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Analyzing students' mathematical communication skills based on their self-efficacy during the Covid-19 pandemic

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Abstract
This study aims to analyze students' mathematical communication skills based on their self-efficacy during the covid-19 pandemic. The method used is descriptive qualitative. The population was VII grade students of SMP Negeri 1 Bantul. The purposive sampling technique was used to select samples. The subject was grouped based on their self-efficacy with high, medium, and low categories to be tested and interviewed about their mathematical communication skills. The instrument in this study was a self-efficacy questionnaire, a test of mathematical communication skills, and an interview guideline. The triangulation technique was carried out by comparing the mathematical communication skills test results with the interview. The result of mathematical communication skills during the Covid-19 pandemic are not in line with their level of self-efficacy. High self-efficacy does not necessarily make students have high mathematical communication skills. The factor causing the misalignment is the fact that the online learning process carried out during the Covid-19 pandemic does not enough facilitate students to hone their mathematical communication skills, both oral and written.

Keywords: covid-19 pandemic, mathematical communication, self-efficacy

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INTRODUCTION

At the end of 2019, the world was shocked by the emergence of the covid-19 virus with a reasonably high rate of spread. Until March 2020, the World Health Organization (WHO) officially announced that COVID-19 had become a global pandemic. This pandemic certainly affects various aspects of life, including education. During the Covid-19 pandemic, learning process in Indonesia was carried out online, and sometime of blended learning.

Even though during limited learning with an online system, the learning process has goals that must be achieved, especially in mathematics learning. According to NCTM (2000) in Principles and Standards for School Mathematics, it states that the process standards in mathematics learning include mathematical problem-solving, mathematical reasoning, mathematical communication, mathematical connections, and mathematical representation. In this case, it is seen that communication skills are one of the standard processes in mathematics learning that are important to be developed in mathematics learning. In addition, in the 2013 curriculum currently in force in Indonesia, the regulation of Ministry of Education and Culture Number 58 of

2014 also states that mathematical communication skills are one of the objectives of learning mathematics (MOEC, 2014).

Mathematical communication skills are one of the process standards in mathematics learning that must be developed. Mathematical communication is not just writing down mathematical ideas to solve problems but also how students communicate, explain, and describe mathematical ideas (Hutapea & Saragih, 2019; Buhaerah et al., 2022; Shomad et al., 2022). In this study, there were four indicators of mathematical communication skills (Saputra et al., 2022) that were measured, namely (1) presenting mathematical statements in pictures, tables, graphs, diagrams, and algebraically; (2) stating contextual problems in mathematics language (using terms, mathematical symbols); (3) perform mathematical manipulations; and (4) draw conclusions, gather evidence, provide reasons or evidence of the correctness of the solution.

This student's mathematical communication skills are closely related to self-efficacy (Nurjanah & Jusra, 2022). According to Saputra and Zulmaulida (2020), one factor influencing students' high and low mathematical communication skills is self-efficacy. Self-efficacy in mathematics is self-confidence in presenting and solving mathematical problems, learning or working on understanding concepts and completing tasks, and communicating mathematics with friends or teachers during learning (Ramadhani & Siregar, 2021; Peciuliauskiene et al., 2022). The self-efficacy indicators measured in this study are 4 points, namely (1) confidence in the skills to understand mathematical material; (2) confidence in the skills to complete mathematics-related tasks; (3) the belief in successfully achieving goals in mathematics learning; and (4) confidence in resilience and tenacity in mathematics learning (Fitriani & Pujiastuti, 2021).

Researchers were encouraged to analyze mathematical communication skills regarding student self-efficacy during the COVID-19 pandemic from the presentation. This study aims to (1) analyze mathematical communication skills based on students' self-efficacy category; (2) describe students' mathematical communication skills during the COVID-19 pandemic.

RESEARCH METHOD

This type of research is descriptive qualitative. The subject of the study was a class VII F student at SMP Negeri 1 Bantul in the 2021/2022 academic year. The selection of research subjects was based on the scores of the questionnaire results so that high, medium, and low student self-efficacy categories were obtained. In the research sample using the purposive sampling technique, each category determined two subjects as the focus of the study. However, only one subject was in the low self-efficacy category in this study, so only five samples were taken. This research instrument is in the form of a student self-efficacy questionnaire, a Mathematical Communication Skills Test, and interview guidelines. This self-efficacy questionnaire scale uses a Likert scale consisting of 4 categories of responses, and the items of the questionnaire statement are divided into positive and negative statements. The measuring student self-efficacy obtained a minimum score of 30 and a maximum of 120. The self-efficacy results are calculated from the number of scores from each respondent and then added up, analyzed and categorized using formulas. The determination of the categorization of students' self-efficacy is carried out by dividing them into three categories according to the opinion of Azwar (2012). The data collection techniques used in this study are test techniques used to

obtain data on students' self-efficacy and mathematical communication skills and non-test techniques to obtain data credibility.

