

The Ability of Logic Thinking and Communication in Solving Mathematic Narrative Task

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Abstract – One evidence of student success was to see student learning outcomes can be seen from the number of students' mistakes. Factors were logical thinking ability and communication. This study aimed to determine the level of logical thinking ability and communication skills on Mathematic narrative tasks. The population were all 1048 students of class VII Muhammadiyah High School of 10 schools with 145 sample with stratified cluster random sampling. The instrument used were descriptive statistics and path analysis with amos program. The results showed that: 1) The level of logical thinking ability and was in the medium category; 2) The ability to think logically had a positive effect on both, 3) Logical thinking ability on solving problem was greater compared with direct method. 4) Both variables had a positive effect on ability to solve mathematic narrative task.

Keywords – Anaysis and Communication, Logical Thinking, Mathematic Narrative Task, and Path Analysys.

I. INTRODUCTION

Soedjadi (2004) argues that mathematics education has two major objectives that include (1) formal objectives, which emphasize the organization of children's think logically and the personal formation of children and (2) material objectives that put emphasis on the application of mathematics and solving skills math problems. This is in accordance with the general objectives of mathematics learning formulated by the National Council of Teachers of Mathematics (2000), namely: (1) learning to communicate (mathematical communication); (2) learning to reason (mathematical think logically); (3) learning to solve problems (mathematical problem solving); (4) learning to associate ideas (mathematical connections); (5) the formation of positive attitude toward mathematics (positive attitudes toward mathematics).

Furthermore, (OECD, 2009) explains that learning mathematics is very important to be mastered by students because math skills is the ability of individuals to formulate, employ and interpret mathematics in various contexts. This includes thinking of mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. Mathematical literacy also helps individuals recognize the role that mathematics plays in the world and make reasonable judgments and decisions needed by constructive, engaging and reflective citizens.

Factors that must be fulfilled by students to get the ability and the results of good mathematics learning is the ability to solve the problem. Ability to solve the problem is the ability of students to solve math problems that include: (1) ability to write down the known aspect, (2) ability to write the aspect in question, (3) ability to make mathematical model, (4) ability to solve mathematical model, and (4) ability to answer questions about. The ability to Mathematic narrative tasks is part of the problem-solving ability. Problem-solving ability represents higher intellectual activity, which is considered the majority by experts as the most complex cognitive level because problem-solving abilities are activities that mobilize all the intellectual abilities of individuals in memory, perception, think logically, (Daniela, 2015).

But in reality, many teachers complain because of the low ability of students to do the story. It can be seen fr-

from the number of students' mistakes in doing the story problems so that the students' mathematics achievement is low. One of the causes of students' inability to do the story is they do not understand what is known and what is asked in the matter of the story. Student difficulties in determining a solution is not caused because students do not master the steps in solving a story problem but more likely to the difficulties students to interpret the problem, a sign of the operations they must use in solving the story problems.

Mistakes in solving mathematical problems are caused by several factors such as students' errors can be preconceptions or misconceptions, associative thinking, humanistic thinking, incomplete or wrong think logically, wrong institutions, learning abilities and interests, (Suparno, 2013). Besides (Maria, Mardiyana, & Sri, 2014) concluded that most students only understand the concept. So when faced with a new problem, they experience confusion that stumbles on the error. Other errors are language errors, operational errors, and math errors. However, it is more dominant in operational errors and mathematical themes, less conscientious, (b) assume that writing what is known and questioned does not really matter, (c) assuming that writing what is known and asked will waste time, (d) forgot to write formula, (e) deliberately not writing the formula completely, (f) to do in hurry, (g) is less precise in multiplication operations, (h) not writing the unit completely, (i) assumes that he / she has sufficiently understood the unit written, (j) due to the previous error, (k) has not understood the material of the volume unit and the student thinks differently (l) has not understood the material of the unit area, (m) is not accustomed to writing conclusions, (n) according to the student, the teacher is not so stressed to write conclusions in working on the story, (o) lack of mastering the prerequisite material, (p) not understanding the sequences to be done (Fitri, 2016).

One of the abilities that is closely related to student learning outcomes is the ability to think logically, namely the ability to find a truth based on certain rules, patterns or logic (Dian, 2009; Cristiano, 2017; Rose, Susan, Kim, Tinille, Tracy, & Gina, 2014). This capability needs to be developed in mathematics learning, as it can help students to improve their mathematical understanding of Priatna (Dian, 2009; Mohammad, Golamreza, Mahmoud, 2012). From here it can be said that the effort to improve logical thinking ability can bridge on improving students' mathematics learning outcomes through a correct understanding of the concept of mathematical concepts.

