank Test.

METHOD

1. Research Type and Design

This study employed a Research and Development (R&D) approach aimed at producing an IPAS (Natural and Social Science) teaching module based on Central Kalimantan local wisdom. The development process followed the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) proposed by Isrotun (2022). The ADDIE model was selected because of its systematic and iterative nature, allowing continuous evaluation and improvement throughout each stage of development.

2. Development Procedure

a. Analysis Stage

The analysis stage consisted of three activities: (1) a needs analysis conducted through structured interviews with Grade IV teachers at SDN 3 Sidorejo, Pangkalan Bun; (2) a curriculum analysis examining the Learning Outcomes (CP), Learning Objective Flow (ATP), and Pancasila Student Profile within the Merdeka Curriculum (Fitriyah et al., 2024); and (3) an analysis of student characteristics, including cognitive development, prior experiences, and the socio-cultural background of Grade IV elementary school students in Central Kalimantan.

b. Design Stage

The design stage involved the development of: (1) a module concept map integrating four disaster types with local wisdom-based solutions; (2) learning objectives based on the revised Bloom's Taxonomy (Anderson & Krathwohl, 2001), focusing on the C4 (analyzing) and C6 (creating) cognitive levels; (3) a storyboard for Problem-Based Learning (PBL) activities following the five-step model proposed by Fauzia (2018); (4) assessment instruments; and (5) Student Worksheets (LKPD) and local wisdom information cards.

c. Development Stage

During the development stage, a prototype of the teaching module was produced and validated by two experts: one content expert and one media expert. Revisions were conducted iteratively based on the validators' feedback until the module met the validity criteria established by Titin et al. (2025).

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d. Implementation Stage

The implementation stage consisted of a limited field trial involving 32 Grade IV students at SDN 3 Sidorejo, Pangkalan Bun. The trial was conducted over two instructional sessions, each consisting of four learning periods (4 × 35 minutes). Participants were selected through purposive sampling based on three considerations: (1) the school's location in an area vulnerable to forest and land fires and flooding in Central Kalimantan; (2) the availability of teachers willing to collaborate in the study; and (3) representation of students from both Dayak and non-Dayak family backgrounds.

e. Evaluation Stage

Evaluation was conducted both formatively, throughout each stage of development, and summatively, after implementation. A one-group pre-test and post-test design was employed to measure improvements in students' conceptual understanding. The limitation of using a single-group design was addressed by incorporating effect-size analysis through the N-gain index Sari et al. (2025) and verifying statistical significance using the Wilcoxon Signed-Rank Test.

3. Data Collection Techniques

Data were collected using several instruments: (1) structured interviews with Grade IV teachers during the needs analysis stage; (2) content expert validation questionnaires consisting of 30 items and media expert validation questionnaires consisting of 25 items, both using a five-point Likert scale; (3) a student readability questionnaire containing 15 items covering language clarity, attractiveness of illustrations, contextual relevance, and clarity of instructions; (4) observation sheets to assess the implementation of the PBL learning process; and (5) pre-test and post-test essay assessments designed to measure students' analytical (C4) and creative (C6) thinking skills related to disaster mitigation concepts.

4. Data Analysis Techniques

Data were analyzed using three approaches:

a. Module Feasibility Analysis

The feasibility of the module was determined using the validation score percentage formula:

$$Percentage\ (\%) = (Obtained\ Score / Maximum\ Score) \times 100$$

The feasibility criteria followed Arikunto (2016): ≥85% (Very Feasible), 70–84% (Feasible), 55–69% (Moderately Feasible), and <55% (Not Feasible).

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b. Analysis of Conceptual Understanding Improvement

Students' improvement in conceptual understanding was measured using the N-gain index (Hake, 1999):

N-gain = (Post-test Score − Pre-test Score) / (Maximum Score − Pre-test Score)

The interpretation criteria were as follows: ≥0.70 (High), 0.30–0.69 (Moderate), and <0.30 (Low).

c. Significance Testing

The Wilcoxon Signed-Rank Test ($\alpha = 0.05$) was employed to verify whether the improvement from pre-test to post-test scores was statistically significant and not due to chance. This non-parametric test was selected because of the relatively small sample size ($n = 32$) and the absence of a normality assumption for the data distribution (Fitriyah et al., 2024).

FINDINGS AND DISCUSSION

1. Needs Analysis Results

The results of interviews with Grade IV teachers revealed that: (a) no IPAS teaching modules integrating Central Kalimantan local wisdom were currently available; (b) existing disaster mitigation materials lacked contextual relevance to the actual disaster conditions experienced in Central Kalimantan; (c) teachers expressed a strong need for teaching modules that could be directly implemented using the Problem-Based Learning (PBL) model; and (d) students had direct empirical experiences with both forest and land fires and flooding. Curriculum analysis further indicated that the Phase B IPAS Learning Outcomes provide broad opportunities for integrating local content within the "Earth and Universe" element. In addition, the dimensions of the Pancasila Student Profile—Critical Thinking, Collaboration, and Creativity—can be developed synergistically through local wisdom-based PBL activities.

