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Research articles

The impact of habits of mind on students' mathematical reasoning: The mediating initial ability

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Abstrak Penelitian survei ini bertujuan untuk menganalisis hubungan kebiasaan berpikir dengan penalaran matematis yang dimediasi oleh kemampuan awal siswa. Responden terdiri dari 385 siswa kelas VIII. Data dikumpulkan menggunakan kuesioner melalui Google Form dan tes secara daring. Dari semua sampel yang menerima instrumen, ada 124 orang siswa menyelesaikan semua instrumen dengan lengkap. Instrumen pengumpulan data untuk variabel kebiasaan berpikir (X1) menggunakan angket dengan 32 pernyataan model skala Likert. Data penalaran matematis (Y) diperoleh melalui tes berupa 5 butir soal uraian pada materi relasi dan fungsi. Data kemampuan awal siswa (X2) diperoleh melalui tes objektif berupa 10 butir soal pilihan ganda pada materi himpunan dan koordinat kartesius. Data dianalisis menggunakan statistik deskriptif dan analisis jalur. Hasil penelitian menunjukkan terdapat pengaruh langsung antara kebiasaan berpikir siswa, kemampuan awal, dan penalaran matematis. Terdapat pengaruh tidak langsung kebiasaan berpikir terhadap kemampuan penalaran siswa melalui kemampuan awal sebagai variabel penengah. Temuan penelitian ini mencerminkan bahwa semakin baik kebiasaan berfikir siswa maka semakin baik pula kemampuan penalaran matematis dan kemampuan awal siswa.

Kata kunci *Kebiasaan berpikir, Kemampuan awal, Penalaran matematis, Analisis jalur*

Abstract This study aims to analyze the relationship between thinking habits and mathematical reasoning mediated by students' initial abilities. Respondents consisted of 385 years eight students. Data was collected using a questionnaire via Google Forms and online tests. From all samples, 124 students fully completed all instruments. A questionnaire with 32 statements of the Likert scale model was used to collect data on students' thinking habits (X1). Mathematical reasoning (Y) was examined through a test using five items of essay problems on relations and functions topic. The student's initial ability data (X2) was collected through an objective test using ten multiple-choice questions on set and Cartesian coordinates. The data was analyzed through descriptive statistics and path analysis. The results show a direct influence between students' habits of mind, initial ability, and mathematical reasoning. There is an indirect effect of habits of mind on students' reasoning abilities through initial ability as a moderator variable. The findings of this study indicate that the better the students' habits of mind, the better their mathematical reasoning and initial ability.

Keywords *Habits of mind, Initial ability, Mathematical reasoning, Path analysis*

Introduction

Students' reasoning is one of the concerns in mathematics education worldwide. PISA 2018 shows that several countries have average scores below 450 in mathematics, including the Philippines, Lebanon, Morocco, and Indonesia (Mitari & Zulkardi, 2019; Zaidi et al., 2019).

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TIMSS results also reveal that several countries have below-average mathematics scores, such as Kuwait, South Africa, and Indonesia (Mullis et al., 2016; Mandasari, 2021). For Indonesia, students' mathematical reasoning abilities is still under-performed (Fatra et al., 2022; Mejía-Rodríguez et al., 2021; Zubainur et al., 2020). This data is reinforced by the results of previous research, which indicated that the average percentage of students' mathematical reasoning abilities in the aspect of presenting mathematical models in writing and pictures, making conjectures, manipulating finding patterns, or the nature of mathematical phenomena needs improvement (Fadhillah, 2019; Priyani & Ekawati, 2018a). Thus, continuous studies on mathematical reasoning are essential to be carried out, including the current study that examines the effect of students' habits of mind on their reasoning mediated by initial mathematical ability.

Habits of mind and initial abilities have an important role in learning Mathematics. Hajerina (2017) and Juniawan (2020) reveal that habits of mind in the form of positive affective attitudes can improve students' mathematical reasoning. The more positive the student's attitude towards mathematics, the higher the motivation to learn. This could have positive impacts on students' learning outcomes (Hajerina, 2017; Juniawan, 2020; Sumiarto et al., 2020; Kilpatrick et al., 2002). In addition to the positive affective, students who have initial abilities find it easier to understand the subject of mathematics and will be able to reason well (Dwirahayu et al., 2018; Lestari, 2017; Kilpatrick et al., 2002). Therefore, to improve students' mathematical reasoning abilities, habits of mind and initial abilities could play essential roles.

