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Google-Based Learning and Learning Motivation: The Impact and Interaction on Students' Mathematical Communication

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Abstract: Poor mathematical communication skills and motivation are influenced by several factors, such as the use of learning models used by teachers in learning. The use of appropriate learning models can improve students' mathematical communication skills and motivation. This study aimed to determine the effect of the discussion learning model using Google Classroom and Google Form on students' mathematical communication in terms of students' learning motivation. This type of research is quasi-experimental. Data were analyzed using two-way analysis of variance with unequal cells. Based on the results, it can be concluded that the discussion learning model using Google Classroom provided better communication skills than the learning model using Google Form, (2) there was no difference in the effect of learning motivation on students' mathematical communication, and (3) there was no interaction between learning model and learning motivation towards students' mathematical communication skills. Further research is needed to develop learning models using Google Classroom and Google Form by taking into account the characteristics of other students that are adjusted to the school curriculum.

INTRODUCTION

Mathematics is science taught at every level of education (Crismono, 2017), starting from primary to secondary and higher education (Syazali, 2015). Mathematics has become an essential element in improving science and technology (Wulandari et al., 2016). Mathematics is also one of the subjects that can improve thinking skills (Fajriah & Soraya, 2017). Students will grow their motivation if they think that mathematics is fun (Lestari, 2017). However, some students think that learning mathematics is boring (Sari et al., 2016) unlikeable, and difficult (Mawaddah & Maryanti, 2016). Furthermore, a centred learning process does not provide opportunities for students to be active in teaching and learning activities (Badrun & Hartono, 2013).

Several mathematical abilities must be possessed by every student to master mathematics (Hartini et al., 2016). One of the difficulties in learning mathematics can be seen in students' low mathematical ability even though mathematical communication skills are abilities that must be possessed by high school students (Deswita et al., 2018). Mathematical communication skills are not only a student competency that must be taught

and studied, but should also be pursued so that students can solve mathematical problems (Asmara & Afriansyah, 2018). For instance, when students answer math problems on the three-variable linear equation system, their level of mastery can be categorized as low. This phenomenon shows that mathematics lessons related to communication skills and learning motivation need special attention. Through communication, students can exchange ideas and at the same time, clarify the understanding and knowledge they get in learning. Students' poor achievement is often caused by their low learning motivation (Emda, 2017). Therefore, mathematical communication skills in learning mathematics are also essential to improve (Ariawan & Nufus, 2017).

In building learning motivation and strategic thinking, there are several things that teachers must pay attention to, namely, the type of mathematical thinking, teaching material, class management, the role of the teacher, and the autonomy of students in thinking and doing activities. The application of an appropriate learning model can improve students' communication skills. However, being a creative teacher is not easy; only a small proportion of teachers are creative (Saptono, 2016). Therefore, teachers are required to make the learning process interactive, inspiring, fun, challenging, and motivating (Nurdiansyah & Amalia, 2018).

Nowadays, the digital world plays an active role in technological development, including learning. Moreover, mathematics is known as an elusive science. Educational learning technology is critical (Nurdyansyah & Aini, 2017). Also, in this COVID-19 pandemic, most of the teaching and learning activities are carried out online. Online learning is an educational innovation that involves elements of information technology in learning (Fitriyani et al., 2020). Online learning is learning that uses an internet network with accessibility, connectivity, flexibility, and the ability to generate various types of learning interactions (Septiawan, 2020). Distance learning is implemented in order to break the chain of virus spread and maintain the students and educators' security and safety (Zhafira et al., 2020). Therefore, teachers must think to make learning exciting and foster students' learning motivation.

To answer the challenge of the availability of varied learning resources (Dewi, 2020), teachers can take advantage of several applications, such as e-classrooms, video conference, and telephone or live chat, either via Zoom or WhatsApp group (Dhull & Arora, 2017). Each of these applications has the same general characteristics, namely instant and web-based (Ihsan et al., 2020). These applications help the learning process so that it can be carried out wherever and whenever without the teacher having to attend directly to students (Bulan & Zainiyati, 2020).

Google Classroom is an internet-based learning media created by Google as an E-learning system that allows the creation of classrooms in cyberspace. They have rich features so that they can support various activities (Sutrisna, 2018). Some of the features are conveying learning theory, holding discussions between students and teachers, distributing assignments or exams, and assessing students' assignments.

Rozak & Albantani (2018) state that Google Classroom is an application designed to facilitate interaction between educators and students in cyberspace. Teachers can create their class and share the class code or invite students (Mahardini, 2020). This application provides an opportunity for educators to deepen the scientific field they want to have for students. However, there are certain conditions in applying Google Classroom, namely internet access.

