

Website-Based Blended Learning as an Innovation in Mathematics Learning to Improve Students' Mathematical Representation Skills

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Abstract : *Mathematical representation ability is an important competency in mathematics learning because it allows students to present, interpret, and communicate mathematical concepts through visual, symbolic, and verbal representations. However, this ability is still relatively low due to learning that tends to be teacher-centered and does not utilize technology. This study aims to determine the effect of a blended learning model assisted by a Google Sites-based website on students' mathematical representation ability on similarity and congruence material. The study used a quantitative approach with a pre-experimental method through a One Group Pretest-Posttest design on 21 ninth-grade students of MTs Al-Ihsan Kalikejambon, Tembelang, Jombang. Data were collected using pretest and posttest tests, observation sheets, and documentation, then analyzed using the Shapiro-Wilk normality test and Paired Sample t-Test. The results showed an increase in the average value from 53.29 to 90.14, with a significance value of 0.000 (<0.05), so the alternative hypothesis was accepted. These findings indicate that integrating face-to-face instruction with web-based learning through Google Sites provides an effective learning environment that enhances students' conceptual understanding and mathematical representation skills.*

Keywords : *Blended learning; Website; Mathematical representation skills.*

INTRODUCTION

Education has a strategic role in improving the quality of human resources through the development of 21st century competencies, such as critical, creative, communicative, and collaborative thinking (Mahanal, 2014). In the context of mathematics learning, this competence is realized through students' ability to understand, process, and communicate mathematical ideas appropriately (Umami, 2024). One of the abilities that plays an important role is mathematical representation ability, namely the ability to present mathematical concepts or problems in various forms of representation, such as pictures, diagrams, symbols, tables, graphs, and verbal descriptions (Fitrianingrum & Basir, 2020). Mathematical representation skills help students build conceptual understanding, solve problems, and connect abstract concepts with real situations, making it one of the competencies emphasized in mathematics learning (Andari & Lusiana, 2022).

In geometry material, especially similarity and congruence, mathematical representation skills are very important because students are required to be able to visualize objects, translate images into mathematical models, and explain the relationships between shapes logically (Suningsih & Istiani, 2021). However, various studies show that students' mathematical representation abilities are still relatively low (Suningsih & Istiani, 2021). This low ability is influenced by learning that is still centered on the teacher so that students do not get enough opportunities to construct knowledge, explore various forms of representation, and develop mathematical thinking skills independently (Naja & Sa'o, 2023).

One learning innovation that has the potential to address these issues is the blended learning model, which integrates face-to-face and online learning. This model provides students with the flexibility to learn independently without reducing direct interaction with the teacher. Previous research has shown that blended learning can improve mathematical representation skills compared to conventional learning because students receive broader learning opportunities, both inside and outside the classroom (Mawardi & Budiningsih, 2023).

As educational technology advances, the use of web-based learning media has become an effective alternative to support blended learning. Google Sites is a platform that allows teachers to integrate learning materials, videos, practice questions, evaluations, and various learning resources into a single page that is easily accessible across various devices (Lase et al., 2025). These characteristics support the creation of more flexible, interactive, and student-centered learning so that it can increase engagement and learning independence.

However, most previous studies have focused on the influence of blended learning on learning outcomes or mathematical representation skills in general, while research integrating blended learning models with Google Sites-based websites on similarity and congruence materials is still relatively limited. Therefore, this study has a novelty in the application of a blended learning model assisted by a Google Sites-based website to improve students' mathematical representation skills on similarity and congruence materials (Ramadhani et al., 2019).

Based on the description, this study aims to analyze the effect of a blended learning model assisted by a Google Sites-based website on students' mathematical representation skills. The results are expected to contribute to the development of technology-based mathematics learning and serve as an alternative for teachers in improving students' mathematical representation skills through more interactive, flexible, and learner-centered learning (Nangim & Hidayati, 2021).

METHOD

This study employed a pre-experimental design using a One-Group Pretest-Posttest Design to examine the effect of a Google Sites-assisted blended learning model on students' mathematical representation skills. The study involved two variables: the independent variable, namely the Google Sites-assisted blended learning model, and the dependent

variable, students' mathematical representation skills, which were assessed through four indicators: visual, symbolic, verbal, and contextual representations.

The research was conducted at MTs Al-Ihsan Kalikejambon, Tembelang District, Jombang Regency, Indonesia, on December 18–19, 2025. Prior to the implementation, preparatory activities, including the development of learning materials and research instruments as well as instrument validation, were carried out from November to early December 2025. The population consisted of all ninth-grade students enrolled at MTs Al-Ihsan Kalikejambon during the 2025/2026 academic year. Because the population comprised only one class, a saturated sampling technique was employed, resulting in all 21 students being selected as the research sample.

Research data were collected through tests, observations, and documentation. A pretest and a posttest were administered to measure students' mathematical representation skills before and after the implementation of the Google Sites-assisted blended learning model. Classroom observations were conducted throughout the intervention to evaluate the fidelity of the learning implementation based on the planned instructional procedures. Documentation, including lesson plans, learning materials, students' work, photographs of classroom activities, and the pretest and posttest results, was collected as supporting evidence.

