# PROFILE OF MATHEMATICAL COMMUNICATION SKILLVIEWED WITH PROBLEM-SOLVING SKILL: A CASE OF SECONDARY STUDENTS

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**Abstract:**
The difference in the level of problem-solving skills allows differences in mathematical communication of students in solving mathematical problems.The studyaims to define the profile of precise communication based on the level of problem-solvingskills of secondary students. The sample used 30 secondary school students chosen purposively. The study shows that, based on problem-solving ability, there are 16.67% of students on low level having a difficulty on representing figures/mathematical object into mathematical model; 70% of students on medium level having a trouble on understanding the information given in the problem and the way they express it into symbols, and 13.33% of students on high level do not provide clarity within every step taken in their answer.

**Keywords:** Profile, Mathematical Communication, Problem Solving, Secondary Mathematics

## Introduction

Mathematical communication skills and problem-solving are two abilities that are needed by students in mathematics learning including problem-solving, reasoning and proof, communication, connections, and representation (NCTM, 2007).

Scientific communication can occur verbally and in writing. Verbal, mathematical communication can occur during group discussions. Whereas written communication can arise when students explain the idea or situation of a picture or graphic in their own words in written form, state a position with a view or graphic (draw), state the location into the type of a mathematical model (Rachmayani, 2014). With communication, students can organize and consolidate mathematical thinking(Umar, 2012). Without mathematical communication skills, students will not be able to convey ideas and precise ideas to others (Permata F, Kartono, 2015). So, accurate communication used as an intermediary in uniting mathematical concepts.

Problem-solving is the process of dealing with a new situation, formulating relationships between the facts given, and identifying possible strategies to achieve learning objectives (Isvina, Sugiarti, & Kurniati, 2015). Another ability that is no less important is problem-solving (Rahaju, 2019; Widodo & Dahlan, 2019; Rianti, 2018). Problem-solving skills can be trained (Irianti & Chandra, 2016) through the teaching and learning process in the classroom. By developing problem-solving abilities, students can build new mathematical skills that can solve ethical problems contained in mathematics, as well as other content by applying various strategies that are suitable and reflecting the processes that have carried out in solving issues (Fatimah, 2009). According to Charles Lester and O'Daffer (inRosli et al., 2017, Kai& Joseph, 2011), problem-solving skills include the ability of students to understand problems, plan strategies, and draw conclusions or answers.

In solving problems, not all students have the same way of thinking because every student has a background in mathematics skills that is quite varied. Also, students in solving problems sometimes require different times, depending on the issue at hand. In other words, the ability of students to solvethe mathematical problems determined by their competence (Nunes, Bryant, & Sylva, 2009).

Ifseen from the linkages, mathematical communication skills and problem-solving can be developed together in the learning process (Sutiarso, 2017;

Tinungki, 2015) because one of the determinants of a person in solving problems (problems solving) is mathematical communication skills (Novianti, Khoirotunnisa, 2017).

Whereas, according to (Asmana, 2018), the smooth communication of written mathematics of high and medium-capacity students is equally fluid. The fluid connection of written mathematics with low mathematical ability is not continuous. That is contrary to the result of the study (Ariawan & Nufus, 2017),which states the relationship of mathematical communication skills with the ability to solve problems at high, medium and low-level capabilities of the relationship that occurs is negative. In other words, the higher the mathematical problem-solving ability, the lower the mathematical communication ability. That shows the increasing number of studies on precise communication and problem solving, the more dynamics of new findings that considered for making changes in planning learning strategies for the creation of more effective and efficient future learning solutions.

Therefore, to obtain new images and knowledge related to mathematical communication skills and more critical problem-solving abilities, research is needed "Profile Of Mathematical Communication Skill Viewed With Problem Solving Skill: A Case Of Secondary Students."

## Methods

This study uses a mixed-methods model with an explanatory type. The sample used 30 secondary school students chosen purposively. This study uses a mixed-methods model with a descriptiveexample. The research sample selected on the subject teacher's recommendation. Data analysis in this study uses analysis of students' mathematical ability test results to determine mathematical communication skills based on big, medium, and low-level problem-solving.Then the test results are analyzed to find differences in mathematical communication skills based on the level of problem-solving.

