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Mathematical Thinking Process On Numeracy Literacy Problems For Middle School Students

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Abstract: Mathematical thinking is closely related to the ability to solve problems in everyday life. For this reason, it is important that mathematical thinking skills are placed as a learning goal and at the same time as a way of learning mathematics. The purpose of this study was to determine the characteristics of the mathematical thinking process at each level of mathematical thinking ability. This study uses a qualitative research design by first carrying out a mathematical thinking test using numeracy literacy questions to see errors made by students, followed by interviews to find out students' mathematical thinking processes. Based on the results of students' Mathematical Thinking ability, we can analyze three categories, namely high, medium, and low. The results of the study show as follows, subjects with high mathematical thinking abilities tend to carry out the entire Mathematical Thinking process, subjects with medium mathematical thinking abilities tend not to carry out the Convincing process. Meanwhile, subjects with low mathematical thinking abilities tend not to carry out the Convincing, Generalizing process. Another aspect found in this research is that by studying the mathematical thinking profile, students are better prepared to face math problems by looking at their abilities.

Keywords: Conjecturing, Convincing, Generalizing, Mathematical Thinking, Numerical literacy, Specializing.

Introduction

Mathematics is close to everyday life, therefore mathematics is taught formally from elementary school to college level. In addition to the demands of 21st century skills, the profile of Pancasila students is also a reference for achieving character for all students in Indonesia, the profile of Pancasila students has strong characters, global competitiveness and dignity. (Nurihayanti, 2021). For this reason, it is important for teachers and students to adopt a learning process that focuses on competency development. The achievement of student competencies can be measured from understanding concepts, and skills in applying concepts in various contexts (Abdillah et al., 2021). Thus, students do not only master the content alone, but also master an in-depth understanding of concepts that can be applied in various life contexts. This is expected as an increase in student learning outcomes. It is this holistic achievement of student competence that wants to be evaluated through the National Assessment (Aini, 2013).

Thinking is always associated with solving problems, both problems that arise today, the

past and maybe problems that have not yet occurred. Thinking is a cognitive process that takes place between stimulus and response (Candra et al., 2017). Thinking is a mental activity that involves the brain that is directed towards the goal in completing tasks (Mursidik et al., 2015). When students think about doing an activity, namely solving a problem, there will be a thinking process until they find a solution to the problem. The thought process is a mental activity or a process that occurs in the minds of students when students are faced with new knowledge or problems that are happening and find a way out of these problems (Widyastuti et al., 2013). The thinking process will usually occur until the student succeeds in obtaining the correct answer, in the thinking process there are activities carried out, namely forming understanding, forming opinions and forming conclusions..

The mathematical thinking process is carried out by providing various contextual problems that exist in students' lives to be solved optimally by students in the context of learning mathematics that is interesting for students. (Celik & Ozdemir, 2020). According to (J. Mason, 2010) (Zeynivandnezhad et al., 2013), mathematical thinking is a dynamic process that expands the scope and depth of mathematical understanding.

Thinking mathematically is a process in mathematics, and not a branch of mathematics. Here we will show you how to do it properly and learn from experience. The time and energy spent during the learning process is a wise investment, because it can realize the potential in mathematical thinking. There are three factors that affect the effectiveness of one's mathematical thinking (J. Mason, 2010), (1) competencies used during the mathematical investigation process, (2) confidence in overcoming emotional and psychological states and being able to turn them into luck, (3) understanding of the content of mathematics and if needed in its application (J. Mason, 2010).

Important aspects in mathematical thinking, namely, Conjecturing, Reasoning and Proving, Abstraction, Generalization and Specialization (Breen & O'Shea, 2010). Similar to (J. Mason, 2010) mentions four aspects of mathematical thinking, Specializing, Generalizing, Conjecturing, Convincing. While according to (Van Es & Sherin, 2002) there are only three aspects in mathematical thinking identifying, making connections, reasoning. Several theories about aspects of mathematical thinking from several experts are shown in Table 1 below.