In the field of mathematics education, the importance of logical thinking ability has been expressed by the experts among them (Jacobs et al., 2007; Sfard & Kieran, 2001; Spijunovic & Maricic, 2011; Felda & Cotic, 2012). The ability to think logically is important for life in the Information Age as proposed (Connor & Greene, 2002), and (Sezer, 2008), explains that logical thinking is a prerequisite for education and is the most important skill for problem solving, research, and invention (Thompson, 2011; Paul & Elder, 2008).

Another ability that students must possess is think logically and communication skills. Reason describes how a student draws a conclusion and evaluates whether the conclusion decided is valid or invalid, think logically involved in the problem-solving process. (Armianti 2011; Beth, Elizabeth, Bonnie, Amanda, Lindsay, & Eric 2015; Nguyen & Laura, 2018) explains mathematical think logically with regard to: (1) draw a logical conclusion; (2) provide explanations using models, facts, traits and relationships; (3) estimating solutions' answers and processes; (4) using patterns and relationships to analyze mathematical situations; (5) preparing and testing conjectures; (6) forming an example of an antidote; (7) follow the rules of inference, check the validity of the argument; (8) compile a valid argument; (9) establishing direct, indirect, and indirect use of mathematical

induction. These activities can be done through problem solving, be it math problems or everyday problems or math problems in everyday life, through active learning and can trigger student creativity.

While mathematical communication is an important factor in mathematics and mathematics education, that is how to share ideas and explain understanding, or ideas into objects of reflection, refinement, discussion and improvement. The process of communication also helps build meaning and instill ideas so as to make it public. Schulman (Izzati, 2012; Olga, Elena, & Anna, 2016) suggests that mathematical communication is: (1) important things for students in formulating mathematical concepts and strategies; (2) capital for student success on the approach and completion of investigation and mathematical exploration; and (3) a place for students to communicate with their friends to obtain information, share thoughts and discoveries, brainstorm, assess and sharpen ideas, and to convince others.

Mathematical communication has an important role in the learning of mathematics, because through the communication of mathematics can express, explain, describe, hear that bring students to a deep understanding of mathematics. As defined (NCTM: 1989) in the curriculum standards of mathematics as a means of communication (mathematics as communication) for grades 5-8 (SMP) are able to: (1) modeling situations, either verbally, in writing, in reality, images, graphics, and algebra strategy; (2) reflect and clarify their own concerns about their mathematical ideas and relationships; (3) develop understanding with mathematical ideas into rules and definitions; (4) using the ability to read, listen to interpret and evaluate mathematical ideas; (5) discuss mathematical ideas, make assumptions and arguments convincing; (6) to appreciate the value, mathematical notation, and its role in the development of mathematical ideas.

With mathematical communication skills, students are expected to communicate ideas either in the form of symbols, tables, diagrams, or other media to clarify the circumstances or problems around them. Weigand (1999), explains that communication is an important part of mathematics education as a means to exchange ideas and tools to clarify understanding. In addition, learning mathematics in the classroom should help students to communicate their ideas. The ability of mathematical communication should be developed as described by (Baroody, 1993) that there are at least two important reasons why communication in learning mathematics should be developed in students, namely: (1) mathematics is basically a language; Mathematics is not just a thinking tool, tools for finding patterns, solving problems, or making conclusions; mathematics is also an infinite value tool for communicating ideas clearly, precisely and concisely; (2) mathematics and mathematics learning is, at heart, social activities; as a social activity in learning the interaction of mathematics between students, such as communication between teachers and students, is very important to develop the potential of students' math.