Mathematical reasoning is pivotal to be possessed by students to achieve decent learning outcomes. It is a thinking process to draw conclusions based on facts or relevant data, concepts, and methods (Syaripuddin et al., 2020; Indriani et al., 2018). Among the efforts that can be made in improving students' reasoning is by facilitating habits of mind in the classroom. The ability to think appears when students are unable to solve problems easily. The characteristics of the habits of mind include making questions to solve problems, gathering evidence and choosing the right strategy for solving the problem (Askew, 2020; Yandari et al., 2019; Zubainur et al., 2020). This trait, in fact, has an associative relationship with reasoning ability (Indriani & Imanuel, 2018). The results of this study are expected to strengthen previous findings related to reasoning abilities and habits of mind relationships.

Several studies has been conducted to show that habits of mind are critical in learning mathematics (Hafni et al., 2019; Kusumaningrum, 2021; Matsuura et al., 2013; Prasad, 2020). Furthermore, some studies show the relationship between mathematical reasoning ability and student achievement (Athar et al., 2019; Muthma'Innah et al., 2019; Somatanaya, 2017), the contribution of mathematics to students reasoning ability (Kariadinata, 2012; Nizar, 2007; Sari et al., 2020), and the contribution of metacognition to increase students ability to learn mathematics (Lestari & Jailani, 2018). However, all of them show the general connection without a direct relation from the students mathematical reasoning to students' thinking habits and initial abilities. Therefore, the current study emphasizes the impact of habits of mind on students' mathematical reasoning through initial ability.

This study is structured with the following hypotheses.

Hypothesis I

H_0:: There is no direct effect of habits of mind on students' initial ability.

H_1:: There is a direct effect of habits of mind on students' initial ability.

Hypothesis II

H_0:: There is no direct effect of habits of mind on students' mathematical reasoning ability.

H_1:: There is a direct effect of habits of mind on students' mathematical reasoning ability.

Hypothesis III
H_0: There is no direct effect of initial ability on students' mathematical reasoning ability.
H_1: There is a direct effect of initial ability on students' mathematical reasoning ability.

Hypothesis IV
H_0: There is no indirect effect of habits of mind on mathematical reasoning abilities through students' initial ability.
H_1: There is an indirect effect of habits of mind on mathematical reasoning abilities through students' initial ability.

Theoretical Review

Mathematical reasoning is the ability of students to conclude according to available information and can be proven true (Askew, 2020; Mandasari, 2021; Sari et al., 2019). Similarly, mathematical reasoning is a process of concluding several ideas based on facts through logical and critical thinking in solving mathematical problems (Breen & O'Shea, 2019; Chong et al., 2019; Indriani et al., 2018). In other words, mathematical reasoning is a student's ability to think to solve problems through a process of logical, critical, analytical, systematic, and synthetic thinking. Indicators of reasoning ability include proposing conjectures, problem-solving skills, internalizing concepts, performing mathematical manipulations, drawing conclusions, checking the validity of an argument, and finding patterns or properties of mathematical phenomena to make generalizations (Mandasari, 2021; Maraza-Quispe et al., 2021; Mitari & Zulkardi, 2019).

Student's cognitive and affective aspects influence theoretically-conceptual abilities and mathematical reasoning. The intended cognitive aspect is students' prior knowledge or initial ability. This ability is a prerequisite for students to understand mathematics (Astuti, 2015; Sari et al., 2019), which also influence reasoning ability (Jeannotte & Kieran, 2017; Sumiarto et al., 2020). Having initial ability do support students learn new or advanced lessons (Mandasari, 2021).

In addition to the cognitive ability, an affective aspect of learning is students' attitude in learning mathematics (Chong et al., 2019; Jeannotte & Kieran, 2017). If students have a positive attitude toward mathematics, then these students will thrive to learn mathematics in any learning situation (Kilpatrick et al., 2002; Priyani & Ekawati, 2018a, 2018b; Purnomo, 2016). Habits of mind are attitudes and responses that characterize a person in solving complex problems (Altan et al., 2019; Costa & Kallick, 2008; Dwirahayu et al., 2018; Young, 2018). It is an individual's ability to persist or never give up, think in metacognition, ask questions and pose problems, and use past knowledge in new situations to solve problems at hand (Costa & Kallick, 2008). This study uses refers to these four indicators of habits of mind from Costa.

