The Effectiveness of Google Sites in Supporting Exponent and Logarithm Learning Based on Student Centered Learning

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ABSTRACT

This study aims to develop and examine the effectiveness of Google Sites–based instructional media for exponent and logarithm topics in supporting student-centered learning (SCL). The research employed a Research and Development (R&D) approach using the ADDIE model. The research subjects included experts (7 teachers) for the validity test and users (2 teachers and 80 senior high school students) for the practicality test. Data were collected through Likert-scale questionnaires and open-ended feedback, then analyzed using descriptive quantitative and qualitative methods. The expert validation results indicate that the media is highly feasible, categorized as Very Good (score: 3.90), particularly in technical aspects and instructional feasibility. User feedback confirms that the media is Good (score: 3.48), with technical elements identified as its primary strength. Qualitative findings reveal areas for further development, including improvements in contextual aesthetics, the addition of search and dark mode features, and enrichment of content through teacher-produced instructional videos. The study concludes that the developed Google Sites media is effective as a supporting tool for SCL, as it promotes learner autonomy through strong technical accessibility and adequate pedagogical design. The implication is that teachers can adopt this media to expand the variety of independent learning activities, provided that future development enhances interactivity and content personalization.

Key Word	*Google Sites, Student-Centered Learning, Exponents and Logarithms, Mathematics Learning Media, Digital Media Development.*
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INTRODUCTION

In the era of the Industrial Revolution 4.0, the integration of digital technology in education is no longer merely an option, but a necessity (Huda et al., 2023; Mutaqin et al., 2025; Saripudin & Muhammad Dzikri Fathur Robban, 2025; Triantoro et al., 2022). Various digital platforms have been utilized to create learning experiences that are more interactive, personalized, and student-centered (Ayunda et al., 2024; Daulay & Daulay, 2024; Jusman & Chairan Zibar L. Parisu, 2025; Saputra & Farman, 2025; Shefira et al., 2025). One platform that

has gained increasing popularity is Google Sites, a simple, free website-building tool integrated with the Google Workspace for Education ecosystem (Adila et al., 2025; Farida & Indah, 2021; Febrian et al., 2024; Hidayat & Agung Saputra, 2023; Mutiarani et al., 2025; Muwafiqus Shobri & Qois Rifqi, 2023; Ramanda, 2025; Susilawati & Hakim, 2022; Syalsabillah, 2024). Google Sites offers convenience for teachers to design web-based learning media without requiring complex programming skills (Febrian et al., 2024; Maratus Sholikah, 2025; Widiyanto, 2025). However, in many schools, especially those located in areas with limited access to technology, this platform has not yet been optimally utilized. Even in the context of mathematics learning, the use of Google Sites is often nonexistent. In fact, its potential is substantial for presenting abstract topics such as exponents and logarithms in a more visual, interactive, and easily accessible format. This background underscores the need for deeper exploration of how Google Sites can be adopted as an innovative learning medium in school environments that previously had little to no experience with this platform.

Mathematics, particularly exponent and logarithm topics, is often perceived by students as difficult and abstract (Adilah & Andiani, 2025; Ayu Wulandari et al., 2025; Pasinggi et al., 2025). Learning that still relies heavily on conventional lecture methods, textbooks, and monotonous problem-solving exercises tends to make students easily bored, passive, and less motivated (Ilyas et al., 2025; Irawati et al., 2025; Mukarramah et al., 2024). The lack of interactive and engaging learning media is one of the root causes of this issue. Students need media that not only present information but also allow them to explore concepts independently, interact with content, and receive immediate feedback. Without adequate media support, learning struggles to achieve the goals of student-centered learning, where students act as active agents in constructing their own knowledge (Pertiwi et al., 2022). Therefore, an innovative media breakthrough is needed to shift the learning paradigm from teacher-centered to student-centered, while simultaneously reducing learning fatigue and increasing student engagement.

Google Sites is part of Google Workspace for Education, designed to support collaborative and independent learning (Gunawan et al., 2025; Suryantari & Mulyono, 2023). This platform allows teachers to integrate text, images, videos, links, forms, and embedded interactive content into a single, well-structured web page (Adzkiya & Suryaman, 2021; Basori et al., 2020; Cahya Jendra, 2024; Sunarya et al., 2025). In educational contexts, Google Sites has been identified as a relevant tool for implementing the *Kurikulum Merdeka*, which emphasizes flexible and student-centered learning (Damayanti et al., 2023; Faiz et al., 2025; Fitriyah & Turmudzi, 2025; Mustika et al., 2024; Nugraha

et al., 2023; Nurdin et al., 2023; Safaatullah et al., 2025; Sofiana et al., 2025). From a learning theory perspective, Google Sites aligns with the principles of multimedia learning (Mayer, 2024), which state that presenting information through a combination of text and visuals can enhance understanding and memory retention. Moreover, with its responsive features, Google Sites also supports digital accessibility aspects such as ease of navigation, readability, and compatibility across various devices, making it accessible to students with diverse needs and technological backgrounds (Basori et al., 2020; Cahya Jendra, 2024; Gustini et al., 2025; Susmitasari et al., 2025).