Data analysis of mathematical communication skills based on students' self-efficacy using triangulation techniques from written tests with interviews. Data analysis is carried out by reducing data, presenting data, and verifying and drawing conclusions.

RESULTS AND DISCUSSION

Learning during the COVID-19 pandemic is undoubtedly very different and requires students to be able to adapt quickly. Learning with an online system is still very new for Indonesian students causing culture shock for both students and teachers. This study aims to assess mathematical communication skills reviewed based on student self-efficacy and whether there are differences, both decreases and increases, during the Covid-19 pandemic. Students are categorized based on the shared self-efficacy questionnaire in the initial step. Based on the self-efficacy questionnaire scores that have been given to 30 students of class VII F of SMP Negeri 1 Bantul, the students' self-efficacy is divided into three categories with the following criteria and results.

Table 1. Students' self-efficacy

Categorize	Score Interval	Frequency	Percentage
High	$x > 90$	15	50%
Medium	$60 < x \leq 90$	14	46.67%
Low	$x \leq 60$	1	3.33%

Based on the questionnaire, there were 15 students with high self-efficacy, 14 students with medium self-efficacy and one student with low self-efficacy. From this data, we can conclude that students' self-efficacy in learning mathematics during the Covid-19 pandemic is still very good; 50% of students have high self-efficacy, 46.67% of students have medium self-efficacy, and only 3.33% of students have low self-efficacy. Furthermore, the researcher provided a mathematical communication skills test with three questions, each question following the predetermined indicators of mathematical communication skills. The results of measuring mathematical communication skills are calculated from the number of scores of each respondent and then added up, analyzed and categorized using formulas. The student's mathematical communication skills test has a minimum score of 0 and a maximum of 25; then, the categorization calculation is carried out by dividing them into three categories according to the opinion of Azwar (2012). The results of mathematical communication skills based on student self-efficacy vary greatly. It can be seen in Table 2.

Based on Table 2, there are 15 students with high self-efficacy consisting of 5 students with high mathematical communication skills, 9 in the medium category and 1 in the low category. Furthermore, there are 14 students with medium self-efficacy consisting of 1 student with high mathematical communication skills, eight students in the medium category, and one student in the low category. In the category of low self-efficacy level, there is only one student who also has low mathematical communication skills. According to previous research conducted by Saputra and Zulmaulida (2020) before the covid-19 pandemic in 2012, one factor influencing students' high and low mathematical communication skills was their self-efficacy. However, during the COVID-19 pandemic, although students have good self-efficacy or confidence in

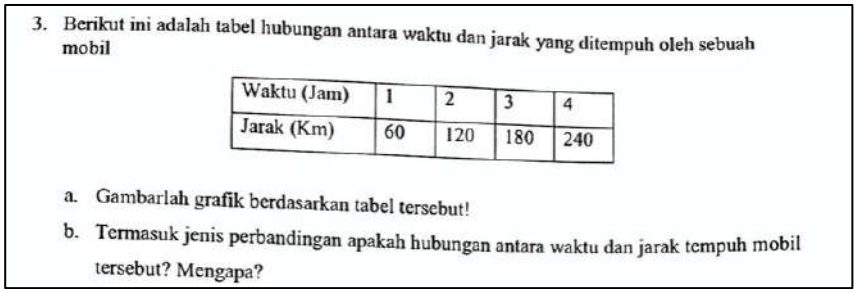
learning mathematics, their mathematical communication skills are not aligned. From table 2, it can be seen that 9 out of 15 students who have high self-efficacy, their mathematical communication skills are only in the medium category; there is even one student with high self-efficacy whose mathematical communication skills are low. In addition, in the medium self-efficacy category, 5 out of 14 students have low mathematical communication skills.

Table 2. The result of mathematical communication skills based on students' self-efficacy

Self-efficacy	Mathematical Communication Skills		
	Score Interval	Category	Frequency
High	$x > 16{,}667$	High	5
	$8{,}333 < x \leq 16{,}667$	Medium	9
	$x \leq 8{,}333$	Low	1
Medium	$x > 16{,}667$	High	1
	$8{,}333 < x \leq 16{,}667$	Medium	8
	$x \leq 8{,}333$	Low	5
Low	$x > 16{,}667$	High	0
	$8{,}333 < x \leq 16{,}667$	Medium	0
	$x \leq 8{,}333$	Low	1

Mathematical communication skills that are not aligned with students' levels of self-efficacy are interesting to review. Researchers sampled interview respondents to validate the student's mathematical communication skills test results. Then one student with high self-efficacy and medium mathematical communication skills (HSE-MMC) was selected, and one student with high self-efficacy and low mathematical communication skills (HSE-LMC). One student with medium self-efficacy and medium mathematical communication skills (MSE-MMC), one student with medium self-efficacy and low mathematical communication skills (MSE-LMC), and one student with low self-efficacy and low mathematical communication skills (LSE-LMC). The selection of five subjects based on self-efficacy groups and mathematical communication skills following the desired sample criteria, namely to see why students' mathematical communication skills during the COVID-19 pandemic were not in line with their self-efficacy levels.