Table 1. Stages of Mathematical Thinking Process

(Burton, 1984)	(Stein et al., 1996)	(Van Es & Sherin, 2002)	**Güzel (2005)**	(Tall, 2009)	(Breen & O'Shea, 2010)	(J. Mason, 2010)	(Stacey, 2011)
Generalizing	Generalization	Generalization	Generalization	Generalization	Generalization	Generalization	Specializing
expect	Reasoning and Proving	Reasoning and Proving	Expect and Test	Problem solving	Reasoning and Proving	Reasoning and Proving	Generalizing
justify	Conjecturing	Conjecturing	abstraction	abstraction	Conjecturing	Conjecturing	Conjecturing

convincing	Abstraction	Abstraction	reasoning	synthesis	Abstraction	Abstraction	Convincing
	Specialization	Specialization	Proving	Proving	Specialization	Specialization	
		Generalization		Modeling			

In this study, the mathematical thinking process used is the theory of (Stacey, 2011) which has been modified based on an in-depth theoretical study of the indicators. In the process of specializing in thinking based on the results of studies from (Burton, 1984) At this stage there are action indicators to check for special conditions when facing problems. In the thinking process based on the results of the study of (Nickerson, 2011) conveying indicators at this stage is a concrete example of an abstract problem, describing / illustrating the problem. (Yildiz, 2016) mentions that this stage has indicators of drawing and finding special conditions. And (Tohir et al., 2020) mentioning indicators at this stage is to make an illustrative depiction of the problem. Based on the results of the study of several theories that have been mentioned above, then at the Specializing stage one indicator is added, so that the indicators used in the study become (a) describe/illustrate the problem, (b) identify problems, (c) devise and try out various possible strategies.

At the Generalizing stage, several theoretical studies on indicators of mathematical thinking ability are as follows, (Harel & Sowder, 2005) convey teaching indicators using limited examples. (Tsang, 2014) also convey that generalization is the act of inferring from specific, observed examples. While (Yildiz, 2016) and (Celik (2016) mentioning the generalization process involves revealing patterns between certain examples. (Uyangör, 2019) conveying Generalization is estimating a wider situation or searching for patterns/relationships. From the results of the theoretical study, at the Generalization stage there is a reduction in indicators, so that the Generalization stage indicators only expand the scope of the results obtained. Meanwhile, in the Conjecturing stage, the indicators are analogous to similar cases, and the Convincing stage the indicators used are (a) looking for reasons why the results obtained can appear, (b) form a pattern from the results obtained, (c) make the opposite of the pattern that has been formed.

((OECD), 2010) defines that mathematical literacy is a person's ability to formulate, apply and interpret mathematics in various contexts, including the ability to reason mathematically and use concepts, procedures, and facts to describe, explain or predict phenomena/events. While according to (Ojose, 2011), Mathematical literacy is the knowledge to know and apply basic mathematics in everyday life. Mathematical literacy contains knowledge of competence and confidence to apply knowledge to the practical world. A person is said to be mathematically literate if he is able to interpret and solve everyday problems (Linuhung, 2015). Literacy ability is the ability of students to solve problems associated with everyday life, after which they can present or communicate the answers to the problems they have solved in mathematical form. (Ralmugiz & Kusumawati, 2020). Mathematical literacy as connecting mathematics with real life, using mathematics appropriately in various contexts, communicating using the wealth of mathematics, synthesizing, analyzing, and evaluating the mathematical thinking of others, understanding and being aware of what has been learned mathematically (Afifah et al., 2018).

Methodology

Research Design

The research method used in this study uses qualitative research methods with a grounded theory approach. Grounded theory is a systematic method of conducting research that shapes data collection and provides an explicit strategy for analyzing it (Charmaz & Thornberg, 2021).

Sample and Data Collection

This research was conducted at SMPN with the research subjects were students of class VIII taken from two students in the high, medium, and low groups of students' mathematical thinking abilities.

In this study using data collection tools in the form of test questions and interviews, test questions using mathematical thinking ability indicators that have been modified from (J. Mason, 2010), (Stacey, 2011). The results of the mathematical thinking ability test of students on numeracy questions are used to classify students into high, medium and low groups. The data is used to select qualitative research subjects. Mathematical thinking ability test in the form of a description using numeration questions to find out students' mathematical thinking processes in solving problems.

Interviews used in this study were intended to determine the causes of errors made by students, and to determine students' thinking processes in solving the problems given. Interviews use unstructured interviews, namely interviews that do not use certain guidelines, but are taken from the results of student completion which are then analyzed qualitatively.

Analyzing of Data

Data on students' initial numeracy abilities were used to group students into three categories, namely high, medium, and low categories. From these data, the subject of qualitative research is determined.

