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THE IMPACT OF SELF-EFFICACY ON MATHEMATICAL THINKING ABILITY

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Abstract

The aim of this research is to determine the characteristics of mathematical thinking based on the impact of self-efficacy on class VIII students on numeracy literacy questions. This research is a qualitative research with research subjects 60 students of class VIII. The data collection instruments used were self-efficacy questionnaires, mathematical thinking ability tests, and interviews. The analysis of the mathematical thinking ability test refers to the modified Stacey indicators. Data analysis was carried out in the following steps, namely the data reduction, the data presentation, the data verification, and the conclusion. The results of the research show that (1) students who have a high category of Magnitude aspect have characteristics of mathematical thinking achievement of 44% (2) students who have a high category of Strength aspect have characteristics of mathematical thinking achievement of 67%, and (3) students who have a General aspect the high category has the achievement characteristics of mathematical thinking of 75%. The achievement of mathematical thinking abilities can be seen from the students' achievements in the Magnitude, Strength, and Generally aspects which are achieved in their entirety or alternately between the two aspects in each aspect of self-efficacy.

Keywords: Literacy Numeracy, Mathematical Thinking, Self-efficacy.

INTRODUCTION

The learning process achieves learning outcomes according to the goals of the teacher (Hazmi, 2019), so every student must be able to go through learning activities that have challenges (Nottingham, 2015). This challenge is very important so that students can survive in class, and can adapt to learn the next material.

One of the ways to solve challenges is to have self-efficacy (Toharudin et al., 2019), self-efficacy makes a difference in how people feel, think and act (Schwarzer, 2014). Low self-efficacy causes feelings of depression and anxiety as well as an overall feeling of helplessness, students who have high self-efficacy will successfully overcome the obstacles they face. Meanwhile, students who have low self-efficacy will avoid tasks and give up easily (Albert Bandura, 2017).

In fact, in schools, many students have low self-efficacy. This is shown by giving up behavior when encountering difficulties in learning or solving problems (Subaidi, 2016). Meanwhile, academic self-efficacy significantly influences student success at secondary and course levels, and higher education (Rhew et al., 2018).

Self-efficacy is a critical component to a student's ability to complete daily classroom activities, perform well on standardized assessments, and be successful overall in school. Student self-

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efficacy is an important dimension in solving mathematical problems (Capron Puozzo & Audrin, 2021), (Subaidi, 2016).

Self-efficacy as belief in one's own ability to be successful in certain circumstances (Albert Bandura, 1986). Self-efficacy attitudes govern how prospects and obstacles are perceived and influence not only people's choices, but how much they are willing to try and persevere until they succeed (Albert Bandura et al., 1999). Individual self-efficacy is built on past successes, especially those that challenged the individual and were overcome with a lot of effort. Otherwise, failure easily destroys an individual's sense of self-efficacy, especially if the individual only achieves easily (Gale et al., 2021) (Albert Bandura, 1995).

Self-efficacy has three dimensions, namely Magnitude, Generally, and Strength (DeNoyelles et al., 2014) (Masitoh & Fitriyani, 2018) and (A Bandura, 1977). The Magnitude/level dimension relates to the difficulty level of the task for each individual which will not be the same. This dimension affects the selection of activities or tasks according to the ability to do so. Individuals have high self-efficacy in tasks that are easy and simple, or also in tasks that are complex and require high competence. Individuals who have high self-efficacy tend to choose tasks whose level of difficulty is in accordance with their abilities.

Dimension Generally (Generalization), this dimension is defined as the extent to which individuals believe in their abilities in various task situations. Individuals will generalize the belief in the success they have obtained from previous experiences. Individuals with high self-efficacy will be able to master several fields at once to complete a task. Meanwhile, the Strength dimension (self-strength or competence) This dimension is defined as the level of an individual's stability in his beliefs regarding his own competence. Self-efficacy is the basis for him to make hard efforts, even when he encounters obstacles.

However, it is important to note that self-efficacy beliefs are not stable over time, or generalizable across disciplines or tasks. In contrast, research articulates that domain- or task-specific self-efficacy is better suited to measure belief in a related domain or task than general constructs (Andrews et al., 2021).

Self-efficacy aspects and indicators used in this study are (1) Magnitude; Degree of confidence overcoming learning difficulties, (2) Strength; demonstrates the belief that efficacy will take place in a particular domain or apply in a variety of situations, (3) Generally; indicates whether efficacy beliefs will last. The indicators used can be seen in Table 1.

