

Development of Google Sites-Based Digital Teaching Materials for Indonesian Language Literacy Skills in Elementary Schools

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ABSTRACT

Twenty-first-century education demands the mastery of foundational literacy skills from an early age. However, the use of technology and interactive learning materials in elementary schools remains limited, particularly in archipelagic regions with minimal digital infrastructure. This situation highlights the need to develop digital learning materials that are adaptable to such constraints. Consequently, this study aims to develop Google Sites-based digital learning materials that are effective, practical, and valid for enhancing the Indonesian language literacy skills of fourth-grade students at SD Negeri 29 in Raja Ampat Regency. The study employs the Research and Development (R&D) method, adapting the Borg and Gall model into a modified six-stage process. Product trials were conducted with 30 students to assess practicality and improvements in learning outcomes. The results indicate that the developed digital learning materials are highly valid and practical, capable of presenting content multimodally – incorporating text, images, and video – with an interface design optimized for low-bandwidth conditions. Empirically, the use of these materials proved effective and significant in improving students' literacy skills. This is evidenced by a 30% increase in average scores for fluent reading, a 38% increase in reading comprehension, and a 38% increase in the ability to write simple responses. Thus, the Google Sites-based digital learning materials are deemed suitable and effective for implementation as an innovative, sustainable solution to address the shortage of literacy learning resources at the primary education level, particularly in 3T (frontier, outermost, and underdeveloped) regions.

Keywords: Digital teaching materials; Google Site; literacy skills; elementary school; Indonesian language

ABSTRAK

Pembelajaran abad ke-21 menuntut penguasaan keterampilan literasi dasar sejak dini. Namun, pemanfaatan teknologi dan bahan ajar interaktif di sekolah dasar masih terbatas, terutama di wilayah kepulauan yang memiliki akses infrastruktur digital minimal. Kondisi ini mendorong perlunya pengembangan bahan ajar digital yang adaptif terhadap keterbatasan tersebut. Oleh karena itu, penelitian ini bertujuan untuk mengembangkan bahan ajar digital berbasis *Google Site* yang efektif, praktis, dan valid dalam meningkatkan keterampilan literasi Bahasa Indonesia siswa kelas IV di SD Negeri 29 Kabupaten Raja Ampat. Penelitian ini menggunakan metode *Research and Development*

(R&D) dengan mengadaptasi model Borg dan Gall yang dimodifikasi menjadi enam tahapan. Uji coba produk dilakukan kepada 30 siswa untuk menilai kepraktisan serta peningkatan hasil belajar. Hasil penelitian menunjukkan bahwa bahan ajar digital yang dikembangkan tergolong sangat valid dan praktis, serta mampu menyajikan materi secara multimodal meliputi teks, gambar, dan video dengan desain antarmuka yang ramah terhadap kondisi *low-bandwidth*. Secara empiris, penggunaan bahan ajar ini terbukti efektif dan signifikan dalam meningkatkan keterampilan literasi siswa. Hal tersebut ditunjukkan oleh peningkatan rata-rata skor kemampuan membaca lancar sebesar 30%, pemahaman makna teks bacaan sebesar 38%, dan kemampuan menulis tanggapan sederhana sebesar 38%. Dengan demikian, bahan ajar digital berbasis *Google Site* dinyatakan layak dan efektif untuk diimplementasikan sebagai solusi inovatif dalam mengatasi keterbatasan sumber belajar literasi secara berkelanjutan di jenjang pendidikan dasar, khususnya di daerah 3T.

Kata Kunci: Bahan ajar digital; Google Site; keterampilan literasi; sekolah dasar; bahasa Indonesia

INTRODUCTION

21st-century learning demands that basic education adapt to foster multidimensional literacy and holistic critical thinking skills (Resmini & Itaristanti, 2017). Literacy skills are no longer merely technical abilities in reading and writing; rather, they have evolved into essential competencies for critically understanding, processing, and using information in problem-solving (Purwanto et al., 2024; UNESCO, 2017). The Indonesian Language subject in elementary school serves as the primary foundation for instilling these foundational skills (Mulyati & Cahyani, 2021). The transformation of education toward the digital era still faces various challenges in practice, particularly regarding the uneven utilization of technology and the limited availability of innovative teaching materials across different regions (Kebudayaan, 2017). On the other hand, science literacy is defined as an individual's ability to utilize scientific knowledge to identify problems, acquire new knowledge, explain scientific phenomena, and draw conclusions based on available scientific evidence (Muizz et al., 2023). Project-based learning is one instructional model designed to help students develop various skills to enhance learning outcomes. This improvement is achieved through activities involving the creation of real products or projects, such as reports or written project assignments given by teachers to students (Nurhabibah, 2023).

