Mathematical communication of junior high student based on the conceptual understanding of triangle

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Abstract. As we know that the mathematical communication is an important skill. Optimization mathematical communication research gave so many option as the effort to optimalized it, such as reading, discussing, writing. All of the option was concerned about learning model and how to learn. Based on the study of literature, at least there were four aspects that could affect the mathematical communication, those were teacher, learning, the learning materials, and the student itself. Not only that four, but also conceptual understanding could affect mathematical communication because the thing that student communicate were the concept that they had. Some of problem about conceptual understanding were found in triangle. On this research, researcher use qualitative method with observation, interview and test as instrument. There were found that learning model was not the only problem of the way to optimalized student mathematical communication because mathematical communication skill not only about how teacher taught in the classroom. That’s why the way to optimalized it has to be fitted to the problem that founded.

1. Introduction

Communication ability has been quite significant in the 21st century. On a research revealed that communication ability has become one of the common competencies and important requirements policy makers set in business and industry competition [1]. For that reason, the communication skills both oral and written cannot be underestimated [2]. The similar way applied in terms of communication in certain school subjects. Through the communication process both oral and written will support someone’s understanding over a concept [3]. One of the school subjects that emphasizes the communication ability is mathematics. One of the mathematics competencies that must be achieved is the ability to communicate called the Mathematical Communication Ability. National Councils of Teacher of Mathematics (NCTM) [4] revealed that mathematical communication is an essential mathematical ability listed in the secondary school mathematics curriculum. Communication is an important part in mathematics and mathematics learning [5]. Regarding to the standard process issued by NCTM, the expected abilities are: 1) the ability of mathematical communication, 2) mathematical reasoning, 3) mathematical problem solving, 4) mathematical connections, and 5) mathematical representation [5]. Lindquist & Elliot argued that to achieve the social goals of fulfilling the labors mathematically awareness lifelong learning, opportunities, and being educated people, they must be able to
communicate mathematically [6]. In line with this, Romberg argued that to strengthen the students’ mathematical ability and to be mathematically aware, students must learn to communicate ideas mathematically [7]. The ability of mathematical communication includes a person's ability to describe the process of solving problems and their idea about the process [8]. This mathematical communication means it can be used as a basic to master other abilities. Students who have mastered the ability of mathematical communication will be able to communicate mathematically. Then, by communicating ideas mathematically it will help students to strengthen their mathematical understanding [9-11]. According to Lim and Chew [12] with effective communication, students will solve problems efficiently and are able to explain concepts and mathematical ability to their friends or teachers.

Being aware of the importance of mathematical communication ability, it is necessary to attempt to optimize the mathematical communication ability in order to achieve the desired standard of graduate competence. As an effort to optimize the communication abilities, the students can be facilitated to familiarize themselves in writing and discussion [9]. In line with that opinion, Mahmudi stated that one of the strategy that can be made related to the effort in improving the ability of mathematical communication is writing mathematically [13]. Encouraging students to talk (discussing and sharing ideas), listening (reading), reading, writing, and reflecting on their learning outcomes and their math problem-solving skill will help strengthen their awareness of thinking as well as their communication abilities [1]. On the other hand, although it is clear that students who are able to communicate will show the indicators mentioned in the discussion above, it does not necessarily ease the assessment of students' communication abilities. In some cases, students sometimes do not consistently demonstrate mastery of these indicators. At that point, teachers instantly apply the learning that includes justified measures to optimize the ability of mathematical communication without looking at the causes and factors of low mathematical communication abilities. It was found that students with higher scores in the test were not necessarily able to communicate their ideas to those around them. It can be seen from the results of student 2 interview who turned out silent when given the opportunity to express his/her idea. While the student 1, regardless of the wrong answer, but he/she had an effort to explain the basic idea on doing the test on mathematical comparison. These problems may have correlated to students' understanding on the mathematical concepts, in line with the result of Wilson's study which revealed that facilitating students to communicate orally and in writing may provide an opportunity for students to understand the mathematical concepts [14].

Based on the description above, there is indication of problem in students' communication ability. The problem is in triangular material. For some students, learning about triangle is fairly difficult. Setiyawati’s study revealed that based on interview with the teachers, students mostly made mistakes in problem-solving related to everyday life [15]. In line with this case, in the same year, Winasmadi found that the students’ difficulty on understanding the material of triangle was due to the teachers’ teaching method [16]. Based on Sulianto’s study, it turned out many students experience the difficulty due to the various type of questions [17]. As mentioned earlier, students' understanding correlates to students' communication abilities, therefore the author was interested to understand students' communication skills on triangle material. This study aims to analyze how to understand the concept of student triangle and analyze the problem of students' mathematical communication ability based on understanding the concept of triangle.

