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Development of Interactive Teaching Materials on Google Sites using a Problem-Based Learning Model for Fifth-Grade Indonesian Language Instruction

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A B S T R A C T

This study aimed to develop interactive teaching materials assisted by Google Sites using a Problem Based Learning (PBL) model for fifth-grade Indonesian language instruction. Interactive teaching materials are defined as digital learning resources designed to actively engage students through interaction with content, tasks, and problem-solving activities, enabling meaningful cognitive involvement during learning. This research was conducted due to the limited use of interactive digital teaching materials in elementary schools, which often results in low student engagement. The study employed a Research and Development approach using the ADDIE instructional design process, including analysis, design, development, implementation, and evaluation stages. Data were collected through observations, interviews, expert validation sheets, practicality questionnaires, and pre-test and post-test instruments in three elementary schools. The validation results showed a validity coefficient of 0.905, categorized as highly valid. Practicality testing indicated very high practicality, with teacher and student responses of 99.58% and 94.16%, respectively. Effectiveness testing demonstrated high effectiveness, with an N-Gain score of 0.80 (80.55%). These findings indicate that Google Sites–assisted interactive teaching materials integrated with the PBL model are valid, practical, and effective for improving student engagement and learning outcomes in elementary Indonesian language learning.

1. Introduction

Education plays a vital role in shaping students' intellectual and emotional development, especially at the elementary level, which serves as the foundation for lifelong learning. At this stage, teachers are required to provide meaningful learning experiences that foster students' curiosity, creativity, and critical thinking. In

Indonesian language learning, students are expected not only to master reading and writing skills but also to develop higher-order thinking skills through language use and comprehension. However, several studies report that elementary classrooms still rely heavily on textbook-centered instruction, which limits student engagement and reduces opportunities for higher-order thinking (Kurniawati & Sukardjo, 2018; Hwang et al., 2019). This condition highlights the need for innovative learning materials that promote active and meaningful learning experiences. Similar conditions have been reported in various elementary school contexts, where the lack of interactive digital teaching materials contributes to students' learning boredom and limited critical engagement (Putri et al., 2025; Suarmita et al., 2025). These conditions indicate the urgent need for digital-based teaching materials that are interactive, engaging, and aligned with students' learning needs (Rahmadani & Taufina, 2020).

The rapid advancement of educational technology provides new opportunities for teachers to design innovative digital learning media that create dynamic and enjoyable learning environments. Web-based platforms enable the integration of multimedia elements such as text, images, audio, video, and interactive assessments in a single learning environment. Google Sites is one such platform that allows teachers to develop structured and accessible learning materials without requiring advanced technical skills (Nugroho et al., 2024). Previous studies published in the *Journal of Educational Sciences* demonstrate that digital modules and interactive multimedia significantly improve students' learning motivation, independence, and conceptual understanding (Abdurrahman et al., 2025; Hasibuan et al., 2025). Moreover, Google Sites is free, device-compatible, and easy to use, making it suitable for elementary school settings with limited technological infrastructure (Mukhti, 2023). Previous research indicates that web-based learning platforms significantly enhance students' motivation, learning independence, and conceptual understanding (Mayer, 2020; Al-Azawei et al., 2017).

The integration of digital learning media aligns with the implementation of the Merdeka Curriculum, which emphasizes student-centered learning, flexibility, and digital literacy development. Digital teaching materials encourage students to explore content independently and actively construct knowledge through interaction with learning resources. Research in JES indicates that well-designed digital modules support learner autonomy and enhance engagement in various subjects (Wahyuni et al., 2025; Rosiana et al., 2023). Therefore, integrating Google Sites into Indonesian language instruction supports curriculum goals while fostering 21st-century learning skills.

The use of digital learning media aligns with constructivist learning theory, which emphasizes learner-centered instruction and knowledge construction through active engagement. Studies have shown that digital modules designed based on constructivist principles support students' autonomy and critical thinking development (Schindler et al., 2017). Moreover, digital learning environments facilitate collaborative learning and reflection, which are essential components of effective language learning (Hrastinski, 2019).

