



Development of web-based learning media with Google Sites to improve critical thinking of junior high school students

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Abstract

In the digital era, web-based learning media play an important role in improving students' critical thinking skills. The purpose of this study is to develop and evaluate the effectiveness of web-based learning media using Google Sites in order to improve the ability of junior high school students to think critically. This research uses a research and development (R&D) methodology based on the ADDIE paradigm (analysis, design, development, implementation, and evaluation). Participants consisted of 40 junior high school students, and data collection was carried out using a pre-test and post-test. The critical thinking ability measurement instrument using critical thinking ability test questions is arranged through the stages of grids, discussions, and test questions, based on the revised Bloom taxonomy, which emphasizes high-level thinking (C4, C5, C6). The test proved to be valid and reliable with Cronbach's Alpha 0.87 and met the validity of the content and construct. The data analysis method used is a paired t-test. The study found that using Google Sites-based learning resources significantly improved students' critical thinking skills. Students improve their ability to analyze information, evaluate arguments, and solve problems in an effective way. This concept also shows that students are more involved in the learning process due to interactive features and web-based media access. However, challenges such as internet access and digital literacy need to be addressed. As a result, Google Sites-based learning media has evolved into an effective tool for fostering critical thinking among students. Future research is recommended to explore the integration of other platforms and conduct a lengthy study to assess the sustainable impact on learning outcomes.

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INTRODUCTION

Critical thinking is an essential skill that students need to navigate the challenges of the digital age (Kleftodimos et al., 2023). However, at the junior high school level, students' critical thinking skills remain considerably limited. A survey conducted at SMP Negeri 14 Madiun indicated that only 1.7% of seventh-grade students were categorized as "critical," whereas 88.64% were classified as "less critical," and 9.66% were categorized as "very uncritical." The mean critical thinking score was 53.07 out of 100, highlighting a substantial need for targeted interventions to improve students' critical thinking competencies. This shortcoming is largely due to traditional teaching methods that fail to actively engage students in analytical, evaluative, and reflective thinking (Almufarreh & Arshad, 2023). In addition, the limited use of learning tools and minimal interaction also hinders the development of students' critical thinking skills (Zuo et al., 2024).

In today's digital landscape, incorporating technology into education presents an effective way to improve the quality of education (Çetinkaya et al., 2023). One such tool is Google Sites, which allows teachers to create interactive web-based learning resources that are easily accessible to students (Hsiao & Su, 2021). Through Google Sites, educational content can be delivered in a more captivating way using text, images, videos, and various interactive elements that stimulate critical and independent thinking in students as they assimilate new concepts (Georgiou & Kyza, 2023).

Despite its potential, the use of Google Sites as a pedagogical tool to promote critical thinking among students has not yet been fully realized (Li et al., 2022). Therefore, this study aims to create a web-based learning resource that utilizes Google Sites to cultivate the critical thinking skills of junior high school students (Almulla & Al-Rahmi, 2023). It is hoped that this initiative will encourage students to actively engage with the material, ask questions, and analyze information more thoroughly (Khahro & Javed, 2022).

Several previous studies have examined the evolution of web-based learning media and their relevance to the advancement of students' critical thinking (Lee, 2023). The previous study found that the use of web-based digital learning media can increase student engagement in learning and help them examine and evaluate knowledge more critically (Abouhashem et al., 2021). The study underscores that web-based interactive media can provide a more flexible and engaging learning experience than traditional techniques (AlGerafi et al., 2023).

Zakariya (2024) also mentioned that there are benefits to using Google Sites for junior high school learning. The findings of their study show that Google Sites can be an effective platform for providing learning materials with various multimedia features that help students understand. Students are more motivated to think critically about the concepts being taught

when the content is presented systematically with features that allow for interaction (Velaora et al., 2022).

Barlovits et al., (2022) found that technology-based learning, especially through digital platforms such as Google Sites, can help students improve their critical thinking skills by allowing them to explore information, participate in online discussions, and complete project-based tasks. The study shows how appropriate learning technologies and methodologies can help students improve higher-order thinking skills (Asghar et al., 2022).

