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The Effect of Learning Motivation on Junior High School Students' Mathematical Representation Ability

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Abstract
This study aims to examine the effect of learning motivation on junior high school students' mathematical representation ability. This research employed a quantitative approach using a survey method. The population of this study consisted of all seventh-grade students at SMP Negeri 13 Semarang in the 2025/2026 academic year, with a sample of 30 students selected through cluster random sampling. The research instruments included a mathematical representation ability test and a learning motivation questionnaire. The data were analyzed using normality and linearity tests, followed by a simple linear regression test. The results showed that learning motivation has a positive and significant effect on students' mathematical representation ability, as indicated by a significance value of 0.000 (< 0.05). The coefficient of determination (R^2) was 0.486, meaning that learning motivation contributes 48.6% to students' mathematical representation ability. This finding suggests that students with higher learning motivation tend to have better ability in representing mathematical ideas through various forms of representation. In conclusion, learning motivation plays an important role in improving students' mathematical representation ability. Therefore, teachers are encouraged to enhance students' motivation in order to support better mathematics learning outcomes.

Keywords: *junior high school, learning motivation, mathematical representation ability, mathematics learning*

INTRODUCTION

Education plays a fundamental role in determining the quality of human life as well as the sustainability of a nation. Through education, individuals not only acquire knowledge but also develop character, ways of thinking, and skills needed to face the dynamics of an ever-changing world (Verma, 2024). Ki Hajar Dewantara stated that education is an effort to develop students' character (moral values), intellect, and physical aspects so that they can achieve the highest level of well-being and happiness, both as individuals and as members of society (Rahmawati et al., 2024). This perspective emphasizes that education has a holistic dimension, encompassing not only cognitive aspects but also affective and psychomotor domains. From a juridical perspective, the primary goal of national education in Indonesia is stated in the Preamble of the 1945 Constitution, namely to enhance the intellectual life of the nation. This is further reinforced by Law Number 20 of 2003 concerning the National Education System, which states that education functions to develop students' abilities and to shape their character and civilization in order to create a dignified nation. Education aims to optimize students' potential so that they become individuals who are faithful and devoted to God Almighty, possess noble character, are healthy, knowledgeable, capable, creative, independent, and responsible democratic citizens. Therefore, education is expected to produce high-quality human resources who are competitive at the global level.

In achieving these goals, mathematics learning plays a highly strategic role. Mathematics is not only a tool for calculation but also a means of developing logical, analytical, systematic, critical, and

creative thinking skills (Widana et al., 2018). This is in line with the Decree of the Head of BSKAP Number 32 of 2024, which emphasizes that mathematics is a key element in strengthening numeracy literacy as a foundation for mastering science and technology. Furthermore, mathematics learning contributes to the development of the Pancasila Student Profile, particularly in fostering critical and creative reasoning, which are essential competencies in the 21st century. In the context of mathematics education, the National Council of Teachers of Mathematics (NCTM) identifies five important process standards: problem solving, reasoning and proof, communication, connections, and mathematical representation (NCTM, 2000). These standards are interrelated and serve as a foundation for developing students' comprehensive mathematical understanding. Among them, mathematical representation ability holds a crucial position as it serves as a bridge between conceptual understanding and mathematical communication.

Mathematical representation ability refers to the ability to express mathematical ideas in various forms, such as visual representations (graphs, diagrams), symbolic representations (equations, formulas), and verbal representations (written or spoken explanations) (Suningsih & Istiani, 2021). This ability enables students to organize information, interpret problems, and select appropriate strategies for problem-solving. In addition, mathematical representation helps students connect different mathematical concepts, leading to deeper and more meaningful understanding. With strong representation skills, students can transform abstract problems into more concrete forms, thereby facilitating the problem-solving process (Kenedi et al., 2019). However, various studies indicate that students' mathematical representation ability in Indonesia is still relatively low. Many students experience difficulties in translating word problems into mathematical models, selecting appropriate representations, and explaining their solutions in different forms (Silviani et al., 2021). The results of the Programme for International Student Assessment (PISA) 2022 also show that Indonesian students' performance in mathematics remains below the international average (OECD, 2023). In Indonesia, 18% of students attained at least Level 2 proficiency in mathematics, significantly less than on average across OECD countries. At a minimum, these students can interpret and recognize, without direct instructions, how a simple situation can be represented mathematically (OECD, 2023). This condition suggests that higher-order thinking skills, including mathematical representation ability, still require serious attention in the learning process.

