Performance Analysis of Mathematics Learning Outcomes Based on Logical-Mathematical and Linguistic Intelligence

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ABSTRACT

This Study Investigates the Relationship Between Logical-Mathematical and Linguistic Intelligence in Influencing Students' Mathematics Learning Outcomes. Data Were Collected from Middle School Students Through Standardized Tests and Analysed Using Statistical Methods. This Research Design Is Quantitative Correlation Using the Dummy Regression Method. The Research Sample Is 60 Students of Lab school Fip Umj Junior High School Indonesia, Which Was Determined by Stratified Random Sampling Technique. Results Indicate That Logical-Mathematical Intelligence Has a Strong Positive Correlation with Problem-Solving and Numerical Skills, While Linguistic Intelligence Significantly Contributes to Understanding Word Problems and Communicating Mathematical Ideas. The Findings Recommendation That a Balanced Approach Targeting Both Intelligences Could Enhance Overall Mathematics Performance.

Keywords: Logical-Mathematical Intelligence; Linguistic Intelligence; Mathematics Learning Outcomes

INTRODUCTION

Education Is One of the Important Elements in Shaping Individuals Who Are Intelligent, Creative, And Have Character. In The Learning Process, Student Success Depends Not Only on Environmental Factors and Learning Methods, But Also on Students' Individual Intelligence. Howard Gardner, In His Theory of Multiple Intelligences, Argues That Intelligence Is Not Just Limited to Traditional Academic or Intellectual Abilities, As Measured In Traditional Iq Tests. Instead, He Identified At Least Eight Different Types of Intelligence, Each of Which Falls Under a Specific Domain (Davis Et Al., 2011). The Eight Types of Intelligence Referred To (Gardner, 1987) Are (1) Verbal-Linguistic, Which Is the Ability to Use Words Effectively, Both in Speaking and Writing. (2). Logical-Mathematical, Which Is the Ability to Use Logic, Numbers, And Abstract Thinking. (3). Visual-Spatial, Which Is the Ability to Understand Space and Use Images and Visualization. (4). Musical-Rhythmic, The Ability to Understand and Produce Music and Rhythm. (5). Bodily-Kinesthetic, The Ability to Use the Body Skilfully and In a Coordinated Manner. (6). Interpersonal, The Ability to Understand and Interact with Others. (7). Intrapersonal, The Ability to Understand Oneself, Introspect, And Have Strong Self-Awareness. (8). Naturalist, The Ability to Understand Nature and Patterns in Nature.

Logical-Mathematical Intelligence Is One Of The Nine Multiple Intelligences, Where A Person Is Considered to Have Logical-Mathematical Intelligence If They Are Able and Interested in Processing Numbers, Both in Reading Data and Doing Calculations (Ndia, 2020). Logical-Mathematical Intelligence Is Related to the Ability to Think Systematically, Use Numbers, Perform Calculations, Find Cause-And-Effect Relationships, And Make Classifications (Al Ahmasi Et Al., 2024). At School, Children Characterized by Mathematical

Intelligence Often Enjoy Certain Subjects Such as Math, Computer Science, Technology, Drawing, Design, Chemistry, And the Like (Johar Et Al., 2023). Meanwhile, Linguistic Intelligence Refers to Someone Who Has the Ability to Use Words Effectively, Both in Speaking and Writing (Hali, 2017). Individuals With High Linguistic Intelligence Find Themselves Prominent in Occupations That Require Strong Communication, Such as Writers, Editors, Journalists, Teachers, Or Lawyers (Lunenburg and Melody, 2014).

Linguistic Intelligence Has Different Characteristics from Logical-Mathematical Intelligence (Šafranj, 2016), But Every Child Has the Opportunity to Have Multiple Types of Intelligence, Such as A Child Who Has Both Linguistic Intelligence and Logical-Mathematical Intelligence. Although Different in Focus and Form of Expression, Both Logical-Mathematical and Linguistic Intelligences Are Important Aspects of The Human Intelligence Spectrum and Can Contribute to Success in Many Areas of Life.