Analysis of the results of the mathematical communication skills test showed that the student's difficulty was not in the questions on the concept of counting or mathematical manipulation. On questions with indicators of performing mathematical manipulations, most students answer correctly; only a few are wrong in the calculation process. Whereas in questions with indicators stating daily events in mathematical language, students can understand the questions and answer them correctly, although some still find it challenging to write them down correctly and systematically. The most significant difficulty of students in the test of mathematical communication skills lies in the questions with indicators of presenting mathematical statements in figures, tables, graphs, diagrams, and algebraically (question 3a); as well as on the indicators of concluding, collecting evidence, providing reasons or evidence of the correctness of the solution (question 3b). The following questions are given related to the indicator.



3. Berikut ini adalah tabel hubungan antara waktu dan jarak yang ditempuh oleh sebuah mobil

Waktu (Jam)	1	2	3	4
Jarak (Km)	60	120	180	240

a. Gambarlah grafik berdasarkan tabel tersebut!
b. Termasuk jenis perbandingan apakah hubungan antara waktu dan jarak tempuh mobil tersebut? Mengapa?

Problem number 3

Below is the table presenting the relationships of time and distance of a car.

Time (hour)	1	2	3	4
Distance (km)	60	120	180	240

a. Make a graph based on the data on the table.
b. What kind of proportion is the relationships between time and distance? Why?

Figure 1. A test question of mathematical communication skills that is difficult for students.

The student test results for the questions in Figure 1, only 6 out of 30 students can answer correctly and completely. Of the five samples, we selected, only the HSE-MMC subjects answered correctly for 3a but were still not quite right for the answer to question 3b, as shown in Figure 2(a). As for the other four subjects, it is still not suitable for both questions, as seen in Figure 2.

In figure 2(b), it can be seen that the HSE-LMC subject has difficulty presenting the diagram and does not write captions on the x-axis and y-axis. The MSE-MMC subject in figure 2(c) looks to be able to present the diagram quite well, but it is not yet equipped with captions on the x-axis and y-axis. The MSE-LMC subject in figure 2(d) looks to be able to present the diagram but is less thorough at the last diagram point and is not equipped with captions on the x-axis and y-axis. Subject LSE-LMC in figure 2(e) It appears confused to describe the graph on the diagram and not supplement it with captions on the x-axis and y-axis. As for the question related to concluding, the five subjects are still not appropriate; even the LSE-LMC subject did not answer. After going through the interview process, they revealed that they had difficulty presenting diagrams because during online learning during the Covid-19 pandemic, they were only familiar with diagrams by looking at questions or assignments, and there was no direct learning activity to make diagrams, so that related details such as x-axis descriptions and y-axis were missed. In addition, the types of description questions given are not familiar because they are used to being given multiple-choice questions during online learning. The lack of variations in this description hinders the development of students' written mathematical communication skills, considering that writing communication skills are not easy and must continue to be honed to be mastered.

On the other hand, the reduction in learning time in online learning during the Covid-19 pandemic also affects students' mathematical communication skills. Both students and teachers feel that learning tends to be in the same direction as the teacher's lecture method to pursue the material. This unidirectional learning makes the process of mathematical communication of students orally reduced or even absent. It is what makes it difficult for students

to question with indicators of concluding, collecting evidence, and providing reasons or evidence of the truth of the solution. Students are not used to expressing opinions and giving reasons for each step of the settlement they work on, so they have difficulty when asked to conclude, collect evidence, and give reasons or evidence of the truth.

