Gender differences in junior high school students' mathematical connection in geometry

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Abstract. Gender differences occur in various fields, including education. Male and females should be treated equally in education, but there are many differences between males and females in various ways. This study aims to analyze differences in junior high school students' mathematical connections by sex. The method used in this study is the subject of qualitative and quantitative research. The research test instrument consisted of 3 questions which included indicators of mathematical connections, namely connections between mathematical topics, connections between mathematics and other fields, and mathematical connections with everyday life. The results of this study showed that of 57 students, 23 male students had an average of 47.41 higher than female students who had an average of 43.15, indicating that men and women had differences in mathematical connection abilities. A common cause is female students who have understood mathematical concepts but have not been able to relate to other things.

1. Introduction

In early childhood, gender differences have been seen in mathematical and scientific tendencies [1]. Around early adolescents, the development of gender identity emerged into a gender pattern towards adult gender roles [2], this process formed trends in aspects of education and work, making different characters, learning mathematics and science became active inside and outside of school [3]. Some publications show that there are no gender differences in acquisition as in the three US Science Exhibits for students in grades 1-12 in mathematics, physics, chemistry, and biology [4]. However, some evidence shows that gender differences favor males better than females, such as the US Mathematics Competition for grades 11 and 12 in 2007, female participants only get a high score of 20% of all participants [5].

Students' problem-solving abilities are influenced by gender differences, where men are better than women in the middle class and above in problem-solving skills [6]. The ability of mathematical creativity is also important and was studied by Bart, who explained that women's scores were higher than men in grade 8 having innovative scores [7]. Male and females have the same ability in mathematical communication but Hendy explained that female students get assess mathematical ideas in writing or forms of visual written communication in mathematics [8].

The ability of students to do ideas connecting mathematics is also an important point in learning mathematics. When students can connect mathematical ideas, their understanding is deeper and more durable. They can see mathematical connections in rich interactions between mathematical topics, in contexts that connect mathematics with other subjects, and in their interests and experiences. Through instruction that emphasizes the relevance of mathematical ideas, students not only learn mathematics, they also learn about the usefulness of mathematics [9]. Math connection skills make students and
teachers try to find mathematics with real life, related to students' lives and interests, relationships between mathematical concepts and learning how mathematical concepts are related to other concepts and school lessons [10].

From some studies, only 5.4% of high school students in Indonesia can solve problems that require a mathematical connection, while 94.6% of students have not been able to associate different representations in a mathematical concept to solve problems in other fields of study or problems related to daily life [11]. Besides, the average ability of students to master the connection tray is 53.5%. This percentage of achievement is relatively low. The percentage of mastery for each connection aspect is the inter-topic connection of mathematics 63%, between topics 41%, mathematics with other subjects 56%, and mathematics with real-life 55% [12].

Mathematics learning in schools from elementary education to grade VIII has content standards that contain material concepts students must learn, including geometry. Geometry is a branch of mathematics that often exists in everyday life. According to Galileo, geometry is the key to understanding nature [13,14]. Based on the report of Trends in International Mathematics and Science Study in 2011 indicated that Indonesia obtained an average mathematical score of 377 on geometry material [15]. Indonesia is ranked 3rd lowest compared to other countries, this is due to the high level of abstraction geometry and students' abstract ability [16,17].

This study aims to analyze, describe and provide information related to the mathematical connection ability of junior high school students. The focus of this research is to provide information on students' mathematical connection abilities in terms of gender differences in the field of geometry.

2. Method
This type of research is qualitative and quantitative research. Quantitative research is in the form of numbers from processed data, made in the form of a percentage of each indicator of a mathematical connection. This research was conducted at Surakarta Batik Junior High School. The subjects of this study were students of class VIII with a total of 57 students, namely 23 male students and 34 female students. Data collection techniques used in this study were 3 question description tests about the geometry of 3 indicators of mathematical connections. This study analyzes how the ability of mathematical connections with three indicators is in line with [18], namely connections between mathematical concepts, connections between mathematics and other sciences, and connections between mathematics and everyday life. Data analysis techniques are following Milles and Hubermans steps, namely data reduction, data presentation and data conclusions [19]. Table 1 shows a description of the score to test the ability of the research connection.

| No | Indicator                                           | Description                                                                 | Score |
|----|----------------------------------------------------|------------------------------------------------------------------------------|-------|
| 1  | The connection between mathematical concept         | Students do not solve mathematical connection problems                       | 0     |
|    |                                                    | Students can connect between mathematical concepts but the methods and results are not correct | 1     |
|    |                                                    | Students can connect between mathematical concepts but the way is not correct and the results are correct | 2     |
|    |                                                    | Students can connect between mathematical concepts in the right way but the results are wrong | 3     |
|    |                                                    | Students can connect between mathematical concepts in the right way and the results are correct | 4     |
| 2  | The connection between mathematics and other sciences | Students do not solve mathematical connection problems                       | 0     |
|    |                                                    | Students can connect mathematics with other fields but the methods and results are not correct | 1     |
|    |                                                    | Students can connect mathematics with other fields but the method is not correct and the results are correct | 2     |
Triangulation is used to confirm the data findings. The steps of data analysis in this study are to provide tests of mathematical connection ability in the field of geometry and then analyze the test results.

3. Result and Discussion
From the results of the average male students have an average score higher than female students in the ability to connect mathematics that is equal to 47.41 for the average male and 43.15 for the average female. An average of each indicator for male and female students will be displayed.