The first is persistence or never give up. Students with this habits of mind try to analyze problems and then develop systems, structures, or strategies to solve problems. When they fail to implement a strategy, they can immediately look for alternative solutions (Hendriana et al., 2018; Young, 2018). The second is metacognitive thinking; ability to know what they know and do not know (Matsuura et al., 2013; Tyaningsih et al., 2020). Students with this ability can describe the steps of problem-solving, explain the stages being carried out, and evaluate the problem-solving process. The third is asking and posing problems. It is a student's ability to find solutions to problems and ask for supporting data for the conclusions made. Students with this ability know how to ask questions to fill the gap between what they know and what they do not know. They will ask questions as supporting data that will be used in problem-solving and these questions will make their understanding better. The last is using past knowledge in new situations, where students in this category make analogies and relate old experiences to similar cases. When faced with a new and confusing problem, they will remember their knowledge and experience as a data source to solve it (Costa & Kallick, 2008; Uiterwijk-Luijk et al., 2019; Young, 2018).

Methods

The current study employed a survey method with a quantitative approach. This is a series of methods by studying samples to find interrelated events (Cohen et al., 2017). The sample in this study was 385 seventh grade secondary students, selected through a convenience sampling as part of the non-probability sampling. This sampling technique does not provide equal opportunities for each element or member of the population to be selected as sample members (Creswell, 2014). The convenience sampling was used because it was still a pandemic condition that did not allow researchers to meet directly with respondents. Of all respondents, only 124 students had complete answers.

A questionnaire consisting of 32 statements was utilized to collect data on habits of mind (X1). The scale used in the questionnaire was a Likert scale which consists of 4 alternative answers: SS (very often, 4 scores), SR (often, 3 scores), JR (rare, 2 scores), and JS (very rare, score 1). The excerpts of the questionnaire items used are presented in Table 1.

Table 1. The excerpts of the questionnaire items

No	Statement	Scale			
		1	2	3	4
1.	No matter how difficult it is, I try to finish math assignments				
2.	I seek various sources to solve difficult math problems				
3.	I can solve math problems correctly using my own way				

Data on mathematical reasoning ability (Y) was collected through a test in the form of an essay of 5 items on the relation and function material topics. For the data on students' initial abilities (X2), a multiple-choice test of 10 items was used on the set and Cartesian coordinates topic as a prerequisite for relation and function material. Figure 1 presents some examples of the test items.

Each test was first tested for validity and reliability using SPSS 26 software. The questionnaire was tested empirically on 124 respondents. A total of 32 items of the questionnaire were valid, so all items were used. Likewise, the reasoning and initial ability test are all valid. The validity test applied the product-moment correlation with a significance value of 0.05. The reliability test utilized the Alpha-Cronbach formula. The reliability test results showed that the three variables were reliable, with a value of $r \geq 0.70$. For the test, other than the validity and reliability test, a test of the level of difficulty and discriminating power of questions was also carried out (Embretson & Reise, 2000). For the difficulty level of the initial ability test, eight questions were moderate and two were difficult. For the reasoning ability, all questions are in the medium category. In terms of the discriminating power, five questions are categorized as sufficient and five questions are good for the initial ability test. For the mathematical reasoning, four questions were in enough category, and one question was in the good category.

Mathematical reasoning
Given P = {x |-3<x<3, x ∈ integers} and Q = {x | x<6, x ∈ natural numbers}. Can the sets P and Q form a one-to-one correspondence? If so, give your reasons and how many one-to-one correspondences can be formed? If not, why?

Initial ability
A teacher surveys a class of 33 students to find out students' favorite sport. If 20 students like swimming, 15 students like basketball, and 3 students do not like both, then how many students do like both sports?

a. 5 students
b. 6 students
c. 7 students
d. 8 students

Figure 1. The sample problems Example of the test items

The data analysis used in the current research was descriptive statistics and path analysis. To describe mathematical reasoning ability and initial ability, we grouped the data into five categories as shown in Table 2.

