
THE IMPLEMENTATION OF GOOGLE PLATFORM- ASSISTED E-LEARNING TO IMPROVE STUDENTS' MATHEMATICAL UNDERSTANDING ON JUNIOR HIGH SCHOOL

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ABSTRACT

The rapid development of digital technology has transformed the educational landscape, encouraging the integration of online learning platforms in classroom instruction. In mathematics education, e-learning tools offer opportunities to enhance students' conceptual understanding through interactive and accessible digital media. This study aims to determine the improvement in students' understanding of mathematical concepts through the implementation of Google Platform-assisted e-learning using Google Meet and Google Forms at SMP Negeri 2 Seruway. The research employed a quantitative approach with a pre-experimental method and a One Group Pretest–Posttest design. The population comprised all eighth-grade students (58 students), with class VIII-A consisting of 16 students selected as the sample. Learning activities were conducted using Google Meet for synchronous sessions and Google Forms for formative assessments on probability material. Data were collected through pretest and posttest instruments, and the results were analyzed using descriptive statistics and correlation tests. Findings revealed an increase in the average score from 53.94 before the treatment to 74.25 after. The hypothesis test used the t-test formula, obtaining a t-count value of 8.26, which was greater than the t-table value of 2.13 at a significance level of $\alpha = 0.05$. These results indicate a significant improvement in students' mathematical understanding after implementing e-learning through Google Meet and Google Forms. In conclusion, the use of Google-based e-learning effectively supports students' conceptual understanding and promotes a more engaging mathematics learning experience.

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INTRODUCTION

Understanding mathematical concepts plays a vital role in the cognitive development of junior high school students. Mathematics is not only about performing calculations or applying

formulas but also about developing logical reasoning, analytical thinking, and problem-solving skills. Conceptual understanding enables students to connect mathematical ideas with real-world contexts, interpret relationships between concepts, and apply them in various problem situations. Therefore, a solid understanding of mathematical concepts at the junior high school level serves as the foundation for higher mathematical thinking and for preparing students to face more complex challenges in future education and daily life.

However, in recent years, many studies have indicated that students' understanding of mathematical concepts remains a major challenge both globally and in Indonesia. According to the Trends in International Mathematics and Science Study (TIMSS) and national assessments conducted by the Ministry of Education, Culture, Research, and Technology, Indonesian students' mathematical performance continues to fall below the international average. Over the past three years, reports have shown that many students experience difficulties in mastering abstract mathematical concepts, particularly in topics that require logical reasoning such as probability, algebra, and geometry. These challenges are often linked to the dominance of traditional teacher-centered instruction, limited opportunities for active learning, and the lack of effective technological integration in the classroom.

At the junior high school level, these problems are also reflected in schools such as SMP Negeri 2 Seruway in Aceh Tamiang Regency. Observations show that students tend to experience difficulties in understanding probability material because the learning process is still dominated by conventional methods. Teachers often rely on simple communication tools, such as instant messaging applications like WhatsApp, to deliver learning materials and assignments, without providing interactive or direct explanations. As a result, students' comprehension of fundamental and abstract mathematical concepts remains limited, and their motivation to learn mathematics tends to decrease. This condition highlights the need for innovative and technology-based learning solutions that can help improve conceptual understanding while maintaining student engagement.

E-learning has emerged as one of the most promising approaches to overcome these issues. Through the use of information and communication technology (ICT), e-learning allows students to learn flexibly, access various learning resources, and interact directly with teachers and peers in virtual environments. Several studies have confirmed the effectiveness of e-learning in improving students' mathematical understanding. Mustakim (2020) reported that the use of digital media in online learning helped enhance students' conceptual understanding efficiently. Similarly, Ernawati (2018) found that the use of Google Classroom enabled students to access materials, videos, and teacher explanations at any time, which improved their comprehension of mathematical concepts. Darmawan (2019) revealed that integrating Google Classroom in mathematics instruction positively affected learning outcomes among high school students. Gustini (2020) showed a significant increase in students' motivation after using Google-based e-learning, with motivation scores improving from 65.13% to 89.73%. Furthermore, Anih (2020) demonstrated that distance learning could effectively enhance students' conceptual understanding of mathematics at the junior high school level.

