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The Relationship between Learning Motivation and Mathematical Communication Skills in Vocational High School Students

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ABSTRACT

This study aims to analyze the relationship between learning motivation and mathematical communication skills in vocational high school students. The background of this study is the importance of mathematical communication in mathematics learning, as well as the low learning motivation of vocational high school students that impacts these abilities. The research method used is quantitative with a correlational approach. The population in this study were grade X students at SMK Negeri 1 Cipanas, with a sample of 26 students from grade X MPLB 3 selected using a purposive sampling technique. The instruments used included a learning motivation questionnaire and a mathematical communication ability essay test. The results showed that there was no positive and significant relationship between learning motivation and mathematical communication skills in vocational high school students. Based on these results, it can be interpreted that high learning motivation does not necessarily align with high mathematical communication skills. This means that even though students have a high learning drive, it does not automatically make them able to communicate mathematical ideas well. This finding implies that increasing learning motivation alone is not enough to improve students' mathematical communication skills. Mathematics learning needs to be designed not only to motivate students but also to specifically train mathematical communication skills such as explaining ideas, using symbols appropriately, and interpreting real-world situations into mathematical models.

Keywords: learning motivation; mathematical communication skills; mathematics learning

INTRODUCTION

Education is the primary foundation in preparing the next generation to excel and be highly competitive amidst global challenges (Aziz et al., 2025; Nisaa et al., 2024). As a country that emphasizes the importance of education, Indonesia continues to strive to improve the quality of human resources through the national education system. In today's digital era, students are required to possess 21st-century competencies, as formulated by Kemendikbud, (2018) these six core competencies are known as the 6c: character, citizenship, critical thinking, creativity, collaboration, and communication. One of the strategic subjects in developing these competencies is mathematics (Fitriyyah et al., 2024; Lestari et al., 2024; Sitepu, 2019).

Mathematics is an exact science considered to play a crucial role in education and contributes to the development of science and technology (Supartinah et al., 2023). Mathematics is not just about numbers and formulas; it also trains logic, perseverance, and the ability to convey thoughts coherently. In the learning process, students are not only required to understand concepts but also to be able to explain their mathematical ideas. This is where mathematical communication skills are crucial, as students' success in mathematics

learning can be seen from their mathematical communication skills (Bulan et al., 2023). This ability includes conveying mathematical ideas or solutions clearly, both verbally and in writing, using representations such as graphs, symbols, tables, or everyday language (Ramadhani et al., 2023). Communication in mathematics plays a role in strengthening critical thinking skills and enabling a deeper understanding of a concept (Hikmah & Saputra, 2023).

In practice, mathematical communication also helps students express problem-solving strategies, present arguments, and connect concepts they have learned. Students who are accustomed to communicating their mathematical thinking tend to be more capable of systematic and logical thinking. In fact, good communication is also correlated with social skills, such as participating in group discussions and expressing ideas confidently (Nurhasanah et al., 2019).

However, according to Sofyan, (2017) the reality on the ground shows that students' mathematical communication skills remain a problem. In one study, more than half of students demonstrated low performance in this aspect. Many students still struggle to convey solutions or explain the steps in a complete and clear manner. One factor often associated with poor mathematical communication is low student motivation to learn (Robiana & Handoko, 2020).

According to Sardiman as cited in Monika & Adman, (2017) learning motivation plays a crucial role in the educational process. It is the driving force that determines how well a student persists in learning and achieves maximum results. When motivation is high, students tend to be more persistent, confident, and eager to master the material, including how to convey mathematical ideas. Conversely, when motivation is low, students become passive, give up quickly, and often show little involvement in learning.

Decreased motivation to learn is also a crucial issue at the vocational high school level. Many vocational high school students feel that mathematics is irrelevant to their field of expertise, resulting in low enthusiasm for learning (Nurfallah & Pradipta, 2021). Yet, mathematics remains necessary in various work contexts, such as understanding data, calculating costs, or reading technical instructions. This lack of motivation in these subjects directly impacts low participation in learning activities that require active communication.

On the other hand, students with high learning motivation tend to be more active in explaining solutions, are more willing to ask questions, and are able to express their thoughts both in writing and verbally. This finding is supported by several studies that reveal a positive relationship between learning motivation and mathematical communication skills (Fitriani et al., (2021); Abdi, (2018); Marniati et al., (2021)). Internally motivated students are better able to use their own language to explain concepts, while those who are less motivated often simply copy without understanding (Fitri & Darhi, 2023).

Although there has been considerable research on the relationship between learning motivation and mathematical communication skills, most of these studies have been conducted on junior high or high school students. However, the learning context in vocational schools has distinct characteristics, being more practical and applied. Therefore, studies specifically exploring the relationship between learning motivation and mathematical communication skills in vocational schools are still very limited.

Furthermore, most previous studies have focused on cognitive aspects such as concept mastery or test scores, rather than on communication skills, which are also important reflections of student understanding. Therefore, research examining how learning motivation influences vocational high school students' mathematical communication skills is crucial, as a way to contribute to improving learning strategies.

