

The Effects of Learning Styles and Learning Motivation on Mathematics Achievement Among Seventh-Grade Students at SMP Makassar Raya

Abdul Hamid¹, Mulyati^{2*}, Nasruddin³, Alfiana⁴

^{1, 2, 3} STKIP YPUP Makassar

⁴ Universitas Sembilanbelas November Kolaka

Corresponding Author: Mulyati mulyatiypup@gmail.com

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ABSTRACT

This study aimed to examine the effects of learning styles and mathematics learning motivation on mathematics achievement among seventh-grade students at SMP Makassar Raya. The study employed a quantitative approach with an ex post facto design. The population comprised 30 seventh-grade students in a single class. All members of the population were included in the sample using total population sampling. The data were analyzed using descriptive and inferential statistics. The descriptive analysis revealed that the mean learning style score was 72.23, with a standard deviation of 9.464, classified as high; the mean mathematics learning motivation score was 72.73, with a standard deviation of 5.172, classified as high; and the mean mathematics achievement score was 80.83, with a standard deviation of 5.402, classified as very high. The inferential analysis indicated that learning styles and mathematics learning motivation jointly predicted mathematics achievement significantly, with the regression equation $\hat{Y} = 18.937 + 0.2247X_1 + 0.6278X_2$ and a coefficient of determination of $R^2 = 0.963$. Together, these variables explained 96.3% of the variance in mathematics achievement. Thus, learning styles and mathematics learning motivation were jointly significant predictors of students' mathematics achievement, with positive regression coefficients

INTRODUCTION

Education encompasses all learning experiences that occur in various environments throughout life. According to Mudyahardjo (as cited in Kadir et al., 2012, p. 59), education includes a range of life situations that influence individual growth and development. Education plays an essential role in improving the quality of human resources. As science and technology advance, education is needed to broaden individuals' perspectives and develop their capacity to respond to contemporary demands (Daniati et al., 2020, p. 224). From a legal perspective, Article 1, Paragraph (1) of Law Number 20 of 2003 on the National Education System defines education as a conscious and planned effort to establish a learning environment and learning process that enable students to actively develop their potential. This development encompasses religious and spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by individuals, society, the nation, and the state (as cited in Awwaliyah & Baharun, 2018, p. 43). Accordingly, education is directed toward the holistic development of students' knowledge, skills, character, and potential.

Mathematics is one of the disciplines that contributes to the development of students' thinking abilities. Its abstract subject matter requires instructional strategies that help students understand concepts progressively. According to Prabowo and Rahmawati (2013, p. 125), teachers need to use appropriate instructional media or teaching aids to support students' understanding of mathematical concepts. In addition to dealing with numbers and operational procedures for solving problems, mathematics can be regarded as a symbolic language for expressing concepts and relationships precisely. James and James (as cited in Awaludin et al., 2021, p. 1) define mathematics as the science of logic concerning shapes, structures, quantities, and interrelated concepts, encompassing three main fields: algebra, analysis, and geometry. Meanwhile, Johnson and Rising view mathematics as a way of thinking and organizing logical proofs. Based on these perspectives, mathematics can be understood as a discipline that examines abstract concepts and their relationships through symbols and logical, systematic reasoning. These characteristics should be considered when designing instruction that addresses students' learning needs.

An interview conducted by the researcher with a mathematics teacher at SMP Raya Makassar on October 18, 2021, indicated that teachers had not fully identified individual students' learning styles. According to the teacher, instruction tended to focus on presenting subject matter, while students' understanding was not always monitored comprehensively. Some students also experienced difficulties adapting their learning approaches to the instructional methods used. Although identifying learning styles was considered important, teachers tended to give greater attention to students who actively participated in class. These conditions were suspected to be related to the low assignment and test scores of some students. Learning styles are one aspect that can be examined to understand students' preferences for receiving and processing information. In their book *Quantum Learning*, DePorter and Hernacki suggest that understanding learning styles can help individuals improve their performance in school, at work, and in interpersonal relationships (as cited in Budiarti & Jabar,

2016, p. 142). In mathematics instruction, understanding students' learning characteristics can inform the design of learning activities that respond to their needs. In addition to learning styles, mathematics learning motivation warrants examination in relation to students' achievement. These theoretical perspectives and preliminary findings provide a basis for empirically examining the effects of learning styles and mathematics learning motivation on mathematics achievement. Therefore, this study is entitled "The Effects of Learning Styles and Learning Motivation on Mathematics Achievement among Seventh-Grade Students at SMP Raya Makassar."

