Development of Web-Based Learning Media Using Google Sites for Lines and Angles

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Abstrak

Penelitian ini dilatarbelakangi oleh rendahnya pemahaman siswa terhadap materi garis dan sudut dalam matematika yang disebabkan oleh kurangnya media pembelajaran yang interaktif dan menarik. Tujuan penelitian ini adalah mengembangkan media pembelajaran berbasis web menggunakan Google Sites untuk meningkatkan pemahaman siswa pada materi tersebut. Jenis penelitian ini adalah Research and Development (R&D) yang diadaptasi dari model Borg & Gall. Instrumen yang digunakan meliputi tes prestasi belajar, wawancara, dan observasi. Teknik analisis data yang digunakan adalah analisis deskriptif dan inferensial untuk data kuantitatif serta analisis tematik untuk data kualitatif. Hasil penelitian menunjukkan bahwa media pembelajaran berbasis Google Sites efektif dalam meningkatkan pemahaman dan motivasi belajar siswa. Kesimpulannya, media ini tidak hanya meningkatkan hasil belajar tetapi juga meningkatkan partisipasi siswa dalam proses pembelajaran. Implikasi hasil penelitian ini adalah bahwa integrasi teknologi berbasis web dalam pembelajaran matematika dapat meningkatkan kualitas pendidikan. Namun, keterbatasan penelitian ini terletak pada sampel yang terbatas dan spesifik, sehingga disarankan penelitian lanjutan dengan sampel lebih besar dan beragam serta penerapan pada mata pelajaran lain.

Abstract

This study is motivated by the low understanding of students regarding the topics of lines and angles in mathematics, which is attributed to the lack of interactive and engaging learning media. The objective of this research is to develop a web-based learning media using Google Sites to enhance students' comprehension of these topics. The type of research conducted is Research and Development (R&D), adapted from the Borg & Gall model. The instruments used include achievement tests, interviews, and observations. The data analysis techniques employed are descriptive and inferential analysis for quantitative data and thematic analysis for qualitative data. The research results indicate that the web-based learning media developed using Google Sites is effective in improving students' understanding and motivation in learning. In conclusion, this media not only enhances learning outcomes but also increases student participation in the learning process. The implications of these findings suggest that the integration of web-based technology in mathematics education can enhance educational quality. However, the study's limitations include a restricted and specific sample, thus further research with larger and more diverse samples and application to other subjects is recommended.

INTRODUCTION

In this digital era, education faces significant challenges in leveraging technology to enhance the quality of learning. The use of technology in education, particularly web-based learning media, has become increasingly important as it can enhance interactivity and student independence in learning. One of the topics in mathematics that requires effective learning media is lines and angles. This study focuses on the development of web-based learning media using Google Sites for this subject matter.

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Lack of Interactive Learning Media: Mathematics curricula are often delivered in traditional ways that are less engaging for students. This leads to a lack of interest and understanding among students regarding the material being taught (Prastowo, 2018). Limited Access to Quality Learning Resources: Many schools, especially in remote areas, face limitations in accessing quality and modern learning resources. Web technology can be a solution to overcome these limitations (Hwang et al., 2015).

Shift in Learning Paradigms: Education today is moving towards more independent and student-centered learning. Web-based learning media support this shift by providing content that can be accessed anytime and anywhere (Lee & Lee, 2014). If the lack of interactive learning media and limited access to quality learning resources are left unaddressed, several negative consequences may occur, including: Decline in Student Interest: Students are likely to lose interest in learning mathematics, resulting in low academic performance (Lai et al., 2016). Educational Disparity: Limited access to quality learning resources can widen the educational gap between students in urban and remote areas (Roschelle et al., 2016). Unpreparedness for Global Challenges: Students who are not accustomed to technology and independent learning will struggle to compete in an increasingly digital and global world (Voogt et al., 2015).

The proposed solution is the development of web-based learning media using Google Sites for the topic of lines and angles. Google Sites is user-friendly for both teachers and students without requiring advanced technical skills (Chang et al., 2013). It can be accessed from various internet-connected devices, allowing students to access learning materials anytime and anywhere (Al-Emran et al., 2016). Additionally, Google Sites supports interactivity and collaboration, enhancing student engagement in the learning process (Dabbagh & Kitsantas, 2012).

This solution is chosen due to the proven effectiveness of web-based learning media in various studies. For instance, research by Lee & Lee (2014) demonstrates that the use of web-based learning media can significantly improve student learning outcomes. Furthermore, Google Sites, as an easily accessible and user-friendly platform, enables the development of interactive and engaging content for students.