2. Description of the Teaching Module

The developed teaching module consists of three main sections: (1) General Information; (2) Core Components, including learning objectives, meaningful understanding, guiding questions, integrated disaster and local wisdom learning units, five-stage PBL learning activities, assessments, enrichment and remedial activities, and reflection; and (3) Appendices, including a glossary, references, student reading materials, worksheets, and assessment rubrics.

The distinctive feature of the module is the explicit integration of disaster types, specific environmental challenges in Central Kalimantan, and local wisdom-based solutions, as presented in Table 1.

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Table 1. Integration of Disaster Topics and Local Wisdom

Disaster Type	Specific Problem in Central Kalimantan	Local Wisdom-Based Solution
Forest and Land Fires	Underground fires in dry peatlands	Saka/Handil: Maintaining peatland moisture through traditional water management systems
Floods	Overflow of the Kahayan River damaging permanent riverside structures	Rumah Lanting and stilt houses: Adaptation through floating and elevated housing systems
Extreme Heat	High temperatures increasing the risk of peatland fires and drought	Huma Betang and Kaleka architecture: Elevated wooden houses with cross-ventilation and traditional fruit forests providing natural shade
Landslides	Riverbank erosion and slope failures caused by deforestation	Riparian Vegetation and Ulin trees: Planting native tree species to strengthen soil stability

Source: Central Kalimantan Local Wisdom-Based IPAS Teaching Module (2026).

3. Expert Validation Results

Content validation consisted of 30 evaluation items covering the alignment of learning materials with Phase B Learning Outcomes, the depth of local wisdom content, the accuracy of disaster-related information, and the appropriateness of the material for students' cognitive development.

Table 2. Content Expert Validation Results

Assessment Aspect	Expert 1 (%)	Expert 2 (%)	Average (%)
Alignment with Phase B Learning Outcomes	90.0	88.0	89.0
Depth and accuracy of local wisdom content	85.0	87.5	86.3
Accuracy of disaster-related facts and concepts	92.5	86.0	89.3
Appropriateness of difficulty level	85.0	88.0	86.5
Quality of assessment instruments	87.5	85.0	86.3
Overall Average	**88.0**	**86.9**	**87.5**

Source: Research primary data (2026).

The content expert validation yielded an overall score of 87.5%, categorized as **Very Feasible** according to Arikunto's (2016) criteria. Suggested revisions included: (1) providing more explicit scientific explanations regarding the mechanisms underlying each local wisdom practice; (2) strengthening disaster-related references with updated statistical data; and (3) adding more structured scaffolding questions within the student worksheets.

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Table 3. Media Expert Validation Results

Assessment Aspect	Expert 1 (%)	Expert 2 (%)	Average (%)
Readability and typography	82.0	84.0	83.0
Illustration and layout quality	80.0	83.0	81.5
Consistency of visual design	84.0	85.0	84.5
Ease of navigation	83.0	84.0	83.5
Suitability for students' age level	85.0	84.0	84.5
Overall Average	**82.8**	**84.0**	**83.2**

Source: Research primary data (2026).

Media expert validation resulted in an overall score of 83.2%, indicating that the module was highly feasible. Recommendations included enlarging the font size on local wisdom information cards, improving the clarity of visual maps in the worksheets, and incorporating QR codes linked to video testimonials from indigenous community leaders as supplementary learning resources.

4. Readability Test and Implementation Results

The readability test conducted with 32 students produced an average score of 91.4%, indicating an excellent level of readability. The highest score was obtained for contextual relevance (93.8%), demonstrating that the contextualized learning approach successfully established a cognitive connection between academic content and students' real-life experiences in Central Kalimantan.

Pre-test and post-test results were analyzed using the N-gain index (Elmi et al., 2023) and verified through the Wilcoxon Signed-Rank Test, as presented in Table 4.

Table 4. Pre-Test, Post-Test, N-Gain, and Wilcoxon Test Results

Conceptual Understanding Indicator	Pre-Test Mean	Post-Test Mean	N-Gain (Category)	Z (Wilcoxon)	p-value
Analysis of causes of four local disasters (C4)	52.3	83.7	0.66 (Moderate)	-4.76	<0.001
Design of local wisdom-based solutions (C6)	38.5	79.2	0.66 (Moderate)	-4.82	<0.001
Linking mitigation actions with community norms (C4)	44.8	85.4	0.74 (High)	-4.91	<0.001
Overall Average	**45.2**	**82.8**	**0.69 (Moderate–High)**	**-4.89**	**<0.001**

Source: Research primary data (2026).

The average N-gain score of 0.69 indicates a moderate-to-high improvement in students' conceptual understanding. The Wilcoxon Signed-Rank Test confirmed that all observed improvements were statistically significant ($p < 0.001$), indicating that the

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gains were unlikely to have occurred by chance. The highest improvement was observed in the indicator related to linking mitigation actions with community norms (N-gain = 0.74, High category). This finding suggests that group discussions during Stage 4 of the PBL process and teacher reinforcement during Stage 5 successfully fostered students' holistic understanding of the social and normative dimensions of disaster mitigation.

