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The Effect of Prior Knowledge and Learning Motivation on Mathematics Learning Outcomes of Junior High School Students

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Abstract: This research aimed to analyze the effect of prior knowledge and learning motivation on the mathematics achievement of junior high school students. This research is a correlational study involving 30 respondents who were taken by cluster random sampling technique. The research instrument consisted of a prior knowledge test and a learning motivation questionnaire. The research data were analyzed using simple and multiple linear regression tests. The results showed that prior knowledge had a strong effect on mathematics achievement (correlation level 0.739) and learning motivation had a very strong effect on mathematics achievement (correlation level 0.806). The results of the multiple regression test show that the prior knowledge and learning motivation simultaneously strongly influence students' mathematics achievement (correlation level 0.837). The results of this study prove that prior knowledge and learning motivation are essential factors in supporting the success of the learning process.

Keywords: prior knowledge, learning motivation, mathematics achievement.

Abstrak: *Penelitian ini bertujuan untuk menganalisis pengaruh pengetahuan awal dan motivasi belajar terhadap hasil belajar matematika siswa SMP. Penelitian ini adalah penelitian korelational yang melibatkan 30 responden yang diambil dengan teknik cluster random sampling. Instrumen penelitian terdiri dari soal tes kemampuan awal dan angket motivasi belajar. Data penelitian di analisis dengan uji regresi linier sederhana dan ganda. Hasil penelitian menunjukkan bahwa kemampuan awal berpengaruh kuat terhadap hasil belajar matematika (taraf korelasi 0,739) dan motivasi belajar berpengaruh sangat kuat terhadap hasil belajar matematika (taraf korelasi 0,806). Hasil uji regresi ganda menunjukkan bahwa kemampuan awal dan motivasi belajar secara bersama-sama memberikan pengaruh yang sangat kuat terhadap hasil belajar matematika siswa (taraf korelasi 0,837). Hasil penelitian ini membuktikan bahwa kemampuan awal dan motivasi belajar adalah faktor penting dalam menunjang keberhasilan proses belajar.*

Kata kunci: *kemampuan awal, motivasi belajar, hasil belajar matematika.*

▪ INTRODUCTION

Education in Indonesia is still the priority sector in today's development era. Because education as one of the efforts to educate the nation's life is a determinant of the progress of a nation. Along with the development of Science and Technology (IPTEK), it is necessary to strive to improve the quality of Education to increase the global competitiveness of graduates. Improving the quality of education in Indonesia is carried out through improving the curriculum from year to year according to the times and needs. In every curriculum development, mathematics has always been a subject that must be taught and mastered by students from primary and secondary education levels. Middle school students' mathematical abilities are critical to their future academic success, choice of college majors, and early career determination (Yu & Sigh, 2016).

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Mathematics is a subject that is considered difficult, uninteresting and boring by most students (Heriyati, 2017). This situation can be seen from the attitude and enthusiasm of students who are lacking when learning mathematics. This fact is also supported by an empirical study at a junior high school in Central Lampung district where there are still many students who score less than the Minimum Completeness Criteria set by the education unit. This often makes teachers need to design effective strategies to improve student mathematics learning outcomes. In designing mathematics learning, teachers also need to pay attention to various factors that can affect student learning outcomes. Student success in learning is influenced by internal and external factors (Suryabrata, 2012). According to Lestari (2017), internal factors consist of initial abilities, learning motivation, level of intelligence, study habits, learning anxiety, while external factors consist of family environment, school, community, socio-economic conditions, and so on.

Initial ability is a factor that needs to get great attention in learning mathematics. This is related to the hierarchical nature of mathematics, meaning that in order to master higher mathematical concepts, it is necessary to master certain concepts as prerequisite skills. Prerequisite skills are initial abilities that must be mastered by students to easily learn advanced mathematical concepts. If the prerequisite skills possessed by students are low, it can cause difficulties in trying to master the next concept (Abdurrahman, 2009; Mulyono, 2017). This situation can be observed in mastering the concept of the Pythagorean theorem as a prerequisite skill in mastering the concept of the common tangent of two circles. The results of empirical studies show that during the Pythagorean theorem learning process, many students seem to have difficulty/confused in determining the sides of the hypotenuse and calculating the length of one side of a right triangle if two sides are known. In this case, students have difficulty determining the length of side AB in the right triangle ABC with the right angles at angle B, if it is known that the length of side BC is 3 cm and the length of side AC is 5 cm. From this it is suspected that the low learning outcomes for the two-circle common tangent material is caused by the lack of students' ability to use the concept of the Pythagorean theorem (prerequisite concept).