Data on the initial ability of students' mathematical abilities are classified based on the level of mathematical thinking, according to (Saifuddin, 2012) classifying students' mathematical thinking ability level is divided into three levels, namely high, medium and low level, from the data determined qualitative research subjects, mathematical thinking level criteria can be seen in Table 1.

Table 1 Characteristics of Mathematical Thinking Ability

LEVEL	SCALE
High	$x \geq 90{,}21$
Medium	$54{,}46 \leq x < 90{,}21$
Low	$x < 54{,}46$

Mathematical thinking process data retrieval is done by looking at the answers from students and in-depth interviews. The data from the students' answers are focused on the achievement of each indicator and mathematical thinking process, as well as differences in the achievement of mathematical thinking processes in the high, medium, and low categories..

After carrying out observations of student answers at each level of student ability, the researcher conducted interviews with research subjects, for each level of ability two research subjects were taken to conduct interviews. Interviews were used to collect in-depth information about students' mathematical thinking processes and confirm the findings in students' answers. In addition, interviews are also part of triangulation to compare with observation data on the results of students' answers to questions.

Findings / Results

(1) Students' Mathematical Thinking Ability

From the results of the mathematical thinking ability test, students are grouped into 3 categories, namely low, medium, and high categories. Two students were taken from each category for analysis, the data are shown in Table 2.

Table 2 Research Subjects

Research Subjects Code	Cognitive Style
MTR_1	Low Mathematical Thinking
MTR_2	Low Mathematical Thinking
MTS_1	Medium Mathematical Thinking
MTS_2	Medium Mathematical Thinking
MTT_1	Low Mathematical Thinking
MTT_2	Low Mathematical Thinking

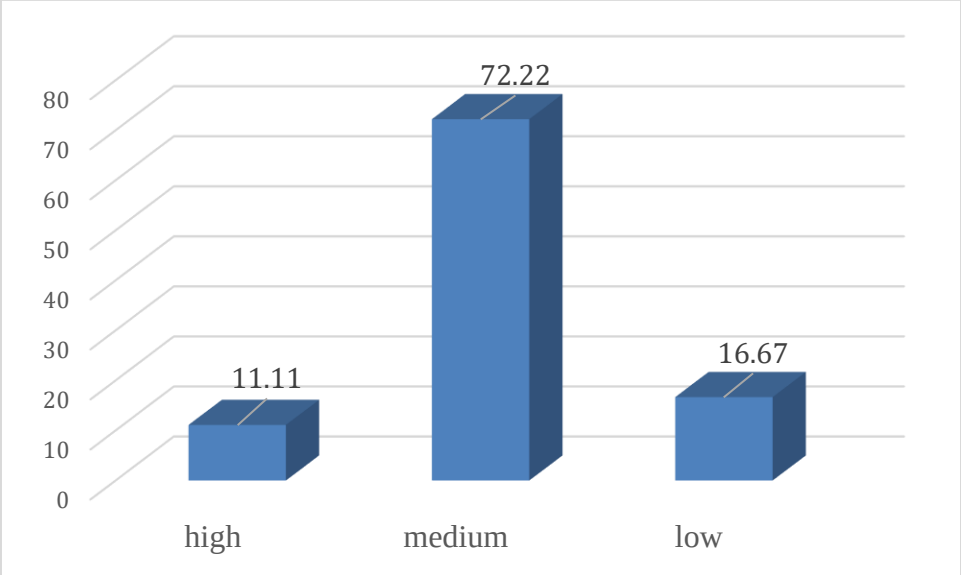


Figure 1. Percentage of Students' Mathematical Thinking Ability Results

In Figure 1 it can be seen that the results of the students' initial mathematical abilities in the low category are 16.67%, the medium category is 72.22%, while students who are in the high category are 11.11%.

(2) Subjects with High Mathematical Thinking Ability

The group in the high category is a group of students who are able to solve problems. Mathematical Thinking Ability achieves ≥ 90,21. The results showed that there were 2 students who were included in the very good category. The following is an analysis of every aspect of the Mathematical Thinking process

Specializing

The results of the study were compiled based on the results of the Mathematical Thinking Ability test which consisted of 3 items of numeracy literacy, in question number 1 consisted of two questions, question number 2 consisted of 3 questions, and question number 3 consisted of 2 questions. The results of student work are divided based on the level of students' ability in solving the questions that have been given. Researchers took samples from students with high category Mathematical Thinking completion

skills. The following is a form of question with the Specializing process.

b. Luas halaman belakang sebuah rumah 60 m^2 akan dibuat taman. Seperenam bagian untuk kolam. Tiga perempat bagian untuk rumput dan tanaman lain, sedangkan sisanya ditutup dengan batu koral. Biaya pembuatannya adalah sebagai berikut:

No	Bagian	Biaya Per-m^2
1	Kolam	Rp. 800.000
2	Rumput	Rp. 200.000
3	Batu Koral	Rp. 400.000

Hitunglah seluruh biaya yang diperlukan untuk membuat taman!

