Mathematical communication of junior high school student based on gender

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Abstract. Mathematics communication skill is one of the important abilities that students must have. This study aims to explain how mathematical communication abilities female and male students in solving rectangles problem. The subject of this study was 6 students who already studied rectangles in the class. In this research, the researcher used a qualitative method. There were found that male students tend to solve problems by stated it into the sketch. While female students tend to solve problems by restating with their own language.

1. Introduction
There are seven abilities that students must have to meet global challenges in the 21st century, one of them is verbal and written communication skills [1]. In mathematics learning, there are 5 important things, first problem solving, second reasoning, third communication, fourth connection, and last representation [2]. So communication skill is important to learn because it uses in facing the 21st century.

Communication is a way to share ideas. Communication can be interpreted as “exchange” but in mathematical communication, communication cannot be interpreted as an exchange of mathematical information but about the construction of information and mathematical knowledge [3]. When students are in class and challenged to think mathematically, communication is important because students can express the result of their ideas orally and write. With communication, ideas will be the object of reflection, improvement and discussion. With mathematical communication, students will explore ideas from various perspectives that help sharpen their thought [2]. There are two important reasons why communication needs to be the focus of mathematical learning, first mathematics as a language and mathematics learning as a social activity [4]. Mathematical communication skills will support other mathematical abilities because with it ideas can be explained, reflected, improved, discussed, and developed [5], [6].

Gender is something that was created after someone was born as a result of two psychological influences, the first is external anatomy and physiology which means visible appearance, therefore this gender is strongly influenced by place or region [7], [8]. According to Albert Bandura’s social cognitive learning theory, social and cognitive factors, as well as actor factors play an important role in learning [9]. In general, male students have a better ability to do visual-spatial tasks than female, in contrast, female students seem to be more capable in verbal skills [10]. Female students are better at working on routine problems and solved with the ways that taught in class. While male students are better at complex problems and they are more analytical and flexible compared to females [11]. Female students have higher levels of mathematical anxiety compared to male students [12]. Male students in mathematics
learning highlighted success in learning mathematics while female students saw mathematics as a relevant field and would be useful in life [13]. Mathematics is often considered a field for men, many students believed that mathematics was a masculine field so that approaches to understanding mathematics in male and female students differed [13], [14].

Based on above explanation, it shows the importance of mathematical communication and there is diversity between the ability of male students and female students. Thus, the aim of this study is to explain how male and female students communicate their mathematical ideas.

2. Methods
This study used qualitative research. The design of this study is Phenomenology. Phenomenology is the study that was derived from philosophy and psychology which the researchers describe the experience from individual or group about a phenomenon that occurs naturally. The subject of this study were 6 junior high school students, who are 3 males and 3 females. Subjects were referred to are participants of students who have studied rectangles in school. In this study, all subjects were given rectangles problem. The rectangles problem made from one indicator of mathematical communication skills, namely “explaining ideas, situation, and mathematical relations orally or in writing” [15]. After all subject solved the problem, the answers from all the subjects were analysed.

3. Result and Discussion
In this study 6 students were asked to solving rectangles problem. S1, S2 and S3 are female students. Whereas S4, S5 and S6 are male students. The rectangles problems are “A swimming pool shaped rectangles measuring 10m long and 6m wide. Around the pool will be made a road with ceramics 1.5m width. How do you find the area of ceramics for the road?”

Translate:
Known: Around the pool will be made a road with 1.5 width.
Asked: What is the area of ceramics for the road and how to find out?
10 + 3 = 13
6 + 3 = 9
13 x 9 = 117
10 x 6 = 60
117 – 60 = 57
The way is to calculate the area of rectangle after that calculate the area with length and width plus three. And finally subtract the total area by the pool area.

Figure 1. S1 answer in rectangles problem
S1 already understood the problem that was given. She illustrated the swimming pool sketch with incomplete information because ceramic width information was not included. She still hadn’t been able to change the information from problems become mathematics models. She hadn’t been using mathematics symbols correctly is shown in Figure 1. She only wrote $10+3=13$, $6+3=9$, $13\times9=117$, $10\times6=60$ and $117-60=57$ but she didn’t write down the purpose of these calculations. Even so. She could solve the problem correctly.