Table 2. Score category **of the test**

No.	Score interval	Category
1.	80≤X≤100	Excellent
2.	66≤X≤79,99	Good
3.	56≤X≤65,99	Fair
4.	40≤X≤55,99	Poor
5.	0≤X≤39,99	Very Poor

Path analysis was used to determine the relationship between variables. The prerequisite test for path analysis was the Kolmogorov-Smirnov test for normality, and the linearity test for linear regression. To examine the direct effect between variables, the regression formula Y = a + b X_1 + bX_2 was used. The indirect effect used $Y = (p_{x_2 x_1})(p_{yx_2})$ and total influence refer to this formula $Y = [p_{yx_1} + (p_{x_2 x_1})(p_{yx_2})]$. SPSS 26 was used for the statistical testing to evaluate the effect between variables. The path analysis design is shown in Figure 2.

Findings

Description of habits of mind

The result of the descriptive analysis on habits of mind is presented in Figure 3. The ability to endure and never give up has the highest average of 76.12, which is in good category. The aspect of habits of mind is marked by students' persistence in solving assignments and trying to find alternative solutions to solve them. Meanwhile, the ability to ask and pose problems has the lowest average; 59.74 in the moderate category. It is characterized by the ability of students to ask questions to collect data, test hypotheses, and make conclusions. In addition, students are also used to formulating effective questions (Sari et al., 2020). Overall, the average of students' habits of mind was 69.86, which is in the good category. This indicates that students responded well to solving problems in learning mathematics.

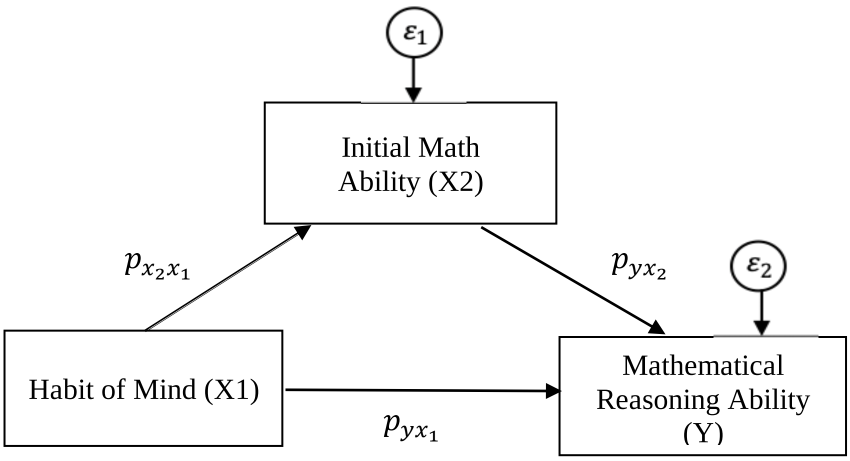

Figure 2. A path diagram for the current study

X_1: Habits of mind
X_2: Initial ability
X_3: Mathematical reasoning ability
$p_{x_2x_1}$: Path coefficient of habits of mind on students' initial abilities
p_{yx_1}: Path coefficient of habits of mind on mathematical reasoning ability
p_{yx_2}: Path coefficient of students' initial abilities on mathematical reasoning ability
ε: Epsilon/Other factors influencing endogenous variables not studied

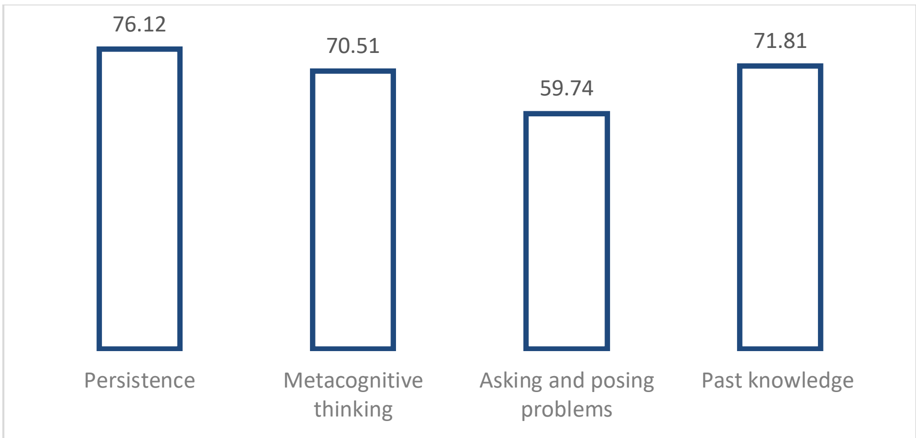

Figure 3. The test result on **each aspect of** students' habits of mind

Description of students' initial ability

The test on students' initial ability resulted in an average score of 56,53. The highest score obtained by students was 100, meanwhile the lowest score was 10. This suggest that students' initial ability was still very diverse. The result (in percentages) of the test on student's initial ability is shown in Figure 4.