In addition to technological integration, selecting an appropriate instructional model is essential for achieving effective learning outcomes. The Problem Based Learning (PBL) model promotes active learning by engaging students in authentic problem-solving situations that stimulate reasoning, collaboration, and critical thinking. Within the PBL framework, learning begins with real-world problems that encourage students to investigate, discuss, and formulate solutions collaboratively. Empirical studies published in JES confirm that PBL significantly enhances students' critical thinking, problem-solving abilities, and learning outcomes at the elementary level (Putri et al., 2025; Ardiana et al., 2025). When combined with digital media, PBL becomes more effective in creating contextual and meaningful learning experiences (Hafni et al., 2025). Problem Based Learning (PBL) is an instructional approach that engages students in solving authentic problems, encouraging critical thinking, collaboration, and reasoning skills. Empirical studies consistently show that PBL has a positive effect on students' problem-solving abilities and learning achievement at the elementary level (Hmelo-Silver, 2004; Yew & Goh, 2016). When integrated with digital learning media, PBL creates meaningful and contextual learning experiences that enhance student engagement.

The fifth-grade theme *"Becoming a Global Citizen"*, particularly the subtopic *"Facts and Opinions,"* plays a crucial role in developing students' critical literacy and analytical thinking skills. This topic equips students with the ability to distinguish factual information from personal viewpoints, which is essential in the digital information era. However, previous studies report that students often struggle to differentiate facts and opinions due to limited exposure to interactive examples and analytical practice (Susanti et al., 2025). Conventional teaching methods frequently fail to provide opportunities for students to critically analyze texts, highlighting the need for interactive and problem-oriented learning materials. This study adopts the ADDIE development model, consisting of Analysis, Design, Development, Implementation, and Evaluation stages (Branch, 2009). The ADDIE model has been widely used in educational research to ensure the systematic development of valid, practical, and effective learning products. Numerous JES-based studies confirm the effectiveness of the ADDIE model in developing digital modules and interactive teaching materials across various subjects and educational levels (Gusmida & Islami, 2017; Maisaroh et al., 2025). Through needs analysis, expert validation, field trials, and evaluation, ADDIE ensures that instructional products meet pedagogical and practical standards. However, research indicates that students often experience difficulties in developing critical reading skills due to limited exposure to analytical and interactive learning activities (Afflerbach et al., 2020). Therefore, the development of digital teaching materials integrated with the PBL model is expected to provide effective support for students in mastering this essential competency.

Several JES studies have reported positive outcomes from integrating digital media with student-centered learning models. For example, Putri et al. (2025) demonstrated that PBL-based teaching modules significantly improved students' reasoning skills, while Abdurrahman et al. (2025) emphasized the importance of usability and user experience in digital learning materials. These findings reinforce

the potential of combining Google Sites with the PBL model to enhance student engagement and learning effectiveness.

However, despite the growing body of research on digital learning media and PBL, studies that specifically focus on integrating Google Sites with the PBL model in Indonesian language learning at the elementary level remain limited. Most existing research concentrates on science, mathematics, or general digital literacy. Therefore, this study addresses this research gap by developing, validating, and evaluating Google Sites–based interactive teaching materials integrated with the Problem Based Learning model for fifth-grade Indonesian language instruction. The developed product is expected to serve as a practical, engaging, and pedagogically sound learning resource that enhances students' active participation, critical thinking, and learning achievement.

2. Methodology

Research Design

This study employed a Research and Development (R&D) approach using the ADDIE model, which includes five stages : Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). The ADDIE model was selected because it provides a systematic framework for creating, testing, and refining instructional products that can be replicated in educational settings. This model has been widely applied in instructional media development to ensure product validity, practicality, and effectiveness (Rahmadani & Taufina, 2020; Ulfa & Nurmayani, 2023).

The goal of this research was to produce interactive teaching materials based on Google Sites using the Problem-Based Learning (PBL) model for fifth-grade Indonesian language instruction on the topic *"Facts and Opinions"*. The study focused on testing three aspects of the product: (1) validity, (2) practicality, and (3) effectiveness.

