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# Gender and Mathematical Communication Ability of Secondary School Students

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**Abstract**. Communication skills was one of the abilities needed in the 21st century, so communication skills need to be mastered by students. The purpose of this study was to analyze the mathematical communication abilities of male and female students at eighth grade. The research method used was a qualitative research method, with subjects consisted of 1 male student and 1 female student who had equal ability. Data collection techniques consist of oral tests, writing tests, and in-depth interviews. Data analysis used includes data reduction, data collection and conclusions. The results show that both of female and male student has the same ability to communicate mathematical ideas both orally and in writing, but female student is better at re-expressing a mathematical description or paragraph in her own language, whereas male student is better at expressing situations in the form of images, diagrams, languages, symbols, expression charts or mathematical models.

## 1. Introduction

Communication skills in the 2013 curriculum was one of the abilities students must possess in order to be ready in the face of the rapid development of technology, information, and communication. Communication was one of the main standards that must exist in mathematics learning according to NCTM. Communication was the ability to explain algorithms and unique ways of solving problems; construct and explain the presentation of real-world phenomena graphically, words and sentences, equations, tables, and physical presentation; giving allegations about geometric images [1]. Communication was an important part of mathematics and mathematics education, and as a way to confirm someone's mathematical thinking process to others [2]. The importance of mathematical communication, among others, was the central force for students in formulating mathematical concepts and strategies and the capital of success for students towards approaches and solutions in mathematical exploration and investigation [3]. By

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communicating ideas that students had, making students' understanding better [4]. But unfortunately the importance of this communication ability had not been supported by students' communication skills.

Communication skills effectively convey ideas including literacy abilities tested in PISA. The results of the PISA survey conducted on class VIII students in Indonesia in 2015, showed that students 'mathematical literacy skills improved from previous years not significantly, with Indonesian students' mathematical literacy scores around 390 below the score set by the OECD 490 and 62nd place from 70 countries [5]. The survey results showed mathematical literacy skills including mathematical communication skills below the PISA standard.

Some research results revealed the difficulties experienced by students in relation to mathematical communication. Difficulties experienced by students include: difficulty translating mathematics into abstract forms [6], and difficulty visualizing mathematical ideas, making mistakes in demonstrating mathematical ideas and when using mathematical terms, and expressing mathematical ideas and using mathematical structures to present mathematical ideas [7].

Lack of students' abilities and difficulties in communication could have an impact on student learning achievement. There was a positive and significant influence between mathematical communication skills and student mathematics learning achievement. With the higher mathematical communication skills of students, the higher the mathematics learning achievement of students [8].

Gender was one of the factors that influence mathematics learning [9]. The concept of gender was the inherent nature of men or women formed by social and cultural factors [10]. The role of men was more related to mental rotation, spatial perception, and spatial visualization and the role of women associated with phonological verbal fluency, generation of synonyms, and grammar [11]. Women had verbal abilities higher than men [12]. Differences in male and female abilities on verbal abilities due to fundamental differences in the cortex. The male brain cortex was more commonly used to perform spatial functions and tends to give a small portion of the cortex to produce and use words than women [13]. In addition, verbal differences between men and women were also related to hormone levels which results in women being better than men in verbal and fluency memory [14]. Differences in verbal abilities between men and women allow for differences in mathematical communication in the terms of gender.

Some of the results of research that found differences in mathematical communication skills of students based on gender included gender and writing in mathematics classrooms, finding women to respond better than their male counterparts [15]. Other research in junior high school students found that mathematics communication of junior high school students in completing tiered math problems in terms of gender differences, the mathematical abilities of male subjects were superior in writing in a more complete and accurate manner, while female subjects more clearly presented verbally and verbally [16].

But the results of the study differed on the mathematical and metacognitive communication skills of junior high school students in circle material based on gender, addressing no differences in the mathematical communication skills of junior secondary students in circle material based on gender [17]. In addition, other opinions stated that verbal skills differences were

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based on small gender and vary depending on the type of skills assessed (eg vocabulary, essay writing) [18].

Based on the theory and results of the research described previously, it showed the lack of students' mathematical communication skills and mathematical communication difficulties of students who are junior high school students. In addition, the results of research and opinions those were different from the gender point of view showed that not always male students had better writing skills than women or women had verbal communication skills those were better than men. The differences that occur were more related to the abilities assessed. It is important to analyze further the ability of mathematical communication in terms of gender. Therefore this study aims to analyze the mathematical communication abilities of male and female students in junior high school students.