RESEARCH METHODS

This study uses a correlational quantitative method with a descriptive and associative approach, because it aims to describe the variables studied, namely learning motivation and mathematical communication skills and to test whether or not there is a statistically significant relationship between these variables, namely the relationship between learning motivation and mathematical communication skills in vocational high school students. The population in this study was all class X students at SMK Negeri 1 Cipanas. The sampling technique was carried out by purposive sampling, namely 26 students from class X MPLB 3.

The research instrument used was a learning motivation questionnaire compiled based on indicators according to Uno, (2008) which include: the existence of desire and desire to succeed, the existence of encouragement and needs in learning, the existence of hopes and aspirations for the future, the existence of appreciation in learning, the existence of interesting activities in learning, and the existence of a conducive learning environment. As well as a mathematical communication ability test instrument compiled based on indicators from Arina & Nuraeni, (2022) which include explaining mathematical ideas and models (pictures, tables, diagrams, algebraic graphs into ordinary language), being able to use mathematical terms, symbols and their structures to present ideas describing relationships and situations, and expressing real objects, situations and everyday events in the form of mathematical models (pictures, tables, diagrams, graphs, algebra).

The data were analyzed using descriptive statistics and correlation tests using IBM SPSS Statistics Version 26. The learning motivation scores were classified as ordinal data, while the mathematical communication ability scores were classified as scale data. Because the data being tested were either ordinal or non-parametric, they did not require assumption testing and used non-parametric tests. The non-parametric test used was Kendall's Tau (Septian et al., 2025). The research hypotheses are as follows:

H_0: p=0 (no relationship);

H_1: p≠0 (there is a relationship);

The criterion for rejecting H_0 is if the p-value is <0.05.

RESULTS AND DISCUSSION

The results and discussion of this study include students' learning motivation, students' mathematical communication skills, and the relationship between students' learning motivation and mathematical communication skills.

Student Learning Motivation

Student learning motivation was measured using a questionnaire instrument consisting of 19 statements with a different number of statements for each indicator. There are 3 statements on the indicator of the desire and desire to succeed with a maximum score of 12, 4 statements on the indicator of the drive and need for learning with a maximum score of 16, 5 statements on the indicator of future hopes and aspirations with a maximum score of 20, there are 3 statements on the indicator of appreciation in learning with a maximum score of 12, 3 statements on the indicator of interesting activities in learning with a maximum score of 12, and 1 statement on the indicator of a conducive learning environment with a maximum score of 4. So the maximum score for the total score of student learning motivation is 76. The scores obtained for each indicator from all students are given the criteria for the percentage of student learning motivation questionnaire assessment according to Rahmi, (2020), the results and criteria obtained are as follows:

Table 1. Results of the Percentage of Assessment and Criteria for the Student Learning Motivation Questionnaire Based on Indicators

Indicator	Percentage Avarage	Criteria
Desire and desire to succeed	66.33%	Strong
Drive and need to learn	85.56%	Very Strong
Hopes and aspirations for the future	79.8%	Strong
Reward for learning	79.17%	Strong
Interesting learning activities	76%	Strong
Conducive learning environment	85.5%	Very Strong
All Indicators	78.49%	Strong

Overall, the learning motivation indicators for 10th-grade students at SMK Negeri 1 Cipanas are in the strong category, meaning most students have sufficient enthusiasm and drive to learn. This is in line with the research findings of Zamsir et al., (2021), which found that students' learning motivation is generally in the high category. Two indicators that reach the very strong category—the drive and need to learn and a conducive learning environment—are the most prominent aspects and can be used as key strengths in designing learning strategies. However, several other indicators still need to be improved to reach the very strong category, such as the desire to succeed and hope for the future, which can be strengthened through a more motivating learning approach, instilling success values, and developing a more concrete future orientation for students.

Students' Mathematical Communication Skills

The mathematical communication ability test instrument consists of four test questions consisting of 1 question on the indicator explaining mathematical ideas and models (pictures, tables, diagrams, algebraic graphs into ordinary language) with a maximum score of 4, 2 questions on the indicator stating real objects, situations and everyday events into the form of mathematical models (pictures, tables, diagrams, graphs, algebra) with a maximum score of 8, and 1 question on the indicator being able to use mathematical terms, symbols and their structures to present ideas describing relationships and situations with a maximum score of 4. So the score for the entire question is 16 and the maximum score for mathematical

communication ability is 64. The scores obtained for each indicator from all students are given the percentage criteria for assessing students' mathematical communication abilities according to Fatoni Sholihin et al., (2024), the results and criteria obtained are as follows:

Table 2. Results of Assessment Percentage and Criteria for Students' Mathematical Communication Ability Tests Based on Indicators

Indicator	Percentage Avarage	Criteria
Explaining mathematical ideas and models (pictures, tables, diagrams, algebraic graphs) in ordinary language	81.75%	Very High
Expressing real objects, everyday situations, and events in the form of mathematical models (pictures, tables, diagrams, graphs, algebraic graphs)	70.63%	High
Able to use mathematical terms, symbols, and structures to present ideas and describe relationships and situations	37.5%	Low
All Indicators	65.13%	High

Overall, the mathematical communication skills of 10th-grade students at SMK Negeri 1 Cipanas are in the good category, especially in the indicator of explaining mathematical ideas and models (pictures, tables, diagrams, algebraic graphs into ordinary language). However, weaknesses in the use of mathematical terms and symbols indicate a need for improvement. Efforts to improve this ability can be done by teachers who more frequently involve students in problem-solving-based activities and the direct use of mathematical terms and symbols, so that they are more accustomed to using terms and symbols correctly. Alternatively, in conducting learning, teachers again remind when solving problems, it is best to write down what is known and what is asked in the problem. Then, getting students used to using mathematical symbols so that students are more practiced and better able to remember (Rahmana Putri, 2021).