METHODS

This study employed a quantitative approach with an ex post facto design. A quantitative approach uses numerical data analyzed through statistical techniques (Khalifa Mustamin, 2015, p. 13). Ex post facto research involves a systematic empirical investigation in which the independent variables are not manipulated because the conditions under investigation have already occurred or cannot be manipulated. In this study, learning styles and mathematics learning motivation served as the independent variables, while mathematics achievement served as the dependent variable. The relationships among these variables were analyzed without administering any intervention to the students. The study was conducted at SMP Raya Makassar in Makassar, South Sulawesi, Indonesia.

Research Design

This study employed an ex post facto design involving two independent variables and one dependent variable. The independent variables were learning styles (X_1) and mathematics learning motivation (X_2), while the dependent variable was students' mathematics achievement (Y). This design was used to analyze the relationships between the independent and dependent variables without manipulating the variables under investigation.

Population and Sample

Population

According to Sugiyono (2016, p. 117), a population comprises objects or individuals with specific qualities and characteristics defined by the researcher for investigation and the drawing of conclusions. The population in this study comprised all 30 seventh-grade students at SMP Raya Makassar during the 2022/2023 academic year.

Sample

This study used total population sampling, in which all members of the population were included in the sample. The sample comprised 30 seventh-grade students in a single class at SMP Raya Makassar, consisting of 13 male and 17 female students.

Research Variables and Operational Definitions

Research Variables

This study involved two independent variables and one dependent variable. The independent variables were learning styles (X_1) and mathematics learning motivation (X_2), while the dependent variable was students' mathematics achievement (Y).

Operational Definitions

Operational definitions were established to clarify the meaning and measurement of each variable examined in the study. These definitions were intended to ensure consistent interpretation of learning styles, mathematics learning motivation, and mathematics achievement among seventh-grade students at SMP Raya Makassar.

Data Collection Techniques

The data in this study were collected through questionnaires and document review.

1. Questionnaires

A questionnaire is a data collection instrument consisting of written questions or statements that respondents are asked to answer (Sugiyono, 2015, p. 199). In this study, questionnaires were used to collect data on students' learning styles and mathematics learning motivation. The questionnaires employed a Likert scale with response options ranging from Strongly Agree to Strongly Disagree.

2. Document Review

Document review was used to obtain data from relevant records, such as students' grade records. In this study, these records were used to collect mathematics achievement data for seventh-grade students at SMP Raya Makassar.

Research Instruments

A research instrument is a tool used by researchers to collect data through measurement (Eko Putro Widoyono, 2014, p. 51). This study used questionnaires to measure students' learning styles and mathematics learning motivation.

Questionnaires

The questionnaires consisted of closed-ended items using a Likert scale. Respondents were asked to select one of the available response options for each statement. The response options ranged from Strongly Agree to Strongly Disagree. The response options and scoring criteria are presented below:

Tabel 1. Skala Likert

Jawaban Pertanyaan	Bobot Nilai	
	Bila Positif	Bila Negatif
1. Strongly Agree (SA)	5	1
2. Agree (A)	4	2
3. Undecided (U)	3	3
4. Disagree (D)	2	4
5. Strongly Disagree (SD)	1	5

Document Review Guide

The document review guide was used to collect and record students' mathematics achievement data from their report card grades for one semester.

Data Collection Techniques

The data in this study were collected using the following techniques:

Questionnaires

A questionnaire is a data collection instrument consisting of written questions or statements that respondents are asked to answer (Sugiyono, 2015, p. 199). In this study, questionnaires were used to collect data on students' learning styles and mathematics learning motivation. The questionnaires employed a Likert scale with response options ranging from Strongly Agree to Strongly Disagree.

Document Review

Document review was used to collect data from relevant documents, such as academic records or students' grade records. In this study, mathematics achievement data were obtained from students' report card grades for one semester.

Validity and Reliability Testing

Instrument Validity

Validity refers to the extent to which an instrument accurately measures the intended attribute. Before use, the questionnaires were reviewed by validators to assess the alignment of the items with the variable indicators and the clarity of the statements. This review provided evidence of content validity and the alignment of the items with the constructs being measured.