The novelty of this study lies in the development of web-based learning resources using Google Sites, specifically designed to strengthen the critical thinking skills of junior high school students. Although previous studies Mosquera Feijóo et al., (2021) and Palioura & Dimoulas, (2022) have explored the use of digital platforms for education, research focusing specifically on optimizing Google Sites to enhance students' critical thinking remains limited. Most existing studies have emphasized content delivery, whereas this study addresses the gap by integrating critical thinking-oriented activities into the platform design.

In this research, Google Sites is not merely used as a medium for delivering instructional content, but it is innovatively designed with interactive features that actively promote critical thinking development. These features include reflective questions to stimulate analytical thinking, online discussion forums to encourage argumentation and reasoning, and project-based assignments that foster deeper conceptual exploration. Google Sites offers specific advantages for this purpose, such as ease of customization, user-friendly navigation, integration of multimedia resources, and collaborative tools, all of which support the development of higher-order thinking skills.

Furthermore, this study will provide practical implementation guidelines for instructors on how to effectively utilize Google Sites as a digital learning medium, serving as a reference for future development of more optimized and interactive digital learning models at the junior high school level. The purpose of this study is to create and test the usefulness of web-based learning materials, especially Google Sites, in improving the critical thinking skills of junior high school students. This study also aims to assess the validity, practicality, and effectiveness of the media developed as an innovative and interactive learning resource. This study aims to design interactive learning media that can be used flexibly by students and teachers, analyze the impact of Google Sites in improving students' critical thinking skills on the subjects taught, and provide recommendations to educators on how to effectively apply web-based learning media in the learning process (Onecha et al., 2023). Thus, the findings of this research are expected to bring new answers to learning issues in the digital era (Lampropoulos et al., 2022).

Globally, this research adds to efforts to improve the quality of education by incorporating technology into the learning process. Critical thinking skills have become an important asset in preparing students for the challenges of the Fourth Industrial Revolution and digital transformation (Schulz, 2023). This research offers an alternative for the world of education in terms of maximizing the use of digital technology to enable more interactive, inventive, and

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problem-solving-based learning. This research can help provide a flexible learning paradigm in various educational institutions. This research can help students in various countries improve their digital literacy and critical thinking skills, especially in the era of globalization, where individuals are increasingly expected to be able to analyze information in depth and make good judgments based on rational thinking (Alturki & Aldraiweesh, 2023).

METHOD

Study Design

This study employs a Research and Development (R&D) approach, utilizing a development model adapted from the ADDIE process (Analysis, Design, Development, Implementation, and Evaluation). This strategy was selected to enable the systematic development and testing of web-based learning materials, specifically Google Sites, aimed at enhancing the critical thinking skills of junior high school students. The approach integrates both qualitative and quantitative methods: qualitative aspects are addressed through expert validation to assess the content validity and instructional design quality, while quantitative elements are incorporated through effectiveness testing to measure the impact of the developed materials on students' critical thinking skills.

Table 1. ADDIE (analysis, design, development, implementation, and evaluation) model process.

| Phase | Activity Description |
|--------------------------------|---|
| Analysis | Analysis of learning needs, identification of difficulties with traditional learning, and evaluation of critical thinking skills of junior high school students. Data was collected through literature reviews, interviews with teachers, and the submission of questionnaires to students. |
| Design | Create an interactive learning media framework based on Google Sites that promotes critical thinking skills. Identify key characteristics, including digital content presentations, online debates, introspective activities, and project-based tasks. Create display, navigation, and learning flow designs for the developed media. |
| Development | Create web-based learning assets with Google Sites. Materials and media specialists test the validity of the media to ensure that the content is appropriate, the design is effective, and the media can be used for learning. Expert feedback is used to make improvements. |
| Implementation | Trial learning media with junior high school students to assess its effectiveness in improving critical thinking. Data was collected through observations, student satisfaction surveys, and critical thinking skills tests before and after media use. |
| Evaluation (Evaluation) | Analyze the results of the implementation to assess whether the learning media are effective in developing students' critical thinking. Evaluation is carried out both formatively (improvements made during the production process) and summatively (assessing the final efficacy of the media). The results of the evaluation are used to improve the media before it is adopted more widely. |