Table 1. One Group Pretest-Posttest Design

Group	Pre-test	Treatment	Post-test
Experimental	O ₁	X	O ₂

Note:

O₁ = Pre-test scores before treatment

X = Treatment (instruction using Google Site-assisted blended learning)

O₂ = Post-test scores after treatment

The research instruments consisted of teaching modules, a Google Sites-based learning website, a mathematical representation skills test, and an observation sheet for monitoring the implementation of the learning process. All instruments were validated by two experts, comprising one university lecturer in mathematics education and one experienced mathematics teacher. The validation results indicated that all instruments achieved a high level of validity and were therefore considered appropriate for use in the study.

The research procedure comprised three stages: preparation, implementation, and completion. During the preparation stage, the learning materials, research instruments, and Google Sites-based learning website were developed and subsequently validated. The implementation stage began with the administration of the pretest, followed by the delivery of the Google Sites-assisted blended learning intervention while classroom observations were conducted, and concluded with the administration of the posttest. The completion stage involved data coding, statistical analysis, hypothesis testing, interpretation of the findings, and preparation of the research report.

Data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics were first employed to summarize students' mathematical representation scores. The Shapiro-Wilk test was then conducted to assess the normality of the data distribution. Finally, a paired-samples t-test was performed to determine whether there was a statistically significant difference between the pretest and posttest scores, thereby evaluating the effect of the Google Sites-assisted blended learning model on students' mathematical representation skills. Statistical significance was determined at the 0.05 level.

RESULT AND DISCUSSION

1. Result

This study used a one-group pretest-posttest pre-experimental design. The experimental group used the bented learning model. Twenty-one ninth-grade students from MTs Al-Ihsan Kalikejambon Tembelang Jombang participated in the study. The study was conducted on December 18-19, 2025, to determine the effect of the bented learning model on students' mathematical representation skills in the similarity and congruence topic.

The researchers implemented the learning process according to the learning tools used in the bented learning model. The stages used by the researchers were divided into three stages: pre-implementation, implementation, and post-implementation. In the pre-implementation stage, activities consisted of the preparation of research instruments carried out in November 2025, instrument validation on December 9, 2025. Furthermore, in the implementation stage, the research was carried out on December 18 and 19, 2025 at MTs Al-Ihsan Kalikejambon Tembelang Jombang, with 21 students as subjects and the material tested was Similarity and Congruence. Finally, in the post-implementation stage, an effectiveness test was carried out which included a normality test and a Paired Sample t Test.

The research was conducted on December 18-19, 2025. Learning was carried out 2 x 40 minutes with a total of 21 students. In the first meeting, learning was carried out in the first and second periods so that students were still in very good condition. Activities in the first meeting were the delivery of material for 25 minutes followed by working on a pre-test and a tutorial on using the website. In the second meeting, learning was also carried out online so that students could carry out learning at their respective homes to participate in learning activities. Activities in the second meeting were reviewing the material and conducting evaluations to measure students' mathematical representation abilities, then the last was giving post-test questions to determine student learning outcomes on the material of Similarity and Congruence. Research activities were carried out with an observer to see that the learning activities were carried out in accordance with the observation sheet for the implementation of the teaching module. The observation sheet for the implementation of the teaching module was filled out by one person who observed the course of learning until the end. The results of the observation sheet for the implementation of the teaching module are as follows as in Table 2.

Table 2. Teaching Module Implementation Observation Sheet

No	Rated aspect	Assessment Yes (✓) or No (X)
Introduction		
1.	The teacher opens the lesson with greetings	✓
2.	The teacher asked the class leader to lead the prayer.	✓
3.	The teacher checks students' attendance	✓
4.	The teacher gives appreciation	✓
5.	The teacher conveys the learning objectives and learning models that will be applied.	✓
Core activities		
6.	The teacher gives a tutorial on operating the website	✓
7.	The teacher displays the material on Similarity and Congruence	✓
8.	Teachers carry out online learning	✓
9.	Implementation of the quiz	✓
Closing		
10.	The teacher concludes the lesson by asking questions to the students.	✓
11.	The teacher closes the lesson with prayer and greetings.	✓
12.	Teachers teach on time according to the teaching module	✓

Descriptive analysis showed an improvement in students' mathematical representation skills after the implementation of a blended learning model supported by a Google Sites-based website. Before the treatment, students' average pretest score was 53.29, while after the treatment, the average posttest score increased to 90.14. This improvement indicates that the implementation of this learning model helped students understand the concepts of similarity and congruence and improved their ability to represent mathematical ideas visually, symbolically, and verbally.

The learning process was implemented through six stages: class presentation, information seeking, concept reinforcement, information acquisition, knowledge synthesis, and closing. At each stage, students utilized the Google Sites-based website to access materials, learning videos, sample problems, and practice independently. The integration of face-to-face and online learning encouraged students to be more active in discussions, explore information, and connect mathematical concepts to everyday life problems.

