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The relationship between students' mathematical disposition and their learning outcomes

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ABSTRACT

The affective aspects must be owned by students in a lesson, where the affective aspects will have a relationship with the cognitive aspects of a student, therefore this study aimed to determine whether there is a relationship between students 'mathematical dispositions and students' mathematics learning outcomes. Using a mixed method and a sequential explanatory plan, the research was undertaken by first collecting quantitative data and then continuing to collect qualitative data. Where, the sample count in this study was 413 students from junior secondary schools 18 in Jambi City, Indonesia who used a total sampling technique. Data were then analyzed with the help of SPSS 21 application to find descriptive statistics in the form of mean, min, max, and category as well as inferential statistics using Pearson Product Moment. The results obtained in this study dominate both the mathematical disposition of pupils and the learning outcomes of pupils in mathematics. This was reinforced by the existence of a relationship between mathematical disposition and student learning outcomes in mathematics which is indicated by the obtained sig <0.05. This means that the mathematical disposition of students which includes the affective aspect of students has a relationship with the cognitive aspect, by having a good affective aspect, the cognitive aspects of the student are also good.

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1. INTRODUCTION

Mathematics is one of the most important sciences to be studied at all educational levels. The essence of learning mathematics is a mental activity to understand meanings and relationships and symbols, then apply them in real situations [1], [2]. Therefore, mathematics is indispensable and useful in everyday life, for science, commerce and industry, and because mathematics provides a powerful, short and unambiguous means of communication and functions as a means of description and prediction. Usually, mathematics is known for its abstractness in addition to some forms which deviate from the reality of the human environment. Mathematics develops greatly when required and technology [3], [4]. Therefore, it is necessary that each one familiarizes himself with mathematics, to understand the role and advantages of mathematics in the future.

The potential of students as learning topics and the role of teachers in the learning process are very important keys to determining the success of education in schools. Successful teaching results from learning outcomes [5]. This learning outcome is determined by both internal and external factors such as the learning

environment, classroom and school climate, self concept and student motivation. Students who have a positive perception of the classroom climate will feel comfortable when entering the classroom, knowing that someone will care for and respect them, and believe that they will learn something valuable [6]-[9]. On the other hand, students with negative perceptions of the classroom climate will be fearful when they are in the classroom and doubt whether they will gain valuable experiences. This is consistent with research that has shown that the classroom climate contributes significantly to the learning motivation of junior high school students [10], [11].

Mathematics is very useful in daily life and in other scientific fields. Mathematics is not just a science that discusses the calculation of numbers inherent in the general public's thinking, but mathematics is a science that can also develop important competencies in a person, both hard skills and mathematical soft skills [12]-[14]. Challenging math skills are mastering science, technology and technical skills related to their field of knowledge. Many kinds of mathematical skills include understanding concepts, problem solving, communication, connection, reasoning, logical thinking, critical thinking and mathematical creative thinking. During this time, soft skills are someone's skills when dealing with others (interpersonal skills) and regulation skills (interpersonal skills). That can achieve maximum performance. Several types of mathematical soft skills include mathematical disposition, independent learning, self-efficacy, self-esteem, self-concept, self-confidence, intelligent thinking habits, value education, culture, and character as well as students' views on learning mathematics [15]-[18]. The mathematical disposition is one of the general skills in mathematics which need to be developed in the learning of mathematics.

Students may enjoy mathematics, but may not display the types of attitudes and thoughts that this standard identifies. For example, students may like mathematics, but believe that problem solving always finds a good answer when using the right way. This belief, in turn, affects their actions when confronted with problem solving. Even if these students had positive attitudes toward mathematics, they did not show important aspects of what we might call mathematical arrangements. Thus, the disposition is more than an interest in mathematics, but must also be sustained by the emergence of attitudes that become indicators or standards in mathematical dispositions [19]-[21].