Research Procedures

Analysis

The analysis phase consisted of identifying problems and learning needs in three elementary schools in Padang City: SD Sabbihisma 04, SDN 04 Kampung Olo, and SDN 18 Air Tawar Selatan. Observations and interviews with teachers and students revealed that most teachers still relied on printed books and PowerPoint slides, with minimal integration of interactive media. Students tended to lose focus quickly and struggled to differentiate between factual and opinion-based statements in texts. These findings indicated the need for engaging digital learning materials that promote student-centered learning (Salahuddin & Anggrayni, 2023).

Design

At the design stage, the researcher formulated learning objectives aligned with the *Kurikulum Merdeka* and structured lesson plans around the PBL model stages: (a) problem orientation, (b) group organization, (c) guided investigation, (d) solution presentation, and (e) reflection and evaluation (Arends, 2012). The content layout and storyboard for Google Sites were designed to include texts, images, videos, and interactive quizzes. Instructional materials were integrated with Google Forms for assessments and Wordwall for game-based tasks

Development

The development phase involved creating the initial version of the Google Sites module and validating it through expert review. Three validators evaluated the product from the aspects of content/material, language, and media/design. Each validator used a four-point Likert scale rating. Feedback from validators was used to improve content clarity, visual layout, navigation, and instruction wording. This process resulted in a validated product ready for field testing.

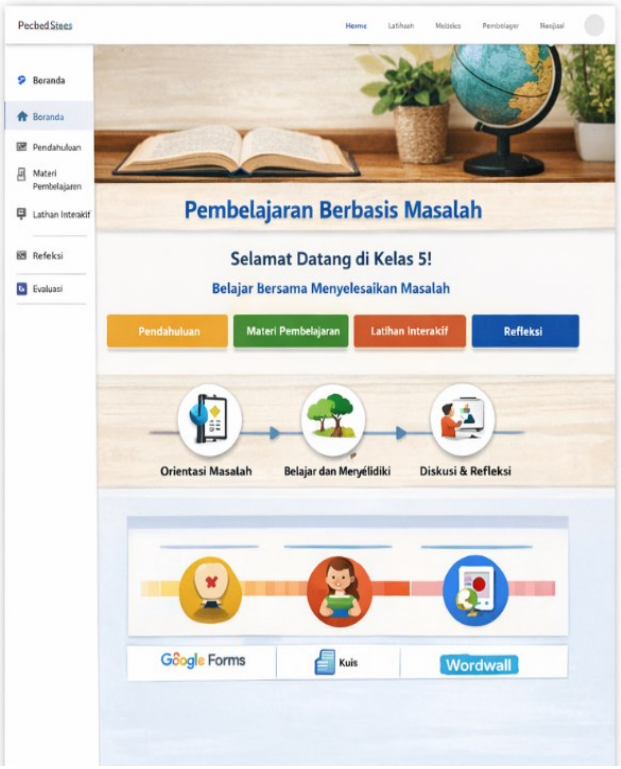

Figure 1. Homepage and navigation structure of the Google Sites–based interactive teaching materials.