Table 1: Aspects and Indicators of Self-Efficacy

No.	Aspects	Indicators
1.	Magnitude	(a) Able to solve problems that are difficult to deal with
		(b) Confident of his own success
2.	Strenght	(a) Dare to face challenges
		(b) Dare to take risks
		(c) Tough or not giving up easily
3.	Generally	(a) Recognizing his own strengths and weaknesses
		(b) Able to interact with others

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The 21st century learning paradigm emphasizes students' ability to find out from various sources, formulate problems, think analytically and work together and collaborate in solving problems (Warsita, 2017). in learning in the 21st century, everyone must have critical thinking skills, knowledge and abilities of digital literacy, information literacy, media literacy and master information and communication technology. Creating opportunities for students and developing their own thinking skills to learn more concepts in various educational fields as well as making them think independently to make the most of their learning experiences. Today's students are challenged to think critically on their own, using available resources to understand more ideas and develop skills in many academic areas (Abdurrahman, Abdullah, Osman, et al., 2020).

The teaching program aims to develop students' problem-solving skills by looking at problems from different perspectives, to acquire Mathematical Thinking and application skills, to accurately, effectively and usefully use mathematics, to develop perspectives on whether the problems they face in life are problems for them. them and reach a certain level of knowledge (Uyangör, 2019).

Every individual is born with unique characteristics. Even though individuals are born twins, the nature of individual twins lies only in their physical appearance, while the mindset of twins is of course very different. By knowing students' thinking processes in solving mathematical problems based on student characteristics, teachers have indirectly provided services to heterogeneous individuals (Widodo et al., 2020).

Mathematical Thinking is one of the most critical goals of mathematics education which has a very important role to play in enhancing conceptual learning (Zeynivandnezhad et al., 2013). Mathematical Thinking is a process that allows students to expand the complexity of their ideas. This process includes specializing, conjecturing, generalizing, and convincing (J. Mason, 2010) (Drijvers et al., 2019).

The aspects of Mathematical Thinking and the indicators used in this research are specializing, conjecturing, generalizing, and convincing, with indicators that have been modified from Stacey's theory as shown in Table 2 (Ferdianto et al., 2022).

Table 2: Mathematical Thinking Process Indicators

Mathematical Thinking Process	Indicators
Specializing	(a) describe/illustrate the problem,
	(b) identify the problem,
	(c) develop and try various possible strategies
Generalizing	broaden the range of results obtained
Conjecturing	analogy to a similar case
Convincing	(a) looking for reasons why the results obtained may appear,
	(b) form a pattern from the results obtained,
	(c) make the opposite of the pattern that has been formed

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METHODOLOGY

Research Design

The method used in this research is descriptive research with a qualitative approach. Qualitative research follows the natural setting in which a research takes place (Abdurrahman, Abdullah, & Osman, 2020), in this case students function as instruments. Qualitative methods require inductive data analysis and theory development, which are based on the data obtained, are descriptive in nature and give more importance to the process being investigated, and make a systematic interpretation of certain events, incidents, or phenomena from the experiences of researchers in their research (Chivanga & Monyai, 2021). This study was limited by focus, specific criteria to ensure data validity and interim design. Also, qualitative data is generated through joint decisions (Tohir et al., 2020). A qualitative research design is used for in-depth investigation of current situations in real-life contexts.

Sample and Data Collection

The subjects of this research were 60 class VIII students at SMP N 9 Cirebon City. Students were expected to be able to describe the mathematical thinking process in solving mathematical problems. Data collection was carried out by distributing student self-efficacy questionnaires, providing numeracy literacy questions, these questions were issued by the Ministry of Education and Culture's educational center, and interviews regarding the Mathematical Thinking process. The collected data is reduced, presented, summarized and verified. Data validation was carried out by triangulation, peer checking and follow-up observations.

Analyzing of Data

The data analysis technique is carried out by: (1) grouping student self-efficacy data into three aspects, namely Magnitude, Strength, and Generally, (2) looking at Mathematical Thinking abilities, (3) analyzing each Mathematical Thinking process using the theories of Mason, Burton, and Stacey.