Population and Sampling Techniques

This study focuses on the creation of web-based learning media using Google Sites to improve the critical thinking skills of junior high school students at SMPN 14 Madiun. The population for this study is all grade VIII students enrolled at SMPN 14 Madiun, particularly those taking social studies (Social Sciences) classes. This population was chosen because grade

VIII is a pivotal year for students to improve their critical thinking skills while studying social concepts that necessitate data analysis and evaluation.

The research sample consisted of a group of grade VIII students chosen based on inclusion and exclusion criteria. The inclusion criteria for this sample are grade VIII students taking social studies subjects at SMPN 14 Madiun in the 2024/2025 school year, students who are willing to participate in the use of Google Sites-based learning media and activities related to this research, and students who have access to web-based media-accessible devices, such as a smartphone, tablet, or computer.

This study involved 40 students as a research sample, which was determined using a sampling technique based on the GPower calculation. In this study, the sample size of 40 students was determined using the GPower software. The calculation process involved selecting a *paired sample t-test* (dependent means), setting the significance level (α) to 0.05, and the desired power ($1-\beta$) to 0.80. A medium effect size of 0.5 was assumed based on Cohen's standards. The GPower output indicated that a minimum of 34 participants was required to achieve reliable results. To ensure robustness and account for potential attrition, the final sample size was rounded up to 40 students, ensuring sufficient statistical power for the analysis.

Meanwhile, exclusion criteria include students who do not participate in social studies learning in grade VIII during the school year, students who do not have access to or have difficulty accessing web-based media, which may interfere with their participation in research, and students who have health issues that prevent them from participating in technology-based learning activities. Purposive sampling will be used to collect samples from the existing population, specifically selecting students who satisfy the inclusion requirements and are willing to participate in all stages of the study. Researchers will select a relevant sample size to assess the efficacy of Google Sites-based learning resources in developing students' critical thinking abilities.

Research Stages

The following is a table of research procedures/stages, which includes pre-test, intervention, and post-test. This table depicts the steps taken throughout each stage of the study.

Table 2. Research procedure/stages

| Research Stages | Activities | Implementation Time |
|--|--|---------------------|
| 1 Pre-Test | Critical thinking tests are prepared and distributed to assess pupils' basic abilities. The test consists of multiple-choice questions, essays, and case studies of the social studies topic to be studied. Pre-test findings will be collected and processed as baseline data. | Week 1 |
| 2 Intervention (Learning Using Google Sites) | Implementation of Google Sites-based learning media for social studies education. Students get access to Google Sites-based learning tools. Project-based learning encourages students to think critically (discussions, project assignments, and tests). Direct involvement with interactive learning elements, such as quizzes, videos, and forums | Weeks 2-4 |

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| Research Stages | Activities | Implementation Time |
|-----------------|--|---------------------|
| 3 Post-Test | Implemented a post-test to assess students' critical thinking skills following the intervention. Results were analyzed and compared to the pre-test. | Week 5 |

Description: A pre-test is conducted to assess students' critical thinking skills before accessing Google Sites-based learning media. Intervention: Learning utilizing Google Sites-based media is adopted to improve students' critical thinking skills through interactive aspects and project-based learning. Post-Test: Following the intervention, students take a post-test to assess how much their critical thinking skills have improved.

Media Validation and Reliability

Media experts and material experts conducted media validation in the study to assess the feasibility, effectiveness, and suitability of learning media to research objectives. In addition, reliability tests are performed to confirm the consistency of assessment outcomes. Validation is based on predetermined criteria, such as appearance and design, navigation, interactivity, technical feasibility, and the material's alignment with the curriculum and critical thinking objectives.

