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Research articles

Zoom vs. Google Classroom: Which is likely more effective for supporting students' learning in mathematics?

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Abstrak Penelitian ini bertujuan memprediksi peluang keberhasilan pembelajaran daring matematika menggunakan platform *Zoom Meeting* dan *Google Classroom* terhadap hasil belajar siswa. Sampel yang digunakan sebanyak 64 siswa kelas XI. Pengambilan data dilakukan dengan tes hasil belajar pada materi matriks kemudian dianalisis menggunakan regresi probit. Berdasarkan hasil analisis, diperoleh peluang sukses siswa terhadap hasil belajar menggunakan platform *Zoom Meeting* 12,46% lebih tinggi dibandingkan dengan *Google Classroom*. *Zoom Meeting* merupakan platform yang dapat digunakan sebagai sarana tatap muka maya, sehingga pembelajaran dapat lebih komunikatif dan interaktif dibandingkan dengan *Google Classroom* yang penggunaannya dibatasi untuk penyampaian konten pembelajaran saja. Dengan demikian, pembelajaran daring menggunakan *Zoom Meeting* lebih direkomendasikan karena berpeluang lebih tinggi untuk meningkatkan hasil belajar matematika siswa.

Kata kunci *Google Classroom, Hasil belajar, Regresi probit, Zoom Meeting*

Abstract The purpose of this study is to predict the probability of successful mathematics online learning using two platforms; Zoom Meeting and Google Classroom, towards students' learning outcomes. The sample used was sixty-four grade 11 students. Data was collected through a test on the matrix topic and then analyzed using probit regression. The results of the analysis show that the student's probability of success to achieve better learning outcomes using Zoom Meeting is 12.46% higher than Google Classroom. In this case, Zoom Meeting can be used as a virtual face-to-face platform so that the teaching and learning process can be more communicative and interactive compared to Google Classroom, where its use is limited to the delivery of learning content only. Therefore, online learning using Zoom Meeting in mathematics is more recommended because it has a higher chance of improving students' learning outcomes.

Keywords *Google Classroom, Learning outcomes, Probit regression, Zoom Meeting*

Introduction

The coronavirus that hit various countries has a wide impact on the world. This led many state leaders to take strategic steps to stop its spread. One of the policies issued in some countries is to make restrictions on social interaction and even to stop various activities outside the home and urge people to stay at home for a certain period of time. In this condition, the Indonesian education system requires educators to make changes in implementing learning. One of the changes is by implementing online learning. Online learning encompasses a range of

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technologies, such as the world wide web, email, chat, new groups and texts, audio and video conferencing delivered over computer networks to impart education (Dhull & Sakshi, 2017). Thus, online learning can be used as an alternative to overcome problems in the direct learning with the social distancing regulations applied by the government.

Naserly (2020) implemented several applications that support online learning; Zoom Meeting, Google Classroom, and WhatsApp Group. The study found that Zoom is suitable as an effective learning media with the lowest level of bandwidth needs, around 700 Kbps. Furthermore, the Google Classroom has easy access patterns designed like social media, and WhatsApp Group is used as an alternative to sending additional explanations in the form of audio. Based on the results of a survey conducted by Statqoanalytics, Zoom Meeting was the most widely used platform as a medium of distance learning (Maulana, 2021).

The use of Zoom Meeting as an online learning tool has also been studied by Rosyid, Thohari, and Lismanda (2020). They found that Zoom has several advantages as a learning application in terms of time, place, and features. By using Zoom, the teachers are easier to control students. Also, the students are not difficult to follow learning anywhere. Conversations during learning can be recorded. On the other hand, Maharani and Kartini (2019) studied mathematical problem-solving skills with Google Classroom. It was shown that Google Classroom has some advantages: easy to use, efficient, open-access, and flexible. Therefore, Google Classroom is considered appropriate to be used in the learning process. In addition to the advantages, Google Classroom supports students' problem-solving skills better and also get positive responses from students.