The data and sources in this research were obtained from student self-efficacy questionnaires, Mathematical Thinking ability tests, and interviews. Questionnaires and test questions were given to 60 class VIII students of SMP N 9 Cirebon City, then several students were taken who belonged to the Magnitude, Strength and General self-efficacy aspects. Interviews were carried out directly to several people who had been determined to find out the Mathematical Thinking process carried out by students in solving the problems given.

Then, the data collected through the results of self-efficacy questionnaires, test results and student interviews were tested for validity aspects using triangulation. Triangulation was carried out to check the suitability of the data obtained between observations, test results (documents), and interview results. Triangulation is an effort to check the correctness of data or information obtained by researchers from various different points of view by reducing as much as possible what occurs in the data collection and analysis process (Tohir, 2019).

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RESULTS AND DISCUSSION

In this research, data collection began by taking self-efficacy data from 60 students using a self-efficacy questionnaire. The following are the results of research on the impact of self-efficacy on mathematical thinking abilities.

Data self-efficacy

Students were asked to complete a questionnaire using a 5-point Likert scale to assess their confidence in their ability to solve the questions. The self-efficacy indicators used in this research are (1) being able to overcome problems that are difficult to face, (2) being confident in one's success, (3) being brave enough to face challenges, (4) being brave enough to take risks, (5) being tough or not giving up easily. , (6) aware of his strengths and weaknesses, (7) able to interact with others. The following are the results of student self-efficacy based on indicators in the form of percentages.

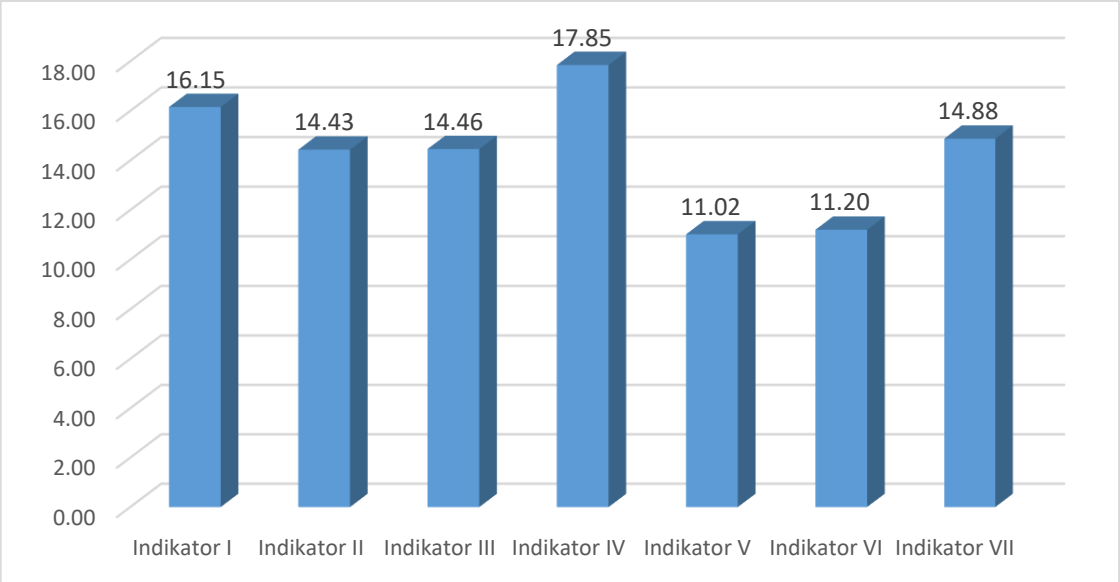

Figure 1: Self-efficacy for each indicator

Figure 1 shows the results of student self-efficacy. It can be seen that the largest self-efficacy data is in indicator IV, dare to take risks, namely 17.85%. Based on this indicator, students have the courage to try new methods even though there is a risk of failure, and they are willing to be appointed as mathematics group leaders.

This shows that students can develop ways of solving problems in their own way, not relying too much on what the teacher has exemplified during learning, so that the student's strength aspect is good. This must continue to be developed so that students' Mathematical Thinking abilities continue to improve.

Indicator V is the lowest self-efficacy score, where indicator V shows whether students are tough or do not give up easily in solving the questions given. Based on Figure 1, it can be seen

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that for indicator V, the self-efficacy value was 11.02%, students' desire to try to improve their incomplete mathematics work is still low, they are more likely to give up when faced with difficult mathematics problems.

