



## The Influence of Student Initial Ability on Mathematics Learning Achievement Viewed from Critical Thinking Aspect

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### ABSTRACT

*There are many factors why the quality of education in Indonesia is low, and one of them is the learning process. Many factors affect the quality of the learning process, one of which is the initial ability of mathematics. Therefore, the purpose of this study is to determine whether student initial ability has any influence on mathematical achievement from the point of view of critical thinking. This research is a survey research with simple regression analysis which selected the sample of 52 out of 109 students from the first semester of the UINSU Medan Mathematics Education Study Program in 2022/2023 academic year. The instrument used in this study was a written test in the form of multiple choices, and the collected data would be analyzed descriptively and inferentially. From the results of data processing, it was found that initial abilities had a significant influence on mathematics learning achievement in terms of critical thinking skills. From the regression analysis, it was found that the regression equation  $Y = 40.929 + 0.589X$  which showed a positive correlation between initial ability and student achievement. In addition, it was also found that initial ability had an influence of 67.6% on learning achievement so it is necessary to improve initial ability to achieve high-quality learning achievement.*

Rendahnya kualitas pendidikan Indonesia disebabkan oleh banyak hal, diantaranya adalah proses pembelajaran. Banyak hal yang mempengaruhi kualitas proses pembelajaran, salah satunya adalah kemampuan awal matematika. Maka dari itu penelitian ini bertujuan untuk mengetahui apakah terdapat pengaruh kemampuan awal terhadap prestasi belajar matematika yang ditinjau dari aspek berpikir kritis. Penelitian ini termasuk penelitian survei dengan analisis regresi sederhana. Adapun sampel dalam penelitian ini dipilih sebanyak 52 orang dari 109 mahasiswa program studi pendidikan matematika UINSU Medan Semester 1 tahun akademik 2022/2023. Instrumen yang digunakan berupa tes tertulis dalam bentuk pilihan ganda. Data yang telah dikumpulkan akan dianalisis secara deskriptif dan inferensial. Dari hasil pengolahan data diperoleh bahwa kemampuan awal memiliki pengaruh yang signifikan terhadap prestasi belajar matematika ditinjau dari aspek kemampuan berpikir kritis. Dari analisis regresi ditemukan persamaan regresi  $Y=40,929 + 0,589X$  yang menunjukkan bahwa kemampuan awal memiliki hubungan yang positif dengan prestasi belajar mahasiswa. Selain itu juga ditemukan bahwa kemampuan awal memiliki pengaruh sebesar 67,6% terhadap prestasi belajar. Sehingga perlu untuk meningkatkan kemampuan awal agar mendapatkan prestasi belajar yang berkualitas.



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## INTRODUCTION

Education is an important thing in human life. In view of the importance of education, the Government has made separate provisions relating to education. The same statement is also stated in the contents of the 1945 Constitution which gives a mandate to the government to educate the nation's life as well as seek and organize a national teaching system regulated by law (Sujatmoko, 2016). This is evidenced by article 31 paragraph 4 which states that "The state prioritizes the education budget of at least twenty percent of the state revenue and expenditure budget as well as from the regional revenue and expenditure budget to meet the needs of implementing national education". The above-mentioned statements show that education is an important priority for the survival of a country.

Referring to Law No. 20 of 2003 concerning the National Education System (Rahman et al., 2021) it is emphasized that national education functions to develop capabilities and shape dignified national character and civilization in the context of educating the nation's life. The proper education can develop a good mindset of people which has an impact on creativity. Creative people can certainly shape a better life. According to these laws and regulations, the government seems to want education to be a pioneer in improving the quality of human resources. Salsabila (2020) noted that human resources are an important factor in creating a better life. The high-quality human resources can make the future of the country better.

Unfortunately, that expectation is not consistent with the reality that has already occurred. Many studies have shown that education levels in Indonesia remain low. Fitri (2021) states that education in Indonesia is very apprehensive. She also explained that the reasons for the low quality of Indonesia's education are at least a variety of factors, including gaps in facilities and infrastructure, lack of government support, myths circulating in the community, lack of quality teachers, and weak learning evaluation standards. The low quality of education can also be seen from the results of PISA in 2019 in which Indonesia was ranked 74th out of 79 countries that took the test (Kurniawati, 2022).

If further investigated, Angkotasana and Watianan (2021) reveal several factors in the quality of education: low physical education facilities, high educational costs, low student achievement, low teacher welfare, low relevance of education to needs, and uneven distribution of educational opportunities. One of the educational problems in Indonesia that need attention is the low student achievement.