5. Discussion

The success of this module development can be attributed to three main factors.

First, the high relevance of the local context. The use of the Kahayan River, Central Kalimantan peatlands, and traditional Dayak architecture as authentic learning references successfully established a cognitive bridge between students' prior knowledge of their immediate environment and scientific concepts of disaster mitigation, consistent with Ausubel's meaningful learning theory (Titin et al., 2025). This finding aligns with Sari et al. (2025), who reported that local wisdom-based teaching materials developed through the ADDIE model significantly enhanced students' cognitive engagement.

Second, the synergy between PBL and local wisdom. The PBL model enabled students to actively simulate and test local wisdom principles through model-building activities. For example, when the flood group demonstrated that their floating-house model remained buoyant during a simulated flood, students experienced empirical confirmation that was far more impactful than simply reading about Rumah Lanting in a textbook. This finding is consistent with Kolb's experiential learning theory (Fitriyah et al., 2024) and reinforces Fauzia's (2018) meta-analysis, which reported a large effect size of PBL on cognitive learning outcomes in Indonesian elementary schools.

Third, the integration of normative values. A unique feature of the module is its explicit connection between disaster mitigation practices and community norms. This approach promotes moral meaning-making and strengthens students' intrinsic motivation to care for the environment (Wati & Misbah, 2020). Compared with the study conducted by Mansur & Kartini (2021), which focused on a single local wisdom theme in West Kalimantan, the present module provides a more comprehensive perspective on how Dayak communities holistically respond to environmental challenges through the integration of four disaster types and four local wisdom-based solutions within a single learning module.

Despite its strengths, this study has several limitations. First, the sample was limited to one elementary school in Pangkalan Bun, limiting the generalizability of the findings. Second, the one-group pre-test and post-test design lacked a control group, reducing the strength of causal inference, although this limitation was partially addressed through the Wilcoxon statistical test. Third, the implementation lasted only two instructional sessions, preventing the measurement of long-term learning impacts. Future studies are therefore recommended to involve larger samples and employ quasi-experimental designs with control groups to provide stronger evidence of effectiveness.

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CONCLUSION

Based on the findings of this study, three main conclusions can be drawn. First, a Central Kalimantan local wisdom-based IPAS teaching module was successfully developed using the ADDIE model (Retnaningsih & Khairiyah, 2022) and the Problem-Based Learning (PBL) approach (Yunsi, 2022). The module integrates four major disaster types forest and land fires, floods, extreme heat, and landslides with four Dayak local wisdom-based solutions, namely Saka/Handil water management systems, Rumah Lanting floating houses, Huma Betang/Kaleka architecture, and riparian vegetation planting.

Second, the developed module was found to be highly feasible based on expert validation results, obtaining scores of 87.5% from content experts, 83.2% from media experts, and 91.4% from the student readability test. These results indicate that the module meets the feasibility criteria established by Mustofa & Handini (2020) and is appropriate for use as a supplementary teaching resource in elementary schools.

Third, the implementation of the module proved effective in improving students' understanding of disaster mitigation concepts. The average N-gain score of 0.69 indicated a moderate-to-high level of learning improvement, which was statistically confirmed by the Wilcoxon Signed-Rank Test ($Z = -4.89$; $p < 0.001$). These findings demonstrate that integrating local wisdom within a PBL framework can enhance students' conceptual understanding and contextual awareness of disaster mitigation issues.

Based on the results of this study, several recommendations are proposed. First, Grade IV elementary school teachers in Central Kalimantan are encouraged to utilize this module as a supplementary teaching resource for IPAS within the Merdeka Curriculum. Second, future researchers are recommended to conduct larger-scale studies using quasi-experimental designs across different districts and municipalities in Central Kalimantan to strengthen the generalizability of the findings. Third, similar modules should be developed for other IPAS topics that can be contextualized through the integration of local wisdom from different regions of Indonesia. Finally, the development of a digital version (e-module) incorporating interactive QR codes is recommended to improve accessibility for schools located in remote areas of Kalimantan where access to printed learning materials may be limited.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to Dr. Rita Rahmaniati, M.Pd, the lecturer of the Bahan Ajar Pengembangan Terpadu Pendidikan Dasar course, for her guidance, support, and valuable insights throughout the development of this study. The authors also extend their appreciation to Group 1 and Group 3 of the course for their collaboration, encouragement, and constructive contributions during the preparation of this teaching module. Furthermore, the authors would like to express their sincere gratitude to SDN 3 Sidorejo Pangkalan Bun for granting permission and providing support during the implementation of this study. The authors also thank the Grade IV teachers and students who actively participated in the research process. Special appreciation is extended to the content and media experts for their valuable suggestions and constructive feedback during the validation stage of the teaching module. Their contributions greatly improved the quality of this research and the developed learning materials.

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