## 2. Method

The type of the conducted research was qualitative descriptive research. The research subjects were two eighth grade students of junior high school in the city of Bandung consisting of one male student and one female student (age range between 13-15 years). Data collection techniques used were triangulation techniques that include written tests, oral tests, and in-depth interviews. The procedures of the research conducted in this research were: (1) written tests; (2) oral tests; (3) in-depth interviews. Oral and written tests were conducted to determine students' mathematical communication skills where the results of the tests were used as references in interviews.

The indicator of the mathematical communication ability test used was adapted from NCTM and Soemarmo ([2],[19]). The written test given was in the form of an essay consisting of three questions with a 90-minute work time. The material tested includes geometric .The writing test indicators include:

(1) the ability to communicate ideas or ideas from existing situations; (2) State the situation in the form of images, diagrams, languages, symbols, or mathematical models; and (3) express a description or paragraph of mathematics in their own language. Oral test instruments were performed after the written test is given. Indicators of oral tests consist of: (1) the ability to explain what is known and asked according to the problem; (2) the ability to explain answers according to the purpose of the problem; (3) ability to reveal reasons for answering questions; (4) the ability to explain images, diagrams, languages, symbols, or mathematical models made; (5) the ability to explain descriptions or paragraphs using their own language. While in-depth interviews were conducted to find out things that are related to students 'abilities that are more in-depth with questions tailored to students' answers in writing and verbally.

Data analysis used adopted from the data analysis of Miles and Huberman which consisted of data reduction, data presentation, and verification [20]. Data reduction was done by summarizing, choosing the main thing, focusing on the important things, looking for themes and patterns. Data presentation was done with narrative text. Data verification was done by making conclusions supported by valid and consistent evidence that is easily understood by researchers and others.

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## 3. Result and Discussion

Problem number 1 on the written test is related to the indicator of the ability to communicate ideas or ideas from existing situations related to building a flat side space. The questions given are as follows: Lukman has a 720 cm long wire, which is cut into twelve equal lengths. The piece of the wire is about to be made into a framework for building space.

a. According to your illustration, what building will Lukman make?

b. Determine how to determine the length of the side of the frame to build the space, then draw it! Student answers to questions number 1 can be seen in Figure 1 (answer is rewritten by author).

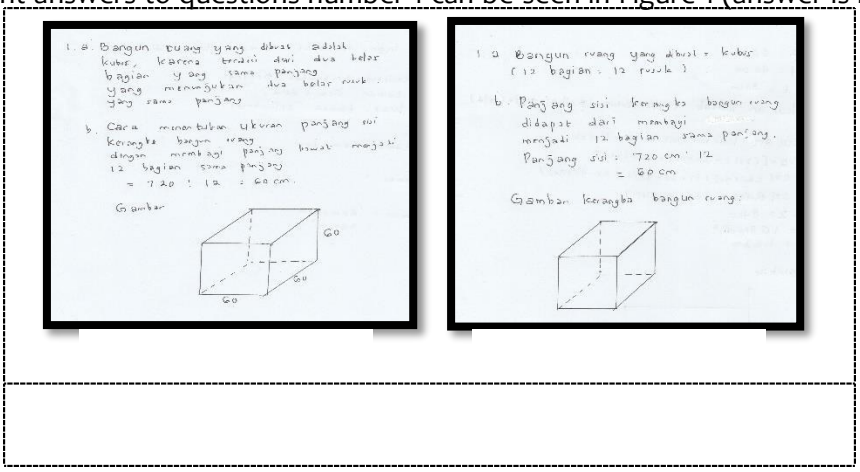

Figure 1.a Figure 1.b

**Figure 1.** Figure example of student answer number 1

Figure 1.a and 1.b show in the written test both female and male students were able to answer correctly. Female students and male students in the writing are able to determine the space made in the shape of a cube and were able to determine the length of the side of the cube with the steps in the process. To determine the length of the sides of the cube frame by dividing the length of the wire into 12 equal parts, namely 720 cm: 12 = 60 cm.

Whereas orally both female students and male students are able to explain what is known, ask questions, answer questions, and reason in answering questions.

Problem number 2 on the written test relates to the indicator stating the situation in the form of images, diagrams, languages, symbols, or mathematical models. The questions given are as follows: Indra will make a box without a lid to store toys from a carton with a length of 60 cm, a width of 40 cm and a height of 30 cm.

