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Critical Thinking and Self Learning Skills in Mathematics Learning Outcomes

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ABSTRACT

The purpose of this study is to determine the relationship of ability critical thinking and self-regulated learning with learning outcomes of Mathematic Student Class V State Elementary School City of Medan, the number of students as many as 153 students. The technique used to analyze the data is the statistical technique of regression and correlation.The research result showed that there was a positive correlation between (1) Critical thinking and Mathematics learning outcomes (2) Self-regulated learning Mathematics learning outcomes (3) Critical thinking, Self-regulated learning and Mathematics learning outcomes. It can be concluded there is relationship between critical thinking, self-regulated learning and Mathematics learning outcomes.

INTRODUCTION

Mathematics is a subject taught in Indonesia from elementary school to university and serves as a benchmark for student graduation, assessed through national exams. Mastery of mathematics, especially at the elementary school level, cannot be underestimated and consistently faces challenges over time. Mathematics is often associated with numbers, formulas, and various arithmetic operations, making it a less favored subject among students. This perception contributes to unsatisfactory mathematics learning outcomes, with students achieving lower results compared to subjects such as Science, Social Studies, and Indonesian Language.

A survey conducted by the Program for International Student Assessment (PISA), under the Organization for Economic Cooperation and Development (OECD), every three years since 2000, revealed that Indonesia ranks second lowest in the field of mathematical sciences. Another survey by the National Center for Education Statistics in 2003, covering 41 countries, positioned Indonesia at 39th place in mathematics learning, below Thailand and Uruguay.

Learning outcomes are not isolated; they result from various factors influencing students, both internal and external. Internal factors include intelligence, critical thinking skills, motivation, health, learning methods, and self-learning independence. External factors encompass family, school, and community environments. Critical thinking skills are believed to be closely related to mathematics, providing students with more accurate guidance in thinking, working, and establishing connections between concepts. Additionally, self-learning independence is considered a significant factor in students' academic achievements, requiring proactive engagement before and after the learning process.

Observations at Medan City Public Elementary Schools indicated suboptimal mathematics learning outcomes among students. Variations in learning outcomes were observed among students, with some achieving scores above the Minimum Mastery Criteria (KKM) and others below. The pre-observation interviews revealed that some students lacked motivation for learning mathematics. Interviews with teachers highlighted that the teaching approach tended to be abstract and delivered through lectures, without exploring alternative methods suitable for different materials and resources.

In conclusion, addressing the challenges in mathematics education requires considering both internal and external factors affecting students. Promoting critical thinking skills and fostering self-learning independence can contribute to improved mathematics learning outcomes. Additionally, adopting diverse and engaging teaching methods tailored to the material and available resources can enhance students' understanding and interest in mathematics.

The current teacher-centered approach in teaching makes the teacher the main driver of the learning process, with students only receiving information from the teacher. Learning activities are one-way, and students are rarely given the opportunity to express their ideas. This teaching method is ineffective as it does not support the development of critical thinking and self-learning independence in students. Ideally, to enhance critical thinking and self-learning independence in mathematics education, a more interactive and discovery-based learning approach should be designed. This approach aims to involve students actively in the learning process, allowing them to explore their potential and enhance their abilities.

Without active involvement during classroom learning, students cannot develop their capacity for critical thinking, reasoning, and solving mathematical problems accurately and robustly. According to De Porter (2001: 79), critical thinking is the practice or careful assessment and evaluation, such as judging the feasibility of an idea or product. Muhibbin defines rational and critical thinking as the manifestation of learning behavior, especially related to problem-solving. This implies that students with critical thinking skills will use principles and basic understanding in answering

questions like "how" and "why." In critical thinking, students are also required to use specific cognitive strategies to test the reliability of problem-solving ideas and address errors or shortcomings.

From the experts' opinions, it is understood that critical thinking involves the ability to think logically, reflectively, and productively, applied to assess situations for making sound considerations and decisions. Fisher (2009: 23) defines critical thinking as skilled and active interpretation and evaluation of observations, communication, information, and arguments. Furthermore, Johnson (2010: 125) states that critical thinking is an organized process that enables students to evaluate evidence, assumptions, logic, and language underlying other people's statements. From these expert opinions, it can be understood that critical thinking is a skillful and organized process allowing students to evaluate evidence from observations and communication, information, and arguments. The goal of critical thinking is to achieve deep understanding.

In addition to critical thinking skills, students' self-learning independence is closely related to the subject of mathematics. Barnadib (cited in Fatimah, 2006: 53) states that independence encompasses behaviors such as taking initiative, overcoming obstacles/problems, having self-confidence, and being able to do things on one's own without assistance from others.