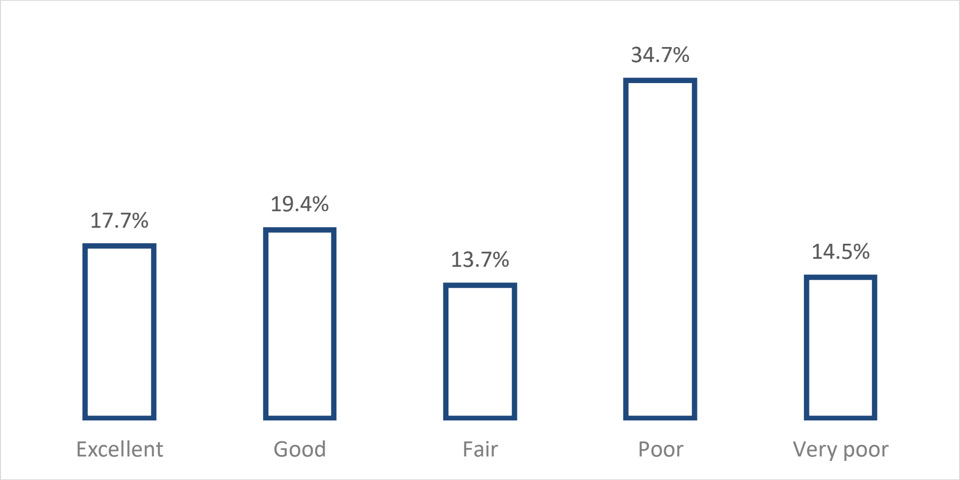

Figure 4. The percentage of students' initial ability

Figure 4 shows that the distribution of students' initial ability was mostly in the low category. This shows that many students still need to improve their initial ability. Students who had initial ability in the excellent and good categories were only 37,1%. The initial ability possessed by students will certainly affect their acceptance of new material because of the integrative and continuous nature of mathematical material (Kilpatrick et al., 2002; Kariadinata, 2012).

Description of mathematical reasoning ability

Table 3 shows students' mathematical reasoning ability in five aspects. Students' ability to find patterns or characteristics of mathematical phenomena to make generalizations (68,71) was higher than other aspects. The student's ability in the aspect of performing mathematical manipulations had the lowest score (51,77). When viewed from the rating scale, it could be concluded that students' mathematical reasoning ability was still low.

Table 3. The results of Students' mathematical reasoning ability

No.	Indicator	Score
1.	Make a conjecture	59,03
2.	Perform mathematical manipulation	51,77
3.	Drawing conclusions, compiling evidence, providing reasons or evidence for the correctness of the solution	58,87
4.	Checks the validity of an argument	55,65
5.	Finding patterns or properties of mathematical phenomena to make generalizations	68,71

The descriptive analysis of the reasoning ability data (Table 3) shows that the lowest score was 20, while the highest score was 96. The variance of mathematical reasoning ability is still very large. This shows that students' mathematical reasoning ability as still very diverse, ranging from the excellent category to the poor category. The average mathematical reasoning ability of students is still in the medium category.

Table 4. Students' mathematical reasoning ability in descriptive statistics

Descriptive statistics	Statistical value
Minimum value	20
Maximum value	96
Average	58.81
Standard deviation	17.84

Figure 5 shows the percentage of students' reasoning ability. More than 60% of the students had reasoning ability below good category. The remaining was in the good and excellent category. This data indicates that many students still need to improve their mathematical reasoning ability to support them in learning mathematics.