Psychologically and pedagogically, fourth-grade elementary school students are in a crucial transitional phase, namely the shift from the "learning to read" phase to the "reading to learn" stage. At this age, students are expected to construct the implied meaning of more complex texts. However, these cognitive demands often clash with the learning styles of the digital native generation (Prensky, 2001). Students in the era of disruption tend to process information in a visual, interactive, and dynamic manner. Unfortunately, the classroom learning ecosystem often still presents material in the form of static, one-way printed materials that fail to accommodate these learning styles (Rusman, 2017). It is this mismatch between students' learning styles and the media used that frequently leads to low reading interest and poor basic literacy comprehension.

Geographical conditions and disparities in the distribution of educational facilities, particularly in eastern Indonesia, present layered challenges in implementing basic literacy. This is exacerbated by significant digital infrastructure gaps for students in the Papua region (Daud & Nur, 2020; Rosdiana et al., 2024). Geographical isolation frequently hinders the distribution of up-to-date printed books. Initial observations at SD Negeri 29 in Raja Ampat

Regency confirmed this phenomenon; fourth-grade students demonstrated significant difficulty in understanding the implied meaning of reading texts and struggled to formulate written responses independently. The need for supplementary teaching materials is crucial, as demonstrated by Noe et al. (2023), who found that the use of supplementary books proved effective in addressing students' comprehension limitations compared to relying solely on a single source book.

Given these constraints of space and time, the digitization of supplementary teaching materials has become an absolute necessity. Digital transformation in the context of elementary education must not merely convert printed text into a passive document format (Portable Document Format / PDF), but must create a new ecosystem of interaction. Various previous studies have consistently demonstrated the effectiveness of integrating interactive digital media in overcoming these challenges. The development of interactive media based on the Google Sites platform has been empirically proven to drastically increase elementary school students' interest and participation in learning (Alfarizi et al., 2025; Suryaman & Azizah, 2023). In line with these findings, Rostiani et al. (2023) found that the use of digital modules is highly effective in promoting self-directed learning outside of face-to-face class hours.

The success of these digital learning materials is grounded in a very strong theoretical foundation: Cognitive Load Theory. According to this theory, a balanced integration of text, illustrative images, and audiovisual elements in a digital environment can facilitate deep conceptual understanding without overburdening students' working memory capacity (Mayer, 2020; Sweller et al., 2011). By breaking down complex information into manageable visual segments (chunking), students are able to convert information from short-term memory into long-term memory much more effectively (Rukman et al., 2022).

Furthermore, the integration of digital learning materials not only impacts the cognitive aspects of reading comprehension but also serves as an essential tool for building students' digital literacy from an early age. In the Society 5.0 era, it is not enough for students to merely be consumers of text-based information; they are expected to be able to navigate and synthesize knowledge from various multimedia formats. Recent research by Purnamasari (2025) confirms that the use of Google Sites-based e-learning is empirically highly effective in stimulating and enhancing students' digital literacy skills. Through a structured interface, this instructional material trains students to perform hypertextual navigation and evaluate content progressively. This multidimensional learning experience gradually shifts students' mindset from passive learners to more exploratory, self-directed learners.

From a technical and operational perspective, the selection of Google Sites as the primary framework for instructional materials is based on its ability to bridge the gap in limited technological infrastructure in remote areas. Unlike complex Learning Management Systems (LMS) or Android apps that require installation and significant device memory, Google Sites operates via cloud computing, which is extremely lightweight. This flexibility allows web-based materials to be accessed smoothly using standard browsers even on low-spec smartphones. Consequently, the technical barriers frequently cited in ICT integration in rural schools (Livingstone, 2012) can be significantly reduced.

Although research on digital instructional materials has been extensively explored, a significant gap analysis remains regarding their implementation in 3T regions (Underdeveloped, Frontier, and Remote). Most previous research has focused on urban school

ecosystems with stable broadband internet infrastructure. Imposing solutions in the form of applications that require high-specification devices risks widening the digital divide in island regions such as Papua (Muhajir, 2020; Rosdiana et al., 2024). Therefore, the novelty of this study lies in the design of digital instructional materials specifically optimized for low-bandwidth access, as well as holistically integrating three main domains into a single interface: reading literacy, writing literacy, and digital literacy navigation – elements rarely integrated in regions with limited learning resources (Gilster, 1997; Wahyuni et al., 2022). Based on the presentation of the problem's urgency and the theoretical framework, this study aims to describe the feasibility and evaluate the effectiveness of a Google Sites-based digital instructional material product in enhancing the literacy skills of fourth-grade students at SD Negeri 29 in Raja Ampat Regency.