A Linguistically and Logically Mathematically Intelligent Child Is One Who Has Exceptional Abilities in Both Areas (Kuo Et Al., 2010). They May Have Excellent Abilities in Understanding and Using Language, And Have Strong Analytical and Problem-Solving Skills in The Context of Math and Logic. Providing Support and Stimulation That Matches Their Interests and Abilities Is Important to Help These Children Develop Optimally (Sarah Et Al., 2024). Stimulation Can Include Providing Access to Interesting Reading Materials, Providing Math Challenges That Are Appropriate to Their Intelligence Level, And Providing Opportunities to Participate in Activities That Strengthen Their Communication and Logic Skills.

The Uniqueness of Children Who Have Two Types of Intelligence with Different Characteristics Is Very Important to Observe to See the Development of Their Learning Outcomes at School. Children Who Have Multiple Intelligences Have Great Potential for Cognitive Development, So It Is Necessary to Conduct Research That Analyses the Two Types of Intelligence on Their Learning Outcomes at School (Yavich and Irina, 2020).

This Study Aims to Analyze the Effect of Mathematical Logical Intelligence and Linguistic Intelligence on Student Learning Outcomes, As Well As Contribute to the Development of Better Learning Strategies. The Results of This Research Are Expected to Have Novelty Value, By Exploring Linguistic Intelligence in The Context of Mathematics, This Research Also Paves the Way for An Inclusive Learning Approach That Better Appreciates the Diversity of Students' Ways of Learning. In Practice, Teachers Can Design More Diverse Learning, Ranging from Verbal Explanations, Discussions, To the Use of Visual Aids and Manipulatives. So That the Research Hypothesis Is That There Is an Effect of the Type of Mathematical Logical Intelligence and Linguistic Intelligence on Mathematics Learning Outcomes.

RESEARCH METHODS

The Subjects Used in This Study Were 7th Grade Students as Many As 2 Study Groups with A Total Of 60 Students, At Lab school University Muhammadiyah Jakarta Indonesia 2024/2025 Junior High School. The Subject Who Became the Research Sample Was Determined Using Stratified Random Sampling. This Research Analysis Uses Dummy Regression, Because It Involves Dummy Variables, Namely Mathematical Logic Intelligence and Linguistic Intelligence, Which Are Measured to See the Effect on Student Learning Outcomes. Dummy Variables Help Represent Non-Quantitative Category Characteristics in Regression Models (Hardy, 1993).

This Study Consists of Two Variables as Follows:

a. **Dependent Variable (Y)**:

Student Learning Outcomes, Measured By Mid-Semester Odd 2024/2025 Assessment Scores.

b. **Independent Variable**:

1) **Logical Mathematical Intelligence (Dummy)**:

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Categorized Into Two:

1: High (Intelligence Score Above a Certain Median/Quartile)

0: Low (Intelligence Score Below a Certain Median/Quartile)

2) **Linguistic Intelligence (Dummy)**:

Categorized Into Two:

1: High (Intelligence Score Above a Certain Median/Quartile)

0: Low (Intelligence Score Below a Certain Median/Quartile)

Regression Model Used: $Y = \beta_0 + \beta_1 D_{\text{Logika}} + \beta_2 D_{\text{Linguistik}} + \epsilon$

Description:

Y : Student Learning Outcomes

D_{Logika} : Dummy Logical Mathematical Intelligence.

$D_{Linguistic}$: Dummy Intelligence Linguistic.

β_0 : Constant Or Intercept.

β_1 : Regression Coefficient for Mathematical Logical Intelligence Dummy Variable.

β_2 : Regression Coefficient for Linguistic Intelligence Dummy Variable.

ϵ : Residual Model.