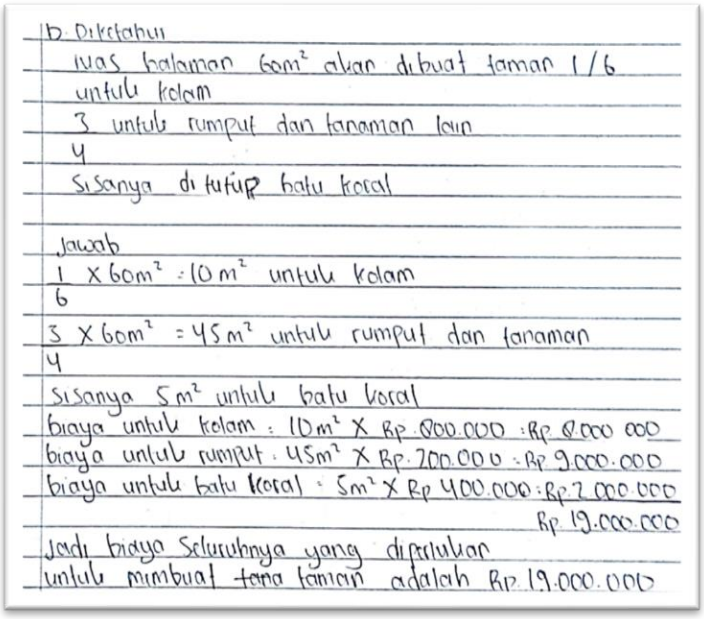
Translation:
The area of the backyard of 60 m^2 houses will be made into a garden, one-sixth part for a pool, three-quarters of a part for grass and other plants. while the rest is covered with coral. The manufacturing costs are as follows:

No	Part	Cost per m^2
1	pool	Rp. 800.000
2	grass	Rp. 200.000
3	coral	Rp. 400.000

calculate all the costs needed to create a garden!

Figure 2. Problem Number 1b

The following is the process of working on the MTT_1 subject in question number 1b



Translation:
Is known
With an area of 60m^2 yards, 1/6 garden will be made for the poold, 3/4 for grass and other plants, the rest is covered with coral.

Answer
1/6 x 10m^2 for pool
¾ x 45m^2 for grass dan plants
The remaining 5m^2 is for coral
Fee for pool 10m^2 x Rp. 800.000 = Rp. 8.000.000
Fee for grass 45m^2 x Rp. 700.000 = Rp. 9.000.000
Fee for coral 5 m^2 x Rp. 400.000 = Rp. 2.000.000
Rp. 19.000.000
so the total cost needed to create a garden is Rp. 19.000.000

Figure 3. Subject Answers MTT_1 Number 1b

The results of the work of the MTT_1 subject in Figure 3 show that the work of the MTT_1 subject is able to solve the problem in number 1b by answering correctly. The subject of MTT_1 understands the concept of comparison, so they have no difficulty in determining each part of the pond, grass, and coral in the problem. Based on the indicators of mathematical thinking ability in the specializing aspect, it can be seen that the MTT_1 subject is able to identify problems by multiplying the part of each part of the park by the area of the entire park. In other indicators the subject has been able to develop and try various possible strategies by multiplying the area of each section by the cost of each part. However, the subject of MTT_1 still has difficulty in the indicators. Describing/illustrating the problem,

it is seen that the subject immediately calculates the answers, so this indicator has not been achieved.

Generalizing

In the generalizing aspect, which has an indicator of expanding the scope of the results obtained, the subject of MTT_1 has achieved the subject of calculating the multiplication of the part of each park with the total garden area, which is then multiplied by the price to be issued. This is done to calculate the cost of the pond, grass and coral sections.

Conjecturing

Aspects of Conjecturing the subject has been able to make an analogy in similar cases by analogizing a pond into one part of a flat plane, so that when dividing into parts of a pond, grass and plants, the subject multiplies each part by the total area of the garden. So that the area of each part of the park can be known.