The general mathematics skills of mathematics students will affect the process of learning about mathematics. Thus, this mathematical arrangement plays a very important role in the continuation of the desired mathematical learning process. A person who studies mathematics should consider mathematics to have an important meaning in his life, especially as a mathematics student, not just a subject that must be fulfilled but must know how important mathematics is in everyday life and other scientific disciplines [22], [23]. For mathematics to be studied by itself, curiosity, persistence, and a positive attitude in the process of learning mathematics. This is also stated by Asrial, *et al.* [24] and Syahrial, *et al.* [25] that learning will be better if students are interested in something because it fits their needs or feels that something to be learned is felt to be meaningful to them. As with learning math, students who are interested in learning math can allow students to be serious about learning and achieve the goals of the math learning process. The process of learning mathematics should students have an awareness of the importance of learning mathematics so that students will try hard to learn and make learning more meaningful in themselves so that the goals of learning mathematics can be achieved properly [26]. With students interested in and aware of the importance of mathematics, it will encourage students to be positive about mathematics such as students will be confident, not easily give up, flexible, diligent, and resilient in learning mathematics.

The importance of mathematical disposition is also stated in Permendiknas No. 22 of 2006 concerning Content Standards, writing down the objectives of mathematics subjects for all levels of primary and secondary education, one of which is having an attitude of appreciating the use of mathematics in life, namely curiosity, attention, and interest in learning mathematics, as well as a resilient and confident attitude in problem solving. This shows that student attitudes and trends towards mathematics or mathematical arrangements are one of the goals to be achieved in the mathematics learning process [27], [28]. To know the mathematical arrangement of students, one must know the indicators of the mathematical arrangement itself. The indicators of mathematical disposition or operational disposition according to NCTM are: 1) Confidence in using mathematics to solve problems, to communicate ideas, and for reasons; 2) Flexibility in exploring mathematical ideas and trying alternative methods in solving problems; 3) Willingness to persist in math tasks; 4) Interest, curiosity, and creativity in doing mathematics; 5) Tendency to monitor and reflect on their own thinking and performance; 6) Assess the application of mathematics to situations that arise in other disciplines and everyday experiences; 7) Respect for the role of mathematics in our culture and its value as a tool and as a language. Mathematical disposition can be considered a very important factor in determining the successful learning of students in mathematics [18].

The learning process is seen as the right tool for analysing students' mathematical skills. According to NCTM, this kind of information (mathematical disposition) is best collected through informal observations of students when they participate in class discussions, attempt to solve problems, and do various tasks

individually or in groups [18]. Assessment procedures such as attitude questionnaires do not capture the various perceptions and beliefs that underpin student dispositions. Therefore, mathematical disposition analysis is better carried out in the learning process because mathematical dispositions or attitudes that are indicators of mathematical dispositions will be more visible and more objective when in the learning process of mathematics.

Therefore, the purpose of this study is to see the relationship between students' mathematical dispositions and mathematical learning outcomes with the following questions; 1) How are the results of students' mathematical dispositions in learning mathematics?; 2) How are student learning outcomes in learning mathematics?; and 3) Is there a relationship between students' mathematical dispositions and mathematics learning outcomes?

2. RESEARCH METHOD

The research used a mixed approach. Creswell stated that mixed methods can refer to the use of quantitative and qualitative data in answering research questions as well as being part of a larger research program designed as a complement to provide information related to different methodological approaches [29]. Type used is a sequential explanation. Explanatory is a research where initial data collection is quantitative and then qualitative data is followed, which means that quantitative data is strengthened by the qualitative data that will be obtained [30].

Where quantitative data were obtained by providing a mathematical questionnaire on disposition and multiple choice questions, followed by qualitative activities, including student interviews. This study used 413 secondary school students at Jambi City, Indonesia using a total sampling technique. The total sampling technique is an example of a collection technique that uses the entire population [31], then interviewing 48 students who were recommended by the teacher to conduct interviews based on the criteria of the researcher, namely four high scores for the highest math test scores and four students with the lowest test scores. The study used one questionnaire, multiple-choice questions and interviews.

In the first data collection process, because it uses a sequential type of explanation, the first data collected is quantitative data using a mathematical disposition questionnaire and multiple-choice questions. The mathematical disposition questionnaire was developed by researchers and validity tests were carried out by experts in their fields, and 18 valid statements were obtained with a Cronbach alpha value of 0.78, then multiple choice questions were also developed by researchers and validity tests were carried out by experts in their fields and obtained statements that valid as many as 15 with a Cronbach alpha value of 0.75. The questionnaire used was a Likert scale 4. Then to process the data, the SPSS 21 program was used to obtain descriptive and correlational statistics to see quantitative data, while for qualitative data using miles & huberman, namely data reduction, data display, and conclusions [32]. The descriptive statistics are presented as summary frequencies, such as average, mode, median, minimum, maximum and standard deviation [33]. In the present study, the descriptive statistics used are the mean, the minimum, the maximum and the category and correlation using the time produced by the person. Table 1 presents the categorization of math dispositions and student learning outcomes in mathematics in this study.