The First Step in Analysing the Data Was to Categorize the Mathematical and Linguistic Logic Intelligence Scores to Create Dummy Variables, 1 For High, And 0 For Low. The Next Step Was to Estimate the Dummy Regression Model with The Help of R 4.2.2 Software. Assumption Testing in Regression Analysis Involving Dummy Variables Is Important to Ensure the Validity and Reliability of The Model. By Fulfilling The Basic Assumptions, Researchers Can Ensure That the Regression Model Provides Accurate Results and Can Be Interpreted Correctly, And Avoid Wrong Conclusions from Data Analysis. The Assumption Tests That Must Be Met Include Normality of Variance, Homogeneity of Variance, Autocorrelation, And Multicollinearity (Bansal and Gurwinder, 2023).

The Hypothesis of This Study:

H_0: There Is No Significant Effect of Mathematical Logical or Linguistic Intelligence on Student Learning Outcomes.

H_a: There Is a Significant Effect of Mathematical Logical or Linguistic Intelligence on Student Learning Outcomes.

The Significance Test Is Carried Out by Looking at the P-Value for Each Coefficient, Which Is Compared with the Value of the 5% Significant Level.

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RESULTS AND DISCUSSION

Data Description

Based On Figure 1, Percentage Information From 60 Samples, Students With Male Gender Are More, Namely 35 (58%) Compared To Female Students, Namely 25 (42%).

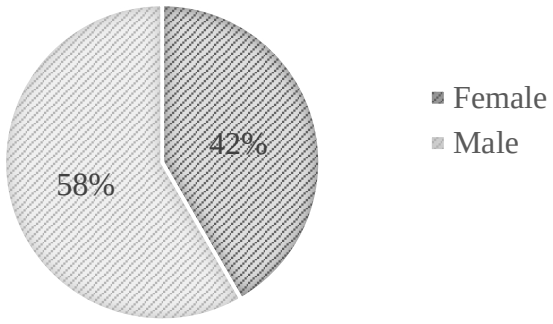

Figure 1. Subject Characteristics Based on Gender

The Distribution Of Student Learning Outcomes Data Is Shown In Figure 2, While The Description For Each Variable Is Shown In Table 1 And Table 2.

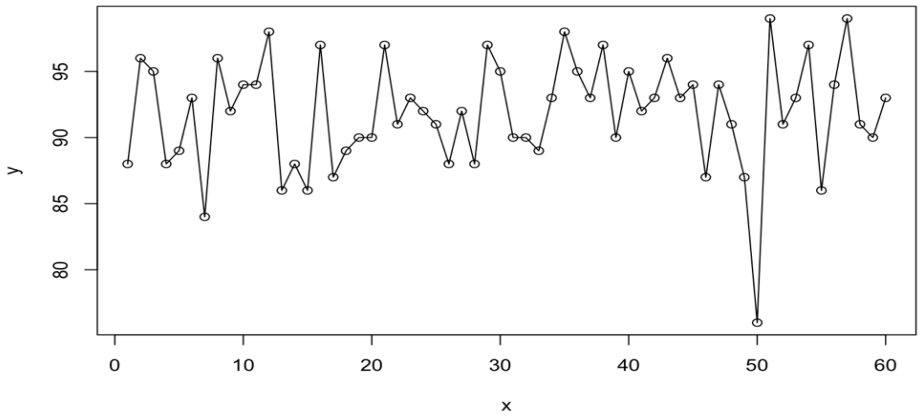

Figure 2. Learning Outcome Data Distribution

Table 1. Description Of Dependent Variable

Variable	**Description**					
Learning Outcomes	Min: 76	1st Quartile : 89	Median: 92	Mean: 91,83	3rd Quartile: 95	Max: 99

Table 2. Dummy Variable Description

	Mathematical Logical Intelligence	
Linguistic Intelligence	High	Low
High	11	19
Low	16	14

Figure 2 Is A Graph Showing the Learning Outcomes (Y) Achieved By 60 Students (X). It Appears from The Graph That the Tendency of Student Learning Outcomes Is in The Interval 85 To 95, And There Are Two Students Who Get Scores Less Than 85. A Detailed Description of The Learning Outcomes Data Is Shown in Table 1, The Learning Outcomes Data Obtained the Minimum Value Is 76, The Maximum Value Is 99, And the Average Value Is 91.83 With A Data Variance Of 17.70.