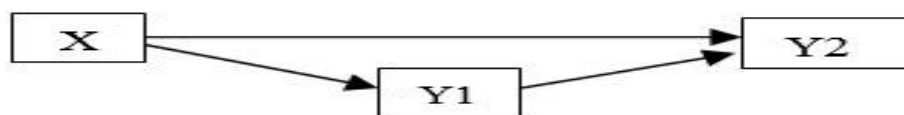
However, students' mathematical think logically abilities are still visible when they are given practice questions in verbal form or in the form of real problems, only a small percentage of students are directly working on them while others are just waiting for answers from friends or teacher explanations then copying them, lack of skills and student activeness in the learning process, especially in solving problems/ problems of mathematics, and the low ability of students in solving math problems. This is due to various factors such as students lacking mathematical think logically and think logically, students have difficulty in solving problems marked by the number of mistakes made by students in answering or working on problems. Students are still embarrassed in communicating their ideas and are still hesitant in raising the issue when the student faces a

problem in solving mathematical problems. When there is a problem presented in another form (incompatible with the given example) the student is still confused how to solve it. This reflects the think logically of the students in the relatively low learning process, the students have not been able to convey or communicate their ideas or opinions. Opinions submitted by students are often poorly structured to make it difficult for teachers and friends to understand.

From the description formulated the problems are 1) whether the ability to think logically have a positive effect on the ability of think logically and communication; 2) whether the ability to think logically positively affect the ability to solve the problem either directly or through the ability of think logically and communication; 3) The think logically ability and communication have a positive effect on the ability to solve the story problem.

II. RESEARCH METHOD

This type of research includes correlational facto ex-post with population of 1048 people spread over 10 accredited schools A and B in seventh grade students of SMP Muhammadiyah in Makassar. The sampling technique used stratified cluster proportional random sampling in which samples were drawn was 50% of accredited A schools as 50% of accredited schools B were five schools as a whole where each school was taken one class by the number of samples as many as 145 Students. Data collection techniques that was with the ability to test logical thinking, think logically and communication skills testing, and the ability to solve the problem of the story. Terms of research instrument that met the validity and reliability as well as validated by the validator validity content (content validity) in testing theoretical validity by involving two experts in the field of mathematics. Technique of data analysis by path path analysis (Path Analysis) with Amos program. Designed the study as shown below.



Description: X: The ability to think logically; Y1: Communication think logically ability; Y2: The ability to solve math story problems.

III. RESULTS

Based on the result of research, the average score of logical thinking ability is 61.29, average score of think logically ability and communication is 64.55, and data score average ability to Mathematic narrative task 69.96 where all three variables were all in medium category. Furthermore, from the results of hypothesis testing obtained Regression Weights as follows.

Table 1. Regression Weights: Group number 1 - Default model

			Estimate	S.E.	C.R.	P	Label
Y1	<---	X1	.250	.098	2.554	.011	par_1
Y2	<---	X1	.423	.224	6.362	***	par_3
Y2	<---	Y1	.422	.186	2.266	.023	par_5

Table 1 shown that X1 has a significant effect on Y1 with $p = 0.011 < 0.05$, X1 has significant effect on Y2 with $p < 0.001 < 0.05$, Y1 effect on Y2 with $p = 0.023 < 0.05$.

Table 2. Standardized Regression Weights Group number 1 - Default model

			Estimate
Y1	<---	X	.177
Y2	<---	X1	.455
Y2	<---	Y1	.190

The influence of logical thinking ability (X) on think logically ability and communication (Y1) has a path coefficient of 0.177, the effect of logical thinking ability (X) on the ability to Mathematic narrative task (Y2) has a path coefficient of 0.455, the influence of think logically ability and communication (Y1) on the ability to solve the story problem (Y2) has a path coefficient of 0.190. To see how much direct influence, indirect influence and total influence can be seen in Table 3 below.

Table 3. Decomposition of the Path Coefficient

No	Influence Variables	L	TL	Total
1	X ₁ Ke Y ₁	0.177	-	0.177
2	X ₁ Ke Y ₂	0.455	0.034	0.488
3	Y ₁ Ke Y ₂	0.190	-	0.190

Based on Table 3 above shows the coefficients that directly affect from X1 to Y1 of 0.177 (total effect). For X1 to Y2 have a direct effect of 0.455 and the indirect effect of X1 to Y2 through Y1 is $PY1X1.PY2Y1 = (0.177) * (0.190) = 0.034$ so that the total effect of X1 to Y2 is $0.455 + 0.034 = 0.488$.

IV. DISCUSSION

The ability to Think Logically Influences Think Logically and Communication Skills

The ability to think logically has a positive effect on students 'think logically and communication ability, it can be interpreted that the better or higher the logical thinking ability possessed by the students, the students' logic thinking and communication ability will be better or higher. Students who have the ability to independently understand and express a problem, plan, analyze an information to then draw the right conclusions according to certain rules either by inductive or deductive thinking deductive, then the student will be easier to manipulate mathematics, allege, develop ideas orally, drawing conclusions, and evaluations.