Google Forms is a component of the Google Docs Service. This application is perfect for students, teachers, lecturers, office employees, and professionals who like to make quizzes, forms, and online surveys. Google Form's features can be shared with people openly or specifically to Google Account owners with accessibility options, such as read-only or editable (can edit documents) (Radyuli et al., 2019). Google Form can effectively support internet-based learning (Iqbal et al., 2018). According to Batubara (2016), Google Form, a tool for assessing the learning process, supports the paper-saving program as a form of environmental awareness (Septiawan, 2020).

Several previous studies have discussed how to apply learning 4.0 assisted by Google Classroom and Google Form and research in improving mathematical communication skills and student learning styles (Adesty et al., 2014; Ambarwati et al., 2015; Andrianti et al., 2016; Ariany & Dahlan, 2017; Atsnan, 2015; Diandita et al., 2017; Hapizah, 2015; Harahap, 2017; Hartati & Suyitno, 2015; Indriani et al., 2018; Khamid & Santosa, 2016; Nopitasari, 2016; Nurhayati, 2018; F. G. Putra, 2016; R. W. Y. Putra, 2015; Setiawan, 2016; Solekha et al., 2013; Sumartini, 2018; Supriadi & Damayanti, 2016; Wibowo, 2017). Also, research conducted by Ompusunggu & Sari (2019) which explains the effectiveness of Edmodo-based e-learning on mathematics communication skills. Furthermore, there is research conducted by Nur (2020), who discusses the use of schoology as a means of online mathematics learning.

Based on previous research, the novelty of this study was the influence of the discussion learning model using Google Classroom and Google Form on students' mathematical communication skills seen from student learning motivation. The purpose of this study was to determine the effect of the discussion learning model using Google Classroom and Google Form on students' mathematical communication skills seen from student learning motivation. This study showed whether Google Classroom or Google Forms that was better to be applied in discussion learning model for students' mathematical communication in terms of student learning motivation.

METHOD

The design employed in this study was a 2 × 3 factorial quasi-experimental design. Two-way ANOVA with unequal cells was performed during the hypothesis testing because this study simultaneously tested two treatment models in groups with different levels of learning motivation. The research design can be seen in Table 1.

Table 1. 2 × 3 Factorial Research Design

Learning Models	Students' Learning Motivation		
	High (y_1)	Medium (y_2)	Low (y_3)
Google Classroom	xy_{11}	xy_{12}	xy_{13}
Google Form	xy_{21}	xy_{22}	xy_{23}

The xy_{ij} is the value of the i-th learning model and j-th is the students' learning motivation, i = 1, 2, 3 and j = 1, 2, 3. The instrument used was a test of mathematical communication skills and student motivation questionnaire. The test instrument consisted of twenty-five multiple-choice items, while the questionnaire consisted of twenty statements. The test in this study was used to measure learning outcomes from classes subjected to treatment (Kristin & Rahayu, 2016).

The population in this study were all students of SMP 7 Negeri Bekasi Regency odd semester for the 2020/2021 academic year. Samples were obtained using a randomized class technique. The

sample was obtained from class XI, which amounted to 2 classes, namely VIII B, and VIII D. The documentation method was used to collect data on semester 2 grades for class X in the 2019/2020 academic year, as well as the test method used to collect mathematical communication data and activation. Student learning with a multiple choice test as many as 25 items for mathematical communication tests and for learning motivation using a questionnaire totaling 20 questions.

The obtained mathematical communication skills data was then analyzed using a two-way analysis of variance with unequal cells with an error rate of 5 %. This hypothesis testing aimed to determine whether there was an influence between each learning model and each category of students' learning motivation as well as the interactions between the two.

RESULT AND DISCUSSION

Research steps were carried out coherently to determine the results of the research. First, before the treatments were given to the research sample, the preliminary data analysis had been carried out (the initial data normality test, the initial data homogeneity test, and the balance test). After the data had been analyzed, the Experimental Class I was given treatment with a learning model using Google Classroom and Experiment Class II was given a treatment with a learning model using Google Form.

The treatments in each class consisted of four meetings and one session for posttest. The results of the normality test can be seen in Table 2.