In carrying out online learning, mathematics teachers need to choose an effective and easy-to-use online learning platform to support students' mathematics learning. Referring to the various online learning applications available along with their benefits or disadvantages, this study aims to predict which platform (Zoom Meeting vs. Google Classroom) is more effective for supporting students' achievement in mathematics. The two platforms are selected due to their intensive use in mathematics teaching and learning (Irfan et al., 2020). A platform is said to be more effective than another if it has a higher estimated probability of success. The statistical analysis that can estimate the probability of success in the students' learning outcomes is probit regression analysis. A platform with a higher estimated probability value indicates a higher chance of success than other platforms. This alleged value will not be obtained if we use t-test for two independent samples. Probit regression analysis is able to provide more information than just compares the means of two independent groups. Measuring the effectiveness of online learning platforms is essential because it can help educators determine the platform to be used in the learning process so that students have a high chance of obtaining better learning outcomes.

Prior Research

The learning activities in a blended format using Zoom are able to provide a positive response to educators because the activities are conducted face to face anywhere and anytime so as not to reduce interaction between teachers and students. Moreover, Zoom is an easy-to-use platform, also learning and administrative duties become more flexible (Adenegan & Abiodun, 2018; Hiong et al., 2019). Online learning using Zoom Meeting and Google Classroom as media to support learning has been carried out, and each platform affects students' learning outcomes with advantages and disadvantages. One of the advantages of Zoom Meeting is that students can ask questions and be creative like when studying face-to-face in class. However, its drawback

requires more costs regarding connections. Some studies (Chavoshi & Hamidi, 2019; Kusuma & Hamidah, 2020; Laili & Nashir, 2020) show that students' mathematics learning outcomes using Zoom Meeting were better than Google Classroom, which were analyzed with descriptive statistics and tested with non-parametric statistics. The use of the apps in supporting online learning can provide a positive experience, create satisfaction, and improve learning outcomes. Not only has an impact on students but also has an impact on teachers, teacher activities in the teaching and learning process with the Zoom Meeting platform are in the good category

Research on online meeting applications for learning during the pandemic and its effect on learning outcomes using various applications such as Quiz Creator, Zoom Meeting, Whatsapp Group, Skype, Hangout meet, Cisco web, go to meeting, Google Classroom, and social media was also conducted by other researchers (Liu & Ilyas, 2020; Pratama et al., 2020; Salehudin, 2020; Sapta, 2016; Semradova & Hubackova, 2016; Yensy, 2020). Mustakim (2020) reviewed the effectiveness of learning media during the Covid-19 pandemic in mathematics based on models, media, and learning methods, as well as obstacles faced by students during online learning. The findings suggest ten points to make mathematics learning even more effective. Some of them are to pose questions that are varied and different for each student and reduce tasks.

The reviewed research suggests that online learning using Zoom Meeting and Google Classroom are effective. However, as far as our concern, the use of probit regression as the data analysis tool are under-researched. In this case, the probabilities of the success of students' learning outcomes by using Zoom Meeting in online learning compared to Google Classroom are yet known. Therefore, we conducted this study so that the estimated probability value could be obtained. Overall, we illustrate the research in Figure 1 to make it easier for readers to understand our study.