In addition to the lack of mastery of the prerequisite concepts, empirical studies also found the fact that during the learning process for the two-circle alliance tangent material the students were more silent or less critical in responding or asking questions about the material explained by the teacher even though the teacher often allowed students to ask questions. The absence of responses or questions from students certainly has two meanings, namely first, students understand the teacher's explanation and second, students do not understand but do not wish to ask questions. However, this was answered when the teacher gave practice questions, and it was seen that there were still many students who were confused in determining the length of the common tangent of two circles. The lack of enthusiasm of students in learning was also seen when the teacher gave homework assignments, the next morning many students flocked to copy their friends' work even until the bell rang and the teacher entered the class. Then based on the results of interviews with students, it is known that the majority of students prefer not to get assignments or study when their math teacher is not present. This description contains aspects of learning motivation, which gives an overview of the weakness of student learning motivation during the learning process of the two-circle

alliance tangent material. Weak student learning motivation will weaken learning activities (Güvendir, 2016; León et al, 2015; Skaalvik et al, 2015). Thus, based on all the researcher's observational data, it is suspected that prerequisite skills (referred to in this study as initial abilities) and learning motivation affect students' mathematics learning outcomes.

Based on the aforementioned theoretical background, this study presents an analysis of whether there is an influence of initial abilities and learning motivation on students' mathematics learning outcomes, as well as how much influence the two together have on students' mathematics learning outcomes.

▪ METHOD

Research Design

This study uses a correlational research design, where this study aims to determine how much influence the independent variables have on the dependent variable. In this study there are two independent variables (X), namely initial ability (X1) and learning motivation (X2), and one dependent variable (Y), namely the results of students' mathematics learning. Initial ability in this study is the ability to master the Pythagorean theorem material which is a prerequisite material for mastering the material concept of the common tangent of two circles. While student learning outcomes are students' ability to master the material tangents of the two-circle alliance. Initial ability data and student learning outcomes are taken from the documentation of scores on tests given by the teacher.

Research Subjects

The research was conducted at one of the junior high schools in Central Lampung Regency. The research subjects consisted of 30 class VIII students. The sampling technique used is cluster random sampling. This technique was chosen because the characteristics of students' abilities between one class and another have similarities.

Research Instruments

The research instrument consists of tests and questionnaires. The test instrument is used to obtain data on students' initial abilities and learning outcomes in mathematics. The test instrument used was the daily test questions on the Pythagorean theorem material (to measure initial ability) and the two-circle common tangent (to measure learning outcomes) made by the teacher which were then tested for validity and reliability. The results of the validity test of the test instrument items using the t test show that the initial ability test questions and learning outcomes are valid and feasible to use. Meanwhile, the reliability analysis of the questions used the Cronbach alpha show reliable test questions.

The questionnaire instrument was made to measure students' learning motivation. The learning motivation questionnaire consists of 30 statements with 5 options. The questionnaire was compiled based on five aspects consisting of 1) perseverance in learning, 2) tenacity in facing difficulties, 3) interest and attention in learning, 4) desire to excel, and 5) independence in learning. The questionnaire instrument before being used was tested for content validity by experts, item validity and reliability testing. The test results show that the questionnaire instrument is valid and reliable.

Data analysis

Research formulates three research hypotheses according to the research questions that have been asked. Testing hypotheses 1 and 2 uses simple linear regression analysis, while testing hypothesis 3 uses multiple linear regression analysis. Both analyzes are carried out if the data is normally distributed and satisfies the linearity test. The results of the normality test using SPSS software show the three research variables, namely initial ability (X1), motivation to learn (X2), and students' mathematics learning outcomes (Y) are normally distributed. Therefore, simple and multiple linear regression tests can be performed. In interpreting the level of relationship or correlation in simple and multiple linear regression, the table "Interpretation of Value Correlation Coefficient r" (Table 1).

Table 1. Interpretation of the correlation coefficient value of r

Coefficient interval	Criteria
0.00 – 0.199	Very low
0.20 – 0.399	Low
0.40 – 0.599	Moderate
0.60 – 0.799	High
0.80 – 1.000	Very High

▪ RESULT AND DISSCUSSION

Effect of Initial Ability on Mathematics Learning Outcomes

Initial ability in this study is the ability of students in mastering the Pythagorean theorem material. Pythagorean theorem material is material that is the basis or prerequisite in mastering the material common tangent of two circles (in this study as a variable learning outcomes in mathematics). Analysis of whether there is influence of initial ability (X1) on students' mathematics learning outcomes (Y) a simple linear regression test was carried out using SPSS.