The results of the inferential analysis showed that the pretest and posttest data were normally distributed based on the Shapiro-Wilk test, with a significance value of 0.086 for the pretest and 0.136 for the posttest (Sig. > 0.05).

Table 3. Normality Test Result

Test	Shapiro-Wilk		
	Statistic	Df	Sig.
<i>Pre-Test</i>	,920	21	,086
<i>Post-Test</i>	,931	21	,136

Since the data were confirmed to be normally distributed, a paired-samples *t*-test was conducted to examine the difference between students' mathematical representation skills before and after the implementation of the Google Sites-assisted blended learning model.

The analysis was performed using IBM SPSS Statistics version 26 by comparing the pretest and posttest scores obtained from the same group of students.

Table 4. Paired Sample t-Test Result

Paired Differences					T	Df	Sig. (2 tailed)
Mean	Std. Deviation	Std. Error Mean	95% Interval Difference	Confidence of the Upper			
-36,857	6,909	1,508	-40,002	-33,712	-24,448	20	,000

Therefore, the hypothesis was tested usg a Paired Sample t-Test. The test results showed a significance value of 0.000 (< 0.05), so H_0 is rejected and H_a is accepted. Thus, there is a significant effect of the implementation of the Google Sites-based blended learning model on students' mathematical representation skills in the topic of similarity and congruence. These findings indicate a statistically significant difference between the pretest and posttest scores. Therefore, it can be concluded that the implementation of the Google Sites-assisted blended learning model significantly improved students' mathematical representation skills.

2. Discussion

The findings of this study demonstrate that the implementation of a Google Sites-assisted blended learning model significantly improved students' mathematical representation skills in the topics of similarity and congruence. The improvement was reflected in students' enhanced ability to represent mathematical concepts through visual, symbolic, and verbal forms. In addition, students showed greater engagement and active participation throughout both face-to-face and online learning activities, indicating that the integration of digital technology into classroom instruction contributed positively to the learning process (Joshi et al., 2023) .

These findings are consistent with previous studies reporting that blended learning effectively enhances students' mathematical representation skills (Khilmi, 2020). However, the present study extends previous research by integrating Google Sites as the primary web-based learning platform. Unlike earlier studies that primarily employed virtual learning environments such as Edmodo, Google Sites enables teachers to organize learning materials, instructional videos, practice exercises, and assessments within a single platform that is easily accessible without requiring students to create individual accounts (Bueno et al.,2022). This accessibility allows students to review learning materials anytime and anywhere, thereby promoting greater learning flexibility and independent study.

The positive effect of the Google Sites-assisted blended learning model can be explained by several factors. First, continuous access to learning resources enabled students to revisit mathematical concepts at their own pace, reinforcing their conceptual

understanding beyond classroom instruction. Second, the integration of interactive learning activities and online practice provided students with additional opportunities to construct mathematical ideas through multiple forms of representation (Halim & Halim, 2024). Finally, combining face-to-face instruction with online learning encouraged students to actively participate in discussions, solve problems collaboratively, and receive timely feedback, all of which support the development of mathematical representation skills. These findings are consistent with Santidar (2025), who emphasized that digital technology can enhance instructional effectiveness while creating a more engaging learning experience.

The results also highlight the importance of integrating appropriate digital learning media with learner-centered instructional approaches. As educational practices continue to evolve in response to rapid technological advancement, combining blended learning with web-based instructional media offers an effective strategy for creating meaningful mathematics learning experiences. The flexibility of online access complements classroom instruction by extending learning opportunities beyond school hours, thereby encouraging students to become more active and self-directed learners.

One of the main strengths of this study lies in the integration of Google Sites into the blended learning model. The platform offers several practical advantages, including ease of access, compatibility with both online and face-to-face learning environments, and the ability to incorporate multimedia resources and interactive learning activities within a single website. These features not only simplify instructional delivery for teachers but also enhance students' motivation and engagement throughout the learning process. Consequently, Google Sites serves as an effective technological support for implementing blended learning in mathematics education.

Overall, the findings suggest that the Google Sites-assisted blended learning model represents an effective instructional approach for improving students' mathematical representation skills. Beyond improving academic performance, this model also promotes student engagement, learning motivation, and independent learning through the meaningful integration of digital technology into mathematics instruction. Therefore, this approach has the potential to serve as an innovative alternative for mathematics teachers seeking to improve the quality of instruction.

CONCLUSION

This study concludes that the Google Sites-assisted blended learning model significantly improves students' mathematical representation skills in the topic of similarity and congruence. Students' mean scores increased from 53.29 on the pretest to 90.14 on the posttest, and the paired-samples t-test confirmed a statistically significant improvement ($p < .05$). These findings indicate that integrating face-to-face instruction with web-based learning through Google Sites provides an effective learning environment that enhances students' conceptual understanding and mathematical representation skills.

Practically, the findings suggest that mathematics teachers may adopt Google Sites-assisted blended learning as an alternative instructional approach, particularly for geometry topics. Schools are encouraged to support its implementation by providing adequate digital infrastructure and professional development for teachers. Future research should employ experimental designs with control groups, larger sample sizes, and different mathematical topics or learning outcomes to further validate and extend these findings.

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