Several previous studies have examined the use of Google Sites in mathematics learning. For example, a thesis by (Mudrikah, 2025) investigated the effectiveness of X-Math media based on Google Sites for transformation geometry topics. The results showed a significant improvement in students' problem-solving abilities and learning interest, demonstrating the effectiveness of the media in mathematics instruction. Other studies have also revealed that Google Sites can support problem-based learning oriented toward student-centered learning (Daud et al., 2025; Ratnasari et al., 2025). Nevertheless, existing research generally focuses on other mathematics topics (such as geometry, basic algebra, or arithmetic) and rarely addresses exponent and logarithm materials, which are highly abstract and rich in specialized notation. In addition, aspects such as website design, user experience (UX), and digital accessibility of Google Sites-based learning media have not been comprehensively evaluated. Most studies primarily measure learning outcomes or motivation, without deeply examining how interface design, navigation flow, and user experience influence media acceptance and effectiveness.

This study addresses a gap in the literature, namely the lack of research that specifically evaluates Google Sites for exponent and logarithm materials through a comprehensive analysis of website design, digital accessibility, and user experience (UX) within a student-centered learning framework. Therefore, the objectives of this study are to: (1) develop and test the feasibility of a Google Sites–based website that integrates multimedia learning principles; (2) analyze its effectiveness in supporting student-centered learning; and (3) evaluate its user experience (UX) and accessibility. This article is expected to provide practical contributions in the form of a ready-to-use media prototype for teachers, as well as theoretical contributions by enriching empirical evidence on the design and effectiveness of simple website platforms for interactive and independent mathematics learning.

RESEARCH METHOD

This study employed a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). This model was selected because it provides a systematic and iterative framework for developing instructional media products that are valid, practical, and effective. The operational description of each stage is presented as follows:

1. Analysis

    This stage aimed to identify learning problems and needs. The analysis was conducted through a literature review on students' difficulties in learning exponent and logarithm topics and the potential of digital learning media, as well as preliminary observations at the partner school. The results of this analysis served as the basis for formulating the website development objectives, namely to create learning media that are interactive, student-centered, and easily accessible.

2. Design

    Based on the identified needs, a website blueprint was designed, including:

    1) Navigation Structure: A hierarchical sitemap consisting of a homepage, learning objectives, materials by subtopics, an interactive question bank, and quizzes.

    2) Content Storyboard: Detailed layouts of each page integrating text, infographic images, short explanatory videos, and simple simulations.

    3) Design Principles: Application of multimedia learning principles (Mayer) and user experience (UX) considerations to ensure ease of navigation and visual comfort.

3. Development

    At this stage, the design was transformed into a tangible product using the Google Sites platform. Development activities included:

    1) Creating web pages and integrating various multimedia elements (text, images, videos, and links).

    2) Developing and embedding interactive quizzes using Google Forms.

    3) Expert Validity Testing (Expert Judgment): The initial prototype was evaluated for feasibility by seven peer reviewers (teachers) using a Likert-scale instrument covering Technical, Design, Interactivity, and Instructional Feasibility aspects. This test constituted part of the formative evaluation to refine the product prior to implementation.

4. Implementation

    The product, revised based on expert feedback, was then implemented in

a limited learning setting. This stage involved two teachers and 80 students from three Grade X classes at a public senior high school in Cirebon City. The website was used as a supplementary learning medium for exponent and logarithm topics over several instructional sessions.

5. Evaluation

The evaluation stage was conducted comprehensively to measure the quality of the final product:

1) Formative Evaluation: Conducted during the Development (expert review) and Implementation stages, focusing on collecting suggestions for improvement.

2) Summative Evaluation: Conducted after implementation by collecting quantitative and qualitative feedback from users (teachers and students) through Likert-scale questionnaires and open-ended questions. These data were analyzed and presented as the research findings.

Participants were divided into two groups: (1) seven peer teachers serving as expert reviewers during the Development stage; and (2) two mathematics teachers and 80 students as users during the Implementation and Evaluation stages.