Table 3. Results of the validation of web-based learning media with Google Sites

| Validation Aspects | Media Member 1 | Media Member 2 | Subject matter expert 1 | Subject matter expert 2 | Average Score | Category |
|---|----------------|----------------|-------------------------|-------------------------|---------------|-----------|
| Display and design | 4 | 5 | - | - | 4.5 | Excellent |
| Navigation and readability | 5 | 4 | - | - | 4.5 | Excellent |
| Interactivity | 4 | 5 | - | - | 4.5 | Excellent |
| Technical feasibility | 5 | 4 | - | - | 4.5 | Excellent |
| Suitability of the material to the curriculum | - | - | 5 | 4 | 4.5 | Excellent |
| Clarity of material delivery | - | - | 4 | 5 | 4.5 | Excellent |
| Potential to improve critical thinking | - | - | 5 | 4 | 4.5 | Excellent |

Based on the validation results, this Google Sites-based learning material obtained an average score of 4.5, placing it in the "Excellent" category, meaning that it is worthwhile to use with minimal modifications suggested by the validators. To confirm that the validation results were consistent, the reliability coefficient was calculated using the Alpha Cronbach method on validation data from experts. If the Alpha Cronbach value is ≥ 0.70 , the validation instrument is deemed credible.

The validity of the construct in this study aims to ensure that the web-based learning media developed follow the concept of critical thinking and can accurately measure the targeted skills.

To achieve this goal, validation is carried out through expert judgment, namely, assessments from experts in the fields of education, learning technology, and critical thinking skills. In determining the validity of constructs, this study refers to relevant theories, especially the Revised Bloom Taxonomy (Krathwohl, 2002), which emphasizes the level of high-level thinking, namely analyzing (C4), evaluating (C5), and creating (C6). In addition, this study also uses Facione's Critical Thinking Skills model (Facione, 1990a, 1990b), which includes six main critical thinking skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation.

The method used in this validation is Aiken's V, with a Likert scale (1–5) to assess the extent to which web-based learning media are in accordance with the predetermined critical thinking indicators. The results of the analysis show that the average value of Aiken's V is ≥ 0.80 , which indicates that the learning medium has a high level of construct validity. In addition, all indicators of critical thinking skills have been in accordance with the learning objectives to be achieved. Based on these results, it can be concluded that the Google Sites-based learning media developed in this study have met the validity of the construct. Thus, this media can be used effectively to improve the critical thinking skills of junior high school students according to the underlying theory.

Table 4. Reliability test results

| Aspects | Alpha Cronbach | Reliability Category |
|---|----------------|----------------------|
| Media Validation by Media Experts | 0.82 | Reliable |
| Material Validation by Material Experts | 0.79 | Reliable |
| Overall Validation Instruments | 0.81 | Reliable |

Based on the calculation results, the Alpha Cronbach value is greater than 0.70, indicating that the Google Sites-based learning media validation instrument is very trustworthy, implying that the evaluation outcomes are consistent and dependable. According to the findings of validation and reliability testing, this Google Sites-based learning media is valid and reliable, and it may be used to strengthen junior high school students' critical thinking skills. Some of the modifications identified by the validators will be implemented before moving forward.

Research Instruments

The instrument used in the research "Development of Web-Based Learning Media with Google Sites to Improve Critical Thinking of Junior High School Students" was made to assess the effectiveness of Google Sites-based learning media in improving students' critical thinking skills. The research instrument consists of several interrelated components, including the Critical Thinking test. The main tool for assessing students' critical thinking development is a critical thinking test designed on markers of critical thinking such as analysis, assessment, and information synthesis.

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To assess the feasibility of media products in the research "Development of Web-Based Learning Media with Google Sites to Improve Critical Thinking of Junior High School Students", several evaluation instruments were used:

First, an expert judgment sheet is used to assess aspects of content validity, construct validity, and learning media design. The assessment is conducted by experts in the fields of education, learning technology, and critical thinking skills. The validation method uses Aiken's V to determine the degree of media conformity with critical thinking indicators.