Nowadays, e-learning continues to develop as an integral part of modern education. Many schools and teachers have adopted Google's educational platforms due to their accessibility, interactivity, and integration with other learning tools. Google Meet, for instance, provides opportunities for real-time communication and discussion, enabling teachers to deliver explanations and students to ask questions directly, similar to face-to-face learning. Meanwhile, Google Forms facilitates the creation of quizzes, assignments, and feedback forms that help assess students' understanding efficiently. Despite the popularity of these platforms, most existing studies have focused on using a single platform such as Google Classroom or Google

Forms without exploring the combined potential of multiple Google tools to create a more interactive and comprehensive learning experience.

In response to this gap, SMP Negeri 2 Seruway initiated the implementation of e-learning using an integrated approach that combines Google Meet and Google Forms to improve students' mathematical understanding. Google Meet serves as a medium for synchronous learning and direct explanation, while Google Forms functions as a tool for formative assessment and practice exercises that provide instant feedback. This integration is expected to overcome the limitations of previous learning methods that relied heavily on non-interactive media and lacked systematic evaluation mechanisms. Through this approach, students can not only receive direct instruction but also immediately apply their understanding through interactive exercises and receive automatic feedback.

Therefore, the main purpose of this study is to determine the improvement of students' understanding of mathematical concepts through the implementation of e-learning assisted by Google platforms specifically Google Meet and Google Forms at SMP Negeri 2 Seruway. This study aims to answer the research question: Is there an improvement in students' conceptual understanding of mathematics after the implementation of e-learning using Google Meet and Google Form at SMP Negeri 2 Seruway?

The results of this research are expected to provide both theoretical and practical contributions. Theoretically, the study will enrich the literature on ICT-based learning media and contribute to the development of effective e-learning models for mathematics education at the junior high school level. Practically, the findings may serve as a reference for teachers, school administrators, and policymakers in designing innovative learning strategies that utilize digital technology to improve students' conceptual understanding in mathematics and support Indonesia's transition toward education in the Society 5.0 era.

METHOD

This study was conducted at SMP Negeri 2 Seruway, located in Desa Sungai Kuruk 1, Kecamatan Seruway, Kabupaten Aceh Tamiang, Provinsi Aceh. The research took place in late January 2025 over five meetings. Three meetings were dedicated to online learning activities, while the remaining two were used for the administration of pretests and posttests through Google Form. A quantitative research approach was adopted in this study. This approach emphasizes objectivity and systematic processes in collecting and analyzing numerical data to test predetermined hypotheses. The study employed a pre-experimental design using the One Group Pretest-Posttest Design. In this design, a single group is observed before and after being exposed to the treatment. The treatment in this context refers to online mathematics instruction utilizing Google Meet and Google Form. The design can be illustrated as follows:

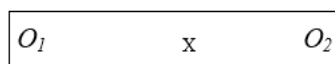


Figure 1. Research Design

Description:

O_1 : Pretest

x : Treatment (online learning using Google Meet and Google Form)

O_2 : Posttest

(Sugiyono, 2018: 74-75)

The population of this study consisted of all eighth-grade students at SMP Negeri 2 Seruway, totaling 58 students. The sample included 16 students from class VIII-A, selected through

purposive sampling based on specific criteria aligned with the research objectives, such as access to digital devices and consistent participation in online learning sessions.

Table 1. Number of Eighth-Grade Students at SMP Negeri 2 Seruway

Class	Male	Female	Total
VIII-A	13	3	16
VIII-B	12	8	20
VIII-C	11	11	22
Total	36	22	58

(Developed by the Researcher, 2025)

This study involved both independent and dependent variables. The independent variable was the implementation of online learning media through Google Meet and Google Form. The dependent variable was the students' conceptual understanding in mathematics, specifically in the topic of probability. Data collection was carried out using pretests and posttests. The pretest was administered before the treatment to measure the students' initial understanding, while the posttest was conducted afterward to assess learning outcomes. The test instruments consisted of open-ended questions that had been validated and piloted.

The validity test was conducted to determine the accuracy and appropriateness of the test items used to measure students' understanding of mathematical concepts. The analysis employed the Product Moment correlation formula, applied to 10 essay questions. The calculations were carried out both manually and with the assistance of Microsoft Excel. According to Hatmawan (2020), an item is considered valid if the *r*-value (calculated correlation) is greater than or equal to the *r*-table value and is positive.