Table 2. The coefficients of the regression equation between X1 and Y

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	26.273	7.108		3.696	.001
	Prior Knowledge	.669	.115	.739	5.801	.000
a. Dependent Variable: Learning Outcomes						

Table 3. Correlation coefficient between X1 and Y

		Learning Outcomes	Prior Knowledge
Pearson Correlation	Learning Outcomes	1.000	.739
	Prior Knowledge	.739	1.000
Sig. (2-tailed)	Learning Outcomes	.	.000
	Prior Knowledge	.000	.
N	Learning Outcomes	30	30
	Prior Knowledge	30	30

The linear regression equation between X1 and Y is determined from the table Coefficients (Table 2). Based on Table 2, the regression equation is obtained $\hat{Y}$=26,273+0,669X. Slope b=0,669 shows that an increase in the value of the initial ability of one unit will increase the average distribution of students' mathematics learning outcomes by 0,669. Meanwhile, the results of the linearity test showed a sig. less than 0.05, it means the relationship between X1 and Y has a linear pattern. Furthermore, the regression significance test was carried out to obtain F_{count} = 33.655 with sig. = 0.000 less than 0.05. This shows that there is a significant effect of initial ability on students' mathematics learning outcomes. The correlation between initial ability and students' mathematics learning outcomes is 0.739 (Table 3) and the value of 0.739 is relatively strong. These results illustrate that students with good initial abilities are likely to obtain good mathematics learning outcomes as well. On the other hand, students with low or low initial abilities are most likely to obtain low mathematics learning outcomes. This is in accordance with the hierarchical nature of mathematics, where past experience (as initial ability) has a big role in the smooth running of the next learning process. This is supported theoretically where past experience is the basis for gaining new experiences during the learning process (Hailikari, 2008; Hamalik, 2011; Rach & Ufer, 2020).

The hierarchical characteristics of mathematics give the sense that mathematical concepts are taught in stages or stages, where one particular concept is a prerequisite for learning other, more difficult concepts. Likewise, the Pythagorean theorem material is a prerequisite in mastering the common tangent material for two circles. Prerequisite concepts must be mastered first in order to master the next concept. This shows that initial ability or prerequisite ability is an important thing that must be considered in learning mathematics. Learning difficulties related to development often appear as learning difficulties caused by not mastering prerequisite skills (Abdurrahman, 2009; Joseph & Dwyer, 2015; Pioke et al, 2022). In this case, it can be said that initial abilities/prerequisites have an influence on students' mathematics learning outcomes (Busra et al, 2019; Hevriansyah & Megawanti, 2016; Osuafor & Njoku, 2016; Rahmadani et al, 2022) and also students' thinking skills including skills critical thinking (Razak, 2017).

Effect of Learning Motivation on Mathematics Learning Outcomes

Motivation to learn in this study is defined as the strength within students that generates activities and learning directions to achieve learning goals. Student motivation is something that needs attention because it involves the success of the learning process, especially in learning mathematics. Whether there is influence of learning motivation (X2) on students' mathematics learning outcomes (Y) a simple linear regression test was carried out using SPSS.

Table 4. The coefficients of the regression equation between X2 and Y

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	18.849	6.763		2.787	.009

Learning Motivation	.751	.104	.806	7.196	.000
a. Dependent Variable: Learning outcomes					

Tabel 5. Koefisien korelasi antara X_2 dan Y

Correlations

		Hasil Belajar	Motivasi Belajar
Pearson Correlation	Learning outcomes	1.000	.806
	Learning Motivation	. 806	1.000
Sig. (2-tailed)	Learning outcomes	.	.000
	Learning Motivation	.000	.
N	Learning outcomes	30	30
	Learning Motivation	30	30

Based on the calculations in Table 4, the regression equation for learning motivation and students' mathematics learning outcomes is obtained $\hat{Y}$=18,849+0,751X. Slope b=0,751 means that an increase in the value of one unit of learning motivation will increase the average distribution of students' mathematics learning outcomes by0.751. Linearity test shows relationship between X2 and Y has a linear pattern. Meanwhile, for the regression significance test, it was found that Fcount = 51.782 with sig. = 0.000 less than = 0.05. This means that there is a significant effect of learning motivation on students' mathematics learning outcomes. The correlation level between learning motivation and students' mathematics learning outcomes is 0.806 (Table 5), this value is classified as very strong. The very strong influence of learning motivation on students' mathematics learning outcomes is because learning motivation will provide direction for attitudes/activities in the learning process, so that all student activities are only focused on efforts to achieve the learning outcomes to be achieved.

High learning motivation is needed in the learning process for the realization of achieving optimal learning goals. Students with good learning motivation will appear in sincerity and persistence to be actively involved in learning activities, which include being active in asking questions, arguing, making conclusions, taking notes, summarizing, practicing something, doing evaluations and exercises in accordance with learning demands (Aunurrahman, 2010; Ng et al, 2016). Student motivation in studying mathematics is an important thing that can affect the improvement of students' mathematics learning outcomes (Azmidar & Malasari, 2022; Herges et al, 2017; Schukajlow et al, 2017).