The low level of students' mathematical representation ability cannot be separated from various influencing factors, both external and internal. External factors include teaching methods, learning media, and the learning environment, while internal factors involve psychological aspects of students, one of which is learning motivation. Learning motivation is a driving force that generates enthusiasm, direction, and persistence in learning activities (Kusnadi & Azzahra, 2024). It plays a crucial role in determining the extent to which students actively engage in the learning process. Students with high learning motivation tend to demonstrate enthusiasm, persistence, and resilience when facing difficulties. They are also more active in exploring various problem-solving strategies and using different forms of representation to understand mathematical concepts. In contrast, students with low learning motivation tend to be passive, show less initiative, and give up easily when confronted with challenging problems (Fernando et al., 2020). This condition limits their opportunities to develop mathematical representation ability optimally. Furthermore, learning motivation not only affects learning outcomes but also affects the cognitive processes that occur during learning. Highly motivated students are more likely to actively construct knowledge, connect concepts, and communicate mathematical ideas through various forms of representation (Nisa et al., 2020). Therefore, learning motivation plays a significant role in supporting the development of students' mathematical representation ability. Although the relationship between learning motivation and mathematical ability has been widely discussed, studies that specifically examine the effect of learning motivation on mathematical representation ability, particularly at the junior high school level, are still limited. Most previous research has focused on instructional models or learning media, while internal factors such as students' motivation have not been thoroughly explored. In fact, understanding the effect of learning motivation on mathematical representation ability is essential for designing effective and student-centered learning strategies. Therefore, this study aims to empirically examine the effect of learning motivation on junior high school students' mathematical representation ability. The findings of this study are expected to contribute to the development of mathematics learning that not only emphasizes cognitive aspects but also addresses affective factors, particularly students' learning motivation. Ultimately, improving students' mathematical representation ability is expected to enhance the overall quality of mathematics learning.

METHOD

The approach used in this study is a quantitative approach with a survey method. The quantitative approach was chosen to analyze whether there is a relationship between students' learning motivation (X) and their mathematical representation ability (Y). The survey method was employed because this study aims to examine the characteristics and causal relationships between variables without any direct treatment or intervention from the researcher (Rukminingsih & Latief, 2020). Through this method, data are collected from respondents using structured instruments, enabling the researcher to capture students' conditions as they naturally occur in the learning environment. Furthermore, the survey method is considered appropriate for this study as it facilitates data collection from a relatively large group efficiently while maintaining the objectivity and generalizability of the findings. This research was conducted at SMP Negeri 13 Semarang, located on Lamongan Raya, Sampangan, Gajahmungkur District, Semarang City, Central Java Province. The population of this study consisted of all seventh-grade students of SMP Negeri 13 Semarang in the 2025/2026 academic year. The sample was determined using a cluster random sampling technique, resulting in class VII C being selected as the research sample, consisting of 30 students.

The research instruments used in this study included a mathematical representation ability test and a learning motivation questionnaire. The mathematical representation ability test consisted of essay questions designed to measure students' visual, symbolic, and verbal representation abilities. The indicators of mathematical representation ability assessed in this study include: (1) constructing geometric figures to explain problems and facilitate their solutions, (2) formulating problem situations based on given data or representations, (3) creating equations or mathematical models from given representations, (4) describing the steps of problem-solving in written form, and (5) solving problems using appropriate mathematical representations (Riyanto et al., 2024).

The questionnaire technique was used to collect data on students' learning motivation. The questionnaire instrument was developed based on relevant indicators of learning motivation to provide a comprehensive description of students' motivation levels. The response options consisted of four categories: strongly agree, agree, disagree, and strongly disagree. The use of four response options aims to avoid neutral answers and encourage respondents to provide more definite responses that reflect their actual conditions. Students' learning motivation was measured using a Likert scale, in which each response option was assigned a specific score, which was then accumulated to obtain the overall motivation score of each student. The results were further analyzed to determine the level of students' learning motivation and its relationship with their mathematical representation ability. The initial stage of data analysis in this study involved a normality test to determine whether the data were normally distributed. This was followed by a linearity test to examine the linear relationship between the variables. To determine the extent of the effect of learning motivation on students' mathematical representation ability, a simple linear regression test was conducted. All data analyses in this study were carried out using SPSS software.

RESULTS AND DISCUSSION

This section presents the results of data analysis and discusses the findings in relation to the research objectives. Prior to testing the research hypothesis, prerequisite tests were conducted, including the normality test and linearity test, to ensure that the data met the assumptions required for further statistical analysis. After fulfilling these assumptions, a simple linear regression analysis was performed to examine the effect of learning motivation on students' mathematical representation ability.

Table 1. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Unstandardized Residual	,072	30	,200*	,984	30	,919

*. This is a lower bound of the true significance

a. Liliefors Significance Corection

Based on Table 1, the results of the normality test using the Kolmogorov-Smirnov and Shapiro-Wilk tests indicate that the residual data are normally distributed. This can be seen from the significance (Sig.) value of 0.200 in the Kolmogorov-Smirnov test and 0.919 in the Shapiro-Wilk test.