In this study, the test was administered to 20 students ($n = 20$), and based on the significance level of 5%, the critical *r*-table value was 0.444. The results of the validity test showed that question number 3 obtained an *r*-value of 0.593, indicating that the item was valid.

Table 2. Validity Qualification Level of Students' Mathematical Concept Understanding Ability

Item No.	Calculated <i>r</i> value	critical <i>r</i> value	Criteria	Validator 1	Validator 2	Validator 3	Conclusion
1	0.266	0.444	Not Valid	Valid	Valid	Valid	Not Used
2	0.367	0.444	Not Valid	Valid	Valid	Valid	Not Used
3	0.593	0.444	Valid	Valid	Valid	Valid	Used
4	0.371	0.444	Not Valid	Valid	Valid	Valid	Not Used
5	0.683	0.444	Valid	Valid	Valid	Valid	Used
6	0.485	0.444	Valid	Valid	Valid	Valid	Used
7	0.715	0.444	Valid	Valid	Valid	Valid	Used
8	0.179	0.444	Not Valid	Valid	Valid	Valid	Not Used
9	0.111	0.444	Not Valid	Valid	Valid	Valid	Not Used
10	0.475	0.444	Valid	Valid	Valid	Valid	Used

(Developed by the Researcher, 2025)

Based on Table 2, it can be observed that five items (numbers 3, 5, 6, 7, and 10) have *r*-values greater than the critical value of 0.444, indicating that these items are valid and therefore used in the final test instrument. Meanwhile, five other items (numbers 1, 2, 4, 8, and 9) were

classified as not valid and were excluded from the instrument. Thus, only the five valid items were used to measure students' understanding of mathematical concepts in the subsequent stages of this research.

Finally, Hypothesis testing was carried out to determine whether there was a significant difference in the average test scores of students from a single sample group. The analysis employed a paired sample t-test to compare the means before and after the implementation of the learning intervention. This test is appropriate when assessing changes in the same group over time, particularly in pretest and posttest scenarios.

Referring to Lestari (2017: 257–258), the hypothesis testing process began with the formulation of hypotheses. This study used a one-tailed (right-tailed) test since the focus was on identifying a potential increase in students' conceptual understanding. The null hypothesis (H_0) stated that there is no improvement in the mathematical conceptual understanding of students at SMP Negeri 2 Seruway after participating in e-learning using Google Meet and Google Form on the topic of probability. In contrast, the alternative hypothesis (H_a) proposed that there is an improvement in students' understanding following the implementation of the digital learning approach. By testing these hypotheses, the study aimed to determine whether the observed differences in student performance were statistically significant and could be attributed to the use of technology-assisted learning media. If the null hypothesis is rejected, it would indicate that the intervention had a positive impact on students' conceptual understanding of probability

RESULTS AND DISCUSSION

Results

In This study employed a quantitative research method with a sample consisting of Grade VIII students at SMP Negeri 2 Seruway during the second semester of the 2024/2025 academic year. The research utilized pre-test and post-test instruments to assess students' understanding of mathematical concepts related to probability. The tests, conducted in essay format, were administered twice. The pre-test aimed to evaluate students' prior knowledge of prerequisite material needed for learning probability. The post-test, conducted after the implementation of online learning via Google Forms and Google Meet, was used to measure the improvement in students' conceptual understanding of probability. The instrument trial is a crucial step to ensure data validity and reliability. The instrument was validated by Mr. Roni Priyanda, S.Pd., M.Pd (lecturer at Universitas Samudra), and two teachers from SMA Negeri 2 Seruway, Ms. Andini, S.Pd and Ms. Prida Fransisca, S.Pd. The test items focused on probability topics such as dice outcomes, coin flips, color selection, and compound events. The trial was conducted on Monday, February 10, 2025, at SMP Negeri 2 Seruway.

a. Research Findings

This study found that the test instruments were validated by experts and proven to be both valid and reliable. Out of 10 essay questions, 5 were valid and used in the research (items 3, 5, 6, 7, and 10), with a reliability coefficient of $r = 0.47$, indicating moderate reliability. Discrimination analysis showed 5 items with fair criteria, and all items had a medium difficulty level.