Learning achievement is the result of a series of learning activities in areas such as cognitive, emotional, and psychological movement, which are written on the final transcript (Syafi'i et al., 2018). Of course, in every learning activity, we hope that students get good learning achievements. The same is true of learning mathematics. As one of the compulsory subjects, mathematics also expects students to have good learning achievements after participating in mathematics learning activities. This is stated in the learning goals of mathematics listed in the 2013 Curriculum, including (1) understanding mathematical concepts, (2) using patterns as conjectures in solving problems and being able to make generalizations based on existing phenomena or data (3) using reasoning on properties, manipulating mathematics both in simplification and in analyzing the existing components in solving problems in the context of mathematics and outside mathematics; (4) communicate ideas, reasoning and be able to compile mathematical proofs by using complete sentences, symbols, tables, diagrams or other media to clarify situations or problems; (5) have an attitude of appreciating the usefulness of mathematics in life; (6) have attitudes and behaviors that are in accordance with the values in mathematics and its learning; (7) perform motor activities that use mathematical knowledge; (8) using simple visual aids and technological results to carry out mathematical activities (Syahril et al., 2021).

From the objectives of learning mathematics, it can be seen that the government hopes the students to have good learning achievements after participating in mathematics learning. However, the reality does not live up to the expectation. In several studies, students were found to have low grades in mathematics. Eka (2018) stated that student achievement in class still did not meet the minimum completion criteria. There were only 11 of 38 students in the study achieved KKM. Of course, these results are not what schools and governments expect. Similarly, a higher education level study conducted by Rismawati (2018) found that PGSD students performed poorly in mathematics-related subjects. This can be seen from the final grades of these students.

The low learning achievement of students is caused by several factors. Salsabila (2020) pointed out that factors that affect students' learning achievement include students' physical condition, intelligence, interests and talents, as well as students' creativity, student motivation, school physical environment, class social environment,

and family social environment. All these factors have a great influence on students' learning achievement. When the problem of low-achievement of students appears, it is possible to analyze and study the factors that affect the low achievement of students.

One of the factors that affect students' learning achievement is their initial ability. Definitively, initial ability can be interpreted as the ability that students have possessed before they joined the lesson (Afniola et al., 2020). Initial ability is important in learning. It can help students understand the subject easily. Initial ability can describe how prepared students are to receive the lesson given by their teachers. Of course, this affects the quality and outcome of these learning activities. Therefore, it is important for teachers to understand the initial ability level of students. By understanding students' initial abilities, teachers can better design learning.

The importance of students' initial abilities can be seen in several studies. Among them, Lukman Gumadi (Putra & Sucitra, 2017) said that there is a positive correlation between initial abilities and learning achievement. In addition, Ni Kadek Sukiarti (Putra & Sucitra, 2017) showed a significant positive correlation between initial abilities and learning achievement. In her study, she explained that people with higher initial abilities tend to have higher learning achievements. On the contrary, people with moderate and low initial abilities tend to have moderate and low learning achievements.

The researchers above conclude that students' initial abilities have a significant influence on students' final abilities after participating in the lessons. There are some of the skills that students majoring in math education must have, even in math education programs. One of the skills that students must master is critical thinking. According to Putri, et al (2020) critical thinking is a must-have ability that allows students to take the initiative in solving problems, analyze everything to solve problems, evaluate ideas, and relate past knowledge to what they have learned. Furthermore Abdullah (2016) mentioned several critical thinking activities that must be carried out in the learning process, including (1) understanding and formulating problems; (2) collecting the necessary information; (3) formulating hypotheses; (4) proving the hypothesis; (5) draw conclusions (6) evaluate and (7) generalize. From this understanding, it can be seen that critical thinking is a high-level thinking skill that requires students to be able to solve problems through experimental activities carried out by associating all the information they have.

The Mathematics Education Study Program at UIN Sumatera Utara Medan also makes critical thinking one of the outputs that students must achieve. Students should have good critical thinking skills so that when they become teachers, they can become professional and competent educators (Uinsu, 2021). The urgency of critical thinking is also reflected in the competencies that must be achieved in the 21st century including critical thinking, logical thinking, creative thinking, collaborative thinking, communication ability, mastering information technology, and communication ability (Muhali, 2019). Therefore, every student is expected to have good critical thinking in every learning process.

As a form of mathematics learning outcomes, students' critical thinking abilities are also influenced by their initial abilities. Not infrequently, the critical abilities of today's students are influenced by their mathematical abilities when they were in high school. This was discovered by Firdha (Razak, 2018) in a study that there is a strong relationship between initial abilities and critical thinking skills in math of junior high school students.

Therefore, it is necessary to look at the influence of initial abilities on student achievement in terms of critical thinking skills. The problem statement in this research is "Does initial ability affect student mathematics learning achievement in terms of critical thinking skills?". In line with that, the purpose of this research is to observe the influence of initial abilities on students' mathematics learning achievement in terms of critical thinking skills

## METHOD

This research is quantitative research using *ex post facto* research with a survey method. The study was chosen because the researchers only selected data on the results of students who completed a semester of association and logic courses.