Ontario Ministry of Education (2006) states that the secret to success in math lessons is to be able to determine what students think and then use that information as a basis for instructional instruction. The teacher learns what students think through communication. When students communicate mathematically, both orally and in writing, they make their thinking and clear understanding to others as well as themselves. Once students can communicate mathematically, teachers can: measure students' attitudes toward math; understand the learning process of students, including misunderstandings that students have; help students understand what they are learning; acknowledge and appreciate other perspectives. When communication is emphasized in a mathematics program, students also have many opportunities to develop and strengthen skills to investigate mathematical concepts and solve mathematical problems, students need to read and interpret information, express their thoughts orally and in writing, listen to others, and think critically about ideas.

Logical thinking is concerned with think logically and communication because of the ability to think logically which is the ability to find a truth based on certain rules, patterns or logic with regard to the ability to file allegations, to manipulate mathematics, to draw conclusions, examining the validity of an argument while the ability of communication is the ability to develop ideas/ ideas orally and in writing, communicate ideas to others, analyze, and express ideas with their own language. The results of this study are in line with the results of the research of (Zurida, 2015; Yuhal & Zeynep, 2014; Eunmo, 2017) with the results of research that there is a correlation between the skills of achievement science process and logical thinking ability.

The Ability to Think Logically affects the ability to Solve the Story Problem

The ability to think logically has a significant effect on the ability to solve the problem of the story, it can be interpreted that the better or the higher the logical thinking ability possessed by the students then the ability to solve the problem of mathematics students will be better or higher.

The ability to think logically significant effect on the ability to solve the problem of the story can be interpreted that students who have the ability to independently understand and reveal something problems, plan, analyze the information to then draw the right conclusions in accordance with certain rules either by inductive or deductive thinking deductive, then the student will find it easier to solve the problem of mathematics by understanding the known aspect, the aspect being asked, making and completing the mathematical model, as well as evaluating and drawing conclusions.

The direct influence of logical thinking ability on the ability to solve the math story problem can be seen the coefficient of the path of 0.455, while the large coefficient of indirect path (through think logically ability and communication Y1) of 0.488. Thus it can be concluded that the effect of logical thinking ability on the ability to solve math problems is greater if through think logically and communication ability compared with directly. It means that students will have the ability to solve the problem of mathematics if the students have logical thinking ability, and the ability of students in solving mathematical problems will get better results if the students have logical thinking ability, and think logically ability and mathematical communication.

One of the abilities that is closely related to student learning outcomes is the ability to think logically, namely the ability to find a truth based on certain rules, patterns or logic Suriasumantri (in Usdiana, 2009). This capability needs to be developed in mathematics learning, as it can help students to improve their math comprehension skills. From this it can be said that efforts to improve logical thinking ability can bridge on improving students' mathematics learning outcomes through a correct understanding of mathematical concepts.

The ability to think logically is a combination of numeracy and logic ability so that students can solve a problem logically. Thinking logically in accordance with mathematics learning that prioritizes numeracy and logic. According to Saifullah (2004) that the ability to think logically is the ability to use numbers properly and make correct think logically, involving many components of mathematical calculation of problem solving, deductive and inductive considerations, and sharpness patterns and relationships as well as related abilities students in numerical or numerical arithmetic and logical thinking.

The result of this research is in line with the result of (Retnawati, 2009; Prathana, Suwimon, & Siridej 2014) research about the effect of logical thinking ability on the ability to solve the problem of the story with the result of research indicate that there is significant influence (at 1% level) on logical thinking ability to the ability of

concept comprehension and ability to Mathematic narrative task, as well as the ability to understand concepts and the ability to Mathematic narrative tasks affect the ability to solve mathematical problems in the real world. Similar results conducted by Suhendri (2012) with the results of research that there is a positive influence of logical-mathematical intelligence, self-confidence, and independence of learning to mathematics learning result and Sri (2013) with result of research that ability of logical thinking mathematically have positive effect to student ability in solving math problem which is packed in story form at class VIII SMP Negeri 9 Kota Cirebon with influence equal to 70, 7%.

The ability of Think Logically and Communication affect the ability of Solving Math Narrative Task.