Pretests and posttests were conducted to assess students' improvement in understanding mathematical concepts related to probability. The average pretest score was 53.94, and the posttest score was 74.25. The t-test result showed $t_{count} = 8.26 > t_{table} = 2.13$, indicating a significant improvement after implementing e-learning through Google Meet and Google Form.

1) Pretest and Posttest

The pretest was conducted to assess students' initial understanding of mathematical concepts in probability before implementing online learning using Google Meet and Google Form. After the pretest, online instruction was carried out, followed by a posttest to measure the improvement in students' conceptual understanding of probability.

Table 3. t-Test: Paired Two Sample for Means

	<i>Pretest</i>	<i>Posttest</i>
Mean	53,94	74,25
Variance	67,80	21,40
Observations	16,00	16,00
Pearson Correlation	-0,06	
Hypothesized Mean Difference	0,00	
Df	15,00	
t Stat	-8,41	
P(T<=t) one-tail	0,00	
t Critical one-tail	1,75	
P(T<=t) two-tail	0,00	
t Critical two-tail	2,13	

(Developed by the Researcher, 2025)

The results of the paired sample t-test show that the calculated t-value (-8.41) is greater in absolute value than the t-critical value (2.13) at a significance level of 0.05. This indicates a significant difference between the pretest and posttest scores. Therefore, it can be concluded that students' understanding of mathematical concepts in probability improved significantly after the implementation of e-learning using Google Meet and Google Form.

Table 4. Recapitulation of Pretest and Posttest Results on Students' Mathematical Concept Understanding

No	Student Initials	Pretest	Posttest	x^2_i
1	AF	59	70	4900
2	AH	65	75	5625
3	FZA	54	80	6400
4	JP	59	75	5625
5	H	44	77	5929
6	KA	55	72	5184
7	LW	61	80	6400
8	MAR	56	78	6084
9	M	48	72	5184
10	N	54	65	4225
11	SD	46	78	6084
12	SR	32	74	5476
13	S	56	75	5625
14	TA	54	67	4489
15	TF	64	70	4900
16	Z	56	80	6400
average score		53,94	74,25	

(Developed by the Researcher, 2025)

The statistical hypothesis testing was conducted to determine whether there was a significant improvement in students' understanding of mathematical concepts after the implementation of e-learning using Google Meet and Google Form. The test used a significance level (α) of 0.05 with a sample size of 16 students. In a one-group pretest–posttest design, the degree of freedom (df) is calculated as $N - 1$.

The hypotheses in this study are formulated as follows. The null hypothesis (H_0) states that there is no significant improvement in students' understanding of mathematical concepts after the implementation of e-learning using Google Meet and Google Form at SMP Negeri 2 Seruway. In contrast, the alternative hypothesis (H_a) states that there is a significant improvement in students' understanding of mathematical concepts after the implementation of e-learning using Google Meet and Google Form at SMP Negeri 2 Seruway.

The hypothesis test was carried out at a 5% significance level ($\alpha = 0.05$). The calculated t-value was then compared with the critical t-value from the t-distribution table to determine whether the null hypothesis should be accepted or rejected.

Table 5. Recapitulation of Pretest Results for Calculating the t-Value of Students' Mathematical Concept Understanding Ability

No	Pre-test (X_i)	Post-test (X_j)	($X_i - X_j$)	(($X_i - X_j$) - \bar{D})	(($X_i - X_j$) - \bar{D}) ²
1	59	70	11	-9.31	86.67
2	65	75	10	-0.31	106.67
3	54	80	26	5.69	32.37
4	59	75	16	-4.31	18.57
5	44	77	33	12.69	161.03
6	55	72	17	-3.31	10.95
7	61	80	19	-1.31	1.71
8	56	78	22	1.69	2.85
9	48	72	24	3.69	13.61
10	54	65	11	-9.31	86.67
11	46	78	32	11.69	136.65
12	32	74	42	21.69	470.45
13	56	75	19	-1.31	1.71
14	54	67	13	-7.31	53.43
15	64	70	6	-14.31	204.77
16	56	80	24	3.69	13.61
average results	863	1188	325	0.04	1402.34

(Developed by the Researcher, 2025)

Based on the results of the data analysis, the calculated t-value (8.26) is greater than the t-table value (2.13) at a significance level of $\alpha = 0.05$. Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_a) is accepted. This means that there is a significant improvement in students' understanding of mathematical concepts after the implementation of e-learning using Google Meet and Google Form at SMP Negeri 2 Seruway on the topic of probability.