The primary instruments were Likert-scale questionnaires (1–4), consisting of:

1. Expert Validation Questionnaire (14 aspect items + open-ended suggestions) to assess the initial prototype.

2. User Feedback Questionnaire (15 aspect items + open-ended suggestions) to evaluate the final product after implementation.
   The questionnaire items were designed based on the Technical, Pedagogical, and Aesthetic aspects.

Data Analysis Techniques :

1) Quantitative Data were analyzed using descriptive statistics by calculating mean scores for each aspect and overall, then categorizing them into Very Good, Good, Fair, or Poor.

2) Qualitative Data from open-ended responses were analyzed using thematic analysis, in which suggestions were grouped by thematic similarity to form the basis for improvement recommendations.

RESULT AND DISCUSSION

Results

The research results are presented based on an analysis of quantitative data from Likert-scale questionnaires and qualitative data from open-ended suggestions. Quantitative data were analyzed to determine the level of feasibility, while qualitative data were used to identify areas for improvement.

1. **Results of Accessibility Testing by Peer Reviewers**

    Seven (peer reviewers) evaluated the website prototype. The average analysis results are presented in Table 1 below.

Table 1.
Results of Average Analysis of the Peer Accessibility
Instrument (n = 7)

Aspect	Mean Score	Category
Technical & Speed	3.97	Very Good
Visual Design	3.81	Very Good
Interactivity	3.86	Very Good
Learning Feasibility	3.95	Very Good
Overall Peer Average	**3.90**	**Very Good**

Category Criteria: Very Good (3.50–4.00), Good (2.50–3.49), Fair (1.50–2.49), Poor (1.00–1.49).

Numerical Findings:

The peer reviewers' assessments indicate highly positive results. All aspects, Technical, Visual Design, Interactivity, and Learning Feasibility, fall within the *Very Good* category, with scores above 3.80. The highest score was obtained in the Technical & Speed aspect (3.97), indicating that the website is perceived as highly stable, fast, and smoothly accessible. The overall mean score of 3.90 confirms that the website is highly feasible from both technical and initial pedagogical perspectives to be tested with primary users (teachers and students).

2. **Feedback Results from Teachers and Students**

    After classroom implementation, feedback was collected from 82 respondents (2 teachers and 80 students). The analysis results are presented in Table 2.

Table 2.
Results of User Feedback Analysis (Teachers and Students) (n = 82)

Dimension	Mean Score	Category
Technical	3.56	Very Good

Pedagogical	3.44	Baik
Aesthetic	3.46	Baik
Overall Teacher Average	**3.48**	**Baik**

Numerical Findings:

Feedback from primary users produced an overall mean score of 3.48, categorized as *Good*. The Technical aspect emerged as the strongest dimension (3.56, *Very Good*), consistent with peer reviewers' assessments. The Pedagogical and Aesthetic aspects scored 3.44 and 3.46, respectively, both falling within the *Good* category. This indicates that while the media was generally well received, there remains room for improvement, particularly in terms of instructional content depth and visual appeal, to reach the *Very Good* category.

3. **Visualization of Comparison of Teacher and Student Feedback Scores**

A comparison of the three assessment dimensions from primary users is visualized in the bar chart below to provide a clear picture of score differences across aspects.
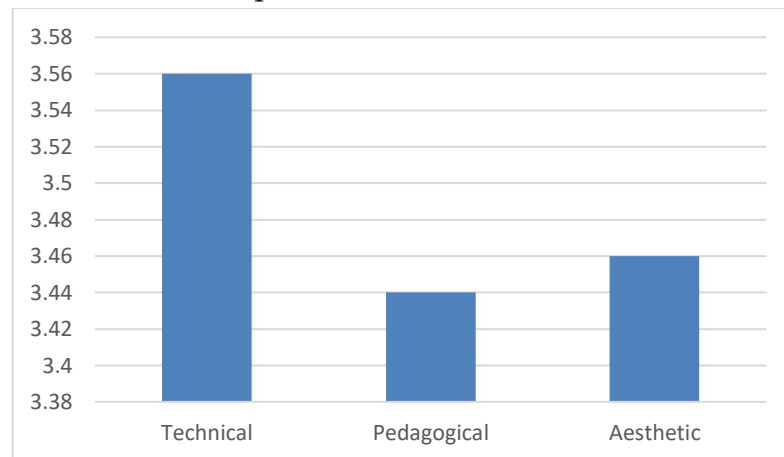

Figure 1.