Enhancing Education Quality: The development of web-based learning media can improve the quality of mathematics education, particularly for the topic of lines and angles, in a more interactive and engaging manner (Prastowo, 2018). Reducing Educational Disparity: By providing widely accessible learning media, this study can help bridge the educational gap between urban and remote areas (Hwang et al., 2015). Preparing Students for a Digital Future: This study also helps prepare students to face the challenges of an increasingly digital and global future (Voogt et al., 2015).

Previous research, such as that conducted by Hwang et al. (2015) and Lai et al. (2016), has demonstrated that technology-based learning media can improve student learning outcomes. However, these studies primarily focused on specific applications or software, whereas this research emphasizes the use of Google Sites, which is widely accessible and user-friendly.

This study specifically focuses on leveraging Google Sites, which has not been extensively explored in the context of mathematics education, especially concerning topics like lines and angles. The developed learning media will be directly integrated into the existing curriculum, ensuring relevance and practical application in classroom learning contexts (Chang et al., 2013). The learning media under development is designed to enhance interactivity and student engagement, in contrast to many previous studies that focused more on static content (Dabbagh & Kitsantas, 2012).

Overall, the development of web-based learning media using Google Sites for lines and angles is a significant step toward improving the quality of mathematics education. This solution is chosen for its ease of use, accessibility, and ability to support interactivity and collaboration. This research is not only important for enhancing student learning outcomes but also for narrowing educational disparities and preparing students for future challenges. With this innovation, it is expected to create a more engaging and effective learning environment and make a significant contribution to the literature on technology-based mathematics education.

METHOD

In the study "Development of Web-Based Learning Media Using Google Sites for Lines and Angles," an adapted Research and Development (R&D) model based on Borg & Gall's framework was utilized. The R&D model was chosen for its systematic approach to educational product development through structured stages, including: research and information gathering, planning, development of product drafts, field testing, product revision, and dissemination.
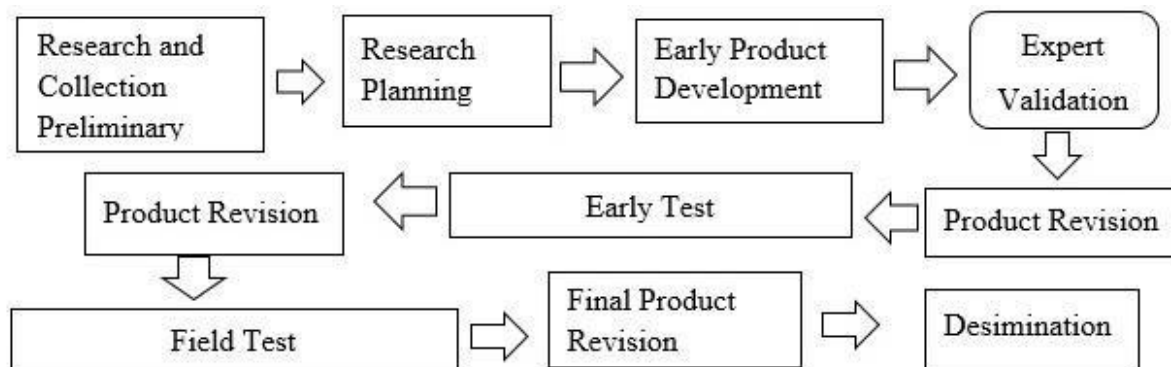

Figure 1. Model Borg & Gall

The instruments used to collect data in this study include questionnaires, interviews, observations, and achievement tests. Questionnaires were employed to gather data on students' responses to the learning media. Interviews with teachers and students were conducted to obtain more in-depth qualitative feedback. Observations were carried out to monitor the use of learning media during the learning process. Achievement tests were used to measure students' improvement in understanding the concepts of lines and angles.

Instrument validity was tested through content validity and construct validity. Content validity involved expert judgment to assess whether the instruments covered all relevant aspects aligned with the research objectives. Construct validity was tested using factor analysis to ensure that the instruments measured the intended constructs.

Instrument reliability was tested using internal consistency techniques, such as Cronbach's Alpha, to ensure that the instruments consistently produced reliable results when tested at different times. The data source for this research was eighth-grade students at one middle school in City X. Additionally, mathematics teachers who taught the lines and angles material also provided data to gain pedagogical perspectives.