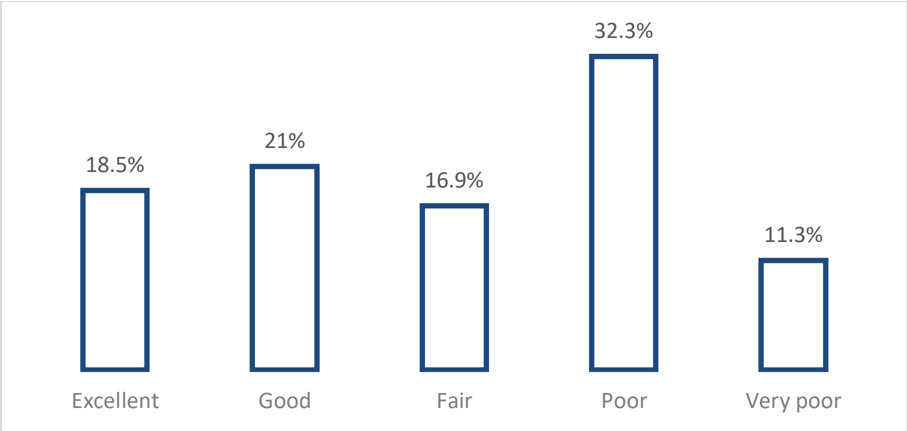

Figure 5. The percentage of students' mathematical reasoning ability

Path analysis test

Model 1 test was used to determine the effect of the independent variable (habits of mind) on the intervening variable (initial ability). Furthermore, a partial test was conducted to test the significance of the path coefficient of habits of mind (X1) on initial ability (X2). The result of the statistical calculation of the t-test can be seen in Table 5.

Table 5. Partial t-test model 1

Coefficients[a]						
Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-26,334	10,493		-2,510	,013
	Habits of mind	1,186	,149	,585	7,970	,000

a. Dependent variable: initial ability

The standardized coefficients beta value or path coefficient is 0,585 (Table 5). The significance column has a value of 0.000 < 0.05, thus, H_0 is rejected and H_1 is accepted. This means that the better the students' habits of mind, the better their initial ability. It could be concluded that there is a significant direct influence between habits of mind on students' initial ability.

The coefficient of determination (R^2) is used to determine the magnitude of the influence of habits of mind on students' initial ability. The result of statistical calculation for the coefficient of determination is shown in Table 6.

Table 6. The coefficient of determination for model 1

Model summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,585[a]	,342	,337	15,748

a. Predictors: (constant), habits of mind

Table 6 shows the magnitude of the coefficient of determination at the R^2 is 0,342. It can be interpreted that the percentage of the effect of habits of mind on students' initial ability is 34.2%, while the remaining 65.8% is influenced by other variables excluded in this study. The residual coefficient for regression model 1 (ε_1) can be calculated based on the Summary Model output in Table 6. The formula used is: $\varepsilon_1 = \sqrt{1 - R^2}$. It is known that $R^2 = 0{,}342$, then $\varepsilon_1 = \sqrt{1 - 0{,}342} = 0{,}811$. Based on the path coefficient from X1 to X2 and the residual coefficient, the structural equation for the regression model 1 can be established as $X_2 = 0{,}585\ X_1 + 0{,}811$.

A regression analysis of model 2 was conducted to partially determine the effect of habist of mind and initial ability on mathematical reasoning ability. The partial test of model 2 is used to test the significance of the path coefficient of habits of mind (X1) and initial ability (X2) on the ability of mathematical reasoning. The result is presented in Table 7.

Tabel 7. Partial t-test model 2

Coefficients[a]						
Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-3.049	8.282		-.368	.713
	Habits of mind	.463	.141	.248	3.278	.001
	Initial ability	.522	.070	.566	7.491	.000

a. Dependent variable: mathematical reasoning abilities

Based on Table 7, the path coefficient value in the standardized coefficients beta column for the variable of habist of mind is 0.248, with a significance of $0{,}001 < 0{,}05$. Therefore, H_0 is rejected and H_1 is accepted. It can be concluded that there is a significant direct effect between habits of mind on students' mathematical reasoning ability. Likewise, for the initial ability variable, the path coefficient value is 0.566 with a significance value of $0{,}000 < 0{,}05$; thus, H_1 is accepted. It can be concluded that there is a significant direct effect between initial ability on students' mathematical reasoning ability. The coefficient of determination (R^2) is used to determine the measure of the contribution of the effect of X1 and X2 on Y. The result of statistical calculation for the coefficient of determination is shown in Table 8.