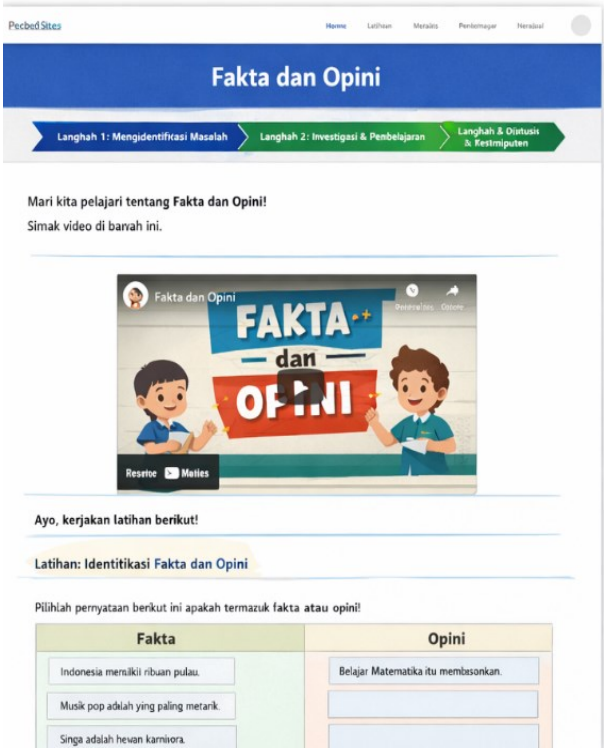

Figure 2. Sample learning activity page integrating Problem Based Learning stages and interactive exercises on facts and opinions.

The development phase focused on producing the initial version of the interactive teaching materials using Google Sites based on the Problem Based Learning (PBL) model. At this stage, the learning content, multimedia elements, and learning activities were systematically integrated according to the design blueprint. The developed Google Sites module consisted of several main components, including learning objectives, problem orientation activities, learning materials, interactive exercises, reflection sections, and formative assessments. Multimedia elements such as instructional videos, contextual images, and interactive quizzes using Google Forms and Wordwall were embedded to support students' understanding and engagement. Figure 1 presents the main interface of the Google Sites module, displaying the homepage and navigation structure designed to facilitate easy access and learner autonomy.

Following the initial development, the product underwent an expert validation process to ensure its quality and feasibility for classroom implementation. Three expert validators assessed the product from the aspects of content/material accuracy, language clarity, and media/design quality using a four-point Likert scale. The validation results indicated that the materials were conceptually appropriate, linguistically suitable for fifth-grade students, and visually engaging. Several suggestions were provided by the validators, including improving instruction clarity, adjusting font size and color contrast, and refining navigation buttons for better usability. These recommendations were incorporated into the revised version of the product. Figure 2 illustrates a sample learning activity page within the Google

Sites module that integrates PBL stages, interactive tasks, and assessment components. After revisions, the teaching materials were declared valid and ready to be implemented in small-group and field trials.

Implementation

The implementation stage was carried out through two trials: a small group trial and a large-scale field trial. The small group trial involved 10 fifth-grade students to identify technical or usability issues, while the field trial involved 42 fifth-grade students in one class. Teachers were given short training on how to use the Google Sites module before conducting the lessons. During implementation, data were collected using teacher and student practicality questionnaires, observation sheets, and pre-test and post-test instruments.

Evaluation

Evaluation was conducted both formatively (during each ADDIE stage) and summatively (after implementation). Formative evaluation involved revisions based on validator feedback and trial results. Summative evaluation assessed the overall validity, practicality, and effectiveness of the product through quantitative and qualitative data analysis (Branch, 2009).

Participants and Instruments

The participants in this study consisted of several groups involved at different stages of the research and development process. Three expert validators participated in the validation stage, representing expertise in content or subject matter, language, and instructional media. Their role was not only to evaluate the quality of the developed interactive teaching materials but also to assess the appropriateness of the research instruments. In addition, one fifth-grade teacher was involved in the practicality testing stage to evaluate the feasibility, clarity, and ease of use of the teaching materials in real classroom conditions. The student participants comprised 42 fifth-grade elementary school students who participated in the effectiveness testing stage. These students were actively involved in learning activities using the developed Google Sites–based teaching materials and completed the pre-test and post-test instruments. The selection of participants was aligned with the objectives of development research, which emphasize expert judgment, practitioner feedback, and learner responses to ensure a comprehensive evaluation of instructional products.

The instruments used in this study included validation sheets, practicality questionnaires, pre-test and post-test instruments, and observation notes. All instruments were developed based on the indicators of learning media evaluation proposed by Sugiyono (2019) and Tegeh and Kirna (2013) to ensure theoretical and methodological relevance. Given that the instruments were self-developed, the researcher placed primary emphasis on establishing their validity and reliability prior to implementation. Content validity was examined through expert judgment involving the validators, who reviewed each instrument item to ensure alignment

with the intended constructs, learning objectives, and evaluation indicators. Based on the experts' suggestions, revisions were made to improve item clarity, relevance, and consistency.