Sampling was conducted using purposive sampling, where participants were selected based on specific criteria: students currently studying lines and angles who were willing to participate in the trial of the developed learning media. Quantitative data from achievement tests were analyzed using descriptive and inferential statistics. Descriptive statistics were used to describe the distribution of student scores, while inferential statistics, such as t-tests, were used to test hypotheses regarding differences in learning achievement before and after using the web-based learning media.

Qualitative data from interviews and observations were analyzed using thematic analysis techniques. This process involved data coding, identifying main themes, and interpreting findings to gain a deep understanding of students' and teachers' experiences in using the learning media.

Table 1. Grid of Instrument Specifications

Aspect Measured	Indicator	Question/Item
Conceptual Understanding	Ability to explain concepts of lines and angles	List and explain types of angles!
	Ability to identify forms of lines and angles in pictures	Identify parallel lines in the following picture!
Application Skills	Ability to apply concepts in problem solving	Calculate the size of the angle in the following problem!
	Ability to use web-based learning media	Explain the steps of using the web-based learning media you have learned!
Attitude towards Learning	Student interest and motivation in using learning media	How interesting and motivating is web-based learning media for you? (Likert Scale)
	Student perception of the effectiveness of learning media	Does this learning media help your understanding? (Likert Scale)

RESULT AND DISCUSSION

Result

The study "Development of Web-Based Learning Media Using Google Sites for Lines and Angles" employed a Research and Development (R&D) model adapted from Borg & Gall. The results of this research can be explained based on the outcomes of each step in the development model utilized.

1. Research and Information Gathering

The initial step in this study involves gathering information through literature review and needs analysis. Literature review indicates that web-based learning media can enhance interactivity and student engagement. Interviews with mathematics teachers reveal that students often struggle to grasp concepts of lines and angles due to less interactive and engaging learning media. Needs analysis shows an urgent need to develop more interactive and accessible learning media to assist students in better understanding the concepts of lines and angles.

Table 2. Literature Review

No.	Literature Sources	Main Findings	Relevance to the Study
1	Hwang, G. J., Lai, C. L., & Wang, S. Y. (2015)	The use of mobile technology enhances student engagement and learning achievement.	Supports the use of web-based media to enhance interactivity.
2	Chang, C., Liang, C., & Tseng, J. (2013)	Web-based tools and technology support interactive learning and improve learning outcomes.	Strengthens the need for interactive media for learning lines and angles.
3	Roschelle, J., Feng, M., Murphy, R., & Mason, C. A. (2016)	Online homework enhances students' mathematics learning achievement.	Demonstrates the effectiveness of web-based learning on student learning outcomes.

Literature review supports the development of web-based learning media. From the reviewed literature, research by Hwang, Lai, and Wang (2015) demonstrates that mobile

technology usage can enhance student engagement and learning achievement, which is relevant to this study as it indicates the potential of web-based technology to improve interactivity. Additionally, research by Chang, Liang, and Tseng (2013) strengthens this argument by finding that web-based tools and technologies support interactive learning and improve learning outcomes. Furthermore, the study by Roschelle, Feng, Murphy, and Mason (2016) shows that online homework can enhance students' mathematics learning achievement, providing additional evidence that web-based learning media can improve students' learning outcomes in mathematics.

Table 3. Interview Results with Mathematics Teachers

No.	Question	Answer
1	Do students often have difficulty understanding the concepts of lines and angles?	Yes, students often struggle because the learning media used are not interactive and engaging.
2	What type of learning media do you think can better assist students?	Interactive media that is easy to access and capable of explaining concepts with clear visualizations.
3	What are the main challenges you face in teaching the topic of lines and angles?	What are the main challenges you face in teaching the topic of lines and angles? The lack of learning media that can capture students' attention and motivate them.

Summary of interviews with mathematics teachers revealing students' difficulties in understanding concepts of lines and angles: Teachers noted that students often struggle with these concepts due to less interactive and engaging learning media. They also identified a need for more interactive, accessible learning media capable of explaining concepts with clear visualizations. The main challenge faced by teachers is the lack of learning media that can capture students' attention and motivation, highlighting the urgent need for the development of better web-based learning media.

Table 4. Analysis Results

No.	Aspect Analyzed	Identified Needs
1	Student Engagement	More interactive learning media to enhance student engagement in the learning process.
2	Accessibility	Learning media that are easily accessible from various devices to support learning outside the classroom.
3	Conceptual Understanding	Media that can visually explain concepts of lines and angles in a more understandable manner.