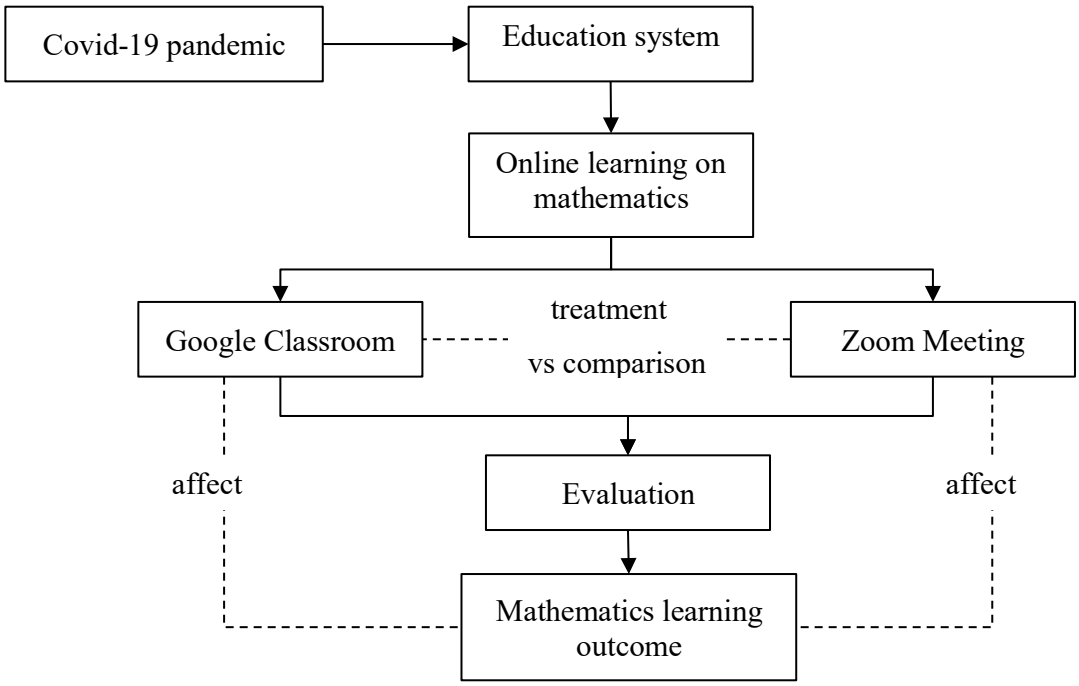

Figure 1. Research framework

Theoretical Review

Digital technology in mathematics teaching and learning

The Covid-19 pandemic has a huge impact on many sectors of human life, particularly on the usage of internet tools as a digital technology employed not just for business but also for education. Teachers are developing digital tools as online learning media because the benefits are not limited by geography or time and may be accessible at any time and from anywhere. In this case, online learning is learning that occurs through the use of multiple technologies to access learning materials and is student-centered, which involves recognition of the unique cognitive structure and understanding that learners bring to the learning process (Sari, 2015).

In mathematics, digital technology serves a didactic role, namely the use of tools for exercising mathematical abilities and the development of mathematical concepts (Drijvers, 2018). In addition, there are three types of communication in digital technology in mathematics: one-way communication, two-way communication, and multidirectional communication. There are several types of themes that appear in the use of digital technology, including Algebratic Description Mode, which focuses on algebraic elements such as matrices and determinants; Formal Description Mode, which focuses on vector spaces and subspaces, basis and dimensions); and Geometric Description Mode, which focuses on geometric elements such as matrices and determinants (focusing on the representation of graphics and vectors in a Cartesian plane). Content can be displayed in the text, video, or multi modalities while using digital technology (Borba et al., 2018; Hillmayr et al., 2020)

Zoom is a cloud-based online chat platform that can be used for teleconferencing, telecommunications, distance education, and social interactions. This application offers simple functions, and Zoom also has simple capabilities for people who want to join a conference or meeting. Zoom can accommodate up to 100 individuals and can make video calls to one user (Gunawan et al., 2020). Using any device, including phones, tablets, and PCs, all participants may see and hear each other and converse using this new cloud meeting zoom technology (Barbosa & Barbosa, 2019). Zoom Meeting can offer content or learning materials using algebraic description mode, formal description mode, or geometric description mode, depending on its qualities. Zoom includes a Sharing Whiteboard function that can be used to demonstrate mathematical subjects, including symbols. Also, the material is given directly and students can communicate in various directions using a web camera as a physical form of student attendance, Zoom is also classified as synchronous classes. For example, when learning takes place by showing presentation slides or videos, students can ask questions via web camera, microphone, board, chat, or message. Not only that but when students use Zoom to learn, there is a camcorder option that may record activities during the learning process so that students can see the completed learning documentation. Therefore, Zoom enables learning with multidirectional communication.

Google Classroom is an internet-based service provided by Google as an online learning system designed to facilitate teachers to create and share assignments with students paperlessly, facilitate teachers to explore their scientific ideas to students, and open discussion rooms (Hakim, 2016; Nirfayanti & Nurbaeti, 2019). Some of the features that teachers can use in Google Classroom are assignments, grading, communication, time-cost, archive course, mobile application, and privacy (Maharani & Kartini, 2019). The application can be used by anyone who joins the class. The classes are designed by teachers according to the actual class or real class in the school (Hammi, 2017). Google classroom includes asynchronous learning, or it can

be said to present learning material/content indirectly, which is presented in text or video through the Materials feature. Furthermore, Google Classroom offers a Question function that may be used to ask questions or as a discussion platform during the learning process to communicate in multiple directions. Assignments can be issued using the Homework tool, and all completed assignments and resources will appear in the Stream section. In Stream section students can watch the class activities. The Grades feature can be used to see the progress of filling out assignments that have been given, provide feedback or evaluate students' homework results directly. To conclude, Google Classroom is designed to help teachers and students communicate in an asynchronous, two-way approach.