Before use, the researcher ensured that these instruments met appropriate standards of validity and reliability, as these aspects are essential when employing self-developed instruments. Reliability testing was conducted using internal consistency analysis on the practicality questionnaires and learning outcome tests to examine the stability and consistency of the measurement results. The findings indicated that the instruments met acceptable reliability criteria for educational research. Observation notes were also structured using predetermined indicators to maintain consistency during classroom observations. Through these systematic procedures, the researcher ensured that all instruments used in this study were valid, reliable, and suitable for collecting data to support the evaluation of the developed interactive teaching materials.

Data Analysis

The data were analyzed quantitatively and qualitatively. Quantitative data from validation and practicality questionnaires were converted into percentages using the formula:

$$Percentage = \frac{Obtained\ Score}{Maximum\ Score} \times 100\%$$

The results were categorized according to predetermined criteria:

- 85–100% = very valid/practical
- 70–84% = valid/practical
- 55–69% = fairly valid/practical
- <55% = less valid/practical

This percentage-based analysis refers to commonly used techniques in educational research (Sugiyono, 2019; Arikunto, 2013).

Effectiveness data were obtained from the pre-test and post-test results and analyzed using the normalized gain (N-Gain) formula (Hake, 1999):

$$N - Gain = \frac{Post - test - Pre - test}{100 - Pre - test}$$

The N-Gain results were categorized as:

- 0.70 = high
- 0.30–0.70 = medium
- <0.30 = low

Qualitative data from observations and validator comments were analyzed descriptively to support the quantitative findings.

Ethical Considerations

All research activities were conducted with permission from the participating schools and under the ethical guidelines of Universitas Negeri Padang. Student data were collected anonymously, and participation was voluntary.

3. Results and Discussion

Results

Validity of the Product

The validity of the Google Sites–based interactive teaching materials was examined as the outcome of the Development stage within the ADDIE instructional design process. Prior to validation, results from earlier ADDIE stages were used as the foundation for product refinement. During the Analysis stage, learning needs and student difficulties in distinguishing facts and opinions were identified, forming the basis for content selection. The Design stage resulted in structured learning objectives, PBL-based learning scenarios, and storyboard layouts that guided the media structure. These stages ensured that the developed product met curricular and pedagogical requirements before entering expert validation.

At the Development stage, the initial prototype of the interactive teaching materials was evaluated by three expert validators focusing on content/material accuracy, language appropriateness, and media/design quality. The results of expert validation are summarized in Table 1.

Table 1. Summary of Product Validity Results

Aspect	Validator Mean (%)	Category
Material/Content	86.15	Very Valid
Language	99.00	Very Valid
Media/Design	86.15	Very Valid
Average Total	**90.5**	**Very Valid**

As shown in Table 1, the developed product achieved an overall validity coefficient of r = 0.905, which falls into the *very valid* category. The language aspect obtained the highest score (r = 0.990), indicating that the instructional language is clear, age-appropriate, and aligned with fifth-grade learners' cognitive and linguistic characteristics. Validators also highlighted that the integration of multimedia elements such as images, videos, and interactive exercises enhanced content clarity and learner engagement. These validation results demonstrate that the product meets essential standards of instructional accuracy, clarity, and design quality, confirming that the outputs of the ADDIE Development stage are pedagogically sound and ready for implementation (Rahmadani & Taufina, 2020; Nugroho et al., 2024).

Figure 1. Homepage and navigation interface of the Google Sites–based interactive teaching materials.

Figure 1 illustrates the homepage and main navigation interface of the Google Sites–based interactive teaching materials developed in this study. The homepage was designed to provide clear guidance for students at the beginning of the learning process by presenting organized menus such as introduction, learning materials, practice activities, and evaluation. The layout uses simple visual elements and readable fonts to ensure accessibility for fifth-grade students. The navigation structure allows students to move easily between learning sections without confusion, supporting independent and guided learning. This design reflects the validators' assessment that the media structure is logical and user-friendly. The clarity of menu organization and instructional directions also supports students' initial orientation in learning activities. Therefore, Figure 1 demonstrates how the media design fulfills validity criteria in terms of usability, clarity, and instructional coherence.