In the early stages, the researchers tested students' initial abilities in association and logic materials they had learned in high school. After the students completed the course on association and logic for one semester, the research team analyzed the results of their mathematics learning in terms of critical thinking skills and compared them with their initial abilities. From these two data, we can see the influence of initial abilities to the student's learning achievement from the critical thinking ability aspect.

This research was conducted under the Mathematics Education Study Program at the State Islamic University of North Sumatra. The populations of this study were 109 students who took the association and logic course in the first semester of the Mathematics Education Department. From this population, the researcher randomly selected samples of 52 students. There are two variables in this study; independent variable (X) for students' initial mathematical ability and dependent variable (Y) for student achievement in terms of critical thinking skills.

The data collected in this study were students' initial mathematical abilities data obtained from the pre-test and student achievement in terms of critical thinking skills data from the final test. The instrument used to obtain students' initial mathematical abilities data was a multiple-choice test. There were 20 questions related to mathematical association and logic that students had learned in high school, 10 questions related to association and 10 questions related to mathematical logic. The same thing was done with instruments to get data on student achievement using a multiple-choice test of 20 questions with details of 10 association questions and 10 questions of mathematical logic. As for the material, it was material that students had learned for one semester in the association and logic course.

After the data was collected, data analysis was carried out including descriptive statistical data analysis and inferential statistical analysis. In the descriptive statistical analysis, students' initial abilities will be grouped following the opinion of Abdorrahman Gintings (Razak, 2018) shown in Table 1.

Table 1. Student initial ability assessment category

Learning Achievement Scores	Category
80 – 100	Excellent
68 – 79	Good
55 – 67	Fair
45 – 54	Deficient
< 45	Poor

In addition, student learning achievement data in terms of critical thinking skills will be grouped based on the categories set by Arikunto (2008) shown in Table 2.

Table 2. Level of students' critical thinking skills category

Percentage of Critical Thinking Skills	Category
80 – 100	Excellent
65 – 79.99	Good
55 – 64.99	Fair
40 – 54.99	Deficient
0 – 39.99	Poor

On the other hand, linear regression test is used in inferential statistical analysis. According to Jaya (2019), regression tests are used to determine dependent variables, which can be predicted separately by independent variables. Regression analysis can determine whether the variation of the independent variable affects the dependent variable.

## RESULT

From the 109 students tested, it was found that the characteristics of the sample are heterogeneous. This can be seen from its cognitive abilities. Cognitive level is divided into three groups; upper, middle, and lower groups. Descriptively, students' initial abilities data and student learning achievement data in terms of critical thinking skills can be displayed as follow (Table 3):

Table 3. Summary of descriptive statistics calculation results

Statistics Data	Student Initial Ability	Student Learning Achievement
Lowest Grade	50	76.25

Statistics Data	Student Initial Ability	Student Learning Achievement
Highest Grade	85.5	93.25
Mean	74.17	84.59
Median	75.12	84.37
Modus	78.75	81.5
Varians	33.37	17.1
Standard Deviation	5.72	4.09

As can be seen from Table 3, students' initial abilities fall into the good category and their critical thinking skills fall into the excellent category.

The results of this study are also viewed statistically inferential. A simple linear regression test was used to observe the influence of initial ability on student learning achievement from the aspect of critical thinking ability with independent variable (X) for student initial mathematical ability and dependent variable (Y) for student achievement in terms of critical thinking skills. Before simple linear regression test, the classical assumption test which consists of a normality test and a linearity test is first carried out. If these two assumptions are met, a simple linear regression test can be performed.

The objective of the normality test is to determine whether the study sample comes from a population with a normal distribution or not. In this study, the normality test used the *Kolmogorov-Smirnov* test with the help of the SPSS program. The results of the test are shown in Table 4.

Table 4. Summary of normality test results

Data	Number of Samples	Asymp, Sig (2-tailed)	Significance Level	Conclusion
Student Initial Ability	52	0.633	0.05	Normal
Learning Achievement	52	0.851	0.05	Normal

Based on the results of data analysis in Table 4, the normality test on students' initial abilities was obtained 0.633 with a significance level of 0.05. This means that the data obtained can be distributed normally by  $0.633 > 0.05$ . Next, a test for student learning achievement data was performed and obtained a result of 0.851. Compared with the significant level, the result was  $0.851 > 0.05$ . In other words, student achievement data is normally distributed. Next, linearity tests were performed. Through this linearity test, we can know whether the two variables have linear patterns or not. The results obtained are  $0.3 > 0.05$  so that the initial ability data and mathematics learning achievement are linear. When the data meets the two required classical assumptions, a regression analysis can be performed. In this study, a simple regression analysis was conducted with the student's initial ability as the independent variable and learning achievement as the dependent variable in terms of critical thinking skills.