Table 1. Categories of student dispositions and student mathematics learning outcomes

Category	Interval	
	Mathematical dispotion	Learning outcome
Very not good	18.0 – 31.5	0.0 – 3.7
Not good	31.6 – 45.0	3.8 – 7.5
Good	45.1 – 58.5	7.6 – 11.2
Very good	58.6 – 72.0	11.3 – 15.0

During data collection, the first activity that must be done is to select students based on the categories provided by the researcher, then give questionnaire of mathematical disposition and student learning outcomes, the questionnaire and test is then processed using SPSS 21 application data to see descriptive statistics, in the form of, the mean, min, max, percentage, and category of students and see if there is an relationship the two variables.

All data were obtained from students' mathematical disposition and learning outcomes, questionnaires and tests on student values, and were collected, calculated and supported by the SPSS 21 application. Descriptive statistics are given for calculating the frequency, percent, mean, minimum and maximum of a sample [29]. In this study, quantitative data were analyzed using parametric statistics derived from the time correlation of the person in the product to determine whether there was a relationship between

mathematical disposition and student learning outcomes en mathématiques. And followed by an interview that serves to reinforce the results of quantitative data. Qualitative data analysis was used by Miles and Huberman in reducing data, displaying data and reaching conclusions [32].

3. RESULTS AND DISCUSSION

Mathematical disposition is an interest in and appreciation for mathematics, which is a tendency to think and act positively. Students' disposition to math is reflected in their attitudes and actions in choosing an approach to tasks that will relate to learning outcomes. Consequently, the novelty of this study is to see that the mathematical disposition of students has a good relationship with the results of students' learning mathematics. This can be viewed from the Table 2 and Table 3. The results of students' mathematical dispositions in mathematics can be seen in Table 2.

Table 2. The results of students' mathematical dispositions in learning mathematics

Range	Classification Category	Total	Mean	Max	Min	%
18.0 – 31.5	Not very good	3	53.5	68	27	0.7
31.6 – 45.0	Not good	12				2.9
45.1 – 58.5	Good	312				75.7
58.6 – 72.0	Very good	86				20.7
TOTAL		413				100

From Table 2, which came from 413 respondents from the junior high school in Jambi after they were obtained and the results obtained using the SPSS 21 application program, the results of the mathematical disposition of students in mathematics have a dominant result is good, with a percentage of 75.7 % for 312 students from a total of 413 students, very good at 20.7% for 86 students from a total of 413 students, not good 2.9% for 12 students out of a total of 413 students, and very bad at 0.7% for 3 students from a total of 413 students. Of the 413 students, the mean score was 53.5, the maximum score was 68, and the minimum score was 27.

The results of the questionnaire analysis in table 2 show that the mathematical disposition of students in mathematics has a good dominant category of 75.7% (312 of 413) students in mathematics. This is shown by the diligence of students in learning mathematics and always being interested in every mathematics lesson in class. This can also be seen from the results of interviews that have been conducted, while student learning outcomes in mathematics can be seen in Table 3.

"What makes you believe that you will get good grades?"
"I am very confident, because I have studied hard."
"What makes you so confident and passionate about learning mathematics?"
"Because I am very interested in the lesson and make me continue to want to find out new things"

Table 3. Student learning outcomes in mathematics lessons

Range	Classification Category	Total	Mean	Max	Min	%
0.0 – 3.7	Not very good	2	8.5	13	2	0.5
3.8 – 7.5	Not good	16				3.9
7.6 – 11.2	Good	321				77.7
11.3 – 15.0	Very good	74				17.9
TOTAL		413				100

From Table 3, which came from 413 respondents from the junior high school in Jambi after they were obtained and the results obtained using the SPSS 21 application program, the dominant results of student learning in mathematics are good, with a percentage of 77.7% for 321 students out of a total of 413 students, very good at 17.9% for 74 students from a total of 413 students, not good 3.9% for 16 students from a total of 413 students, and very bad at 0.5% for 2 students out of a total of 413 students. From the 413 students, the mean score was 8.5, the maximum score was 13, and the minimum score was 2.