Convincing

Aspects of the Convincing mathematical thinking process which has 3 indicators, only indicators are looking for reasons why the results obtained can appear which can be achieved. The MTT_1 subject has been able to analyze the steps that must be taken in solving the given questions, so that the right answer is obtained.

A summary of the achievement of indicators from each aspect of the mathematical thinking process and indicators that have not been achieved by the subject of MTT_1 can be seen in Table 3.

Table 3. Summary of MTT_1 . Subject Analysis

	Specializing	**Generalizing**
Description of Think Mathematically	Indicator Identify problems, Develop and try various strategies that may be achieved and Describe / illustrate problems that have not been achieved	Indicators Expanding the range of results achieved.
	Conjecturing	**Convincing**
	Indicator Analogy in similar cases is achieved.	Indicators Looking for reasons why the results obtained can appear to be achieved and Form a pattern from the results obtained, Making the opposite of the pattern that has been formed has not been achieved

(3) Subjects with Medium Mathematical Thinking Ability

The group in the medium category is a group of students who are able to solve problems. Mathematical Thinking Ability achieves $54{,}46 \leq x < 90{,}21$. The results showed that there were 13 students who were included in the very good category. The following is an analysis of every aspect of the Mathematical Thinking process

Tabel berikut menunjukkan daftar harga dan diskon pada beberapa toko. Semua toko tersebut menjual barang yang sama

Nama Toko	Baju	Celana	Baju	Celana
Jaya	25%	10%	Rp. 80.000	Rp. 100.000
Andini Busana	20%	15%	Rp. 80.000	Rp. 100.000
Selaras	15%	20%	Rp. 80.000	Rp. 100.000
Bagus Fashion	10%	25%	Rp. 80.000	Rp. 100.000

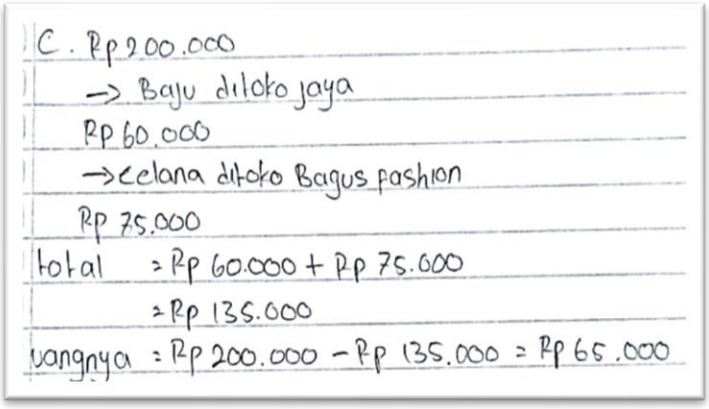
c. Yuni memiliki uang Rp. 200.000 dan ingin membeli satu buah baju dan satu buah celana. Agar sisa uangnya paling banyak, di toko mana saja (baju dan celana boleh dibeli pada toko yang berbeda) ia harus membeli? Jika uangnya sisa, berapa rupiah sisa uangnya?

The following table shows a list of prices and discounts at several stores. all these shops sell the same stuff.

Shop name	Shirt	Pants	Shirt	Pants
Jaya	25%	10%	Rp. 80.000	Rp. 100.000
Andini Busana	20%	15%	Rp. 80.000	Rp. 100.000
Selaras	15%	20%	Rp. 80.000	Rp. 100.000
Bagus Fashion	10%	25%	Rp. 80.000	Rp. 100.000

Yuni has Rp. 200.000 money and wants to buy one shirt and one pants. In order to have the most money left, in which store (shirts and pants can be purchased at different stores) should he buy? if the money is left over, how much money is left?

Figure 4. Question Number 2c



C. Rp. 200.000
→ shirt in Jaya shop Rp.60.000
→ pants in Bagus Fashion shop Rp.75.000
Total = Rp. 60.000 + Rp. 75.000
= Rp. 135.000
Money = Rp. 200.000 – Rp. 135.000
= Rp. 65.000

Figure 5. Subject Answers MTS_1 Number 2c

Specializing

The results of the work on the MTS_1 subject in Figure 5 show that the subject has been able to illustrate that to get more remaining money, the cheapest price must be taken, so that the indicator describing / illustrating the problem is achieved. Then the subject chooses the store that has the biggest discount, which allows spending the least money, here the subject is able to compile and try various possible strategies. While the subject did not write down the discount calculation given by the store in advance with the price of the shirt and pants, so that the indicator of identifying the problem had not been achieved.