Discussions

The research conducted at SMP Negeri 2 Seruway in class VIII-A aimed to analyze whether there was an improvement in students' mathematical conceptual understanding on the topic of probability after implementing online learning through Google Meet and Google Form. This

study employed a one group pretest-posttest design, where students were given a pretest before the treatment and a posttest after the implementation of e-learning. The total number of students involved was 16, and both pretest and posttest consisted of five questions. The mean score increased from 53.94 in the pretest to 74.25 in the posttest.

The hypothesis test used the t-test formula, obtaining a t-count value of 8.26, which was greater than the t-table value of 2.13 at a significance level of $\alpha = 0.05$. This result indicates that H_0 was rejected and H_a was accepted, meaning there was a significant improvement in students' mathematical understanding after the implementation of e-learning using Google Meet and Google Form.

The application of e-learning through these Google platforms encouraged students to be more active and engaged during online lessons. Students could interact directly with teachers and peers, similar to face-to-face learning conditions, and found it easier to understand the material. The use of Google Form also allowed for efficient assessment and immediate feedback, making the learning process more effective compared to conventional online learning conducted only through WhatsApp or text-based communication.

In comparison with previous studies, similar findings were reported by Putra & Sari (2021), who found that the integration of Google Classroom and Google Meet significantly enhanced students' engagement and understanding in mathematics due to real-time interaction and collaborative activities. Likewise, Rahmawati (2020) emphasized that Google-based e-learning tools improved students' comprehension and participation, particularly in abstract topics such as probability and algebra. These findings are consistent with the current study, showing that digital learning platforms not only serve as substitutes for traditional classrooms but also foster deeper conceptual understanding.

However, unlike previous studies that primarily focused on Google Classroom, this research emphasizes the combination of Google Meet for synchronous interaction and Google Form for formative evaluation. This combination proved more dynamic, as students could directly discuss difficult concepts during virtual meetings and then assess their understanding through interactive quizzes. Therefore, this study extends the existing literature by demonstrating that the integration of multiple Google platforms enhances both engagement and conceptual comprehension in mathematics learning.

In conclusion, the implementation of Google Platform-Assisted E-Learning effectively improved students' mathematical understanding, particularly in the topic of probability. The interactive and structured design of learning through Google Meet and Google Form allowed students to grasp abstract mathematical concepts more easily. The results of this study are in line with and further strengthen the evidence from earlier research that supports the use of Google-based digital platforms as effective tools

CONCLUSION

This study set out to investigate whether the integration of Google Meet and Google Form in online mathematics instruction could improve students' conceptual understanding, particularly in the topic of probability. As stated in the Introduction, the goal was to develop a more interactive and effective online learning model in response to the challenges of digital education post-COVID-19.

The results presented in the Results and Discussion chapter confirmed the research hypothesis. There was a statistically significant improvement in students' conceptual understanding, with the posttest scores showing a marked increase compared to the pretest. This suggests that combining synchronous interaction through Google Meet with formative assessment via

Google Form provides a more effective approach than using single, less interactive platforms like instant messaging.

These findings have several implications. Theoretically, they affirm that technology-supported, interactive instruction can enhance students' abstract reasoning and conceptual comprehension. Practically, the study provides a model for teachers and schools to implement more meaningful digital learning strategies, especially in resource-limited or rural contexts. From a policy perspective, it supports continued integration of multi-platform e-learning as part of long-term educational modernization efforts.

However, the study was limited by its small sample size and short intervention period. These constraints may affect the generalizability of the findings. Further limitations include the lack of qualitative insights into student engagement and learning behaviors.

Future research is encouraged to involve a broader and more diverse sample, apply the intervention over a longer period, and incorporate mixed-methods approaches to capture both quantitative outcomes and qualitative experiences. Exploring additional digital tools and comparing different platform combinations could also offer new insights into optimizing online learning environments.

In conclusion, this research provides strong evidence that integrating Google Meet and Google Form is a promising strategy to improve conceptual understanding in mathematics. The approach contributes to the development of more engaging and effective digital education practices, making it a valuable reference for future implementations in secondary education.

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