Table 8 shows the measure of the coefficient of determination at the R Square value is 0,546. This indicates that the effect of habits of mind and initial ability on mathematical reasoning ability is 54,6%. In comparison, the remaining 45,4% contributes to other variables not included in this study. The residual coefficient for regression model 2 (ε_2) was calculated using the formula $\varepsilon_2 = \sqrt{1 - R^2}$. It is known that R^2 in Table 8 is 0,546, then $\varepsilon_2 = \sqrt{1 - 0{,}546} = 0{,}674$. Based on the path coefficient from X1 to Y and X2 to Y, as well as the residual coefficients, the equation for regression model 2 is $Y = 0{,}248\ X_1 + 0{,}566\ X_2 + 0{,}674$.

Table 8. The coefficient of determination for model 2

Model summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,739[a]	,546	,538	12,121

a. Predictors: (Constant), initial abilities, habits of mind

The analysis of the test was used to determine direct, indirect, and total effects. Based on regression model 1 and model 2, it can be concluded that:

- The direct effect of habits of mind (X1) on initial ability (X2) is 0,585.
- The direct effect of habits of mind (X1) on mathematical reasoning ability (Y) is 0,248.
- The direct effect of initial ability (X2) on mathematical reasoning ability (Y) is 0,566.
- The indirect effect of habits of mind (X1) on mathematical reasoning ability (Y) through initial ability (X2) is $0{,}585 \times 0{,}566 = 0{,}331$.
- The total effect of habits of mind (X1) on mathematical reasoning ability (Y) is $0{,}248 + 0{,}331 = 0{,}579$.

The basis for making decisions to test the significance of the indirect effect is if the value of direct effect is less than (<) indirect effect, then indirectly X1 through X2 is having a significant impact on Y, and vice versa. The path analysis found that the direct effect was less than indirect effect, $0{,}248 < 0{,}331$, then H_1 was accepted. Therefore, there is a significant indirect effect between habits of mind on mathematical reasoning ability through students' initial ability. Overall, the results of the path analysis can be seen in Figure 6.

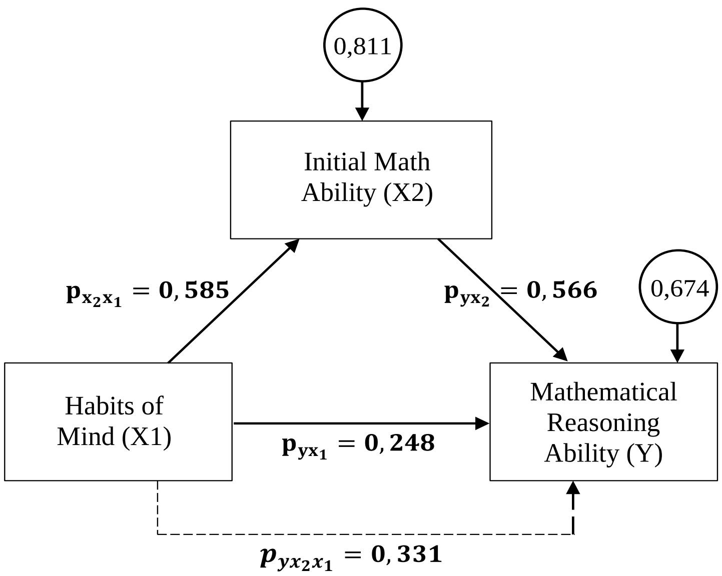

Figure 6. The result of path analysis

Discussion

Direct effect of habits of mind on initial ability

The finding of this study show that there is a direct positive influence between habits of mind on students' initial mathematical ability. That is the better the students have habits of mind, the better they initial abilitiy or vice versa. Habits of mind is one of the affective skills that could help students in learning, especially in mathematics. Prior studies revealed that the possession of habits of mind will train students use their time productively and improve their intelligence, one of which is the initial ability to learn mathematics (Askew, 2020; Kreijns et al., 2019; Priyani & Ekawati, 2018a; Sari et al., 2019).

As the finding reveal that students' habits of mind were already in the good category, but on the other hand, most of the students still had low initial ability. However, students with very good or good habits of mind tend to have very good and moderate initial ability. Meanwhile, students with enough or less habits of mind tend to have moderate to very poor initial ability. This shows that habits of mind associate with students' initial ability (Altan et al., 2019; Mandasari, 2021; Sumiarto et al., 2020).