METHODOLOGY

Type and Design

This study employs the Research and Development (R&D) method by adapting a modified version of the Borg and Gall (1983) development model. This research design was selected because it provides a systematic and iterative framework for designing, developing, and evaluating an educational product namely, digital instructional materials based on Google Sites so that the resulting product meets the criteria of validity, practicality, and effectiveness in real learning contexts. The development process was structured into six main stages. The first stage involved a needs analysis conducted through a preliminary study to identify students' literacy conditions, learning constraints, and technological availability. The second stage focused on designing the instructional framework, including interface layout, learning flow, and material organization aligned with curriculum objectives. The third stage consisted of product development using the Google Sites platform, emphasizing multimodal content presentation and low-bandwidth accessibility. The fourth stage was limited pilot testing to obtain initial feedback regarding usability and clarity. The fifth stage involved revising the product based on expert validation and user responses. Finally, the sixth stage was field implementation to evaluate the effectiveness of the product in improving students' literacy skills. Throughout the development process, all instruments, learning materials, and evaluation procedures were systematically aligned with the elementary school curriculum and adapted to the cognitive and developmental characteristics of elementary students, ensuring pedagogical appropriateness and contextual relevance.

Data and Data Sources

This study was conducted at SD Negeri 29 in Raja Ampat Regency during the second semester. The primary data subjects for testing the product's effectiveness were the 30 fourth-grade students. Additionally, the classroom teacher and school principal were actively involved as expert informants and sources of qualitative data to provide evaluations, validation, and practical feedback during the product's implementation in the classroom. The core data collected was classified into three categories: product feasibility data from expert testing, practicality data from the percentage of user responses in the field, and effectiveness data based on students' literacy test scores.

Data Collection Methods

Data collection was conducted comprehensively and using a triangulation approach, employing four main instruments. First, a cognitive literacy skills test focused on reading fluency, comprehension of implied meaning in text, and the ability to write simple responses. This test was administered before (pre-test) and after (post-test) the treatment involving the use of digital teaching materials. Second, a Likert-scale questionnaire distributed to teachers and students to measure the perceived practicality and ergonomic comfort of using the media. Third, a semi-structured interview guide was developed to explore the root causes of literacy challenges and gather in-depth technical feedback from users. Fourth, a participatory observation sheet was used to directly record students' engagement levels, interaction focus, and independent activities while accessing Google Sites via their devices in the classroom.

Data Analysis

To ensure the accuracy of interpretations, the collected data was analyzed using a combination of qualitative and quantitative approaches. Qualitative data obtained from observation notes, interview transcripts, and revision suggestions from expert validators was analyzed descriptively through the stages of data reduction, data presentation, and drawing conclusions. This process served as the primary foundation for refining the quality of the digital instructional materials. Meanwhile, quantitative data derived from survey responses and test instruments were analyzed using statistical software. To test the product's effectiveness, a parametric t-test (Paired Sample t-test) was employed to assess the significance of differences in literacy proficiency scores before and after using the digital instructional materials. This statistical analysis aims to draw precise and indisputable conclusions regarding the level of effectiveness of the developed product innovation.

RESULTS AND DISCUSSION

Product Development Results

This research and development effort has produced an innovative product in the form of Google Sites-based digital teaching materials specifically designed to facilitate Indonesian language literacy learning for fourth-grade elementary school students. The product creation process followed six systematic stages adapted from the Borg and Gall model. During the needs analysis and design phase, it was found that students required media that was not only text-based but also interactive while remaining bandwidth-friendly (low-bandwidth). As a solution, the final product features an integrated navigation structure. The site includes a home page, learning material presentations integrated with multimodal elements (reading texts, visual illustrations, and supporting video links from YouTube), as well as interactive assessment features linked to Google Forms for quizzes and written assignment spaces.

Prior to implementation, this product underwent validity testing by subject matter experts and media experts. Based on the feasibility test results, this instructional material was deemed highly valid and suitable for use both conceptually and technically. Several minor revisions made during the limited pilot phase included adjusting the font size to be more eye-friendly for elementary school-aged children, as well as simplifying the navigation button layout (user interface) to avoid confusing students. In line with the initial design objective to address infrastructure challenges in 3T regions (Underdeveloped, Frontier, and Outermost), this instructional material proved optimal as it can be accessed smoothly via basic-standard smartphones without requiring the installation of additional apps that burden device memory.