Students learning outcomes

Linn and Miller (2005) explain that student's learning outcome is a product of the learning experience process carried out by students. Learning outcomes are statements about what is expected of the student to know, to understand, to do and to evaluate as a result of the learning process (Divjak & Ostroški, 2009). It is indicated by the scores obtained by students from tests or exams given by the teacher (Windasari & Istiqlal, 2020). In this study, learning outcomes were collected after students were treated to induce changes in behavior based on their knowledge, understanding, attitudes, and abilities. The purpose of measuring learning outcomes is to see how effective a certain learning method is, in this case, online learning or digital technology.

Students' learning outcomes can be influenced by several aspects, one of them is the use of online learning tools (Pradja et al., 2019; Zurimi, 2019). Kusumantara, Santyadiputra, and Sugihartini (2017) examined the use of digital technology as a learning tool that can affect students' learning outcomes. The findings of this study suggest that the use of digital technology compared to conventional learning has a substantial impact on learning outcomes. It can be assumed that the use of digital technology as a learning tool will have an impact on learning outcomes. Indeed, the aim of this research is to predict the successful use of digital tools that affects students' learning outcomes. Google Classroom and Zoom Meeting are the two platforms used as learning tools in the current research. In this case, whether one platform is likely more effective than another for mathematics learning.

Methods

The current research follows a quantitative study with treatments. According to Sugiyono (2017), treatment is as a free variable and the observation result is as a non-free variable. The sample in this study was 64 students of 11^{th} grade. The research design can be seen at Table 1. Each class consisted of 32 participants. At the final meeting of matrix material, the score of the students' mathematics learning outcome is retrieved. The dependent variable in this study is a platform used as an online learning tool. The independent variable, on the other hand, is the students' learning outcome, which is measured in percentages.

Table 1. Research design

Class	Treatment	Observation
E_1	X_1	O_1
E_2	X_2	O_2

E₁ (Experiment class I); ***E₂*** (Experiment class II); ***X₁*** (Treatment- Zoom Meeting); ***X₂*** (Treatment- Google Classroom); ***O₁, O2*** (Observation Results)

Instrument

Data was collected using a test about matrix. Prior to its use for research, the validity and reliability of the test were examined. Table 2 shows the validity scores. The score of r_{table} for 30 respondents is 0.361 at the 5% level. Thus, the test used in this study was valid because the score of each question was more than 0.361. Afterwards, the reliability was tested, resulted in Cronbach's alpha 0.531. If the alpha coefficient value is at an interval of 0.400 – 0.599 then the instrument is in the medium category, so that the instrument can be used in this study (Sugiyono, 2017)

Table 2. The validity of the test

	question 1	question 2	question 3	question 4	question 5
Total Score	0.363*	0.441*	0.431*	0.381*	0.393*

* Significant at the level 5%

Data analysis

Data was analyzed using probit regression with the help of SPSS 24. Probit regression is a regression method used to analyze regression data with the normal Cummulative Distribution Function (CDF) approach to estimate the probit model (Gujarati, 2004). If the dependent variable consists of 2 categories, the model obtained is a binary probit model or it can be called a probit model. The term "probit" stands for "probability unit" so that it can be said that probit regression is a regression model that deals with probability units (Ardianti & Marlena, 2020). The Probit model is a log-linear model approach used to analyze the relationship between one dependent variable and several independent variables where the dependent variable is both dichotomy and polychotomy. This model can also be used when the response/dependent variable is in the form of proportions (Marlena & Nugrheni, 2019).

In general, the probit model can be expressed in (1):

$$\text{probit}[\pi(x)] = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p \qquad (1)$$

The probit regression parameters are β_0, $\beta_1, \ldots \beta_p$, and the independent variables are x_1, $x_2, \ldots x_p$ (Agresti, 2002). To determine whether the independent variables contained in the model have a significant relationship with dependent variables, statistical hypothesis testing is used.

A partial test is performed to test the meaning of the β coefficient partially by comparing the β estimate with the standard error estimator.