The Relationship between Learning Motivation and Students' Mathematical Communication Skills

Student learning motivation was measured using a questionnaire, so the learning motivation score is classified as ordinal data. However, students' mathematical communication skills were measured using a test. Therefore, the mathematical communication skills score is classified as scale data. Because the data tested is ordinal, it does not require assumption testing and uses non-parametric tests. The non-parametric test used is Kendall's Tau.

Table 3. Kendall's Tau Correlation Test of Learning Motivation and Mathematical Communication Ability

			Learning Motivation	Mathematical Communication Skills
Kendall's tau_b	Learning Motivation	Correlation Coefficient	1.000	-0.317
		Sig. (2-tailed)	0.000	0.067
		N	26	26
	Mathematical Communication Skills	Correlation Coefficient	-0.317	1.000
		Sig. (2-tailed)	0.067	0.000
		N	26	26

Based on Table 3, the results of the Kendall's Tau correlation test conducted using the IBM SPSS Statistics Version 26 application show a significance value (p-value) of 0.067 > 0.05. This indicates that statistically, there is no significant relationship between learning motivation and students' mathematical communication skills. In addition, the Kendall's Tau correlation coefficient value of -0.317 indicates a negative relationship, although not significant. This means that there is a tendency that the higher students' learning motivation, the lower their mathematical communication skills, but this relationship is not strong enough to be considered statistically significant. The correlation value of -0.317 is also included in the low correlation category, which means the relationship between the two variables is weak. Therefore, it can be concluded that there is no positive and significant relationship between learning motivation and mathematical communication skills of vocational high school students at SMK Negeri 1 Cipanas.

The reason for the lack of a positive and significant relationship between learning motivation and mathematical communication skills is that students' learning motivation does not always directly influence their mathematical communication skills. Students with high motivation may be more focused on understanding the material, but they are not necessarily accustomed to conveying mathematical ideas verbally or symbolically. Mathematical communication is also a complex skill that requires specific practice, just as logical thinking and the use of symbols without practice.

Individual factors also play an important role, because some students with high motivation may feel confident in learning, but still have difficulty conveying mathematical concepts verbally, especially if their learning style is more visual or kinesthetic. This is in line with the research of Puspawati et al., (2022) who obtained the results of the factors causing errors of students with high, medium and low motivation in solving mathematical communication skills problems in terms of learning motivation, namely, internal factors including lack of interest and motivation of students towards mathematics lessons which result in students being less skilled and lazy as well as physiological factors and psychological factors especially in the intelligence aspect which affect the learning outcomes of these students.

Although a weak negative correlation indicates that increased motivation is not always followed by increased mathematical communication skills, this does not mean that motivation is not important in the mathematics learning process. Based on the results of interviews with several high school mathematics teachers in Ubaidah's research in Septian et al., (2020) concluded that students' attitudes towards mathematics tend to be less motivated or quickly get bored with the methods generally applied to mathematics subjects so that they are considered less effective, this shows that students' low mathematical communication skills are inseparable from the role of teachers, where the learning model used is still conventional and teacher-centered. It is important for teachers to design learning methods that not only motivate students but also involve them in mathematical communication activities such as group discussions, presentations, or collaborative problem solving. Thus, students are not only motivated to learn but also skilled in conveying mathematical ideas accurately and coherently.

CONCLUSION

The conclusions of this study are as follows: (1) Overall, the learning motivation of vocational high school students has strong criteria; (2) Overall, the mathematical communication skills of vocational high school students have high criteria; (3) There is no positive and significant relationship between learning motivation and mathematical communication skills in vocational high school students.

It is recommended to consider other variables such as math anxiety, self-efficacy, learning styles, critical thinking skills, and the teaching methods used by teachers in the classroom, which may be more related to mathematical communication skills. The researchers suggest that those who will conduct similar research or continue this research consider a larger number of subjects and a broader scope so that the results can be generalized. Research instruments should also be more varied, beyond using questionnaires or written tests. Future research can use in-depth interviews, direct classroom observations, or document studies such as student learning process notes to obtain more contextual data. Thus, the quality of the data obtained will be richer and more in-depth.

The limitation of this study lies in the use of a quantitative approach, which was unable to fully uncover the processes, context, and reasons behind the findings. Therefore, further research is recommended to employ a qualitative or mixed methods approach to further explore the meaning and dynamics of the variables studied, resulting in more comprehensive and in-depth results. This study also focused solely on the relationships between variables without further exploring their influence.

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