On the other hand, students with low motivation are generally less able to endure learning longer and are less serious in doing assignments. Low student learning motivation can result in decreased learning activity so that learning objectives are not achieved optimally. The results of an empirical study in one of the junior high schools in Lampung district found several motivational aspects that were suspected of causing low student mathematics learning outcomes including: 1) students rarely asked questions even though in reality students did not understand the material taught by the teacher, 2) there were still many students who committed plagiarism (cheating) homework on other friends, and 3) the majority of students choose not to study when their math teacher is not present. The results of this study can be interpreted that

students who are less motivated will find it difficult to obtain optimal learning results, even though in fact the students' initial abilities are sufficient. But it is different with students who have high learning motivation, they will be more focused on attitudes/activities in the learning process so as to achieve optimal learning outcomes will continue to be sought. The results of this study are also supported by previous research which proves that student learning motivation has a very strong effect on mathematics learning outcomes (Capinding, 2022; Heriyati, 2017; El-Adl & Alkharusi, 2020; Garcíaa et al, 2016; Gupta & Zheng, 2020; Güvendir, 2016; Lestari, 2017; Skaalvik et al, 2015; Yu & Singh, 2016). Motivation can encourage students to engage in deep information processing and to persevere and exert effort to rise even when school subjects become boring or tiring (León et al, 2015). In-depth information processing is required for learned information to be retained and applied in a meaningful way.

Effect of Initial Ability and Learning Motivation on Mathematics Learning Outcomes

Analysis of the effect of initial abilities and learning motivation on student learning outcomes used multiple linear regression because more than one independent variable (predictor) and one dependent variable (criteria). The results of multiple linear regression analysis with SPSS are presented as follows.

Table 6. The coefficients of the multiple regression equation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	14.899	6.611		2.253	.033
	Prior Knowledge	.298	.137	.329	2.169	.039
	Learning Motivation	.530	.141	.568	3.745	.001

a. Dependent Variable: Learning outcomes

Based on the results of data analysis (Table 6), the regression equation for initial ability and learning motivation with students' mathematics learning outcomes is obtained=14.899+0.298 X1+0,530 X2. From this equation, it can be interpreted that an increase in the initial ability score of one unit will increase the value of the distribution for students' mathematics learning outcomes by 0.298 and an increase in the value of one unit's learning motivation will increase the value of the distribution for student mathematics learning outcomes by 0.530. Regression significance test analysis obtained Fcount = 31.667 with sig. = 0.000 less than 0.05, meaning that there is an influence of early ability and learning motivation on students' mathematics learning outcomes. The correlation level of X and Y is 0.837 and this correlation value is classified as very strong. The correlation level of 0.837 is greater than the correlation level of each initial ability and motivation to learn with students' mathematics learning outcomes, namely 0.739 and 0.806. This can be interpreted that the effect of initial abilities and learning motivation on students' mathematics learning outcomes is greater when compared to the

respective influences of initial abilities and learning motivation on students' mathematics learning outcomes. Good initial abilities will provide convenience and provision for students to be able to understand higher or more difficult mathematical concepts (Abdurrahman, 2009) and with high learning motivation students will be more focused in mastering each mathematical concept, which is interrelated and abstract (Çiftçin & Yildiz, 2019; Hamalik, 2011; Higgins et al, 2019; Kriegbauma et al, 2015; Park et al, 2016). Thus, good initial abilities supported by high learning motivation will have a major influence on student mathematics learning outcomes.

▪ CONCLUSION

Initial ability and motivation to learn are important factors and determine success in the learning process. Based on the results of the study it can be concluded that: (1) there is an influence of early abilities on students' mathematics learning outcomes with a strong correlation level (0.739), meaning that early abilities contribute greatly to students' mathematics learning outcomes (by 55%). The regression equation obtained for the initial abilities and results of students' mathematics learning is=26.273+0.669 X. (2) there is an effect of learning motivation on students' mathematics learning outcomes with a very strong correlation level (0.806) with a contribution of 65% and we get a regression equation=18,849+0.751 X. (3) initial ability and learning motivation together have a very strong influence on students' mathematics learning outcomes (correlation level 0.837) with a contribution of 70% and a regression equation is obtained=14.899+0.298 X1+0,530 X2. The correlation level in the multiple regression analysis is higher than the correlation level in the simple regression. In other words, the effect of initial ability and learning motivation is greater than the effect of each initial ability and learning motivation on student mathematics learning outcomes. This study implies that in an effort to improve students' mathematics learning outcomes, teachers need to instill prerequisite concepts so that students will be more optimal in accepting higher material concepts. Teachers also need to be motivators to foster enthusiasm and motivation for student learning so that they can optimize learning processes and outcomes.

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