Table 2 Shows the Number of Students with High Mathematical Logical Intelligence Category and High Linguistic Intelligence as Many As 11 People, High Mathematical Logical Intelligence Category and Low Linguistic Intelligence as Many As 16 People, Low Mathematical Logical Intelligence Category and High

Linguistic Intelligence as Many As 19 People, And Low Mathematical Logical Intelligence Category and Low Linguistic Intelligence as Many As 14 People. Intelligence Scores for Both Logical Mathematical and Linguistic Categories Are a Minimum Of 0 And A Maximum Of 100. A Score in the High Category If It Is Greater Than the Medium Value Of 50, And A Score in The Low Category If It Is Less Than Equal To 50.

Classical Assumption Test

a. Normality Test

The Results of Normality Testing with The Kolmogorov-Smirnov Test Show That The P-Value Of 0.059 Is Greater Than the Significance Level Of 0.05. This Indicates That the Residual Data Distribution Is Normally Distributed.

b. Homoscedasticity Test

Homoscedasticity Testing Uses the Breusch-Pagan Test. The Homoscedasticity Test Is to Determine Whether the Error Variance (Residuals) Of the Regression Model Is Constant or Not. The Test Results Show That The P-Values Of 0.2959 Are Greater Than the Significance Level Of 0.05. Thus, It Can Be Decided That the Error (Residual) Of the Regression Model Is Constant.

c. Multicollinearity Test

One Way to Detect Multicollinearity Is by Calculating the Variance Inflation Factor (Vif) Value. The Vif Value of The Linguistic Intelligence Variable Is 1.998, And the Logical Mathematical Intelligence Variable Is 2.123, Each Obtaining a Vif Value of Less Than 10. So, It Can Be Concluded That There Is No Multicollinearity Violation in the Model.

d. Autocorrelation Test

The Autocorrelation Test Is Performed Using the Durbin-Watson Test. If The Durbin Watson Value Is Close To 2, The Violation Is Not Detected or There Is No Autocorrelation, Or by Observing The P-Value. The Results of The Autocorrelation Test Show a Durbin Watson Value Of 2, 0767 Close To 2 And A P-Value Of 0.6301 Greater Than the Significant Value Of 0.05. Thus, It Can Be Concluded That There Is No Autocorrelation Violation in The Model.

Results Of Regression Analysis Test

The Researcher Chose Regression Analysis to Find Out What Variables Are Statistically Significant to Statistics Learning Outcomes. Broadly Speaking, There Are 3 Things That Are Seen. First, The R-Square Value, The Aim Is to See the Proportion or Percentage of Variance in The Dependent Variable Explained by The Independent Variable as A Whole. Second, The Anova Table, The Purpose Is to Test Whether The R-Square Value Obtained Is Statistically Significant or To Test Simultaneously the Independent Variable on The Dependent Variable. Third, The Regression Coefficient Table, The Purpose Is to See the Significance of All Independent Variables on The Dependent Variable.

a. R Square Value

The R-Square Value Obtained Is 0.536 Or 53.6%, Meaning That the Variation in Learning Outcomes Is Influenced by The Independent Variables, Namely Mathematical Logical Intelligence, And Llinguistic Intelligence. While 46.4% Is Influenced by Other Factors.

b. Significance Test

Tests Regarding the Presence or Absence of the Influence of Each Independent Variable on the Dependent Variable Can Be Explained as Follows:

Variable	β	**S.E**	**T-Value**	**P-Value**
Linguistic Intelligence	4,600	1,074	4.282	0,000
Mathematical Logical Intelligence	6,367	1,109	5,740	0,000
Linguistic Intelligence * Mathematical Logical Intelligence	-1,445	1,5653	0,923	0,36

Linguistic Intelligence Variable Has a Positive Relationship Direction (4.600) And Significantly Affects Learning Outcomes. This Refers to the P-Value Of 0.000 Less Than the Significance Level Of 0.05. So, The Hypothesis (Ho) Is Rejected, And It Can Be Concluded That There Are Differences Between Students with High Linguistic Intelligence and Students with Low Linguistic Intelligence. Students With High Linguistic Intelligence Have Higher Learning Outcomes Of 4.600 Compared to Students with Low Linguistic Intelligence. The Results of This Study Are in Line with The Results of Previous Research Conducted by Handayani Et Al., (2021).