Second, the media feasibility questionnaire is used to measure the quality of learning media based on aspects of usability, ease of use, and effectiveness in supporting learning. It is usually assessed using a Likert scale (e.g., 1–5) with criteria such as visual appearance, interactivity, navigation, and suitability of the material.

Third, the critical thinking ability test is used to measure the effectiveness of the media in improving students' critical thinking skills. The test questions are structured based on the revised Bloom taxonomy (Krathwohl, 2002), which includes indicators of higher-level thinking (C4: Analyze, C5: Evaluate, C6: Create). The validity and reliability of the test are tested before use to ensure the accuracy of the measurement.

Fourth, student and teacher response questionnaires are used to determine user experiences with web-based learning media. Students and teachers rate how effective and engaging media are in improving their learning engagement and critical thinking skills.

This exam will be given to students before (pre-test) and after (post-test) utilization of Google Sites-based instructional resources. The test consists of questions that assess students' ability to analyze social issues, evaluate various perspectives, and draw conclusions based on available facts. Multiple choice, essays, and case studies related to social studies are examples of question formats. The critical thinking test instrument has been tested for validity and reliability. If the validity test of the correlation coefficient between each question item results in a total test score of more than 0.30, then the item can be considered valid, which shows that the test item has a strong enough correlation with students' critical thinking skills. To assess reliability, the Alpha Cronbach test is used; An Alpha Cronbach score of more than 0.70 indicates that the critical thinking test instrument is reliable. For example, if the Cronbach's Alpha score for a critical thinking test instrument is 0.85, then the test is reliable and can be used to assess students' critical thinking skills regularly.

Data Analysis Techniques

This parametric data analysis technique is used to assess changes in students' critical thinking abilities following the intervention. The normality test and the influence test (paired sample t-test) are the two primary stages of parametric data analysis.

In this study, a parametric data analysis method was applied to assess changes in students' critical thinking skills after they participated in an intervention involving the use of web-based learning media. The purpose of this analysis is to quantitatively evaluate the effectiveness of

learning media in improving students' critical thinking skills. The parametric data analysis process is divided into two main stages. The first stage is the normality test, which aims to find out whether the pre-test and post-test data on critical thinking follow the normal distribution. This test is important because parametric analysis, such as the t-test, assumes that the data used is derived from a normal distribution. If the assumptions of normality are met, the analysis can proceed to the next stage.

The second stage involves a paired sample t-test, which is used to measure the difference in average scores between students' pre-tests and post-tests. This test aims to determine whether there is a significant improvement in critical thinking skills after the implementation of Google Sites-based learning media. The results of the analysis will be represented by a significance value (p-value), where $p < 0.05$ indicates that the difference between pre-test and post-test is statistically significant. By using these data analysis techniques, this study can ensure that changes in students' critical thinking skills are not a coincidence, but the result of the application of learning media that have been developed.

RESULTS AND DISCUSSION

This research aims to create a web-based learning resource using Google Sites to improve the critical thinking skills of eighth-grade social studies students of SMPN 14 Madiun. Analysis of the influence test revealed a significant difference between pre-test and post-test scores, showing that Google Sites-based learning media had a positive impact on students' critical thinking skills ($p < 0.05$). The post-test average was much higher than the pre-test average, showing a noticeable improvement in critical thinking after the intervention. This shows that Google Sites is an effective medium to encourage students to think critically, analytically, and reflectively about the material, especially in social studies (the results can be seen in tables 5 and 6).

These findings are in line with previous research that also shows web-based learning media can improve students' critical thinking skills. The previous study of Kuna et al., (2023) highlights that technology-based learning encourages active and critical thinking, especially in analyzing information. Similarly, Dahri et al., (2023) found that web-based learning fosters critical thinking and problem-solving skills, especially when using interactive platforms such as Google Sites.