Comparison of Mean Scores of Assessment Aspects Based on Teacher and Student Feedback (n = 82)

Graph Interpretation:

The bar chart clearly illustrates that the Technical aspect score (3.56) exceeds those of the Pedagogical (3.44) and Aesthetic (3.46) aspects. Nevertheless, all three scores are well above the minimum threshold of the *Good* category (2.50), indicating an overall positive acceptance of the developed learning media.

4. **Qualitative Findings from Respondents' Suggestions and Comments**

Based on an analysis of open-ended feedback from experts, teachers, and students, several themes for improvement were identified. These findings are descriptively summarized in Table 3 below.

Table 3.

Categorization of Qualitative Suggestions for Website Development

No.	Thematic Category	Examples of Direct Respondent Comments
1	Visual Design & Appearance	"It would be better to use a website with brighter images so it is more engaging." "My suggestion is only regarding the background; replace it with one that matches the material." "Maybe add some images so it's not too boring."
2	Functionality & Technical Features	"It could be considered to add a search feature and dark mode for more comfortable use." "A search or filter feature could be added to make usage easier."
3	Content Quality & Ownership	"If there are YouTube learning links, it would be better to use teacher-made instructional videos." "Continue improving the quality of the appearance and content to make it more interesting."
4	Navigation & Layout	"Improve the layout…"
5	Compatibility & Responsiveness	"Easy to use on various devices."

Description of Findings:

1. The *Visual Design & Appearance* theme emerged as the most dominant suggestion. Respondents specifically requested improvements in brightness, background visuals, and the addition of graphic elements to reduce monotony.

2. The *Functionality & Technical Features* theme was also prominent, with specific requests for the addition of a search feature and dark mode to enhance user comfort.

3. Suggestions related to *Content Quality & Ownership* indicated a preference for teacher-created instructional videos rather than reliance on external sources.

4. Other suggestions, though less frequent, concerned improvements in navigation layout and ensuring ease of access across different devices.

Synthesis of Qualitative Data:

Overall, respondents' suggestions converge on the need to refine visual aesthetics, add more comprehensive supporting features, and enhance the quality and relevance of multimedia content.

The learning website can be accessed here:

https://sites.google.com/view/yandara-122070007/materivideo

Discussion

Based on the research findings, this discussion elaborates on the underlying reasons for the results obtained, their relationship to relevant theories and previous studies, an evaluation of design principles, and the practical implications for various stakeholders.

Analysis of Quantitative and Qualitative Results

The consistently high technical aspect scores (3.97 from peer reviewers and 3.56 from users) indicate that the Google Sites platform successfully fulfills fundamental usability principles, namely effectiveness, efficiency, and user satisfaction. Ease of access across multiple devices reflects a responsive design, which is a crucial factor in contemporary educational information systems. However, qualitative suggestions to add search functionality and dark mode reveal the need for a higher level of usability and accessibility. These suggestions align with the principles of Universal Design, particularly Flexibility in Use and Perceptible Information (Arviani & Nugroho, 2024). Implementing these features would accommodate diverse user preferences and sensory needs while enhancing equitable access.

The finding that the pedagogical aspect received the highest score from experts (3.95) but a slightly lower score from users (3.44) suggests two important points. First, from the peer reviewers' perspective, the content and learning flow meet feasibility standards. Second, from the students' perspective, although the pedagogical quality is considered good, there remains room for improving engagement. Qualitative suggestions to add more images, use teacher-produced videos, and improve layout respond to the need for multimodal information presentation. This is consistent with the Cognitive Theory of Multimedia Learning, which emphasizes that learning is more effective when words and images are presented together, as well as the principle of Perceptible Information, which stresses that information should be communicated effectively through multiple modalities. Replacing external videos with teacher-created videos also reflects personalization efforts, which can enhance relevance and strengthen students' emotional connection to the learning material.

Relationship to Theory and Previous Research

The findings of this study reinforce and refine conclusions from prior research. Studies on e-learning systems have shown that well-designed UI/UX significantly increases user motivation and engagement (Hudha & Haryono, 2025; Imalian et al., 2025). The high technical scores and positive navigation feedback in this study provide additional empirical support for these claims. Furthermore, research indicating that mobile-based and responsive academic systems enhance accessibility and flexibility is also relevant, given that the developed Google Sites can be optimally accessed via smartphones (Qona'ah et al., 2024; Syafrillah & Oktasari, 2023).