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a. Make a mathematical model to calculate the required carton size!
b. Calculate the size of the carton needed to make two boxes according to the size available!
c. Draw in the form of beam networks!
Student answers to questions number 2 are in Figure 2 (answer is rewritten by author).

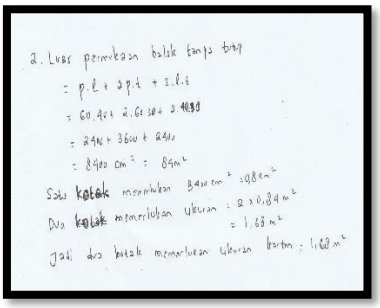

Figure 2.a

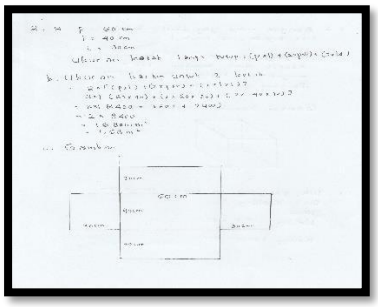

Figure 2.b

Figure 2. Figure example of student answer number 2

Figure 2.a shows in writing test that female students are capable of cardboard size which is required to make two beam-shaped boxes without a lid, but do not write mathematical models and images of beam nets. Female students only answer how to determine the carton for two boxes without closing by multiplying the surface area of the beam without a cap multiplied by 2, that is 2 x [pl + 2pt + 2lt)] = 2 x [(60 x 40) + (2x60x30) + (2x60x40) ] = 16800cm$^2$. Figure 2.b shows the male student is able to calculate the size of the cardboard needed, able to write a mathematical model i.e. size of box without lid = (pxl) + (2xpxt) + (2xlxt), with p = length, l = width, and t = height, and draw a picture of the beam net without lid. In question number 2 male students are more complete and precise in answering questions.

Orally female students were able to explain how to determine the size of the cartons needed but could not explain precisely the mathematical model that must be made and how the shape of the beam networks. Orally male students are able to explain how to determine the size of the carton needed to make two boxes, can explain exactly the mathematical model that must be made and how the shape of the beam nets without closing.

Problem number 3 related to indicators reveals a description or paragraph of mathematics in its own language. The questions given are as follows:

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A square garden is known. Create a story with your own language the situation above. Add other information if necessary, then arrange questions and answers to the information
Student answers to questions number 3 are in Figure 3 (answer is rewritten by author).

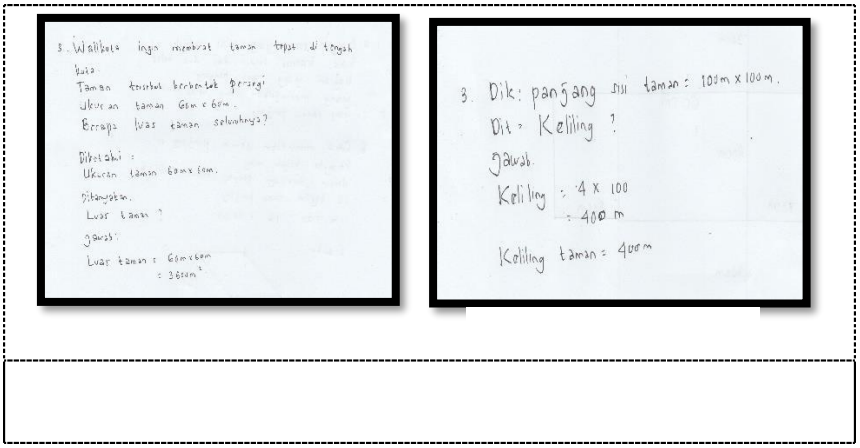


Figure 3.a Figure 3.b
Figure 3. Figure example of student answer number 3

Figure 3. a shows that female students answer better, more complete and clearer than male students. Female students in writing are able to add information from a statement, make stories and questions, and arrange answers according to the questions themselves.
Figure 3. b shows that male students only write what is known, ask and answer immediately without making the necessary information and making questions in their own language.
Likewise orally female students are able to explain descriptions or paragraphs with their own language, while male students are less able to explain descriptions or paragraphs with their own language.