The results of the question analysis in Table 3 show that the students' mathematics learning outcomes have a good dominant category of 77.7% (321 of 413) students in mathematics. This is shown by

the active students in learning and proven by the results of the tests given. This can also be seen from the results of interviews that have been conducted, while

"How did you perform while studying mathematics?"
"You could say I have a good achievement in mathematics."
"What things can you prove if you have deep persuasion in learning mathematics?"
"I am often chosen to represent the school to take part in the mathematics olympiad, then I can prove it by getting a score above 85 every semester"

The results from motivation and science process skills to basic physics practicum 1 are described in Table 4. This table shows that the sig value of 0.26 is smaller than 0.05. It can be concluded that there is a relationship between the mathematical position and learning outcomes of junior high school students with a positive R value of 0.697. If the sig value <0.05, there is a relationship [34].

Table 4. Relationship between mathematical disposition and mathematics learning outcomes

		Mathematical disposition	Learning outcome
Mathematical disposition	Pearson Correlation	1	.697*
	Sig. (2-tailed)		.026
	N	130	130
Learning outcome	Pearson Correlation	.697*	1
	Sig. (2-tailed)	.026	
	N	130	130

Mathematical disposition is one of the general mathematical skills and basic social mathematical attitudes that require the attention of teachers to perform their learning. A study by Pratiwi and Ependi pays attention to cognitive and affective strengths contained in thinking and mathematical dispositions are rational that in learning mathematics students and students need to prioritize the development of thinking skills and mathematical dispositions [35]. This prioritization becomes increasingly important when it is associated with the demands for advancement in science and technology and an increasingly tight competitive atmosphere for graduates of all levels of education. According to Rasendiz, to reveal the mathematical dispositions of students, it is possible to do so by making a scale of dispositions and observations. The disposition scale contains the statements for each provision element [36]. Thus, mathematical disposition is one of the general skills or emotional abilities of students that are required to implement effective learning of mathematics.

With a strong mathematical disposition, students can support achieving other mathematical abilities, both cognitive and emotional. Such as problem-solving skills, mathematical communication, comprehension of mathematical concepts, and others [37], [38]. Because mathematical disposition is a positive attitude or tendency of students to act and ponder on mathematics. With a mathematical disposition being a foundation in students, it can allow other mathematical abilities to be developed. With a strong mathematical disposition in students, it will encourage students to interpret and appreciate mathematics and the role of mathematics in different aspects of life and other disciplines [39].

From the learning process, students obtain learning outcomes which are the result of an interaction of learning actions, namely experiencing a process to improve their mental abilities and teaching actions, namely teaching students. Teachers as educators perform curriculum-based learning engineering, in which the teacher uses educational principles and theories of education. Learning outcomes based on Chen, Yang and Hsiao and Bremholm and Skott are abilities that students possess after receiving their learning experience [40], [41]. A way to learn about an individual learning outcome is to test these students. Mathematics is not isolated knowledge that can be perfect because of itself, but the existence of mathematics is primarily to help humans understand and master social, economic and natural problems [42]-[45].

The results of the study in this study are in line with research by Izzati with the results of the study that there is an effect of mathematical connections and dispositions on learning outcomes [46]. Similarly, research by Mandur, Sadra, and Suparta has shown that the ability to make connections, representational skills and mathematical arrangements make a significant contribution to the learning of mathematics [47]. In addition, there are internal student factors that also have an impact on successful or unsuccessful learning in terms of learning outcomes. As a result, many factors can influence students' learning outcomes, one of which is their mathematical disposition. So that many factors can affect student learning outcomes, one of which is mathematical disposition.

4. CONCLUSION

The results obtained in this study are dominant both in students' mathematical disposition as well as in students' learning outcomes in mathematics. This is reinforced by the existence of a relationship between the mathematical layout and the student's learning outcomes in mathematics. This means that the mathematical disposition of students which includes the affective aspect of students has a relationship with the cognitive aspect, by having a good affective aspect, the cognitive aspects of the student are also good.

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