Figure 2. Learning content display integrating text, images, and instructional videos.

Figure 2 presents an example of learning content displayed in the Google Sites module, showing the integration of text, images, and instructional video within a single learning page. This integration was intentionally designed to accommodate different learning styles and to support students' understanding of the concept of facts and opinions. The combination of visual and audiovisual elements helps clarify abstract concepts and maintains student attention during the learning process. Clear explanations are provided alongside illustrations to reinforce key ideas and support reading comprehension. Validators noted that the language used in the materials is appropriate for fifth-grade students and supports conceptual

understanding. Figure 2 highlights how content presentation contributes to high validity scores in both the content and language aspects.

Practicality Test

The practicality test involved both teachers and students using the Google Sites module during classroom implementation. The results are presented in Table 2.

Table 2. Practicality Test Results

Respondent	Mean Score (%)	Category
Teacher	99.58	Very Practical
Student	94.16	Very Practical
Average	**96.87**	**Very Practical**

As shown in Table 2, the practicality scores from both teachers and students indicate that the product is highly user-friendly, visually attractive, and effective in supporting independent and guided learning. Teachers reported that the module's navigation and structure aligned well with the lesson flow and that students were able to access the materials easily using smartphones or laptops. These findings are consistent with previous studies showing that digital media integrated with PBL encourages students to take a more active role in learning (Ulfa & Nurmayani, 2023; Salahuddin & Anggrayni, 2023).

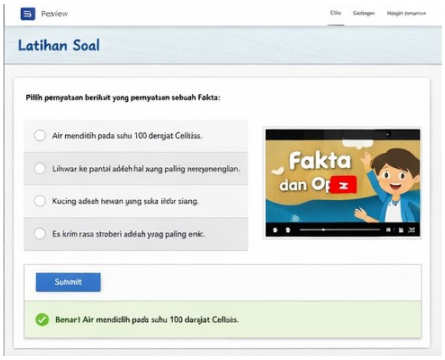

Figure 3. Interactive quiz and evaluation feature in the Google Sites module.

Figure 3 shows an interactive quiz feature embedded in the Google Sites module, which serves as a formative evaluation tool during the learning process. The quiz allows students to immediately apply their understanding by identifying factual and opinion-based statements. Immediate feedback is provided after students submit their answers, helping them recognize mistakes and reinforce correct concepts. The quiz design is simple and visually engaging, enabling students to complete the tasks independently. Students reported that the quiz was easy to use and enjoyable, which contributed to high practicality scores. Teachers also indicated that the quiz supported classroom assessment without requiring additional printed materials. Thus, Figure 3 illustrates how interactive features enhance the practicality and effectiveness of the developed teaching materials.

Figure 4. Classroom implementation of the Google Sites–based interactive teaching materials.

Figure 4 depicts the classroom implementation of the Google Sites–based interactive teaching materials during Indonesian language learning activities. The image shows students actively engaging with the learning materials using digital devices under the guidance of the teacher. This visual evidence supports observation data indicating increased student participation and focus during lessons. The use of digital media encouraged students to explore learning content, discuss problems with peers, and complete tasks collaboratively. Teachers reported that students were more enthusiastic and attentive compared to conventional learning sessions. Figure 4 demonstrates that the developed teaching materials can be effectively implemented in real classroom settings and supports the high practicality ratings obtained from both teachers and students.

Effectiveness Test

The effectiveness of the Google Sites–based materials was measured using pre-test and post-test scores and analyzed using the N-Gain formula (Hake, 1999). The results are summarized in Table 3.