Likewise, for indicator VI which measures awareness of one's strengths and weaknesses, from the results of distributing questionnaires to students, only a self-efficacy value of 11.20% was obtained. Many students are hesitant to solve unusual math problems, students are also less confident that they can complete the given math assignment well, therefore they are not sure they will get the best score in the upcoming math test.

In addition to looking at each indicator, the self-efficacy questionnaire was also reviewed in this study from the aspect of self-efficacy which consisted of aspects of Magnitude, Strength, and Generally. The results of the questionnaire data can be seen in Figure 2.

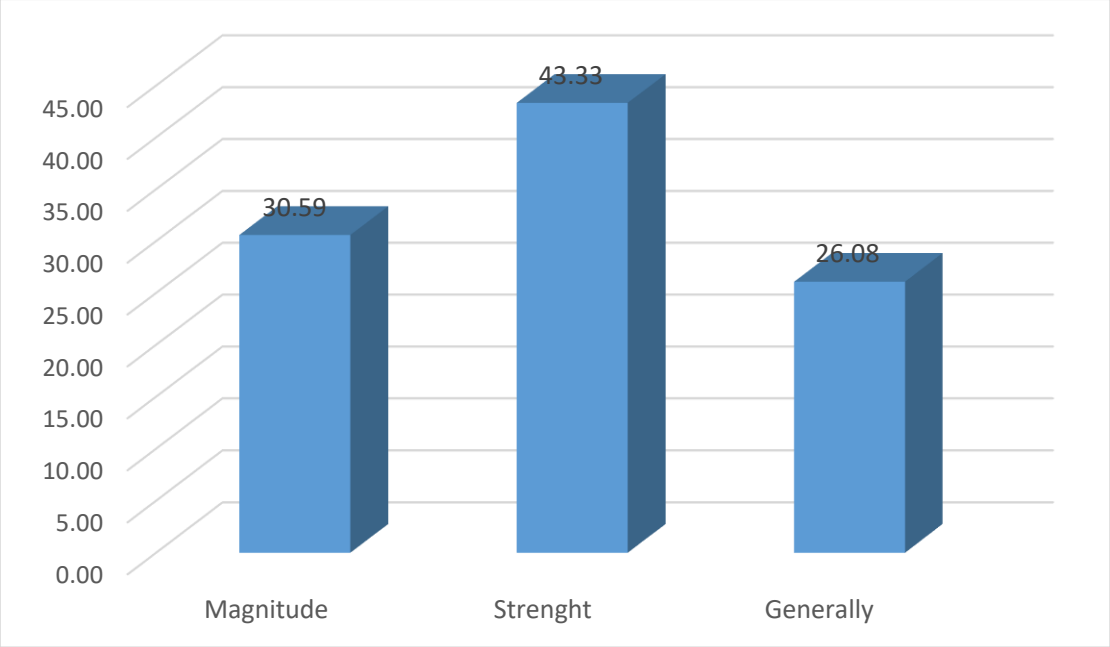

Figure 2: Aspects of self-efficacy

Figure 2 can be seen that the aspect of self-efficacy that the aspect of Strength has the greatest value, which is equal to 43.33%. This shows that students' efficacy beliefs will take place in certain domains or will progress in various situations. The aspect of daring to take challenges, daring to take risks and not giving up easily, the most dominant indicator of the strength aspect in students is the attitude of daring to take risks by continuing to try new ways even though there is a risk of failure. But students are more likely to avoid trying new ways, and prefer the way exemplified by their teacher.

While the lowest self-efficacy aspect is the Generally aspect, an aspect that shows students whether their efficacy beliefs will continue, which only reaches 26.08%. This is shown by students being able to interact with others, seen from students trying to communicate with

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friends to find the best solution to the problem at hand, and feel comfortable when discussing it with anyone.