Based on the above opinion, it can be understood that independence is a state where an individual has a competitive desire to progress for their own good, can make decisions and take initiatives to overcome challenges, has self-confidence in performing tasks, and takes responsibility for what they do. Seifert and Hoffnung (cited in Desmita, 2011: 12) define autonomy or independence as "the ability to govern and regulate one's own thoughts, feelings, and actions freely and responsibly while overcoming feelings of shame and doubt." This implies that independence or autonomy is the ability to control and regulate one's thoughts, feelings, and actions freely, making efforts to overcome feelings of shame and doubt independently.

Self-actualization tendencies influence various aspects of an individual. This drive towards self-actualization propels individuals forward towards the next level of maturity, followed by growth and self-adjustment. Therefore, it can be said that the drive for self-actualization originates from within the individual, and their activities are self-determined.

RESEARCH METHOD

This research utilizes a quantitative approach with a survey method and correlational techniques to depict the variables under investigation and simultaneously investigate the relationships among them. The study aims to provide evidence of the relationships between variables influencing mathematics learning outcomes (Y),

comprising critical thinking skills (X1) and self-learning independence (X2). The relationships among these three variables can be illustrated in the following diagram:

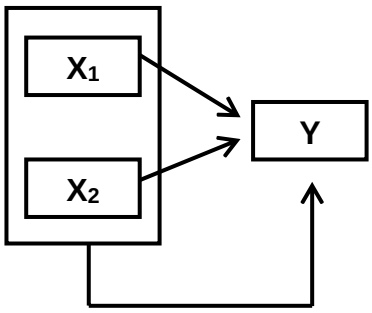

Figure 1.
Constellation of Research Problems

The population in this study comprises all fifth-grade students of State Elementary Schools in Medan. The target population (sampling frame) is 153 fifth-grade students of State Elementary Schools. The assessment of mathematics learning outcomes is in the form of a multiple-choice test with 25 items. The evaluation of critical thinking skills consists of 30 multiple-choice items. The assessment of self-learning independence is in the form of a questionnaire with 32 statements. Descriptive analysis involves three aspects: (a) presenting data in the form of frequency distribution and histograms, (b) measures of central tendency including mean, median, and mode, and (c) measures of data dispersion such as range, variance, and standard deviation.

Descriptive analysis for this study includes three variables: (Y) mathematics learning outcomes, (X1) critical thinking skills, and (X2) self-learning independence. Each variable is presented with frequency distribution and histograms, measures of central tendency, and measures of dispersion. Inferential analysis includes three aspects: correlation test, multiple correlations, and significance testing. Correlation analysis is used to determine the strength of the relationship between independent and dependent variables. Regression analysis is employed to estimate the value of variable Y based on the value of variable X and to estimate the change in Y for each unit change in variable X. Hypothesis testing in this study involves the use of t-tests, where the calculated t-value is compared to the critical t-value. The coefficient of determination is used to express the magnitude of the contribution of independent variables to the dependent variable.

RESULTS AND DISCUSSION

The data obtained from the mathematics learning outcome test, consisting of 25 questions with a total of 153 students. The scores of mathematics learning outcomes were obtained through data description calculations, revealing the mean (X) = 45.15, mode (Mo) = 44, and median (Me) = 44. The scores of mathematics learning outcomes

are organized into a frequency distribution in Table 1 and presented in the form of a histogram, as shown in the following table.

Table 1.
Frequency Distribution of Mathematics Learning Outcome Scores

Interval Class	Lower limit	Upper limit	Frek. Absolut	Frek. Relatif	Frek. Kumulatif
12 – 20	11,5	20,5	10	6,54%	6,54%
21 – 29	20,5	29,5	20	13,07%	19,61%
30 – 38	29,5	38,5	22	14,38%	33,99%
39 – 47	38,5	47,5	30	19,61%	53,60%
48 – 56	47,5	56,5	36	23,53%	77,13%
57 – 65	56,5	65,5	28	11,76%	88,89%
66 – 74	65,5	74,5	11	7,19%	96,08%
75 – 83	74,5	83,5	6	3,92%	100,00%
Jumlah			**153**	**100,00%**	

Based on the data table above, out of the 153 research samples, 30 students (19.61%) scored mathematics learning outcomes in the average group, and 52 students (33.99%) scored below the average group, while 81 students (46.40%) scored above the average group. The data obtained from the critical thinking skills test, consisting of 30 questions with a total of 153 students. The scores for critical thinking skills, obtained through data description calculations, reveal the mean = 45.80; mode = 43, median = 46.67; standard deviation = 14.733, and variance = 217.072. The scores for critical thinking skills are organized into a frequency distribution in Table 2 and presented in the form of a histogram, as shown in the following table.