Item validity was subsequently examined by correlating each item score with the total questionnaire score using the Pearson product-moment correlation. The following formula was used:

$$r_{xy} = [n\sum XY - (\sum X)(\sum Y)] / \sqrt{\{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]\}}$$

Where:

- r_{xy} = correlation coefficient between the item score and the total score;
- n = number of respondents;

- X = item score;
- Y = total questionnaire score;
- Σ = summation.

The calculated correlation coefficient was compared with the critical r value at a significance level of .05, with $n - 2$ degrees of freedom. An item was considered valid if its correlation coefficient was positive and exceeded the critical r value. Items that did not meet this criterion were considered invalid (Sugiyono, 2016, p. 228).

Instrument Reliability

Instrument reliability refers to the consistency of measurement results obtained when an instrument is administered to the same participants under relatively similar conditions. A reliable instrument produces reasonably consistent measurement results. The level of reliability is expressed by a reliability coefficient calculated using a method appropriate to the characteristics of the instrument

$$r = \frac{K}{(K - 1)} \left\{ 1 - \frac{\sum s_i^2}{s_t^2} \right\}$$

(Sugiyono, 2016, p. 365).

To determine whether an instrument is reliable, the calculated coefficient is compared with the critical value at a significance level of $\alpha = .05$. If the $r_{hitung} > r_{tabel}$ calculated coefficient exceeds the critical value, the instrument is considered reliable; otherwise, $r_{hitung} < r_{tabel}$ it is considered unreliable (Hasan, 2013, p. 311).

Data Analysis Techniques

Descriptive Statistical Analysis

Descriptive statistical analysis was used to summarize the score characteristics of each research variable. The data were presented in frequency and percentage distribution tables and summarized using the mean, median, mode, standard deviation, variance, maximum, minimum, and range (Sugiyono, 2016, p. 46).

Inferential Statistical Analysis

Inferential statistical analysis was used to test the research hypotheses. Before hypothesis testing, normality and linearity tests were conducted to assess the relevant assumptions.

a. Normality Test

The normality test was conducted to determine whether the residuals of the regression model were normally distributed.

b. Linearity Test

The linearity test was conducted to assess whether the relationship between each independent variable and the dependent variable was linear. Testing was

performed at a significance level of 5% ($\alpha = .05$). The multiple linear regression equation is as follows:

$$Y = b_0 + b_1X_1 + b_2X_2$$

c. Calculating the Correlation Coefficient

The Pearson product-moment correlation coefficient was calculated using the following formula:

$$r_{X_1.X_2} = \frac{n \sum X_1X_2 - (\sum X_1)(\sum X_2)}{\sqrt{\{n \sum X_1^2 - (\sum X_1)^2\}\{n \sum X_2^2 - (\sum X_2)^2\}}}$$

d. Significance Test of the Correlation Coefficient

The following hypotheses were formulated to test whether there was a statistically significant relationship between the independent and dependent variables:

H_0 : $\rho = 0$; there is no statistically significant relationship between the independent and dependent variables.

H_1 : $\rho \neq 0$; there is a statistically significant relationship between the independent and dependent variables.

Statistical Hypotheses

To test the research hypotheses, the statistical hypotheses were formulated as follows:

1. Hipotesis I

$H_0 : \beta_1 \leq 0$ lawan $H_1 : \beta_1 > 0$

2. Hipotesis II

$H_0 : \beta_2 \leq 0$ lawan $H_1 : \beta_2 > 0$

3. Hipotesis III

$H_0 : \beta_1 \leq 0$ dan $\beta_2 \leq 0$ lawan $H_1 : \beta_1 > 0$ dan $\beta_2 > 0$