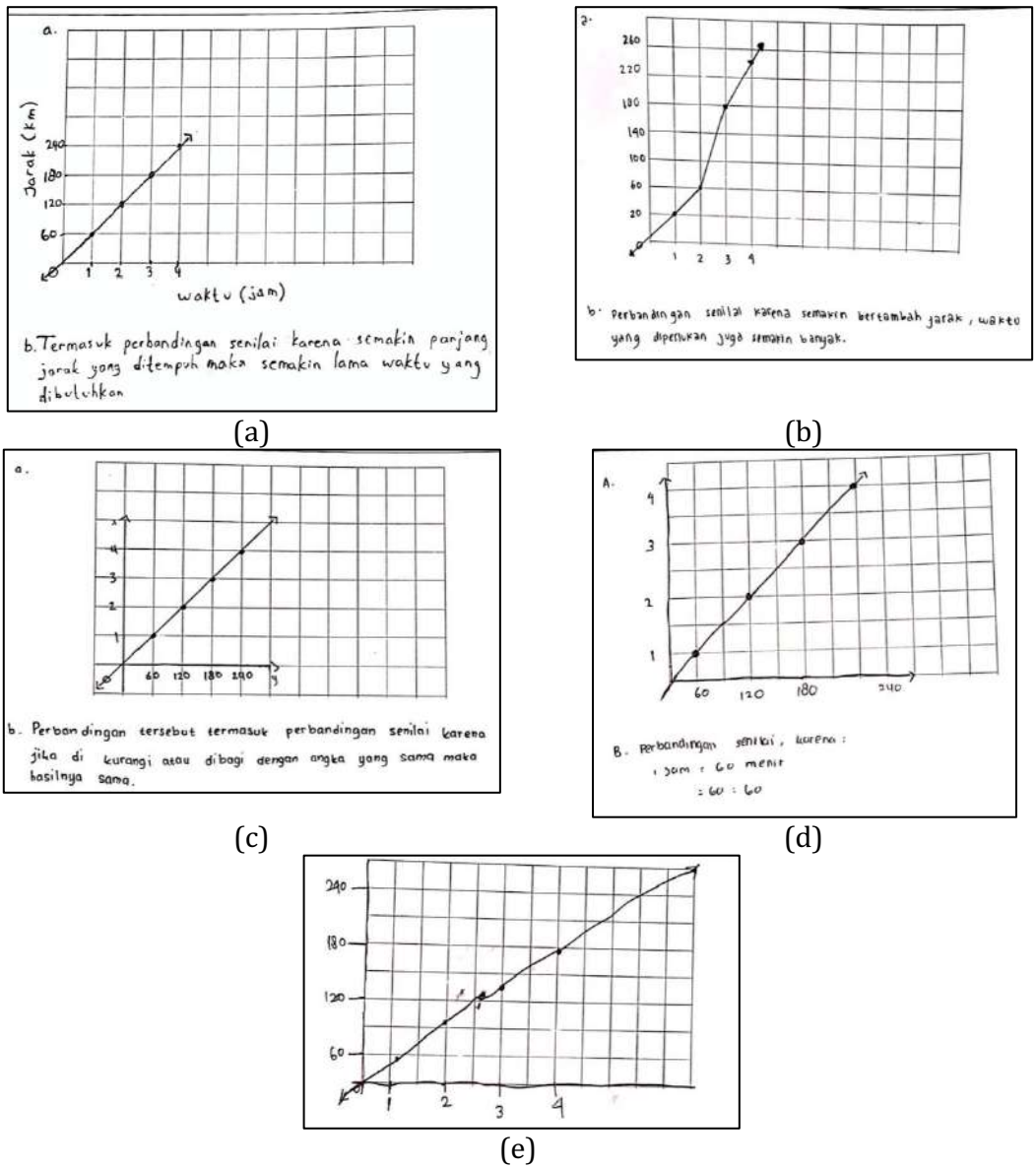


Figure 2. HSE-MMC subject answer (a), HSE-LMC subject answer (b), MSE-MMC subject answer (c), MSE-LMC subject answer (d), and LSE-LMC subject answer (e)

The analysis of students' mathematical communication skills based on self-efficacy during the Covid-19 pandemic showed that high self-efficacy does not guarantee that students' mathematical communication skills are also high. The majority of students have high self-efficacy, but it turns out that their mathematical communication skills are still lacking. The misalignment between the level of self-efficacy and students' mathematical communication skills during the Covid-19 pandemic occurred due to the online learning process that

did not facilitate students to hone their mathematical communication skills. Unidirectional learning from teacher to student and the provision of excessive multiple-choice type questions without being balanced with description-type questions are factors hindering the development of students' mathematical communication skills during the Covid-19 pandemic.

CONCLUSION

Based on the analysis and discussion results, it can be concluded that students' mathematical communication skills during the Covid-19 pandemic are not in line with their level of self-efficacy. High self-efficacy does not necessarily make students have high mathematical communication skills. The factor causing the misalignment of students' mathematical communication skills with their level of self-efficacy is that the online learning process carried out during the Covid-19 pandemic does not enough facilitate students to hone their mathematical communication skills, both oral and written.

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