Presenting the needs analysis results that highlight important aspects to consider in the development of web-based learning media. This analysis identifies the need to enhance student engagement through more interactive media, ensure media accessibility across various devices to support learning outside the classroom, and provide clear visualizations to help students understand concepts of lines and angles. These needs underscore the importance of developing learning media that can address these challenges and improve the quality of mathematics education for students.

2. Planning

The planning phase involves designing the initial concept of web-based learning media using Google Sites. Based on the needs analysis results, a learning media concept was developed that includes various interactive elements such as instructional videos, animations, quizzes, and interactive assignments. The primary goal of this planning is to create media that can be easily

used by both teachers and students, while enhancing students' understanding of the taught material.
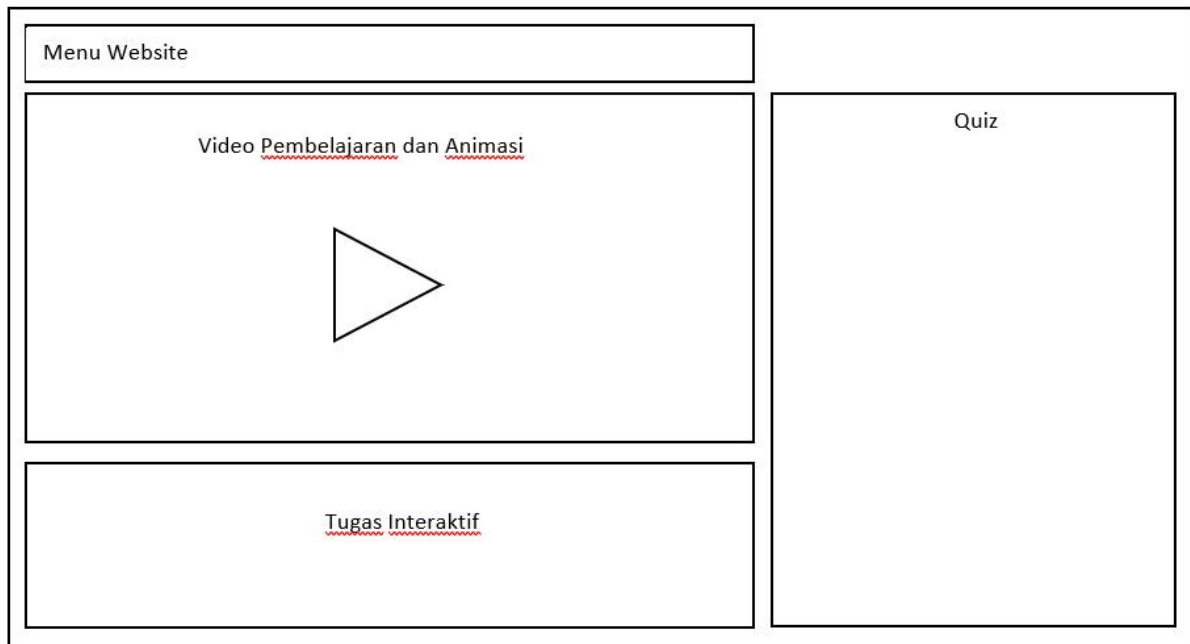

