How influential the mathematical disposition of mathematical communication skills is? (the evaluation of middle school students)

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Abstract. This study aims to examine the effect of mathematical disposition of junior high school students on mathematical communication skills. This study used a correlation method with a quantitative approach. The subjects in this study were 31 student which is the eighth grade at one of the junior high schools at Bandung. The instrument used consists of a test instrument which is a test of mathematical communication skills with the indicator is forming a mathematical model; arguments based on analysis of images and concepts; and the appearance of conceptual models, such as images, diagrams, tables and graphs and non-test instruments in the form of questionnaires about students' mathematical dispositions. The results of the study show that the mathematical disposition of junior high school students has a positive influence on mathematical communication skills. Students' mathematical communication skills are influenced by mathematical dispositions of 74.5% and 25.5% influenced by other factors beyond students' mathematical dispositions. This shows that the relationship between students' dispositions and its mathematical communication skills is strong enough. Students who have a positive disposition towards mathematical learning tend to be active and can express ideas well.

1. Introduction
In mathematics learning, there is a combination of affective and cognitive abilities, in this study highlighted the relationship between students’ disposition ability and their mathematical communication. Mathematics is not just a thinking tool, a tool to find patterns, solve problems or draw conclusions, but mathematics is also a tool to communicate ideas clearly, precisely, and concisely and precisely. Mathematics learning is a social activity and also as a vehicle for interaction between students and students and between teachers and students. In this study examined whether students who have a good mathematical disposition, also have good mathematical communication skills?

Studying mathematics is a series of learning about concepts, procedures, and applications in a learning activity. Each student will have a different response to the challenges given when learning mathematics, whether a good response such as enthusiasm, or an unfavorable response such as staying quiet, not responding. The series of activities in learning mathematics requires self-availability from students to try to construct ideas, collect a set of examples, and attempt to understand and solve the
problems given. [1] Stated that around 25% - 32% of non-cognitive variables regarding mathematical stages can predict students' academic mathematical results. The attitude towards mathematics is the attitude of students towards mathematics that approves, rewards, interests, and desires to learn it. Students' attitudes are seen from the affective component which is expressed as interest, satisfaction, curiosity, judgment, etc., which refers to the spread of general mathematical dispositions and habits of thought. Disposition does not only refer to attitude, but also the tendency to think and act positively. Students' mathematical attitudes are manifested in the way they complete tasks such as flexible thinking, critical spirit, perseverance, independence, accuracy and precision, and so on, which are important in mathematics [2]. Mathematical disposition is a tendency of students' actions and attitudes toward mathematics. Disposition of students towards mathematics can be seen from attitudes and actions in completing tasks. Students' mathematical dispositions are seen from self-confidence, curiosity to find alternative solutions, perseverance, and tendencies of students in reflecting on ways of thinking about the tasks given. Van De Walle [3] said that the disposition of mathematics refers to their motivation and self-confidence to do mathematical tasks and the attitudes and beliefs of students about mathematics.

Mathematical disposition is not a single scale, but multi-dimensional from intellectual and emotional factors related to completing tasks that require mathematical thinking or processes, [4]. Mathematical disposition is a combination of attitudes, behaviors, motivations, interests, and real feelings from mathematical achievements that can activate or hinder mathematics learning. Mathematical disposition is "... an individual's' tendency to have experience of certain attitudes, beliefs, feelings, emotions, moods or temperaments with respect to mathematics "[5].

Greennes explain that mathematical communication is a central force for students in formulating mathematical concepts and strategies, communication is the capital of students' success in approaching and solving mathematical exploration and investigation, and communication as a place for students to obtain information or share thoughts, assess and sharpen ideas to convince others [6]. In line with Stacey explained that one of the factors that contribute to determining student success in solving problems is mathematical communication skills [7].

On the other hand, this mathematical communication ability still seems to be an obstacle for students. Based on the results of Stacey study [7], in the lower secondary school, the students still could not understand mathematical communication, students had difficulty in showing the problems provided in the form of images. While the results of the study of Sudayana show that some students have difficulty expressing mathematical ideas in writing, they find it easier to communicate verbally which makes it difficult for students to make mathematical models [8]. Pataleon examined how students communicate mathematical ideas when given problems in proving geometry and proof of algebra and found that in proving geometry, the subject explains what is understood, presents ideas in the form of images and symbols, and accurately explains the content or meaning of representation and clear, but the subject cannot convey arguments systematically and logically [9]. Whereas in proving algebra, the subject describes what is understood, explains the method used, and explains the content or meaning of symbolic representation accurately, systematically, logically, but the argument presented is not clear because it is not sufficiently detailed and incomplete.