However, this study identifies a gap that has been relatively underexplored in previous research: the application of in-depth web accessibility principles in website-based mathematics learning media. Web Content Accessibility Guidelines (WCAG) emphasize that content should be perceivable, operable, understandable, and robust for all users (Fithriyaningrum et al., 2021). Suggestions for dark mode relate to the principle of making content easier to see and hear (adequate contrast), while requests for a search feature relate to the principle that users should be able to navigate and locate content effectively. Thus, the respondents' feedback represents not merely general input, but an intuitive demand for compliance with universal accessibility standards that should be integral to digital educational design.

Evaluation of UX, Pedagogical, and Aesthetic Principles

The evaluation indicates that the developed website meets fundamental principles well, yet still offers opportunities for refinement toward a more mature level of implementation.

Principle	Level of Fulfillment	Analysis Based on Findings
User Experience (UX)	Basic Fulfilled, Advanced Needed	Core usability principles (efficiency, learnability) are well met. However, Universal Design principles such as Flexibility in Use and Tolerance for Error have not been fully optimized.
Pedagogical	Good, with Room for Innovation	Learning flow and content support instructional objectives. Stronger application of multimedia learning principles and personalization through teacher-created videos can reduce cognitive fatigue and increase relevance.
Aesthetic	Functional, Needs Contextualization	Layout is considered neat, but aesthetics in digital education should support pedagogy. Suggestions for "backgrounds aligned with the material" indicate a need for contextual

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aesthetics, where visual elements actively support mathematical concept understanding.

Implications for Students, Teachers, and Schools

The findings of this study carry strategic implications for multiple actors within the educational ecosystem.

For Students:

The use of this website supports the realization of student-centered learning. Good accessibility enables students to learn independently according to their own pace and learning styles. Enhanced multimedia content can transform abstract mathematical learning into a more concrete and engaging experience, potentially increasing intrinsic motivation and self-efficacy.

For Teachers:

The website serves as an extension of teachers' pedagogical capacity. Teachers can shift from being the primary source of information to facilitators who guide student exploration. Centralized and easily managed resources also simplify instructional logistics and open opportunities for differentiated learning by providing enrichment or remediation materials within the same platform.

For Schools:

The adoption and development of web-based learning media represent a concrete step toward institutional digital transformation, aligning with the demands of the digital era and the *Kurikulum Merdeka*. Investment in building teachers' capacity to design and evaluate similar media can result in a sustainable digital repository of learning materials that is updatable, shareable across schools, and capable of improving both efficiency and quality of educational resources.

CONCLUSION

Based on the entire sequence of analyses, this research on the development of a Google Sites–based website for exponent and logarithm topics has successfully achieved its objectives. Overall, the developed media have proven to be feasible and effective as a support for student-centered learning. The key findings indicate that the website obtained very high validity from expert evaluations, with an average score of 3.90 (*Very Good* category), as well as positive acceptance from users (teachers and students), with an average score of 3.48 (*Good* category). The technical aspect emerged as the main strength of the media, as reflected in the highest scores for access reliability, loading speed, and responsive interface compatibility across multiple devices. This strength forms

a crucial foundation for the implementation of independent learning, as accessibility and ease of use are essential prerequisites for student-centered learning.

The strengths of this media are not limited to technical aspects but also extend to its ability to fulfill fundamental pedagogical principles. The website design, which integrates text, images, and videos, applies multimedia learning principles that help concretize abstract mathematical concepts. User feedback confirms that the learning flow and interactive activities, such as quizzes, support students' learning autonomy by enabling them to access, explore, and evaluate their understanding independently and at their own pace. Consequently, the media effectively functions as a learning resource that shifts the teacher's role from the sole transmitter of information to a facilitator, an essential characteristic of student-centered learning.

Nevertheless, this study also identifies several shortcomings and limitations that should be acknowledged. From a media perspective, qualitative feedback highlights the need for further enhancement in aesthetic aspects and advanced functionality, such as the addition of a search feature, dark mode, and enrichment of visual content and contextual teacher-produced videos. The primary limitation of the study lies in the restricted scope of the trial, which was conducted in only one school with three classes; therefore, caution is required when generalizing the findings. In addition, uneven internet connectivity in students' home environments may hinder optimal access outside of school. This study also did not conduct a longitudinal or in-depth analysis of the website's impact on learning outcomes, and it focused solely on a single content package (exponents and logarithms).

Accordingly, the practical implications for teachers include the need to provide more structured guidance when using this media, while schools are encouraged to support adequate network infrastructure. Recommendations for future research include conducting broader-scale trials, developing materials for other mathematics topics, and designing experimental studies to measure the significant impact of the media on students' academic achievement and independent learning skills.

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