**Table 1. Scoring Rubric Problem-solving ability from the results of the analysis Charles, Lester and O'Daffer (in Rosli et al., 2017; Kai&Joseph, 2011)**

| No. | Score | Understanding Problems |
|---|---|---|
| 1. | 2 | Complete Understanding of the Problem |
| 2. | 1 | Part of the problem misunderstood |
| 3. | 0 | Misunderstanding Total Problems |
| **No.** | **Score** | **Planning a Solution** |
| 1. | 2 | Completion planningcan lead to the rightsolution ifimplementedcorrectly |
| 2. | 1 | Partly correct planning based on the part of the problem that interpreted correctly |
| 3. | 0 | Misconceptions of Total Planning |
| **No.** | **Score** | **Possible Answer** |
| 1. | 2 | Correct answer |
| 2. | 1 | Copy error; computational error;partial answers to problems with many answers |
| 3. | 0 | There are no answers or wrong answers based on incorrect plans |

Table1 is a scoring rubric of problem-solving analysis results conducted by Charles, Lester, and O'Daffer (Rosli et al., 2017; Kai & Joseph, 2011 ). Meanwhile,the indicator of mathematical communication ability used were (1) Ability clicking connect real objects, drawings, and diagrams into mathematical ideas;(2) The ability to explain concepts, situations, and mathematical relations in writing; (3) Ability to state events or ideas in precise language or symbols (Nari, 2015).

**Results**

The following is a discussion of the effects of calculating problem-solving scores and analyzing mathematical communication skills of students from low, medium, and significant problem fraction levels. The choice or alternative of matching students' problem-solving abilities on a scale that calculated using a standard deviation based on the level of problem-solving ability.

Then the results obtained from the ability of mathematical communication ability based on the level of problem-solving of students as follows :

1. Profile mathematical communication skills based on low-level 16,67% of students have low-level problem-solving skills. The strength of the problem fraction to state a picture into an accurate idea, the student, experiences a total error in understanding the problem, making a mistake in planning a solution and the answer is inferred wrong However, in terms of stating events or ideas in mathematical language some problems misinterpreted, problem planning is partly correct from issues that are misunderstood correctly and still make mistakes in interpreting events or ideas in precise language.

   When viewed from its mathematical communication skills, most students find it challenging to interpret images fully into mathematical ideas.Students are not careful in performing arithmetic operations so that some of the answers do not become correct solutions to problem-solving. According to what stated (Pratiwi, 2015) draw the problem based on information on the issue without analyzing the actual problem and not by the problem-solving steps or there is already by the problem-solving step but not yet at the expected problem-solving.
2. Profile of mathematical communication skills based on medium level problem-solving skills.

   There are 70% of students have moderate-level problem-solving abilities; some of the problems misunderstood or misinterpreted the settlement plan is partly correct based on the part.

   I saw from the ability of mathematical communication it tends to be able to answer questions related to explaining the idea of situations and mathematical relations and mathematical relations in writing with real objects, pictures, graphics, and algebra.

   But, students can solve problems while not being able to connect images or real objects into mathematical ideas.Learners can write down the information contained in the questions, and most of the information delivered is incomplete in planning a solution having problems in concluding. Have difficulty understanding the information provided in the problem and the way they express it into symbols.
3. Profile of mathematical communication skills based on a high-level problem-solving skills.

   There are 13,33% of students who have high-level problem-solving skills to understand the problem with complete planning problem solving, leading to the correct solution when viewed from its mathematical communication capabilities that are incomplete for any information submitted.

   Meanwhile, the similarity of the high, medium and low-level mathematical abilities is inaccurate in writing units.From the point of students' errors learners who often appeared in solving the problem, namely a) a lack of understanding of the issue raised, (b) lack of knowledge of strategy, (c) the inability to translate into mathematical form, and (d) the failure to use the math right (Yeo, 2009).

   Based on the score of problem-solving ability are 16.67% of students have a low-level problem-solving ability, 70% of students have a medium level problem-solving ability, 13,33% of

students have a high level of problem solving ability.

**Table 2. The Scale of Answers on Test Questions Based on Level of Problem Solving Capability (Azwar, 2012)**

| Interpretation | |
|---|---|
| Scale | Ability |
| $x < 22{,}4$ | Low |
| $22{,}4 \leq x \leq 29{,}6$ | Medium |
| $x > 29{,}6$ | Hight |

The choice or alternative used in the table is a mapping of high, medium, and low levels of problem-solving abilities using scales and standard deviations.

**Table 3. Levels of Solving Ability Student Problems**

| Scale | Learner Code |
|---|---|
| $x < 22{,}4$ | C4, C12, C23, C24, C27 |
| $22{,}4 \leq x \leq 29{,}6$ | C1, C5, C7, C8, C9, C10, C11, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C25, C26, C28, C30 |
| $x > 29{,}6$ | C2, C3, C6, C29 |

Table three is a mapping of students' problem-solving abilities. Where if the score of students ' problem-solving ability is $22{,}4 \leq x \leq 29{,}6$ included in the low-level problem-solving ability, the count of students' problem-solving ability included in the medium level problem-solving ability and the score of the problem-solving ability is involved in the high-level problem-solving ability.

## Conclusion

Based on the analysis of 30 students with a mathematical communication ability profile based on the level of problem-solving ability, that is,precise communication of students with high and medium level problem solving can both identify the problem and write a short answer directly on the essence of resolution. Meanwhile, the similarity of high, medium and low levels of mathematical abilities is not careful in writing units.

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