Table 2.
Frequency Distribution of Critical Thinking Ability Scores

Interval Class	Lower limit	Upper limit	Frek. Absolut	Frek. Relatif	Frek. Kumulatif
13 – 20	12,5	20,5	11	7,19%	7,19%
21 – 28	20,5	28,5	8	5,23%	12,42%
29 – 36	28,5	36,5	16	10,46%	22,88%
37 – 44	36,5	44,5	39	25,49%	48,37%
45 – 52	44,5	52,5	26	16,99%	65,36%
53 – 60	52,5	60,5	28	18,3%	83,66%
61 – 68	60,5	68,5	15	9,8%	93,46%
69 – 76	68,5	76,5	8	5,23%	98,69%
Jumlah			**153**	**100,00%**	

Based on data from Table 2, out of 153 research samples, the scores for critical thinking skills in the average group consist of 26 students (16.99%), and 74 students

(48.37%) scored below the average group, while 53 students (34.64%) scored above the average group. The data obtained from the self-learning independence questionnaire, consisting of 32 questions with a total of 153 students. The scores from the Self-Learning Independence questionnaire, obtained through data description calculations, show the mean (X) = 111.30; mode (Mo) = 106; median (Me) = 111. The scores for self-learning independence are organized into a frequency distribution in Table 3 and presented in the form of a histogram, as shown in the following table :

Table 3.
Frequency Distribution of Learning Independence

Interval Class	Lower limit	Upper limit	Frek. Absolut	Frek. Relatif	Frek. Kumulatif
77 – 85	76,5	85,5	14	9,15%	9,15%
86 – 94	85,5	94,5	15	9,8%	18,95%
95 – 103	94,5	103,5	19	12,42%	31,37%
104 – 112	103,5	112,5	36	23,53%	54,90%
113 – 121	112,5	121,5	31	20,26%	75,16%
122 – 130	121,5	130,5	20	13,07%	88,23%
131 – 139	130,5	139,5	11	7,19%	95,42%
140 – 148	139,5	148,5	7	4,58%	100,00%
Jumlah			**153**	**100,00%**	

Based on the data table above, out of 153 research samples, the scores for self-learning independence in the average group consist of 36 students (23.53%), and 48 students (31.37%) scored below the average group, while 69 students (45.10%) scored above the average group. The first hypothesis proposed in this study states that there is a positive and significant relationship between critical thinking skills and mathematics learning outcomes, as indicated by the calculated t-value, which is significantly greater than the critical t-value at a significance level of $\alpha = 0.05$, namely 1.645. The calculated t-value is 6.936 > 1.645. The relationship pattern between these two variables is expressed by the regression equation $\hat{Y} = 20.658 + 0.535\ X1$. This equation indicates that the relationship between critical thinking skills and mathematics learning outcomes for fifth-grade students at SDN 060827, Medan Amplas Subdistrict, Medan City, is positive. This is evident in the regression coefficient or the value of b in the regression equation, which is a positive figure of 0.535. This implies that each increase in critical thinking by 1 unit will be followed by an increase in mathematics learning outcomes by a decrease of 0.535 units. Conversely, if critical thinking skills decrease by 1 unit, mathematics learning outcomes are more likely to decrease by 0.535 units. The value of the intercept coefficient a is 20.658, which means that if there is no critical thinking ability.

Based on the data table above, out of 153 research samples, the scores for self-learning independence in the average group consist of 36 students (23.53%), and 48

students (31.37%) scored below the average group, while 69 students (45.10%) scored above the average group.

The first hypothesis proposed in this study states that there is a positive and significant relationship between critical thinking skills and mathematics learning outcomes. This is indicated by the calculated t-value, which is significantly greater than the critical t-value at a significance level of α = 0.05, namely 1.645, or t-value 6.936 > 1.645.

The relationship pattern between these two variables is expressed by the regression equation $\hat{Y}$ = 20.658 + 0.535 X1. This equation indicates that the relationship between critical thinking skills and mathematics learning outcomes for fifth-grade students at SDN 060827, Medan Amplas Subdistrict, Medan City, is positive. The regression coefficient (b) is a positive figure of 0.535, implying that each increase in critical thinking by 1 unit will be followed by an increase in mathematics learning outcomes by a decrease of 0.535 units.

The coefficient of determination (R Square) is 0.242 or 24.2%, indicating a positive influence of students' critical thinking skills on mathematics learning outcomes, while the remaining 75.8% is attributed to other factors.

The second hypothesis states that there is a positive and significant relationship between self-learning independence and mathematics learning outcomes. This is indicated by the calculated t-value, which is significantly greater than the critical t-value at a significance level of α = 0.05, namely 1.645, or t-value 5.436 > 1.645.