Figure 2. Perencanaan Media

3. Development of Product Draft

In this stage, a prototype of the learning media using Google Sites is developed. This prototype includes systematically organized learning modules aligned with the current curriculum. Each module features interactive videos explaining concepts of lines and angles, animations illustrating the process of angle formation, as well as quizzes and assignments designed to assess students' understanding. The use of Google Sites allows for the creation of content that is easily accessible and usable by students across various internet-connected devices.
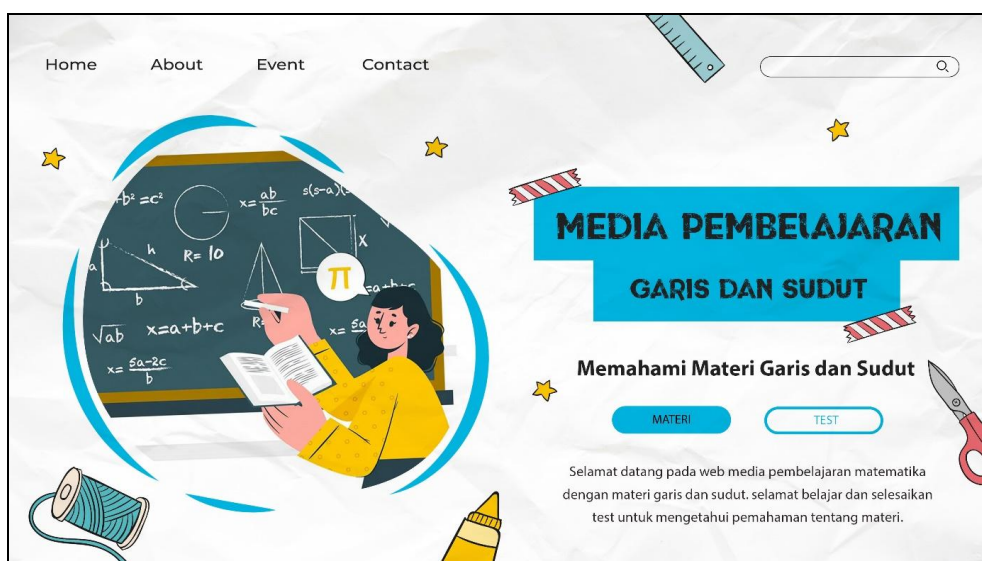

Figure 3. Development of Product Draft

4. Field Testing

The prototype of the learning media was tested with a small group of eighth-grade students at one middle school in Medan. The trial results indicated that the web-based learning media using Google Sites was highly appreciated by the students. Students reported feeling more interested and motivated to learn using this media. Observations during the trial showed that students were more actively engaged in learning activities and demonstrated a better understanding of concepts related to lines and angles. Teachers involved in the trial also provided positive feedback and suggested some improvements to further enhance the interactivity and usability of the media.

Table 5. Field Trial Results

No.	Aspek yang Dinilai	Findings and Results
1	Student Acceptance	Students find Google Sites-based learning media very engaging and are motivated to learn.
2	Student Engagement	Students are more actively involved in learning activities compared to previous teaching methods.
3	Understanding of Concepts	Students demonstrate better understanding of line and angle concepts after using this learning media.
4	Teacher Feedback	Teachers provide positive feedback and suggest some improvements to enhance interactivity and user-friendliness of the media.
5	Observation During Trial	Observations indicate increased active participation by students and better understanding of concepts.

5. Product Revision

Based on the feedback from the field testing, revisions were made to the learning media. Some improvements included adding more animations to explain complex concepts, simplifying site navigation for easier use by students, and introducing interactive features such as discussion forums to enhance collaboration among students. These revisions aim to optimize students' learning experiences and ensure that the learning media meets educational needs effectively.

6. Dissemination and Implementation

After finalizing the product, the web-based learning media using Google Sites was disseminated and implemented on a larger scale across several middle schools in Medan City. A final evaluation was conducted to assess the effectiveness of this learning media in enhancing students' understanding of lines and angles. The evaluation results indicated that students using the web-based learning media achieved higher scores in achievement tests compared to those using conventional teaching methods. Teachers also reported that this media helped them deliver the material in a more engaging and interactive manner.

Data from the achievement tests were analyzed using descriptive and inferential statistics. Descriptive analysis showed that the average scores of students using the web-based learning media were higher than those of students using traditional teaching methods. The t-test conducted indicated a significant difference between the two groups, with a p-value of less than 0.05, demonstrating that the web-based learning media using Google Sites significantly improved students' understanding of lines and angles.

Table 6. Results of Student Learning Achievement Tests

Group	Number of Students (N)	Mean Score	Standard Deviation (SD)
Traditional Learning Media	30	70.4	8.5
Web-Based Learning Media using Google Sites	30	82.3	7.4

Table 6 presents the descriptive analysis results of students' achievement test scores in two different groups. The group using traditional teaching methods consisted of 30 students with an average score of 70.4 and a standard deviation of 8.5. Meanwhile, the group using web-based learning media via Google Sites also consisted of 30 students with an average score of 82.3 and a standard deviation of 7.4. These data indicate that the average scores of students using web-based learning media via Google Sites are higher compared to those using traditional teaching methods.

Tabel 7. Results of T-test

Statistical Test	T Value	df	P value
Uji t	-5.67	58	< 0.05

Table 7 shows the results of the t-test conducted to examine the difference in average scores between the two groups. The obtained t-value is -5.67 with degrees of freedom (df) of 58, and the p-value is less than 0.05. These results indicate that there is a statistically significant difference in the average scores between students using traditional teaching methods and those using web-based learning media via Google Sites. In other words, web-based learning media via Google Sites significantly improves students' understanding of lines and angles.