The results of the regression analysis using SPSS are shown in Table 5 below:

Table 5. Summary of regression test results

Independent Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig
	B	Std. Error	Beta		
KAM	40.929	4.284		9.554	0.000
	0.589	0.58	0.822	10.223	0.001

From Table 5, the regression equation can be compiled by  $Y = 40.929 + 0.589 X$ . This equation shows that every 1% increase in students' initial abilities will make student achievement increase by 0.589.

The t-test will be used to test this hypothesis. Using Table 5, it is known that the significance value 0.001 is less than the significance level 0.05, so it can be concluded that  $H_0$  is rejected and  $H_a$  is accepted. This means that there



is a significant influence between students' initial abilities on learning achievement in terms of critical thinking skills on students of the Mathematics Education Study Program.

In this study, the determination coefficient is also calculated to determine the magnitude of the influence of the independent variable on the dependent variable. The purpose is to see how much the influence of student initial ability on mathematics learning achievement from the aspect of critical thinking skills. By using SPSS, the calculation results for the coefficient of the determination coefficient is 0.676 or equal to 67.6 percent.

## DISCUSSION

As can be seen from the descriptive statistics in Table 3, the average initial ability of students is 74.17. Referring to the theory, the students' initial abilities belong to the good category. Even so, there are still students with moderate initial ability, even those who lack it. On the other hand, the learning achievement in terms of critical thinking skills is also shown at 84.59, which means that it falls into a very good category.

The data tabulation also shows that students with high initial ability have higher learning achievement, while those with moderate and low initial ability have moderate and lower learning achievement. This shows that the initial ability of mathematics has a contribution and influence on student achievement. This is in accordance with Piaget's theory (Nuryati & Darsinah, 2021) which states that every child who develops their thinking skills according to regular phase, a certain scheme or structure will appear at a certain phase of development, and the success at each phase is very dependent on the previous phase.

Jean Piaget's statement indirectly states that students' learning achievement is influenced by their initial abilities. Good initial ability is a sign of success at some phase of a student's life. This success will be the capital for students to succeed again in the next phase. Zulkarnain (2019) expressed the same view in his research at the Bina Generation Informatics Vocational School, Bogor, for the 2018/2019 Academic Year. The results of Zulkarnain's research show that initial ability has a positive effect on mathematics learning achievement.

Similarly, the results of the inferential statistics conducted show that there is an influence between initial ability and student achievement. First, the simple linear regression analysis produces the regression equation  $Y=40.929+0.589X$ . From this regression equation, it can be seen that initial ability has a positive influence on students' performance. Furthermore, the result of the determination coefficient also shows 67.6%. The data showed that the influence of the independent variable Student Initial Ability on the dependent variable Learning achievement in terms of critical thinking skills was 67.6%. The remaining 32.4% is influenced by other variables outside the regression equation.

As a result of the hypothetical test conducted, it was found that  $H_0$  was rejected and  $H_a$  was accepted. This shows that initial mathematics ability has a significant influence on mathematics learning achievement in terms of critical thinking skills. Students with good initial abilities will also be more likely to achieve good learning achievement. This is consistent with Agustyaningrum's analysis of Piaget's theory of learning. According to Agustyaningrum (2022) when learning math, teachers should first remind students of previous materials related to the recent learning materials. This will make it easier for students to understand the concept of learning materials.

This view indirectly confirms that initial ability is one of the factors that affect students' achievement. Improving students' initial abilities can improve their learning achievement. Supardi (2011) expressed the same thing that initial ability is the basic material or capital that someone can use to generate new information. Some of the above theories clearly reveal the influence between students' initial ability and learning achievement. Saputro (2015) conducted a similar study of active students in the IKIP PGRI Pontianak Mathematics Education Research Program in the 2013/2014 academic year. According to his findings, initial ability has a significant impact on students' learning achievement. Simbolon and Siahaan (2020) also found that initial mathematical ability had a 93.10 % impact on students' learning achievement.

From some of the relevant studies mentioned above, initial mathematical ability will be an asset for students to learn further learning materials. This will certainly affect the quality of students' mathematics achievement. In other words, students' initial mathematical abilities have a significant influence on mathematics learning achievement in terms of critical thinking skills.

## CONCLUSION

According to the data analysis and discussion, it can be concluded that student initial ability have a significant influence on their learning achievement in terms of critical thinking skills. It was also found that the effect of student initial ability on learning achievement was 67.6%.

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