The relationship pattern between these two variables is expressed by the regression equation $\hat{Y}$ = 1.583 + 0.394 X2. This equation indicates that the relationship between self-learning independence and mathematics learning outcomes for fifth-grade students at SDN 060827, Medan Amplas Subdistrict, Medan City, is positive. The regression coefficient (b) is a positive figure of 0.394, implying that each increase in self-learning independence by 1 unit will be followed by an increase in mathematics learning outcomes by a decrease of 0.394 units.

The coefficient of determination (R Square) is 0.164 or 16.4%, indicating a positive influence of students' self-learning independence on mathematics learning outcomes, while the remaining 83.6% is attributed to other factors.

The third hypothesis states that there is a positive and significant relationship between critical thinking skills, self-learning independence, and mathematics learning outcomes. This is indicated by the calculated t-value, which is significantly greater than the critical t-value at a significance level of α = 0.05, namely 1.645, or t-value 6.217 > 1.645.

The relationship pattern between these three variables is expressed by the regression equation $\hat{Y}$ = -9.681 + 0.461X1 + 0.305X2. This equation indicates that the relationship between critical thinking skills, self-learning independence, and

mathematics learning outcomes for fifth-grade students at SDN 060827, Medan Amplas Subdistrict, Medan City, is positive. The regression coefficients (b1 and b2) are positive, implying that each increase in critical thinking or self-learning independence by 1 unit will be followed by an increase in mathematics learning outcomes by a decrease of 0.461 or 0.305 units, respectively.

The result of the simple correlation analysis between critical thinking skills and self-learning independence with the mathematics learning outcomes of fifth-grade students at Elementary Schools in Medan City obtained a critical value (rtabel) of 0.579. From these results, it can be concluded that both variables are strong and positively correlated. Regarding the coefficient of determination analysis between variable X2 and Y, the R Square value is 0.335 or 33.5%. This indicates a positive influence of critical thinking skills and self-learning independence on the mathematics learning outcomes of fifth-grade students at Elementary Schools in Medan City, accounting for 33.5%, while the remaining 66.5% is attributed to other factors.

Discussion

Based on the results of the statistical tests, it is shown that critical thinking contributes significantly to mathematics learning outcomes. The higher the critical thinking skills of students, the higher their mathematics learning outcomes. Critical thinking skills are viewed as a directed and clear process used in learning activities such as problem-solving, decision-making, analytical abilities, and scientific research, as emphasized by Johnson's theory (2010: 125).

Similarly, student self-learning independence contributes significantly to mathematics learning outcomes. Positive self-learning independence makes students proactive in their learning activities independently based on their own motivation, without depending on others. On the other hand, if a student's self-learning independence is low, they may not be proactive in learning activities and tend to study only when instructed. Therefore, one of the factors to improve mathematics learning outcomes can be determined through student self-learning independence, which is a state where an individual has the desire to compete for personal advancement, makes decisions and takes initiatives to overcome challenges, has confidence in completing tasks, and takes responsibility for their actions. This is supported by Slavin's statement that a person with high self-learning independence will develop high self-confidence. Additionally, curiosity about various subjects tends to increase in individuals with high self-learning independence.

The statistical test results indicate that both critical thinking skills and self-learning independence together significantly contribute to mathematics learning outcomes. Higher critical thinking skills and positive self-learning independence provide an indication of high self-confidence, thus enhancing the mathematics learning outcomes of fifth-grade students at Elementary Schools in Medan City.

CONCLUSION

Based on the presentation of the findings above, it is concluded that the first hypothesis is accepted, indicating a positive relationship between students' critical thinking skills (X1) and mathematics learning outcomes (Y) for fifth-grade students at Elementary Schools in Medan City. The second hypothesis is accepted, signifying a positive relationship between self-learning independence (X2) and mathematics learning outcomes (Y) for fifth-grade students at SDN 060827 in Medan Amplas District, Medan City. The third hypothesis is accepted, indicating a positive simultaneous relationship between students' critical thinking skills (X1) and self-learning independence (X2) with mathematics learning outcomes (Y) for fifth-grade students at Elementary Schools in Medan City.

In line with the research findings, the researcher recommends several things for researchers, teachers, students, and educational institutions:

1. There is a need to enhance critical thinking skills and self-learning independence to improve students' mathematics learning outcomes. This requires support from various parties, especially fostering good collaboration between teachers and parents, as well as creating a conducive environment to support learning activities.
2. To achieve optimal learning outcomes, teachers should motivate students more frequently and provide opportunities for students to be active, creative, critical, and engage in interactions, enabling them to understand the material presented during the learning process at school.

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