**Translate:**

**Known:** Rectangular pool with a size $10\text{m}\times6\text{m}$. Around the pool is made $1.5\text{m}$ road and installed ceramic.  
**Asked:** What is the area of ceramics for the road and how to find the area of ceramics for that road?  
**Answer:** 

$\begin{align*} L_1 &= p \times l = (10+3) \times (6+3) = 13 \times 9 = 117 \text{ m}^2 \\
L_2 &= 10 \times 6 = 60 \text{ m}^2 \\
\text{So, the area of ceramics for the road} &= 117 \text{ m}^2 - 60 \text{ m}^2 = 57 \text{ m}^2 \\
\text{How to solve:} \ (1) \ \text{the length of the pool plus the length of the road,} \\
&\text{the width of the pool plus the width of the road, then both are multiplied;} \ (2) \ \text{the area of the pool, length multiplied by the width;} \\
&\text{(3) the result of area 1 is 117 m}^2 \text{ minus area 2 (the pool) that is 60 m}^2 \text{ and the result is 57 m}^2. \\
\end{align*}$

**Figure 2.** S2 answer in rectangles problem

Based on Figure 2, S2 already understood the problem. She could change the problem became mathematics models. Although she didn’t sketch the problem, she wrote down all the information with her words. S2 already used mathematics symbols as $L$ for the area, $p$ for the length of pool, and $l$ for the width of pool. She could solve the problem correctly with her own words.

S3 already understood the question problems. She illustrated the problem into a sketch with information such as the length of pool, the width of pool, and the width of ceramics. S3 had been using mathematics symbols as $L$ for the area. She could calculate the area of pool. But she misunderstood about the length and the wide of the pool after being surrounded by ceramics. S3 only added $1.5\text{m}$ for ceramics that were supposed to be $3\text{m}$. So S3 couldn’t solve the problem correctly.
Known: (rectangular sketch)

Asked: What is the area of ceramics for the road and how to find out?

Answer: The area of pool = 10 m × 6 m = 60 m²
The area of pool + ceramic = (10m+1,5m) × (6m+1,5m) = 11,5 m × 7,5 m = 86.25 m²

\[ L_2 - L_1 = 86,25 m - 60 m = 26,25 m \]

Figure 3. S3 answer in rectangles problem

Based on Figure 4 we can see that S4 understood the problem that was given. He had been able to illustrate the problem into sketch with complete information. However, S4 hadn’t use mathematical symbols correctly. Can be seen from Figure 4, S4 just wrote 13×9=117, 117-60=57 without writing down the purpose of these calculation. He could solve the problem correctly.

Translate:

Known: Rectangular, length = 10m, width = 6m, ceramic 1.5m

Asked: what is the area of ceramic?

Answer: 13m × 9m = 117m² - 6 × 10 = 117 - 60 = 57 m²
So, the area is 117m² - 60m = 57m²

Figure 4. S4 answer in rectangles problem
Translate:
Known: length = 10m width = 6m
Asked: the area of ceramic?
Answer: Large area – the area of pool
Large area = 10 + 3 = 13
= 6 + 3 = 9
= 13 × 9 = 117 m²
The area of pool = 6 × 10 = 60 m²
= 117 – 60 = 57 m²

Figure 5. S5 answer in rectangles problem

S5 understood the problem. S5 also illustrated the problem even though the information was incomplete. In the process of solving the problems, S5 could write mathematics symbols properly is shown in Figure 5. S5 had been able to write symbol L for the area, p for the length of pool, and l for the width of pool. He wrote 117-60=57 without explaining the purpose of these calculations. However, S5 could answers the problem correctly.

Translate:
The pool: length = 10m, width = 6m, the width of the road = 1.5 m
Asked: what is the area of the road?
Answer: 13 + 9 + 13 + 9 = 22 + 22 = 44
6 + 10 + 6 + 10 = 16 + 16 = 32
44 – 32 = 12

Figure 6. S6 answer in rectangles problem
S6 understood the problem. S6 had been able to write down all information and turn it into mathematics symbols, such as \( p \) for the length of the pool, and \( l \) for the width. S6 had also been able to illustrate problems into sketch even though the information was incomplete. Based on Figure 6, S6 wrote \( 13+9+13+9=22+22=44 \) without writing down the purpose of these calculations. In the process of solving problems, S6 already understood the idea to solve the problem was using subtraction, but he used the wrong formula. He was fooled by the word “around” in the problem, so he used circumference formula which should use area formula. So that S6 answers the problem incorrectly.

4. Conclusion
Female students communicate their ideas by explaining the problem with her own language. In this study, we can see that only one female student who illustrated the problem into a sketch with complete information. While three male students solving the problem by communicating their ideas with illustrated using the sketch and adding information. Both male students and female students, still use mathematical symbols imperfectly.

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