Generalizing

In the aspect of the mathematical thinking process Generalizing the subject of MTS_1 has carried out the activity of generalizing the answers to the questions given, it can be seen from the students who immediately wrote down the cheapest price from which store without carrying out the calculations first, so that the indicator Expanding the scope of the results obtained was achieved

Conjecturing

The subject of MTS_1 is able to make an analogy with the questions given by multiplying the percentage of discounts given by several shops with the price of goods offered to buyers, the subject has reached the analogy indicator in similar cases.

Convincing

The subject of MTS_1 still has difficulties in the aspect of the mathematical thinking process convincingly, for all indicators in this aspect have not been achieved.

A summary of the achievement of indicators from each aspect of the mathematical thinking process and indicators that have not been achieved by the subject of MTS_1 can be seen in Table 4..

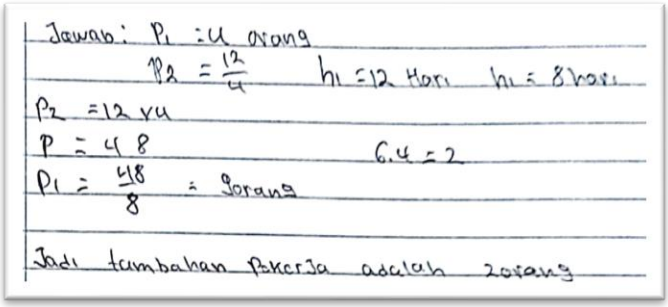
Table 4. Summary of MTS_1 . Subject Analysis

	Specializing	**Generalizing**
Description of Think Mathematically	Indicator Describing / illustrating the problem, Develop and try various strategies that may be achieved Identify the problem has not been achieved	Indicators Expanding the range of results achieved
	Conjecturing	**Convincing**
	Indicator Analogy in similar cases is achieved.	All indicators in convincing aspects have not been achieved

(4) Subjects with Low Mathematical Thinking Ability

Figure 6. Question Number 1a

Translation
the yard of a house will be made into a garden, the work takes 12 days with 4 workers. In order for the garden work to be completed in 5 days, how many additional workers are needed?



Translation
Answer : $P_1 = 4$ people
$h_1 = 12$ day, $h_2 = 8$ day

so additional workers is 3 people

Figure 7 Subject answer MTR_1 Number 1a

Specializing

Aspects of the mathematical thinking process Specializing the MTR_1 subject has begun to be achieved with several indicators carried out by the subject, the subject has been able to identify problems by writing down the number of first workers completed for 12 days and trying various strategies that might be achieved to calculate the number of workers needed to complete during the 12 days. 8 days. The subject still has difficulty in describing/illustrating the problem, so this indicator has not been achieved.

Generalizing

The subject of MTR_1 still has difficulty in generalizing the answers that have been made so that the indicators for expanding the scope of the results obtained have not been achieved.

Conjecturing

Aspects of the mathematical thinking conjecturing process, the subject is still having difficulties, so that the analogy indicator in similar cases has not been achieved

Convincing

The subject of MTR_1 still has difficulties in the aspect of the mathematical thinking process convincingly, for all indicators in this aspect have not been achieved.

A summary of the achievement of indicators from each aspect of the mathematical thinking process and indicators that have not been achieved by the subject of MTR_1 can be seen in Table 5.

Table 5. Summary of MTR_1 . Subject Analysis

	Specializing	**Generalizing**
Description of Think Mathematically	Indicators, Identifying problems, Composing and trying various strategies that may be achieved, Describing / illustrating problems that have not been achieved	Indicators Expanding the scope of the results obtained have not been achieved
	Conjecturing	**Convincing**
	Indicator Analogy in similar cases has not been achieved	All indicators in convincing aspects have not been achieved

Discussion

In solving mathematical problems, it is necessary to have good mathematical thinking skills, each student's mathematical thinking ability is different according to the work given by students. (Mustafa et al., 2019). In junior high school, mathematical thinking skills need special attention (Saragih & Napitupulu, 2015),

this is used as the foundation for the next level. The results of this study indicate that in one class the mathematical thinking ability in the medium category is more than in the low and high categories, in line with the results of the study (Tohir et al., 2020).