The hypothesis:

$H_0 : \beta_1 = 0$ (platform type does not significantly affect the value of students' mathematics learning outcomes)

$H_1 : \beta_1 \neq 0$ (platform type significantly affects the value of students' mathematics learning outcomes)

The statistics used are Wald test statistics (2), namely:

$$W = \frac{\hat{\beta}_i}{SE(\hat{\beta}_i)} \qquad (2)$$

$\hat{\boldsymbol{\beta}}_{\boldsymbol{i}}$ (Estimator for β_i); ***SE*** (Standard error estimator β_i)

According to Hosmer dan Lemeshow (2000), the ratio generated from the test statistic below H_0 will follow the standard normal distribution. So that the decision is obtained from the results of comparing the Wald test statistic with the standard normal distribution at the significance level α, so that the test criterion is to reject H_0 if the value $|W| \geq Z_{a/2}$ or p-value ≤ α.

A simultaneous test is carried out to test the significance of the coefficient β as a whole or simultaneously, using the Likelihood Ratio Test.

The hypothesis:
$H_0 : \beta_1 = \beta_2 = ... = \beta_p = 0$
H_1 : there is at least one $\beta_1 \neq 0$ with i = 1, 2, ..., p

Because the independent variable in this study is only one and is a dummy variable, the overall hypothesis test is not different from the partial test (Ardianti & Marlena, 2020), which are:

H_0 : $\beta_1 = 0$ (platforms does not significantly affect students' mathematics learning outcomes)
H_1 : $\beta_1 \neq 0$ (platforms significantly affect students' mathematics learning outcomes)

According to Agresti (2002), the test statistics used in the Likelihood Ratio Test is (3):

$$G^2 = -2\ln\left[\frac{\left(\frac{n_1}{n}\right)^{n_1}\left(\frac{n_0}{n}\right)^{n_0}}{\sum_{i=1}^{n}\hat{\pi}_i^{y_1}(1-\hat{\pi}_i)^{1-y_1}}\right] \qquad (3)$$

$\boldsymbol{n_1}$ (number of observations with a value of y = 1); $\boldsymbol{n_0}$ (number of observations with a value of y = 0); $\boldsymbol{n}$ (n_1+n_0)

The value of G^2 follows the chi-square distribution pattern (χ^2) with the degree of freedom p (the difference in the number of parameters of the two likelihood functions) at the significance level α, then the test criterion is to reject H_0 if $G^2 > \chi^2_{(a,p)}$ or p-value ≤ α, and accept in the other case.

The model suitability test (Goodness of Fit Test) is used to determine whether there is a significant difference between the observation results and the model prediction results (Permatasari, 2016).

The hypothesis:
H_0 : The model is suitable (there is no difference between the regression model and the results of the prediction model)

H_1 : Model does not match (there is a difference between the regression model and the results of the prediction model)

The test statistics used are (4):

$$\chi^2 = \sum_k^g \frac{(O_k - n'_k \bar{\pi}_k)^2}{n'_k \bar{\pi}_k (1 - \bar{\pi}_k)} \qquad (4)$$

Where O_k is the number of response variable values in the k-th observation, $\bar{\pi}_k$ is the mean of the estimated probability, g is the number of observations, and n'_k is the number of subjects in the k-th observation. Reject H_0 if the value $\chi^2 \geq \chi^2_{(a,\, g-2}$ or p-value $\leq \alpha$.

Findings and Discussion

This section presents the results of analysis after all necessary data have been collected and tested. The results show that the mean score of the class using Zoom Meeting is 89.90, while the mean score of the class using Google Classroom is 77.93.

Table 3. Probit analysis results

Parameter	Estimate	Error	Z	Significance
Platforms	0.506	0.039	-12.986	0.000
Intercept	0.770	0.030	42.346	0.000

Table 3 indicates that the independent variable, platforms, are significant at alpha level 5%. It can be concluded that in partial testing, the dummy variable "Platforms" significantly affects the probability of success of student learning outcomes. Furthermore, the table also shows a probit regression model with the formula Probit = Intercept + BX. The probit model is Probit = 0.770 + 0.506 Platforms.