Based on the results of interviews conducted in depth, both students were able to know the elements that were known, asked, how to calculate and give reasons in answering because students were accustomed to learning to write down elements that were known, asked, and answers to working on mathematical problems. However, female students have difficulty in making mathematical models and drawing sketches that are considered complicated, while male students have difficulty in composing words to make statements and make questions with their own language so that they immediately determine the elements that are known, asked, and immediately answer the questions without make statements and questions first.

## 4. Conclusion

From results described in the previous section, we draw the following. Female and male students have the same ability to communicate mathematical ideas both orally and in writing. Female students are better at re-expressing mathematical descriptions or paragraphs in their own language. Male students are better at expressing situations in the form of images, diagrams,

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languages, symbols, expression graphs or mathematical models.

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**6. References**

[1] Schoen, H. L., Bean, D. L, and Ziebarth, S. W. 1996) "Embedding Communication throughout the Curriculum". In P.c. Elliot, and M.J. Kenney. (Eds.). (1996 ) Yearbook. "*Communication in Mathematics*", K-12 and Beyond. Reston, VA:NCTM.

[2] NCTM 2000 *Principles and Standards for School Mathematics* USA The National Council of Teacher mathematics, Inc.

[3] Greenes, C. and Schulman, L 1996 "*Communication Processes in Mathematical Explorations and Investigations*" In P. C. Elliott and M. J. Kenney (Eds.) 1996 Yearbook. Communication in Mathematics. K-12 and Be.vond USA NCTM.

[4] Pape, S. J., Bell, C. V., and Yetkin, I. E. 2003 Developing Mathematical Thinking and Self-Regulated Learning: A Teaching Experiment in a Seventh-Grade Mathematics Classroom *Education Studies in Mathematics*, Vol. 53, 179-202

[5] OECD 2016 . *PISA 2015 assesment and aanalytical framework: science, reading, mathematics, financial, literacy, and collaboration problem solving*. Paris : OECD Publishing

[6] Driver, M. K., and Powell, S. R. 2015 Symbolic and nonsymbolic equivalence tasks: The influence of symbols on students with mathematics difficulty. Learning Disabilities Research and Practice

[7] Firdaus 2016 Efectivity of Cooperatif Learning of NHT Type in Mathematics Learning at Senior High School. Jurnal Sainsmat , 5 (1), 94-105.

[8] Astuti, A., and Leonard, L 2015 Peran Kemampuan Komunikasi Matematika Terhadap Prestasi Belajar Matematika Siswa. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 2(2).

[9] Keitel, C. Ed 1998 *Social Justice and Mathematics Education: Gender, Class, Ethnicity, and the Politics of Schooling; International Organisation of Women and Mathematics Education (IOWME)*. Freie Universität Berlin.

[10] Santrock, John W. 2010 *Psikologi Pendidikan.* Jakarta PT Fajar Interpratama Offset

[11] Reilly, D., Neumann, D. L., and Andrews, G. 2016 . Sex and sex-role differences in specific cognitive abilities. Intelligence, 54, 147-158.

[12] Maccoby, E.E and Jacklin, C.N. 1974 The Psychology of Sex Differences. Stanford:Stanford University.

[13] Masykur, Moh dan Fathani, Abdul Halim 2009 *Mathematical Intellegence: Cara Cerdas Melatih Otak dan Menyanggulangi Kesulitan Belajar*. Jogjakarta:AR-RUZZ MEDIA

[14] Kimura, D 2000 *Sex and cognition* MIT press.

[15] Rubenstein, R. N. 2007 Focused strategies for middle-grades mathematics vocabulary development *Mathematics Teaching in the Middle School*,13(4), 200–207.

[16] Prayitno, Sudi., St.Suwarsono, dan Tatag Yuli Eko Siswono 2013 *Komunikasi Matematis Siswa SMP dalam Menyelesaikan Soal Matematika Berjenjang Ditinjau dari Gender*. Makalah

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[17] Diandita, E. R., Johar, R., dan Abidin, T. F. 2017 Kemampuan Komunikasi Matematis Dan Metakognitif Siswa Smp Pada Materi Lingkaran Berdasarkan Gender. *Jurnal Pendidikan Matematika*, *11*(2), 79-97.

[18] Hyde, JS 2016 . Sex and cognition: gender and cognitive functions. *Current opinion in neurobiology* , *38* , 53-56.

[19] Soemarmo. U 2012 *Pembelajaran Matematika Berbasis Pendidikan karakter* Bandung Jawa Barat

[20] Milles, M.B. and Huberman, M.A. 1984. *Qualitative Data Analysis*. London: Sage Publication