The communication process in mathematics learning is said to be good if students are able to build the knowledge gained. Communication skills include the ability to communicate conceptual understanding, reasoning, and problem-solving as the goal of mathematics learning, and this is the reason why mathematical communication skills are important for students. Increasing student’s mathematical communication skills and significant learning achievements can be done by making changes in learning [10].

Some studies show there is a relationship between cognitive and affective abilities in students. Fitrianna his study revealed that most students in junior high school who have high, moderate, and low mathematical dispositions do not have the ability to write steps with words in solving mathematical problems yet and have not been able to solve problems with mathematical expressions and students can't create problem situations based on data or representation provided [11]. In Erlita's research the mathematical disposition ability of junior high school students is still low which can be seen from many
students do the modeling work of other students in doing math exercises, without having a high curiosity towards mathematics [12]. So that when students do not have a positive disposition towards mathematics, students will tend to be passive towards the tasks given. Based on the above research, it can be seen that there is a relationship between attitudes towards mathematics as well as learning outcomes in mathematics. So that researchers are interested in knowing whether there is an influence on the disposition of students with mathematical communication skills?

2. Method
This study uses a correlational method, with a quantitative approach, which aims to find the influence or relationship between the two variables in this study to find the relationship between students' mathematical dispositions and their communication skills. The population in this study was one of the junior high schools in the city of Bandung. While the sample in this study were 32 students of class VIII. The instruments in this study consisted of test instruments in the form of mathematical communication skills and mathematical disposition questionnaires. The test instruments were in the form of test questions for mathematical communication skills as many as 4 items with circle material. The measured in this communication ability is the emergence of conceptual models, such as images, diagrams, tables and graphs; forming mathematical models or algebraic equations; and arguments based on analysis of formal drawings and concepts. Each question has a one to five scores. While non-test instruments in the form of questionnaires as many as 36 scale statements regarding mathematical dispositions. The scale used is the Likert scale model consisting of 5 options, namely: Strongly agree (SS), agree (S), doubtful (R), disagree (TS), strongly disagree (STS). Mathematical disposition aspects which include: confidence in solving mathematical problems, communicating ideas or ideas, and giving reasons; diligent and persistent in completing math assignments; have interest and curiosity in working on mathematics; assess mathematical applications in other fields of everyday life.

This research was conducted in 4 stages, namely: (1) Submission of mathematical disposition questionnaire; (2) Test of mathematical communication skills; (3) Analysis of data, namely looking for the effect of mathematical disposition of junior high school students on mathematical communication skills; (4) Concluding the results of the study.

3. Results and discussion
Finding out the effect of students' disposition ability on mathematical communication skills is done by statistical regression tests. The following is a statistical description of the data on students' mathematical disposition and communication skills.

| Table 1. Descriptive statistics. |
|---------------------------------|
|                                | N | Minimum | Maximum | Mean   | Std. Deviation |
| Disposition                    | 32| 73.37    | 133.04  | 102.0869 | 15.38391      |
| Communication                  | 32| 5        | 19      | 13.00   | 4.385         |
| Valid N (listwise)             | 32|          |         |         |               |

The average mathematical disposition of students 102 with a minimum value of 73.37 and a maximum value of 133.04. While 13 mathematical communication skills with a minimum value of 5 and a maximum value of 19. Performed the normality and linearity test first, before regression statistical tests. The results of the normality test show the value of Sig. from test questions and questionnaires more than 0.05. Referring to the decision making in the Kolmogorov-Smirnov normality test, it can be concluded that the data is normally distributed. Thus, the assumptions or normality requirements in the regression model have been fulfilled. Furthermore, the linearity test of communication skills was carried out on the mathematical disposition of junior high school students. This linearity test aims to find out a linearly significant relationship between these two variables. The results of the linearity test are presented in the following Table 2:
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Table 2. Linearity test.

| Sum of Squares | df  | Mean Square | F     | Sig.  |
|----------------|-----|-------------|-------|-------|
| disposition *  | (Combined) | 6137,438 | 13  | 472,111 | 7,087 | .000 |
| Between Groups | Linearity | 5463,548 | 1   | 5463,548 | 82,010 | .000 |
|                | Deviation from Linearity | 673,890 | 12  | 56,157 | .843 | .611 |
| Within Groups  | Total | 1199,163 | 18  | 66,620 | 7336,601 | 31 |

Based on the table above, obtained the value of deviation from linearity sig. is 0.611 more than 0.05. Then it can be concluded that there is a significant relationship between students' mathematical dispositions with their mathematical communication skills. Next is the regression statistical test to see whether there is an influence on the disposition of junior high school students to their mathematical communication skills. The results of the tests are presented in Table 3, Table 4 and Table 5 below:

Table 3. Regression test.

| Model | Sum of Squares | df  | Mean Square | F     | Sig.  |
|-------|----------------|-----|-------------|-------|-------|
| 1 Regressi on | 443,840 | 1   | 443,840 | 87,508 | .000b |
| Residual | 152,160 | 30  | 5,072 | 596,000 | 31 |
| Total  |                |     |            |       |       |

Based on the regression test in Table 3, the value of Sig. equal to 0.000 which indicates that there is a significant influence of mathematical disposition on mathematical communication skills of junior high school students, with a significance level of 5%.

Table 4. Model summaryb.

| Model | R       | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|---------|----------|-------------------|---------------------------|
| 1     | .863a   | .745     | .736              | 2.252                     |

a. Predictors: (Constant), disposition
b. Dependent Variable: communication

Table 4 shows that the correlation coefficient value is 0.863 and the R-Square determination coefficient value is 0.745 (74.5%) so that it can be interpreted in this study, students' mathematical communication skills are influenced by mathematical dispositions of 74.5% and 25.5% influenced by other factors beyond students' mathematical dispositions. This shows that the relationship between students 'mathematical dispositions and students' mathematical communication skills is strong. Because in this study mathematical dispositions affect more than 50% of communication skills in middle school students.

Table 5. Coefficients.

| Model | Unstandardized Coefficients | Standardized Coefficients | t     | Sig.  |
|-------|-----------------------------|---------------------------|-------|-------|
| 1     | (Constant)                  | -12,109                   | 2,714 | -4,463 | .000 |
|       | disposition                 | .246                      | .026  | .863  | 9.355 | .000 |

a. Dependent Variable: communication
Table 5 shows the results of testing about the influence of mathematical dispositions on mathematical communication skills, namely:

\[ Y = 0.246x - 12.109 \]

This can be interpreted that if there is no mathematical disposition in students, the consistent value of students' mathematical communication is -12.109. But in fact, the data above cannot be zero, because the data for mathematical disposition variables are obtained from questionnaires that use the Likert scale (5 answer options) so that the variable X cannot be equal to 0. Therefore, intercept which has a negative value is not need to be interpreted. The regression coefficient number is 0.246, meaning that each addition of 1% mathematical disposition, the mathematical communication of students will increase by 0.246, indicating a mathematical disposition has a positive effect on mathematical communication skills. This is in line with [13] that mathematical creative thinking dispositions and positive perceptions in junior high school students are very influential on mathematics learning because students who have high thinking dispositions and positive perceptions will be better at learning mathematics.

The following is an example of the work of students who have a good mathematical disposition in solving mathematical communication problems in circle material. Students are given a circle image and instructed to find the center of the circle accurately. Previously students have studied the elements of the circle.

![Figure 1. The answer of three students which have a good mathematical disposition.](image)

Students work and explain in different ways, some students who have low mathematical dispositions only answer a minimum without being accompanied by information, they only make a point in the middle of the circle by guessing. Some students try to measure it with a ruler, some try to use the term. Interestingly, there are students who trace the circle and then cut it and fold it into four, so that the intersection points are found. Through good communication skills, a problem will be more quickly represented correctly and this will support solving problems because mathematical communication skills support other mathematical abilities, such as problem-solving abilities. Students need to build conception and translate it in the form of communication [14].

Students who have good mathematical dispositions, they provide an explanation of the steps they are working on, they apply the concepts they learned before. Conception in students will be a rational basis between information that is known in geometry problems and solving problems found, the process occurs throughout the problem-solving activities and communicating geometric problem solving is one of the contributions of student conception [15].

4. Conclusion

Based on the discussion of data analysis, it can be concluded that in this study the mathematical disposition of junior high school students had a positive influence on mathematical communication skills of 74.5% and 25.5% influenced by other factors beyond mathematical disposition. Students who have good mathematical dispositions, they will also have good mathematical communication skills, they will be able to throw ideas in conceptual models such as images, make mathematical models or algebraic equations and can argue based on the analysis. This is in line with [16] who revealed: "in general the dispositions and mathematical representations play an important role in improving students'
mathematical power competencies". Positive mathematical disposition is needed by every student in learning mathematics, so it should be found the right way to strengthen or improve mathematical disposition skills, so that not only communication skills are increased but all aspects are needed in learning mathematics. According to Pasaribu, a mathematical disposition is the relationship and appreciation of mathematics which is a tendency to think and act positively [17].

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