Table 2. Normality Test

No.	Class	$L_{observed}$	N	$L_{critical}$	Results	Description
1.	Experimental I	0.1183	31	0.159	H_0 accepted	Normal
2.	Experimental II	0.1003	24	0.173	H_0 accepted	Normal

From the results of the calculation, H_0 was accepted. Based on the test decision, it can be concluded that the final normality test in the experimental class I resulted in $L_{max} = 0.1183$, $L_{0,05;31} = 0.159$, and DK = {L| L > 0.159}. In the experimental class II, it was obtained that $L_{max} = 0.1003$, $L_{0,05;24} = 0,173$, and DK = {L|L > 0,173}. Thus, $L_{obs} = 0.1183 \notin$ DK and $L_{obs} = 0.1003 \notin$ DK. On the other hands, both experimental classes were normally distributed. In the homogeneity test, it was found that all sample groups were homogeneous.

Between the experimental class I and the experimental class II, the results of $\chi^2_{obs} = 3.48$ while the results of $\chi^2_{0.05;1} = 3.841$, and DK = $\{\chi^2 | \chi^2 > 3.841\}$; . Thus, $\chi^2_{obs} = 3.48 \notin$ DK. It means that the variance of experimental class I and experimental class II was homogeneous. Based on the results of the prerequisite tests, two-way ANOVA with unequal cells can be performed. The final results of the hypothesis test can be seen in Table 3.

Table 3. The Summary of Two-Way ANOVA with Unequal Cells

Sources	JK	Dk	RK	F_{obs}	Fα	Decision
Learning Models (A)	1380.65	2	1380.65	5.52	4.04	H_0 is rejected
Motivation Category (B)	221.47	2	110.74	0.44	3.19	H_0 is accepted
Interaction (AB)	111.02	2	55.51	0.22	3.19	H_0 is accepted
Error	12261.45	49	250.23	-	-	-
Total	13974.59	54	-	-	-	-

Based on Table 3, it was revealed that there were result differences in the mathematical communication skills between Google Classroom and Google Form on the three-variable equation system material. Furthermore, low, moderate, and high learning motivation posed no difference in mathematical communication skills. Based on the results of the two-way ANOVA calculation, it was found that there was no interaction between the learning models and student's learning motivation in mathematical communication skills. The summary of the marginal mean is presented in Table 4.

Table 4. Marginal Mean of Learning Model and Student's Learning Motivation

Learning Models	Motivation			Marginal Mean
	High	Moderate	Low	
Google Classroom	80.3659	58.4091	71.8519	72.4444
Google Form	70.0000	54.3750	65.5000	62.4737
Direct	55.0000	54.8077	56.5909	55.3226
Marginal Mean	67.9339	55.5114	65.1449	63.3094

In the first hypothesis, it was known that H_{0A} was rejected, so it was necessary to do multiple comparison tests between rows (between learning models). The summary of the multiple comparison test is presented in Table 5.

Table 5. The Summary of Multiple Comparison Test

No	H_0	F_{obs}	$2.F_{0.05:\ 2:n}$	Results
1	$\mu_{1.} = \mu_{2.}$	11.5140	6.00	H_0 is rejected
2	$\mu_{1.} = \mu_{3.}$	33.6010	6.00	H_0 is rejected
3	$\mu_{2.} = \mu_{3.}$	6.0224	6.00	H_0 is rejected

Based on Table 5 in the first null hypothesis, there were differences in mathematical communication skills between students who receive learning using Google Classroom and Google Form. From Table 4, it can be concluded that the mathematical communication skills of students who received Google Classroom were better than the students who received Google Forms. These results also complement previous studies by who found that Google Classroom can improve students' spatial abilities and concept understanding. Furthermore, based on Table 5 in the second null hypothesis, there was a learning achievement difference between students who received Google Classroom and direct learning. From Table 4, it can be concluded that the mathematical communication skills of students who received Google Classroom were better than the students who received direct learning. Based on Table 5 in the third null hypothesis, there were learning achievement differences between students who learned using Google Form and direct learning. From Table 4, it can be concluded that the mathematical communication skills of students who received Google Form were better than the students who received direct learning.

CONCLUSION

Based on the results of research and discussion, it can be concluded that Google Classroom produced better mathematical communication skills compared to Google Forms and direct learning. Google Forms produced better mathematical communication skills compared to direct learning. Different levels of motivation (high, moderate, low) did not give different effects on students 'mathematical communication. Also, there was no interaction between learning models and learning motivation on

students' mathematical communication skills.

Based on the research findings, Google Classroom and Google Form can improve mathematical communication skills. It is also suggested to other researchers to carry out further research to develop learning models using Google Classroom and Google Form by paying attention to other student characteristics adjusted to the school curriculum.

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