2. Method
This study used a qualitative method. This study is a hermeneutic phenomenology research. The hermeneutic phenomenology research is a study of the meaning experience of a situation or object based on phenomenology philosophy [18]. It was chosen in order to identify, understand, and describe a phenomenon in the field, in this case is the problem of grade VII junior high school students’ communication ability. The location of this study was in Junior High School 1 Karangampel Indramayu District with the subject of study was the students of grade VII D in the junior high school. Research subjects were chosen based on several criteria, such as the result of comprehension test on the triangle material concept, the observation result, the document analysis, and the submission from the subject
teacher. In line with this, the data in this study was taken in several ways, namely observation, document analysis, concept comprehension test, and interview. The procedure of data collection and processing in this study started with Collecting documents, observation and took videos. After we got video of observation data and document files, continue with Triangle concept comprehension test. Data of triangle concept comprehension were followed-up as subject selection. The subject that has been chosen was gave Students’ interview. Not only the students’, but also the teacher was interviewed. The process of Interview was also taped in video. Finally, all of the data that has been collected were analyzed in analysis of research data. Document analysis (video, file, and portfolio) were analyzed to found the problem and causal factors. Al last, Solutions and suggestions are made based on the analysis, data, and theory.

3. Result and discussion
Mathematics has several competencies to be achieved, one of which is the ability to communicate called the Mathematical Communication Ability. According to Lim and Chew with effective communication, students will be able to solve problems efficiently and can explain the concept and mathematical ability to their friends or teachers [12]. subsequently, by communicating ideas mathematically it will help students in strengthening their mathematical understanding [9-11] It means that students’ learning experiences play a significant role in helping students understanding. The argument formed by students in communicating cannot be separated from the students' understanding. In this study, selected subjects have a heterogeneous triangle concept (high, medium, low). The subjects of the study then interviewed to explore the ability of mathematical communication and other related matters. There were 6 selected subjects in this study.

Subject 1 with the high test results of triangle concept comprehension test, did not experience a significant problem in explaining the procedure of solving the triangle problem. However, when asked about the reasons why the steps were taken, the subject experienced significant difficulties. Subject 1 who had a high comprehension test score of the concept of triangle found it difficult to convey ideas related to the fundamental concept. It was indicated by the difficulty that arose when asked about the reason for the answer given, he was confused. Subsequently, based on the results of interview with subject 3 with the medium test results of the triangle concept comprehension test, he/she was able to provide ideas related to the concept asked in the triangle concept comprehension test. In the interview, he/she was able to answer questions that had previously failed to be answered.

Subject 2 obtained the medium test results of triangle concept comprehension test having the same tendency as the subject 4, 5 and 6 which got the low result on concept comprehension test of triangle material. Subjects 2, 4, 5, and 6 were more passive in conveying ideas. Many questions were answered with the word "forgot", "just so" or using body language like nodding and shaking. The arguments expected to be extracted during the interview session were not very visible. This resulted in the absence of indicators of mastery of mathematical communication ability.

Based on the results of document analysis (video learning), it turns out it was caused by several factors. First, the lessons that teacher presented tend to be teacher-centered. Teacher provided short questions that did not trigger the students to be active. Based on the theory of didactic situations, the teacher should present an action situation on learning. The sequence of the action situations refers to the process by which students strategize, it can have concluded that they find themselves a way to solve problems [19]. The second factor is the ability of the teacher in the presentation of triangle concepts. Based on observations, document analysis, and interview with the teacher, Presentation of basic concepts such as line-segment representations of equal size, naming angles, and also lack of triangles terms presentation. This raises an indication that the problems found in students in the article written by Mulyana such as not being able to distinguish angles and angle values, and not able to form an equilateral triangle, arising from the lack of the teachers themselves [20]. The third factor of the reason for the students’ weakness in communication ability is internal factors of the students themselves.

The internal factors of students were very diverse. One that appears in most subjects was that they already considered mathematics as a difficult subject. In addition, subject 1 said that the learning in the
classroom did not accommodate students to express their thoughts. They only responded based on the insights provided in the textbook. The main factor in subject 2 is that he/she only focused on how to solve triangular matter-related problems. It implied the results of interview where he/she expressed more opinion with the word "just like that". Subject 3 who was able to communicate ideas related to the concept of triangle because he/she reading material after school repeatedly. The low result of the triangle concept comprehension test was caused by the poor health condition during the test so that they did not do the test optimally. Subsequently Subjects 4, 5 and 6 did not express much different opinions, where the main difficulty was the difficulty of understanding mathematics. In the interview process, subject 5 said that before the lesson began. He/she was already lazy to hear the word "mathematics". Based on that research study, we found that the affective was had so many contributions about how mathematical communication skill was built. Besides that, conceptual understanding also makes a great impact for student’s mathematical communication skill. Based on Brousseau, the thing that is communicated in mathematical communication skills is mathematical understanding (knowledge) itself [19].

4. Conclusion
Based on the data from the study and data analysis, the students' understanding of the concept of triangle is still low. It can be seen from the students’ low test results on understanding the concept of triangle. It affects the students’ own mathematical communication ability. The students’ oral communication ability is still low based on the indicators set out in this study. The indicators of mathematical communication ability are 1) Linking information from pictures, tables, diagrams to mathematical ideas; 2) To express their mathematical thinking to be understood by friends, teachers and others; and 3) Using mathematical language to express ideas appropriately. Furthermore, it was found that the cause of the low ability of communication was due to the teacher factor, learning, and also internal factor of student. It is expected to be a reference for further research that problems that can lead to low student communication abilities may arise from various factors. So the next research will not necessarily choose a particular model or method of learning as a solution in optimizing the ability of mathematical communication.

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