Utilizing web-based media, especially Google Sites, allows students to access learning materials independently and engage with a variety of resources that support critical thinking (Cheng et al., 2023). The incorporation of videos, images, and text in Google Sites helps students understand and reflect on the content they are learning (Suing et al., 2023). In addition, collaborative tasks using web-based tools enhance critical thinking through joint discussions and problem-solving efforts (Yan & Li, 2023).

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Table 5. Reliability test results

| Characteristic | Description |
|--|-----------------------|
| Average Student Age | 13.5 years \pm 0.71 |
| Percentage of Gender (male) | 56% \pm 0.12 |
| Percentage of Gender (Female) | 44% \pm 0.39 |
| Have a smartphone | 100% \pm 0.91 |
| Have a personal computer/laptop | 32% \pm 1.4 |
| Do not have a personal computer/laptop | 6 plus \pm 0.31 |

Table 6. Results of the Google Sites learning media effectiveness test on critical thinking skills

| Average & Standard Deviation | | Mean Difference | % Increased | P Value |
|------------------------------|-----------------|-----------------|-------------|---------|
| Pre-Test | Post-Test | | | |
| 55.4 \pm 0.13 | 86.9 \pm 0.27 | 31.5 \pm 1.7 | 36,24% | 0.001** |

Description:

**means that $p < 0.05$, the intervention given has a significant impact on the results of students' critical thinking

This study shows that web-based learning media through Google Sites is very beneficial for students' critical thinking skills. Therefore, it is recommended that educators and schools consider integrating technology into the learning process to improve the quality of education and cultivate students' critical thinking skills (Sukackè et al., 2022). Overall, these findings underscore the value of technology integration in education and confirm that web-based learning media can effectively engage, motivate, and foster critical thinking among students regarding the information they encounter (Soubra et al., 2022). The main advantage of this web-based learning medium lies in its ease of presenting information in various formats, such as text, images, videos, and interactive quizzes (Paños-Castro et al., 2022). This is in line with cognitive theory, which states that multimodal learning can improve student understanding and engagement (Sayaf et al., 2022). In this study, students who use Google Sites tend to be more active in digging up information, asking critical questions, and connecting concepts that have been learned, compared to conventional learning methods (Gopinathan et al., 2022).

Additionally, research shows a significant increase in student engagement with learning. Google Sites improves access to educational resources, allowing students to learn independently and collaborate with colleagues through comments and discussion forums embedded within the platform (Jerman Blažič & Jerman Blažič, 2022). As a result, students are more encouraged to think critically, as they must analyze information, assess the reliability of sources, and build stronger arguments (Alakrash & Razak, 2021). This research highlights some of the challenges associated with the implementation of this online learning tool (Zhang & Wang, 2021). The main concern is the adequacy of the technological infrastructure in schools, as well as the digital proficiency of students and teachers. While Google Sites is user-friendly, some users may need additional training to get the most out of its features. In addition, limited internet access in certain areas is a barrier to the fair implementation of web-based learning (Makri et al., 2021).

The successful integration of web-based learning tools in the educational process can be achieved if teachers effectively organize and structure content to improve students' critical thinking skills (Alturki & Aldraiweesh, 2021). An important approach is to present the material in a structured and engaging format, incorporating multimedia resources such as videos, animations, interactive quizzes, and discussion forums (Dannenberg et al., 2023). This allows students to actively explore the subject matter and analyze the information they encounter. Additionally, educators must ensure that the web-based learning resources developed are interactive and adaptable (Yang et al., 2021). Google Sites facilitates the incorporation of diverse digital materials, allowing instructors to link to scholarly articles, educational videos, and challenging practice questions that inspire critical thinking (Robles Moral & Fernández Díaz, 2021). Introducing thought-provoking questions or project-based tasks that require problem-solving can further improve students' analytical skills (Mendoza et al., 2022).