During the field implementation phase, practicality was assessed through a questionnaire distributed to classroom teachers and 30 fourth-grade students at SD Negeri 29 in Raja Ampat Regency. The results showed a very positive user satisfaction rate. The majority of students reported that the attractive visual design and ease of website navigation greatly helped them in learning and reviewing material independently at home. Meanwhile, classroom teachers confirmed that managing learning through web links is far more efficient and practical for monitoring students' evaluation records compared to using conventional printed textbooks.

Effectiveness on Literacy Skills

To measure the product's effectiveness regarding literacy skills, an empirical test was conducted using a pre-test and post-test design. This test focused on three main indicators of basic literacy for fourth-grade students: reading fluency, comprehension of reading material, and writing simple responses. A summary of the comparison of test results before and after the use of Google Site-based digital teaching materials is presented in Table 1 below.

Table 1 Results of Improvements in Students' Literacy Skills

Literacy Skills	Pre-test Average	Post-test Average	Increase (%)
Reading Fluency	65	85	30%
Comprehension of Reading Content	60	83	38%
Writing Responses Simple	58	80	38%

Source: Researcher's Analysis (2026)

Discussion

Based on the quantitative data in Table 1, there was a highly significant improvement in all aspects of students' literacy skills after using digital teaching materials. A parametric t-test also confirmed that this improvement in literacy skills was statistically significant ($p < 0.05$). The most notable findings were observed in the aspects of 'Understanding Reading Content' and 'Writing Simple Responses,' which each experienced the highest increase of 38%.

The success of this improvement in reading comprehension can be deeply interpreted through the lens of Cognitive Load Theory. According to Sweller et al. (2011) and Mayer (2020), students at the concrete operational stage have limited working memory capacity when processing long static texts. This limitation was successfully addressed by the architectural structure of this digital instructional material, which does not merely transfer book text to the screen in its raw form but breaks information into logical segments (chunking) and integrates it with illustrative videos (multimodality). Psychologically, this facilitates students at SD Negeri 29 in Raja Ampat Regency in visualizing the narrative of the text, thereby fostering reading comprehension that is holistic, contextual, and not abstract. Additionally, the direct evaluation feature on the Google Site platform, which requires students to type their reflections, has proven effective in gradually and enjoyably developing sentence-construction skills (writing literacy), minimizing the psychological pressure that often arises when students must write on paper.

The empirical findings of this study simultaneously address the gap analysis previously presented in the introduction. While the use of cutting-edge digital technology is often assumed to be ineffective and impossible to implement in regions with limited educational infrastructure, such as the island regions of Papua (Rosdiana et al., 2024), this research overturns that pessimism. The lightweight and flexible cloud-based nature of Google

Sites overcomes these geographical barriers, proving that low-bandwidth digital media can serve as a powerful tool to combat the severe literacy education gap in 3T regions.

Furthermore, the implications of this study confirm and expand upon findings from previous research. These results align with the study by Suryaman & Azizah (2023), which demonstrated that the interactive interface on Google Sites is empirically effective in eliminating classroom boredom and enhancing student learning participation. These findings also strongly support the postulate by Rostiani et al. (2023), which asserts that self-paced digital modules are highly effective in fostering self-directed learning skills. While the study by Noe et al. (2023) demonstrated that printed supplements are crucial for explaining complex material, this study introduces a novel innovation by holistically digitizing such supplements. In line with Purnamasari's (2025) study, the practice of navigating within Google Sites inherently trains students' digital literacy competencies, transforming them from passive readers into critical digital information explorers.

Not only does this research integrate the three domains of reading, writing, and digital literacy into a single platform ecosystem, but it also provides a blueprint for an adaptive learning architecture for schools with limited physical learning resources (Resmini & Itaristanti, 2017; Wahyuni et al., 2022). Conceptually and practically, the integration of this innovative product demonstrates that learning technology is not merely a tool for knowledge transfer but has evolved into an agent of change for a meaningful, inclusive, and sustainable literacy ecosystem (Reigeluth & Karnopp, 2013).

CONCLUSION

This study concludes that the Google Sites-based digital instructional materials developed are valid, practical, and effective in improving Indonesian language literacy among fourth-grade elementary students. The effectiveness of the product is evidenced by measurable increases in students' literacy skills, including reading fluency (30%), comprehension of text content (38%), and the ability to produce written responses (38%). These findings indicate that the structured and segmented presentation of learning materials effectively supports students' cognitive processing. In addition, the instructional materials facilitate independent learning and improve instructional efficiency, making them suitable for implementation in elementary schools, particularly in 3T regions with limited educational infrastructure.

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