The Mathematical Logical Intelligence Variable Has a Positive Relationship Direction (6.367) And Significantly Affects Learning Outcomes. This Refers to the P-Value Of 0.000 Less Than the Significance Level Of 0.05. So, The Hypothesis (Ho) Is Rejected, And Can Be Concluded That There Are Differences Between Students with High Mathematical Logical Intelligence and Students with Low Mathematical Logical Intelligence. Students With High Mathematical Logical Intelligence Have Higher Learning Outcomes Of 6.367 Compared to Students with Low Mathematical Logical Intelligence. The Results of This Study Are in Line with The Results of Research Conducted by Saragih and Abdul Mu'in (2014).

The Interaction Between the Two Variables of Linguistic Intelligence and Mathematical Logical Intelligence Has a Negative Relationship Direction (1.445), But Does Not Significantly Affect Learning Outcomes. This Refers to the P-Value Of 0.36 Which Is Greater Than the Significance Level Of 0.05, So the Hypothesis (Ho) Is Not Rejected.

CONCLUSION

This Analysis Enables a Deeper Understanding of The Influence of Mathematical Logical Intelligence and Linguistic Intelligence on Student Learning Outcomes, By Considering the Intelligence Categories Separately. The Model Is Useful for Teachers and Educators to Design Learning Strategies That Suit the Needs of Students Based on Their Intelligence Type. Student Learning Outcomes Are Influenced by Both Linguistic Intelligence and Mathematical Logical Intelligence. The Variation of Mathematic Learning Outcomes Is Quite High Which Can Be Explained by Both Linguistic Intelligence and Mathematical Logical Intelligence Variables By 53.6%. This Research Has the Potential to Be Continued by Involving Other Types of Intelligence to See Their Influence on Learning Outcomes.

Based On the Research Results Obtained, Both Types of Linguistic and Logical Mathematical Intelligence Have a Significant Effect on Math Learning Outcomes. Thus, Recommendations From The Results Of This Study Include Teachers Must Know The Type Of Intelligence Possessed By Students, Use Innovative Learning Strategies And Can Have A Real Influence On Improving Students' Intelligence Consistently,

Provide Opportunities For Students To Continue To Practice, Experiment, And Learn In An Atmosphere That Supports The Exploration Of Ideas And Problem Solving, Provide A Comfortable Learning Space And Access To Various Reading Materials And Teaching Aids That Support Both Types Of Intelligence, And Provide Challenges That Are Slightly More Difficult Than Their Abilities Will Stimulate The Development Of Mathematical And Linguistic Logical Intelligence..

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Program Script with R Software

Install. Packages("Dt")

Install.Packages("Lmtest")

Library (Dt)

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```
Library (Readxl)

Library (Lmtest)

Library (Car)

Library (Cardata)

#Input

Data Dummy <- Read Excel ("/Users/Ismah/Documents/Riset Internal Umj/Data.Xlsx")

View (Data_Dummy)

Datatable (Data_Dummy, Class = 'Display')

Summary (Data_Dummy)

#Regresi Dmmy

Dummy <- Lm (Hb ~ Kl + Klm, Data = Data_Dummy)

Dummy

Hasil = Summary (Dummy)

Hasil

#Tes Normalitas

Ks. Test (Hasil$Residuals, "Pnorm")

#Tes Homogenitas

Bptest (Hasil, Studentize = False, Data = Dummy)

#Tes Autokorelasi

Dwtest (Hasil)

#Tes Multicollinearities

Vif (Dummy)

X<-Data_Dummy$No

Y<-Data_Dummy$Hb

Plot (X, Y, Xlab="X", Ylab="Y",Type="O")
```