The ability of think logically and communication has a positive effect on the ability to solve the story problem, it can be interpreted that the better or the higher the think logically and communication skills possessed by the students then the ability to solve the problem of mathematics students will be better or higher. Students who have the ability to relate the known facts to a conclusion by having the ability to file allegations, manipulate mathematics, develop ideas orally and evaluate will be easier in solving mathematical story problems by knowing the known aspect, knowing the aspect being asked, mathematical models, and draw conclusions.

Communication is a very important part in learning mathematics. Communication is a way to share ideas and clarify understanding. In communicating ideas can be mirrored, improved, discussed and developed. The process of communication also helps build meaning and embodies ideas and communication processes can also publish ideas.

Math communication skills are indispensable for students. Depdiknas (2004) states that one competency that is expected to be achieved in learning mathematics related to mathematics skills is the competence of communicating ideas with symbols, tables, graphs or diagrams to clarify the situation or problem and solving it. Furthermore, Depdiknas (2004) also stated that the mathematical ability chosen and determined has been designed in accordance with the ability and needs of students to develop optimally, the competence associated with this communication must be achieved during the learning process takes place in the classroom. Communicating the outcomes and learning process and finding these mathematical ideas will be very important because they will be used by students both when they are in school, in college, in work or in the community. The students' mathematical communication skills are important to develop as they include the ability to communicate conceptual understanding, think logically, and problem solving as the objectives of mathematics learning.

In addition to think logically communication is also an important part in learning mathematics. Think logically is one of the basic competencies of mathematics in addition to understanding, communication and problem solving. Think logically is also a mental process in developing the mind of some fact or principle. Think logically is a process of thinking that is done in one way to draw conclusions.

The results of Sitti, Upu, & Awi (2013) found that students with high communication category and mathematical think logically ability reach level 4 means students with high ability to give complete and correct answers, students with medium ability of communication category and mathematics think logically reached level 3-4. Level 4 means that students give complete and correct answers and level 3 means that students give

almost complete and correct answers, but there is little error, students with moderate ability of communication category and mathematical think logically reaches level 0-2. Level 2 means that students give complete and correct answers, level 1 means that students give vague answers and level 0 means wrong answer and no detail.

Students who have think logically ability when the student has the ability to propose allegations, the ability to manipulate mathematics, the ability to draw conclusions, compile evidence, provide reasons or evidence of the truth of the solution, the ability to draw conclusions from the statement, the ability to check the validity of an argument, the ability to find patterns or traits from mathematical phenomena to make generalizations.

The result of this research is in line with the research result of Okvita (2009) with the result of the research explaining that there is influence of think logically ability and communication to the ability to solve the story problem through the learning problem problem posing model of the main function of the students of class VIII SMP Negeri 10 Semarang. The percentage of the influence of think logically ability and communication on the ability to solve the problem of the story through the model of learning problem posing the subject matter of function in the students of class VIII SMP N 10 Semarang of 68.8%.

V. CONCLUSION

Based on the results of descriptive analysis and hypothesis testing, the conclusions are drawn as follows: (1) the level of logical thinking ability, think logically and communication ability, and the ability to solve the problem of narrative task are in the medium category; (2) the ability of logical thinking to positively affect the think logically and communication ability with a large influence is 0.177 or 17.7%; (3) the ability to think logically has a positive effect on the ability to solve the story problem. Direct influence of 0.455 or 45.5% while indirect influence (through think logically and communication ability) of 0.488 or 48.8%, it means that students will get better results if students have logical thinking ability, and think logically and communication ability mathematics; (4) think logically ability and communication have a positive effect on ability to solve math story problem equal to 0.190 or 19%.

VI. SUGGESTION

Based on the above conclusions, the suggestion were: (1) the students were to improve logical thinking ability, verbal ability, think logically and communication ability, and ability to solve math story problems; (2) think logically ability and communication have a positive effect on ability to Mathematic narrative task. So it is advisable to teachers and students to constantly improve the effectiveness in the learning process of mathematics to obtain the ability and results of high learning mathematics: (3) is expected to educational practitioners to apply the development of aspects of logical thinking ability, think logically and communication skills, and the ability to Mathematic narrative tasks in students through the guidance of teachers and tutoring in each school to handle the three variables; (4) is expected in the next research, so that researchers choose other variables that are suspected as factors that affect the ability to Mathematic narrative tasks and student learning outcomes, such as the application of learning models and methods, teacher professionalism, education systems and curriculum.

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