Mathematical Thinking Ability Data

The results of the Mathematical Thinking ability test for SMP N 9 Cirebon students, for questions number 1 and 2 many students were still able to complete, it can be seen from the percentage of achievement for solving questions number 1 and 2 which was 60%, and in question 4 there was a decrease, but not much different from questions number 1 and 2. However, in question number 3 compared to the other 3 questions, many students have not been able to complete it, as shown in Figure 3

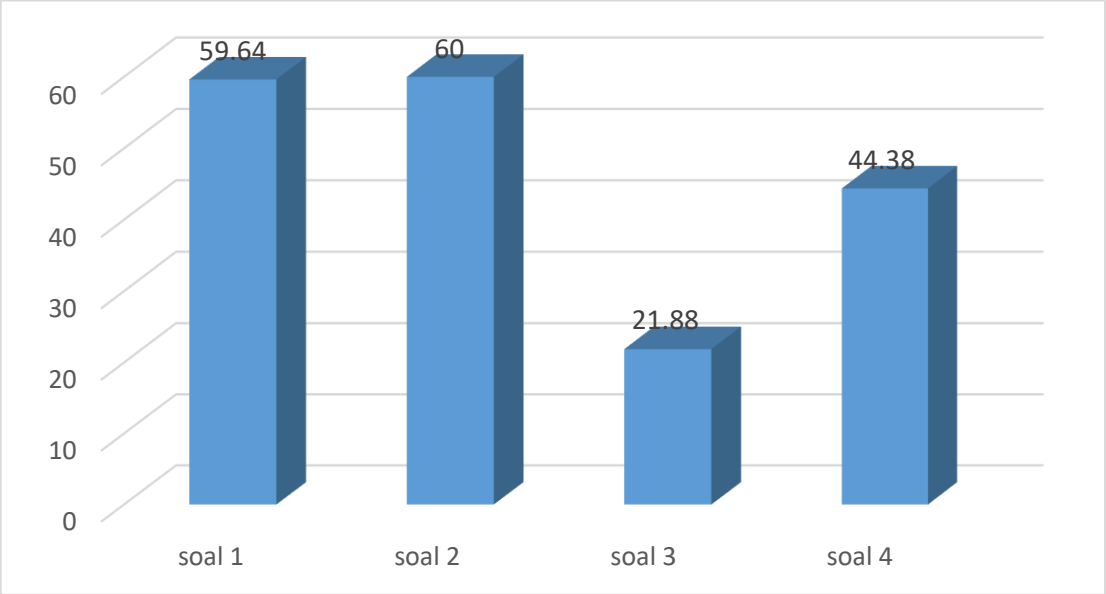

Figure 3: Average Mathematical Thinking Ability

Question number three is the question that is considered the most difficult by students. This can be seen in Figure 3 that the average score for Mathematical Thinking ability for question number 3 is 21.88. Based on the results of the analysis of student number 3's answer who asked about the number of seats at the back, the number of seats in the back 3 rows, and how much income if ¾ of the seats were filled with a ticket price of Rp. 60,000,000,-.

Students' answers to question number 3 of the 3 questions given, on average students only completed one question. There were several steps taken on the question by students to answer the number of seats at the back, as shown in Figure 4. There were students who solved it by finding the difference in the pattern formed from the known number of rows of seats. Several other students divided the rows of seats into even rows and odd rows of seats, then looked at the difference between each row of even seats and odd rows of seats, so that the number of seats in the last row could be known. Some other students only wrote down the answer, without writing down how the answer could be obtained.

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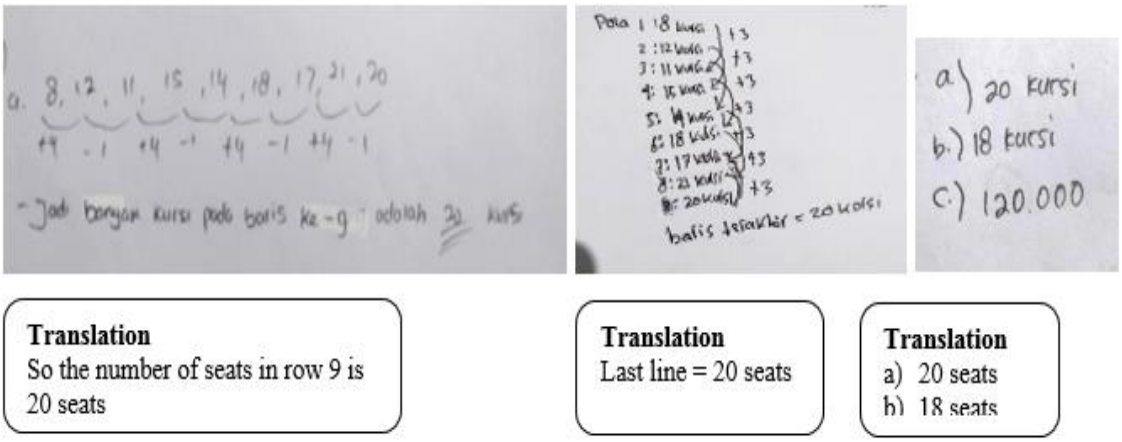
Often people think that studying mathematics is studying existing formulas, giving examples of how these formulas are used (Budhi et al., 2015). Problems can be solved with solutions that can be done by most students, and if possible come from the students themselves. Using mathematics and mathematical thinking patterns in everyday life and in studying science (Amir, 2015).