Qualitative data from interviews and observations were analyzed using thematic analysis techniques. The thematic analysis results indicated that students found the web-based learning media via Google Sites more engaging and helpful in enhancing their understanding of the material. Teachers also reported an increase in student motivation and participation during learning sessions. These findings are consistent with previous research showing that technology-based learning media can enhance student engagement and learning outcomes.

Discussion

This study successfully developed a web-based learning media using Google Sites that effectively enhances students' understanding of lines and angles. The research results indicate that students using this media experienced significant improvements in academic performance compared to those using conventional teaching methods. Additionally, this learning media also enhanced student motivation and participation during lessons. Teachers involved in the study reported that the media helped them deliver content in a more engaging and interactive manner.

These findings are consistent with previous research demonstrating that web-based learning media can improve student learning outcomes. For example, studies by Hwang, Lai, and Wang (2015) showed that mobile technology in learning enhances student engagement and academic achievement. Similarly, research by Chang, Liang, and Tseng (2013) found that web-based tools and technology support interactive learning and improve student performance across various subjects. This study also aligns with the findings of Roschelle, Feng, Murphy, and Mason (2016), indicating that online homework improves students' math performance.

To strengthen these findings, reference can be made to other studies highlighting the benefits of technology in education. Lee and Lee (2014) found that using digital textbooks enhances self-directed learning strategies and academic achievement. Research by Al-Emran,

Elsherif, and Shaalan (2016) also indicated that a positive attitude towards mobile learning enhances learning outcomes in higher education. Furthermore, Voogt et al. (2015) emphasized that Information and Communication Technology (ICT) has a positive effect on teaching and learning when used appropriately.

The researchers assume that web-based learning media, such as that developed using Google Sites, can provide a more interactive and engaging learning experience for students. This assumption is grounded in constructivist learning theories, which emphasize the importance of interaction and active engagement in the learning process. According to constructivist theory, learning is an active process where students construct their own knowledge through interaction with their learning environment (Piaget, 1970; Vygotsky, 1978). Web-based learning media provide a rich and interactive learning environment, allowing students to explore mathematical concepts through various digital tools and resources.

Moreover, motivational theories such as Self-Determination Theory developed by Deci and Ryan (2000) state that students' intrinsic motivation can be enhanced through a learning environment that supports their basic needs for autonomy, competence, and relatedness. Well-designed web-based learning media can give students greater control over their learning process, enabling them to learn at their own pace and providing timely feedback, all of which can enhance their intrinsic motivation.

The findings of this research are further supported by experts who emphasize the importance of technology in education. According to Jonassen (2000), technology can enhance learning by providing tools that allow students to visualize and manipulate complex concepts. Similarly, Mishra and Koehler (2006) developed the Technological Pedagogical Content Knowledge (TPACK) framework, which demonstrates that effective use of technology in education requires a well-integrated blend of technological, pedagogical, and content knowledge.

In the context of this study, the web-based learning media using Google Sites integrates technology with pedagogy and mathematical content to create an effective learning environment. Google Sites provides a flexible and user-friendly platform for developing rich and interactive learning content. This enables teachers to design learning modules that cater to students' needs and facilitate greater interaction between students and subject matter.

The conclusion drawn from this research is that the development of web-based learning media using Google Sites proves effective in enhancing students' understanding of lines and angles. This media not only improves students' learning outcomes but also enhances their motivation and participation in the learning process. These findings support previous research and educational theories that emphasize the importance of student interaction and active engagement in learning.

Thus, this research makes a significant contribution to the literature on technology-based mathematics education. The implementation of web-based learning media using Google Sites is expected to serve as a model for the development of similar learning media in other subjects. The success of this study demonstrates that technology can be used to create more engaging and effective learning environments, ultimately enhancing students' overall learning outcomes.

CONCLUSION

In conclusion, the study "Development of Web-Based Learning Media Using Google Sites for Lines and Angles" demonstrates that this learning media is effective in enhancing students' understanding and motivation. The implications of these findings suggest that integrating web-based technology in mathematics education can improve educational quality. However, the study is limited by its sample size from a single school and specific subject matter, which may restrict the generalization of results. For future research, it is recommended to conduct studies with larger and more diverse samples, and explore the use of web-based learning media in other subject areas. Further research should also consider technical aspects and infrastructure to ensure that all students have equal access to the technology used.

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