Table 3. Results of Pre-test, Post-test, and Gain

Test Type	Mean Score	N-Gain (%)	Category
Pre-test	60.00	-	-
Post-test	91.52	80.55	High

The results show a significant improvement in students' learning outcomes, with an average N-Gain of 0.80 or 80.55%, categorized as *high effectiveness*. This indicates that the implementation of the Google Sites module successfully enhanced students' understanding of facts and opinions in texts. These findings align with Hake's (1999) interpretation that an N-Gain above 0.70 demonstrates substantial learning progress. During the implementation, students were highly engaged in analyzing examples, completing interactive tasks, and participating in discussions. The PBL structure, combined with multimedia content, encouraged students to explore learning materials more deeply and collaboratively. Teachers also reported an increase in student participation and enthusiasm throughout the lesson sessions.

Figure 5. Problem-based learning activity on facts and opinions in the Google Sites module.

Figure 5 illustrates a problem-based learning activity presented in the Google Sites module, focusing on the task of distinguishing between factual and opinion-based statements. The activity presents a contextual problem that requires students to analyze information, discuss possible interpretations, and categorize statements based on evidence and personal judgment. This structure reflects the core stages of the Problem Based Learning model applied in the study. Students were encouraged to think critically and collaborate with peers to solve the given problem. Teachers observed that this activity promoted deeper understanding and improved students' analytical skills. Figure 5 helps explain the significant improvement in learning outcomes and supports the high effectiveness results obtained from the N-Gain analysis.

Discussion

The high validity, practicality, and effectiveness of the developed materials demonstrate that Problem-Based Learning integrated with Google Sites can significantly enhance the quality of Indonesian language instruction at the elementary level. The results of this study support previous research that emphasized the importance of digital media in increasing learning engagement and conceptual understanding (Rahmadani & Taufina, 2020; Nugroho et al., 2024). The interactive design allows students to learn through exploration and discovery, aligning with the principles of constructivist learning theory (Arends, 2012).

The PBL model encourages students to analyze, evaluate, and synthesize information by engaging with authentic problems. This process helps students construct knowledge more meaningfully than in traditional teacher-centered instruction. The digital integration through Google Sites further strengthens the learning experience by providing immediate feedback, accessibility, and multimedia enrichment (Ulfa & Nurmayani, 2023). Students' positive responses and high learning gains reflect the potential of this innovation to foster 21st-century learning skills such as critical thinking, collaboration, and communication. The findings also suggest that using technology does not replace teachers but enhances

their instructional roles. Teachers serve as facilitators who guide students in navigating digital learning materials and problem-solving tasks. This is consistent with Wibowo and Astuti (2022), who stated that technology-assisted learning can strengthen the implementation of the Merdeka Curriculum by promoting autonomy and creativity among learners.

However, while the product proved highly effective in this context, its application remains limited to a single topic ("Facts and Opinions") and a specific sample of students. Future studies should replicate this research across different subjects, grade levels, and school contexts to confirm its broader applicability. Additional research could also explore the long-term retention effects and the integration of Google Sites with other digital tools such as Learning Management Systems (LMS) or augmented reality-based applications.

4. Conclusion

This study was conducted with the objective of developing Google Sites–based interactive teaching materials integrated with the Problem Based Learning (PBL) model and examining their validity, practicality, and effectiveness in fifth-grade Indonesian language learning on the topic of facts and opinions. The results demonstrate that this objective was successfully achieved. The developed teaching materials were proven to be highly valid based on expert evaluations, very practical according to teacher and student responses, and highly effective in improving student learning outcomes, as indicated by the N-Gain analysis.

The findings directly address the research problem identified at the beginning of the study, namely the limited use of interactive digital teaching materials and students' difficulties in distinguishing between factual and opinion-based information. The integration of multimedia elements and PBL-oriented learning activities enabled students to actively engage in problem analysis, collaborate with peers, and construct understanding through guided inquiry. Furthermore, the use of Google Sites provided an accessible and flexible platform that supports student-centered learning and aligns with the principles of the Kurikulum Merdeka. Therefore, it can be concluded that the developed interactive teaching materials constitute a feasible and effective learning resource for enhancing student engagement and analytical skills in elementary Indonesian language instruction.

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