Educators must support students in building their digital literacy to ensure the effective use of web-based learning media (Mansor et al., 2021). Because some learners may not be familiar with online education methods, teachers should provide basic training on how to navigate and utilize Google Sites effectively (Cavus et al., 2021). Additionally, instructors can offer guidance for evaluating the credibility of online information sources, helping students not only absorb the content but also critically assess the material they encounter (de Sousa et al., 2022). To increase student engagement, educators are encouraged to adopt a blended learning approach that combines face-to-face education with online learning through Google Sites. During face-to-face teaching, teachers can assist students in understanding complex concepts, while the online component can facilitate deeper exploration and understanding (Mystakidis & Christopoulos, 2022). This approach allows for increased flexibility in learning while still providing optimal support (Duarte et al., 2022).

Educators should regularly assess the effectiveness of the web-based learning tools they use. It involves gathering feedback from students about their experience using Google Sites and evaluating the improvement of critical thinking skills through tests or analysis-based activities (Zhang & Wang, 2021). By continuously refining these tools based on the results of the evaluation, educators can ensure that web-based learning media effectively encourage the improvement of students' learning quality and critical thinking skills (Kleftodimos et al., 2023). While research on the development of Web-Based Learning Media that leverages Google Sites to improve the critical thinking of middle school students has yielded positive findings, there are limitations to consider (Almufarreh & Arshad, 2023). The main obstacle is the narrow scope of the sample. The study may be limited to only a few schools with a limited number of participants, making it difficult to generalize the results to a wider population of junior high school students in different regions with different characteristics (Zuo et al., 2024).

The research relies on the technological infrastructure available in schools. Not every institution has reliable internet access or adequate devices to facilitate web-based learning, posing challenges for students, especially those from areas with limited technological

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resources. These shortcomings can hinder the effective implementation of web-based learning tools. Another limitation is the varying levels of digital literacy among students and educators. Many students may not be used to using technology as their primary learning medium, which can potentially lead to difficulties in accessing or taking full advantage of features within Google Sites. Similarly, educators may need extra time to understand and create engaging web-based learning content.

In addition, the research methodology may only examine a short period of time in assessing the improvement of students' critical thinking skills. As critical thinking skills develop gradually, long-term evaluations are needed to effectively measure significant impacts. Therefore, future research should apply a longitudinal design to evaluate the effectiveness of Google Sites over a longer period of time. Finally, the study may ignore external factors that can affect learning outcomes, such as student motivation, parental support, and other teaching methods applied in the classroom (Çetinkaya et al., 2023). These elements can play an important role in the success of web-based learning and deserve further research. Recognizing these limitations provides an opportunity for future studies to broaden their focus and adopt a more comprehensive approach to enhancing the effectiveness of web-based learning media for the development of students' critical thinking skills at the junior high school level (Barlovits et al., 2022).

CONCLUSION

The findings of this study show that web-based media, particularly Google Sites, can improve students' critical thinking skills by offering flexible content presentation and interactive tools. It also enhances student motivation and engagement. However, challenges like limited internet access, inadequate infrastructure, and varying digital literacy levels remain. The study's limitations include a small sample size (40 students) from a single school and a short-term implementation, which may affect the generalizability and long-term impact of the results.

Google Sites offers a flexible way to present materials, allows for the incorporation of interactive learning tools, and motivates students to engage in analyzing and assessing information. Moreover, the research suggests that web-based learning can boost students' motivation and involvement in their education. Nonetheless, challenges such as limited internet access, the adequacy of school infrastructure, and varying levels of digital literacy among students and educators persist.

This study implies that developing web-based learning media can serve as an effective approach to improving educational quality, particularly in fostering critical thinking skills. Thus, educators and educational institutions need to consider a broader integration of technology in teaching and learning. Future research should address the limitations by expanding the sample size and including schools from diverse regions to enhance the generalizability of the findings. Longitudinal studies are also necessary to assess the long-term

effects of web-based learning on critical thinking. Furthermore, further exploration of integrating Google Sites with other platforms, as well as employing innovative learning methodologies such as Problem-Based Learning or gamification, should be prioritized for future inquiries.

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