Direct effect of habits of mind on mathematical reasoning ability

This study found that habits of mind directly affected mathematical reasoning ability. Costa and Kallick (2008) assert that learning that implements habits of mind affects how students behave when faced with problems they cannot answer. This is different from conventional learning, which only focuses on the number of questions that students can answer correctly. Therefore, when students have habits of mind, it will encourage them to keep trying to solve problems. This is very much needed in mathematics problem-solving, one of which requires reasoning ability. Widodo et al., (2019) explicates that one of the factors that contribute to mathematical ability is students' habits of mind. Lack of habits of mind in the learning process likely affect students' mathematical reasoning ability. This means that students who are less accustomed to thinking will be more easily discouraged and do not try to find other solutions when faced with complex problems.

In this study, most students were already in the good category of habits of mind, while most students are still in the category of low scores for mathematical reasoning ability. But, students with good habits of mind tend to have good or moderate mathematical reasoning ability. Meanwhile, students with low habits of mind tend to have poor or very poor mathematical reasoning ability. This result aligns with another study (Indriani et al., 2018), which show an association between students' mathematical reasoning ability and their habits of mind. In other words, this study proves that, there is a significant direct influence between habits of mind on students' mathematical reasoning ability as prior studies found (Burgess, 2012; Elsayed & Nasef, 2020; Handayani et al., 2018; Nisa et al., 2020).

Direct effect of initial ability on mathematical reasoning ability

This study provides evidence that initial ability has a significant direct effect on the mathematical reasoning ability. The better the students' initial ability, the better their mathematical reasoning ability or vice versa (Priyani & Ekawati, 2018a). In learning mathematics, many factors affect students' achievement, one of which is students' initial ability. Mathematics subject matter is mutually sustainable, and this requires students to have good initial ability so that they can understand mathematics well. The understanding gained in learning mathematics develops gradually until a comprehensive mathematical concept is finally obtained (Athar et al., 2019; Sari et al., 2019, 2020). In other words, the initial ability becomes a precondition for mastering complex mathematics subject matter so that students have high reasoning ability.

In this study, most of the students still had poor initial ability. Likewise, with mathematical reasoning ability, most students were still in the poor category. Students with good initial ability tend to have good mathematical reasoning ability or otherwise. This proves that the initial ability affects the students' mathematical reasoning ability. The results of this study confirm previous research (Shodikin, 2015) that initial ability affect the improvement of mathematical reasoning ability, and it is elements that significantly influence students' mathematics learning outcomes (Hevriansyah & Megawanti, 2016). Thus, there is a significant direct effect between initial ability on students' mathematical reasoning ability (Hasibuan et al., 2022; Sari et al., 2020).

Indirect effect of habits of mind on mathematical reasoning ability through initial ability

Based on the results of statistical analysis (Table 8, Figure 6), the path coefficient of the indirect effect of habits of mind on mathematical reasoning ability through initial ability is greater than the direct effect. This means that the initial ability could be one of the intermediary factors to link the habits of mind and mathematical reasoning ability. Students' mathematical ability is influenced by their affective and cognitive aspects. One of the affective aspects is habits of mind. Students' habits of mind in the learning process are needed because it encourages students to thrive in the learning process. Therefore, habits of mind are very influential in improving the mathematical reasoning ability of a student (Hasibuan & Nurjanah, 2020; Priyani & Ekawati, 2018a).

Conclusion

The current study reveals that there is a significant influence of habits of mind on students' initial ability and habits of mind on students' mathematical reasoning ability. Students with strong habits of mind tend to have decent initial ability and reasoning ability or vice versa. In addition to the direct influence, it turns out that there is also a significant indirect effect of habits of mind on the mathematical reasoning ability through students' initial ability. In other words, the better the students' habits of mind, the better their initial ability. This has positive implications for the development of students' mathematical reasoning ability. Thus, the initial ability becomes one of the intermediary factors for students' mathematical reasoning ability. This study contributes to the development of mathematics teaching involving affective aspects, where habits of mind could help students leverage their mathematical reasoning. Moreover, it enriches the existing literature about the topic and confirms the findings of previous studies about the impact of habits of mind on mathematical reasoning.

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