Both significance values are greater than 0.05, indicating that the data meet the assumption of normality.

Table 2. Tests of Linearity

ANOVA Table							
			Sum of Squares	df	Mean Square	F	Sig.
Representation * Motivation	Between Groups	(Combined)	1759,967	20	87,998	3,970	,019
		Linerity	951,502	1	951,502	42,925	,000
		Deviation from Linearity	808,465	19	42,551	1,920	,158
	Within Group		199,500	9	22,167		
	Total		1959,467	29			

Based on Table 2, the results of the linearity test indicate that there is a linear relationship between learning motivation and students' mathematical representation ability. This is shown by the significance value of the linearity component, which is 0.000 and less than 0.05, indicating that the relationship between the two variables is statistically significant. In addition, the significance value for the deviation from linearity is 0.158, which is greater than 0.05. This indicates that there is no significant deviation from linearity, meaning that the relationship between learning motivation and mathematical representation ability can be considered linear.

Table 3. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	25,042	10,913		2,295	,029
	Motivation	,660	,128	,697	5,141	,000

a. Dependent Variable: Representation

Based on the Table 3, the results of the simple linear regression analysis indicate that learning motivation has a significant effect on students' mathematical representation ability. This is evidenced by the significance value (Sig.) of 0.000, which is less than 0.05, indicating that learning motivation significantly affects mathematical representation ability. The regression equation obtained from the analysis is Y = 25.042 + 0.660X, which shows that the constant value is 25.042, meaning that if learning motivation is assumed to be zero, the mathematical representation ability score is 25.042. The regression coefficient of 0.660 indicates that every one-unit increase in learning motivation will increase students' mathematical representation ability by 0.660 units. Furthermore, the standardized coefficient (Beta) value of 0.697 indicates a strong positive effect of learning motivation on mathematical representation ability.

Table 4. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,697[a]	,486	,467	5,99990

a. Predictors: (Constant), Motivation

Based on the Table 4, the value of R is 0.697, which indicates a strong relationship between learning motivation and students' mathematical representation ability. The R Square value is 0.486, meaning that 48.6% of the variance in students' mathematical representation ability can be explained by learning motivation, while the remaining 51.4% is influenced by other variables not examined in this study. The results of this study indicate that learning motivation has a positive and significant effect on students' mathematical representation ability. This is evidenced by the regression analysis results, which show a significance value of 0.000 (< 0.05) and a regression coefficient of 0.660. In addition, the coefficient of determination (R^2) of 0.486 indicates that learning motivation contributes 48.6% to the variance in students' mathematical representation ability.

This finding suggests that learning motivation is an important factor influencing students' ability to represent mathematical ideas. This result can be explained theoretically, as learning motivation plays a crucial role in encouraging students' cognitive engagement during the learning process. According to Pratama (2024), motivation is closely related to students' internal drive to engage actively in learning activities, which affects the quality of their cognitive processes. Students with high

motivation tend to be more active, persistent, and enthusiastic in solving mathematical problems. They are more likely to explore various strategies and utilize different forms of representation, such as visual, symbolic, and verbal representations. In contrast, students with low motivation often show less engagement and tend to rely on procedural approaches without fully understanding the underlying concepts, which limits their ability to construct meaningful representations (Nisa et al., 2020). The findings of this study are consistent with previous research (Fernando et al., 2020), which indicates that motivated students demonstrate better performance in mathematical problem-solving and representation. This is also supported by the findings of Rismayanti et al. (2023), who states that motivation significantly influences students' learning processes, including how they process information, solve problems, and express their understanding. Therefore, students with higher motivation are more capable of transforming abstract mathematical concepts into more concrete and understandable forms.

CONCLUSION

Based on the results of this study, it can be concluded that learning motivation has a positive and significant effect on junior high school students' mathematical representation ability. This is supported by the results of the regression analysis, which show a significance value of 0.000 (< 0.05) and a coefficient of determination (R^2) of 0.486, indicating that learning motivation contributes 48.6% to students' mathematical representation ability. These findings suggest that students with higher levels of motivation tend to demonstrate better ability in representing mathematical ideas through visual, symbolic, and verbal forms. Therefore, learning motivation is an important factor that needs to be considered in mathematics learning. Teachers are expected to create learning environments that can enhance students' motivation, as this will indirectly improve their mathematical representation ability. However, since there are other factors influencing students' representation ability, further research is recommended to examine additional variables, such as learning strategies, self-efficacy, and instructional media, in order to obtain a more comprehensive understanding of the factors affecting students' mathematical learning outcomes.

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