Table 4. Probit regression calculations

Platforms	**Probit = 0.770 + 0.506 Platforms**	**Probability**	**Percentage**
Zoom Meeting	= 0.770 + (0.506 × 1) = 1.276	0.8980	89.8%
Google Classroom	= 0.770 + (0.506 × 0) = 0.770	0.7734	77.34%

Table 4 shows that the probit value for the Zoom Meeting is 1.276 and the probit value for the Google Classroom is 0.770. By using Standard Normal Cumulative Probability Table, we found that for Z = 1.276 (Zoom Meeting), the cumulative probability is about 89.8%, and for Z = 0.770 (Google Classroom), the cumulative probability is about 77.34%. It means, online learning using Zoom Meeting platform has 89.8% probability of success on students' mathematics learning outcomes while using Google Classroom platform has 77.34% probability of success on mathematics learning outcomes. It means online learning with Zoom Meeting has a probability of success 12.46% greater than Google Classroom on students' mathematics learning outcomes. In Table 5, the significance value of the likelihood ratio Chi-Square is 0.000 < 0.05 so that in Omnibus Test, H_0 is rejected. This means that at the 5% level, it can be concluded that the current model outperforms the null model.

Table 5. Omnibus test

Likelihood Ratio Chi-Square	df	Sig.
3401.334	2	0.000

The effect to learning outcomes using Zoom Meeting is better than google classroom because Zoom Meeting has a video feature so that students can communicate two-way with teachers as in face-to-face learning. According to Ismawati and Prasetyo (2020) video conference learning can assess the development and activeness of students directly, can be a means as a place to learn distance, provide opportunities for students to participate in the learning process, and can provide retention for students. The findings of this study are in line with some prior research (Chavoshi & Hamidi, 2019; Naserly, 2020).

Zoom Meeting is one of the popular teleconferencing applications with 257,853 users and is the most efficient with bandwidth needs of about 700 kbps compared to other online meeting platforms (Pratama et al., 2020). In Kusuma and Hamidah's (2020) study, the results of learning mathematics using the Zoom Meeting platform are better and more effective, due to some reasons: (1) the material can be easier to understand because the teacher directly explains the material presented; (2) students can ask questions and discuss as freely as during class lectures; (3) Questions from students can also be responded to immediately so that it is more effective and easier to understand by students; (4) students do not feel bored with the material presented/explained by the lecturer because it is face to face directly; (5) the activeness of students can be seen and monitored, so that students are encouraged to be more focused and not open other applications during the learning process; (6) scheduling and recording features, chat and HD quality video features are facilities that support the learning process. On the other hand, students are less interested in following the learning in Google Classroom since there is no established interaction, particularly in the teaching of mathematics (Fiyanti et al., 2020).

Using Zoom Meeting as an online learning tool in the teaching and learning process during the pandemic has proven to be quite beneficial. However, good internet facilities are required to use the application and the cost to have a premium version. Poor internet connection in rural areas should be enhanced even more so that those who study and work from home will be able to carry out their daily activities without difficulty during the pandemic. As a result, teachers and students are supported to have a mutual understanding when conducting online learning during and after a pandemic (Setiani, 2020).

Zoom is the best conference app when it comes to connecting to conference equipment such as telecommunications and webcams to allow multiple people to join from one place and device (Johnston, 2020). In using Zoom, educators can create chat rooms to provide virtual information, deliver learning materials, discuss and interact directly as in conventional learning. This study successfully investigated the differences in students' mathematics learning outcomes using Zoom Meeting platform and Google Classroom. This learning model factor is very determining the learning outcomes of learners, especially in mathematics lessons.

Conclusion and limitation

This study found that using the Zoom Meeting for online learning is possibly more effective than using Google Classroom. The class that used Zoom Meeting had an average score of 89.90, whereas the class that implemented Google Classroom had an average score of 77.93 on the test of matrix topic. The probit regression analysis reveals that Zoom Meeting has a 12.46 % better

probability of succeeding in supporting students' learning outcomes. The cumulative probability of Zoom Meeting is about 89.8%, and the cumulative probability of Google Classroom is about 77.34%. This percentage shows that students have the opportunity to get a score of 89.8 if they use online learning through Zoom Meeting and have the opportunity to get a score of 77.34 if they use online learning with Google Classroom in a score range of 0 - 100. The limitation of this study is that Zoom Meeting is used in synchronous learning, while Google Classroom is employed in asynchronous learning. As a matter of fact, the Google Meet features were not used in this research.

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