The mathematical thinking process at the stage of specializing in research subjects are all able to complete the indicators at this stage, these findings are in line with the research results (Putri et al., 2020) which shows the student's ability to describe things that are known from the problem, how to determine the solution, and try to see from various examples. And the average achievement score of male students' mathematical thinking ability is equivalent to the mathematical thinking ability of female students (Sari et al., 2022).

In the process of convincing mathematical thinking, the research results show that the convincing aspect of students who have medium and low categories is not achieved, and for the category of high mathematical thinking ability, only an indicator of finding reasons why the results obtained can appear has been achieved and the other two indicators have not been achieved. Based on research results from (Abdurrahman, Abdullah, & Osman, 2020) also stated that in the convincing aspect between the experimental class and the control class there was no difference with an average value of 2,497 which was very much different from other aspects of other mathematical thinking processes..

The results of research on the mathematical thinking process, the subjects showed that they had demonstrated some elements of specialization, generalization, and conjecture without showing any element of convincing. Mathematical thinking skills can educate students in dealing with a rapidly changing life (Abdurrahman, Abdullah, Osman, et al., 2020), students can develop their thinking skills, making students responsible for their own thinking and learning.

Conclusion

Based on the results and discussion, it can be concluded that mathematical thinking abilities are realized based on the achievement of indicators in the mathematical thinking process which include identifying problems, developing and trying various strategies that may be achieved, describing / illustrating problems, expanding the scope of the results obtained, making analogies in cases that similar, Looking for reasons why the results obtained can appear achieved and Forming a pattern from the results obtained, Making the opposite of the pattern that has been formed. The better the subject in meeting these indicators, the better the mathematical thinking process. Subjects with high mathematical thinking abilities have good mathematical thinking abilities. Most of the indicators have been achieved, including identifying problems, developing and trying various possible strategies, expanding the range of results obtained, making analogies in similar cases, looking for reasons why the results obtained can appear. There are some indicators that are lacking such as describing / illustrating the problem, forming a pattern from the results obtained, making the opposite of the pattern that has been formed. for indicators. Describing / illustrating problems having difficulty in illustrating the problems that exist in the problem or providing an overview related to the problem with the form of the subject matter of mathematics. Almost all students who have mathematical thinking abilities for all categories of students still have difficulty in forming a pattern and the opposite of the pattern that has been formed Students have carried out the mathematical thinking process Specializing, Generalizing, Conjecturing, and Convicing, but not optimal. Subjects with moderate mathematical thinking abilities have achieved several indicators such as describing / illustrating problems, developing and trying various possible strategies, expanding the scope of the results obtained, making analogies in similar cases. For indicators of identifying problems, looking for reasons why the results obtained can appear, forming a pattern from the results obtained, and making the opposite of the

pattern that has been formed having difficulty in identifying things that are known in the problem, so students immediately write down the answers. And the mathematical thinking process achieved by Specializing, Generalizing, and Conjecturing, students still have difficulty in convincing the process. Subjects with low mathematical thinking abilities have achievement indicators Identify problems, Develop and try various possible strategies, Analyzing similar cases, for indicators Describing / illustrating problems, Expanding the scope of results obtained, Looking for reasons why the results obtained can appear, Forming a pattern from the results obtained, Making the opposite of the pattern that has been formed has difficulty in using indicators in solving problems. The mathematical thinking process achieved is Conjecturing, and Specializing. Students still have difficulty in the generalizing process by writing down the steps for solving the problem clearly, and writing down what concepts are used in the solution.

Recommendations

Almost all problems that exist in everyday life require a mathematical thinking process in solving them. Mathematical thinking processes are needed in solving various problems that contain everyday life situations. Based on the research results, the recommendation that can be conveyed is that the teacher must always control the students' mathematical thinking process, this is intended to minimize students' errors in solving mathematical problems, and can improve students' mathematical thinking skills. And further researchers can carry out for other levels, even university level.

Limitations

The limitations of this study are related to the characteristics of the mathematical thinking process which is only based on solving arithmetic literacy questions, and for class VIII students. Thus, it is still very open to conduct further research to see the mathematical thinking process for other grade levels, even for students. This study focuses on 3 categories of students' mathematical thinking abilities, namely high, medium, and low. In addition, when conducting interviews online, it makes the character of each student less exposed.

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