Table 2. Scores for indicators of mathematical connection ability

| No | Indicator                                         | Male Score | Male %  | Female Score | Female % |
|----|--------------------------------------------------|------------|---------|--------------|----------|
| 1  | The connection between mathematical concepts     | 52         | 44.8%   | 50           | 44.6%    |
| 2  | The connection between mathematics and other fields | 47         | 40.51%  | 38           | 33.9%    |
| 3  | The connection between mathematics and everyday life | 58         | 50%     | 57           | 50.8%    |

Table 2 shows that the average value of the ability of mathematical connections for male and female students in Surakarta Batik Junior High is not good enough, only indicator 3 reaches 50%. This means that almost half of male and female students can have mathematical connection ability on indicator 3. From the three indicators, we can see that male students have begun to be active in connecting mathematical ideas. Perhaps this is the reason why they have better connection skills than female students. This statement is supported by Heong [20] who stated that students who are guided to think critically can show a positive impact on their educational development.

Almost the same as male students, female students have not achieved mastery results above 50%. The highest average score for female students is on indicator 3 and low on indicator 2 which only has a score of 33.9%, even these results indicate those female students do not have good mathematical connection skills in connecting mathematics and other fields such as physics. After discussing the overall average score obtained by male and female students, the next discussion is about students who can answer perfectly or students who can get the highest score from the assessment rubric. In this case, some male and female can score perfectly, but not many. A perfect score is when students can answer the questions given in the indicators given. The following discussion is in more depth the differences in answers from male and female students. The problem has many alternative answers to get perfect answers because the questions have open answers, male and female students have different answers.
3.1. The connection between mathematical concept

The following is a matter of testing mathematical connection skills with connection indicators between mathematical concepts. In this problem, the connected concept is a rectangular concept and the concept of comparison. The male students’ answer to the question in Figure 1 are presented in Figure 3 and the female students’ answer to the question in Figure 2 are presented in Figure 4.

![Figure 1. Male students’ answer in indicator 1](image1)

![Figure 2. Female students’ answer in indicator 1](image2)

![Figure 3. Male students’ answer in indicator 1](image3)

![Figure 4. Female students’ answer in indicator 1](image4)

In this problem is indicator 1 namely the relationship between mathematical concepts, students are expected to have a good ability to connect problem-solving using various methods or in using
mathematical concepts. As seen in Figure 1, male students can connect solutions with comparisons, male students can connect length and width results by comparing them, although some male students are still less able to deal with the concept of quadratic equations. For female students can be seen in Figure 2, female students are able to correctly answer flat wake questions that connect to the concept of quadratic equations. Most female students can answer questions about quadratic equations but some of them have not been able to answer with other mathematical concepts. The female students did not compare or did not incorporate into the concept the comparison of the width and length values they had already obtained. Here we can see that male and female students still have the same weaknesses in connecting concepts to other concepts.

3.2. The connection between mathematics and other sciences

The following is a matter of testing mathematical connection skills with connection indicators between mathematics and other sciences. In this problem, the concept of connectedness is the concept of circumference of a circle and the concept of speed in physics. The male students’ answer to the question in Figure 5 are presented in Figure 7 and the female students’ answer to the question in Figure 6 are presented in Figure 8.

Figure 5. Male students’ answer in indicator 2

Figure 6. Female students’ answer in indicator 2
In this indicator students are expected can connect mathematical concepts with other learning concepts, students are required to be able to explain mathematical ideas with other learning concepts. In the problem above, students are expected to be able to connect mathematics with concepts of physics. It can be seen from Figure 5, that male students explain neatly with the help of physics concepts, not all male students can answer things like the above but some male students managed to link with the concept of physics. It can be seen from Figure 6, female students explain not helped physics formula, female students explain more reasoning with the help of mathematical concepts. This is also true and unexpected coming from students’ thinking. But because this indicator is expected to link with concepts between fields, better grades are given to male students. This is supported by selection [3], Indonesian female prefer biology topics and male prefer physics-related topics and at the international level women are found to be very lacking in all math and science olympiad except biology olympiad.

3.3. The connection between mathematics and everyday life

The following is a matter of testing mathematical connection skills with indicators of the connection between mathematics and everyday life. In this problem, the concept that is connected is the concept of getting up flat with everyday problems. The male students’ answer to the question in Figure 9 are presented in Figure 11 and the female students’ answer to the question in Figure 10 are presented in Figure 12.
In this indicator, students are expected can connect mathematical concepts with real life. In the problem above, students are expected to connect the answers of the stimulus given to the mathematical concepts. In Figure 9, male students, most students can answer appropriately, this is because male students are less precise in the concept of a circle even though it can connect between mathematical concepts with...
everyday life. For female students Figure 10 can be seen, that female students have been able to work on the problem according to the indicators appropriately and can connect with daily life.

4. Conclusion
The ability of male students is better than female students can be seen from male students having an average of 47.41 and 43.15 female students with a slight difference from the answers of each sex. In indicator 1, male and female students have their respective weaknesses in connecting concepts with other concepts. Some male students do not have the concept of quadratic equations and female students do not have an understanding of the concept of length and width in the concept of a two-dimensional figure. In indicator 2, male students can associate mathematical concepts with physics, but female students have not been able to relate them despite getting the right answer. In indicator 3, female students are more appropriate in connecting mathematical concepts with real problems.

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