DISCUSSION

1. The Effect of Learning Styles on Mathematics Achievement among Seventh-Grade Students at SMP Raya Makassar

The descriptive analysis showed that the learning style scores of seventh-grade students at SMP Raya Makassar were classified as high. The mean questionnaire score was 72.23, falling within the interval of 67–79, with a standard deviation of 9.464, a variance of 89.564, a median of 70.00, and a mode of 68. Testing of the first hypothesis indicated that learning styles were a significant predictor of students' mathematics achievement. The positive regression coefficient indicated that higher learning style scores were associated with higher mathematics achievement. This interpretation refers to the scores obtained from the questionnaire and should therefore be considered in relation to the specific learning style indicators measured. Given the ex post facto design, the finding demonstrates a statistical relationship and does not establish causality. This finding may inform teachers' consideration of students' learning characteristics and needs when

designing mathematics instruction. Teachers can provide varied learning activities, including visual representations, oral explanations, discussions, and problem-solving exercises. These activities should be selected according to the learning objectives and the characteristics of the subject matter, alongside ongoing monitoring of students' understanding. Accordingly, the findings may serve as a basis for developing instruction that responds more effectively to students' learning needs.

2. The Effect of Learning Motivation on Mathematics Achievement among Seventh-Grade Students at SMP Raya Makassar

The descriptive analysis showed that mathematics learning motivation among seventh-grade students at SMP Raya Makassar was classified as high. The mean motivation questionnaire score was 72.73, falling within the interval of 67–79, with a standard deviation of 5.172, a variance of 26.754, a median of 73.00, and a mode of 77. Hypothesis testing indicated that mathematics learning motivation was a significant predictor of students' mathematics achievement. The positive regression coefficient indicated that higher mathematics learning motivation was associated with higher mathematics achievement. This finding suggests that students with stronger learning motivation tended to achieve better learning outcomes. However, given the *ex post facto* design, this relationship should be interpreted as a statistical association and does not establish causality. Learning motivation refers to the drive that directs and sustains students' engagement in learning activities. The findings may inform teachers' efforts to support learning motivation by creating an enjoyable learning environment, establishing clear learning goals, providing constructive feedback, and offering opportunities for active participation. These efforts can be directed toward supporting students' engagement in mathematics learning.

3. The Effects of Learning Styles and Learning Motivation on Mathematics Achievement among Seventh-Grade Students at SMP Raya Makassar

The descriptive analysis showed that mathematics achievement among seventh-grade students at SMP Raya Makassar was classified as very high. The mean mathematics achievement score was 80.83, falling within the interval of 80–100, with a standard deviation of 5.402, a variance of 29.178, a median of 80.00, and a mode of 80. These statistics describe students' mathematics achievement based on the report card grades used in this study. The individual hypothesis tests indicated that learning styles and mathematics learning motivation were each significant predictors of mathematics achievement. Both regression coefficients were positive, indicating that higher learning style and motivation scores were associated with higher mathematics achievement after accounting for the other independent variable in the model. The overall hypothesis test rejected the null hypothesis, indicating that learning styles and mathematics learning motivation jointly predicted mathematics achievement significantly. The regression equation was $\hat{Y} = 18.937 + 0.2247X_1 + 0.6278X_2$, with a coefficient of determination of $R^2 = 0.963$. Together, these variables explained 96.3% of the variance in mathematics achievement within the study sample, while the

remaining 3.7% was not explained by the model. These findings highlight the relevance of considering students' learning characteristics and motivation in mathematics instruction. However, given the ex post facto design, the results indicate statistical associations and do not establish causality. Furthermore, the study involved 30 students in a single class, so caution is needed when generalizing the findings beyond the group studied.

CONCLUSION

Based on the findings and discussion, the following conclusions were drawn:

1. Learning styles were positively and significantly associated with mathematics achievement among seventh-grade students at SMP Raya Makassar, with a t value of 18.643. The coefficient of determination of 92.73% indicated that the model using learning styles as a predictor explained 92.73% of the variance in mathematics achievement within the study sample.
2. Mathematics learning motivation was positively and significantly associated with mathematics achievement among seventh-grade students at SMP Raya Makassar, with a t value of 22.461. The coefficient of determination of 94.68% indicated that the model using mathematics learning motivation as a predictor explained 94.68% of the variance in mathematics achievement within the study sample.
3. Learning styles and mathematics learning motivation were jointly significant predictors of mathematics achievement among seventh-grade students at SMP Raya Makassar, with an F value of 360.811 and positive regression coefficients. The coefficient of determination of 96.3% indicated that the two variables jointly explained 96.3% of the variance in mathematics achievement within the study sample.

These findings indicate statistical associations and do not establish causality because the study employed an ex post facto design.

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