Translation
So the number of seats in row 9 is 20 seats

Translation
Last line = 20 seats

Translation
a) 20 seats
b) 18 seats

Figure 4: Student Answer Number 3

Self-efficacy on Mathematical Thinking Ability

Aspect Magnitude High Category

Nine students had a high magnitude aspect, but for the Strength and Generally aspects, most students were in the moderate category, none were in the low category. Only four students achieved Mathematical Tinking abilities with high magnitude aspects, or around 44%. The achievement of students' Mathematical Thinking abilities can be seen from the achievement of the Strength and Generally aspects simultaneously or separately in the High Category Magnitude Aspect.

The research findings show that the achievement of the Mathematical Tinking ability of students who have high magnitude aspects is only 44%. Even though the value is not too large, this proves that students who have high category Magnitude aspects still carry out Strength and Generally mathematical thinking processes.

Students with high category magnitude aspects are able to overcome problems that are difficult for them to face, and are confident in their own success. Students will be ready to face various challenges if students feel they are able to do it. And conversely students will avoid activities or work on assignments if they feel unable to do so.

The Magnitude component has implications for the choice of behavior that students will try based on expectations of self-efficacy at the level of task difficulty. The student will try to carry out certain tasks that he perceives he can carry out and he will avoid situations and behavior that he perceives as being beyond the limits of his abilities.

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Aspects of High Category Strength

Twelve students who were classified in the high category of the Strength aspect, only two students who had the high category of the Magnitude aspect, and four people who had the generally high category aspect. The achievement of students in Mathematical thinking skills which have a high category of Strength aspects is as many as eight people, or around 67%. The achievement of students' Mathematical Thinking abilities can be seen from the achievement of the Magnitude and Generally aspects simultaneously or separately in the High Category Strength Aspect.

Students with a high category of Strength aspects have the characteristics of being brave in facing challenges, daring to take risks, tough and not giving up easily. Students feel confident about their own competence.

Students will be ready to face various task situations, various challenges if students feel they are able to do so. And conversely, students will avoid activities or work on assignments if they feel unable to do them. Students who have strong beliefs about their abilities will maintain their efforts. Students with a high level of strength will have a strong belief in their own competence. On the other hand, students who have a low level of strength tend to give up easily in completing their assignments.

The Strength aspect (strength of belief) is related to the strength of the student's belief in his abilities. Strong and steady expectations of students will encourage them to be persistent in trying to achieve goals, even though they may not have supporting experiences. On the other hand, weak hopes and doubts about one's abilities will be easily shaken by experiences that do not support.

Aspects Generally High Category

Of the eight students belonging to the generally high category, only two students had the high category of the Magnitude aspect, and four students had the high category of the Strength aspect. There were six students' achievement in Mathematical Thinking abilities which had aspects in the generally high category, or around 75%. The achievement of students' Mathematical Thinking abilities can be seen from the achievement of the Magnitude and Strength aspects simultaneously or separately in the Generally High Category Aspects.

Students who have the General aspect will be confident in their abilities in various task situations. Individuals will generalize the belief in the success they have obtained from previous experiences, giving rise to the belief that success is not only in that case but can be used in other businesses. Individuals with low self-efficacy will believe that they are only able to perform some behaviors in certain situations, while individuals with high self-efficacy believe that they can perform any behavior in any condition and situation.

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CONCLUSION

The results showed that (1) students who have a high category of Magnitude aspect have a characteristic of achieving Mathematical Thinking of 44%, (2) students who have a high category of Strength aspect have a characteristic of 67% of Achievement of Mathematical Thinking, and (3) students who have a Generally has characteristics of Mathematical Thinking achievement of 75%.

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