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Mathematics Connection Process of Students With Low Mathematical Ability in Solving Contextual Problems Based on Gender

Baiduri [1*], Octavina Rizky Utami Putri, Ikrimatul Alfani

[1,3] *Mathematics Education Department, University of Muhammadiyah Malang, East Java, Indonesia*
[*] *Corresponding author. Email: baiduriumm@gmail.com*

ABSTRACT
The purpose of this study was to explore and describe the mathematical connection process of students with low math abilities in solving problems based on gender. Descriptive exploratory research with a qualitative approach was used in this study. A male student and a female student of class X MIPA with low math abilities were the research subjects. Data were collected through written tests and interviews with research subjects. Data credibility is obtained through method and time triangulation. Furthermore, the data were analyzed using an interactive model which included data reduction, data presentation, and conclusion drawing. The results showed that male students made a connection process in mathematics, with other sciences and in everyday life at the stage of understanding problems and carrying out problem solving. This is different from female students who make mathematical connections internally and externally with everyday life. At the stage of making a settlement plan, male and female students made connections internally by choosing the strategy to be used. Meanwhile, at the stage of re-checking the answers of female students and male students, there was no connection.

Keywords: *Contextual problem, Math ability, Mathematical connections, Problem solving.*

1. INTRODUCTION

Mathematics is built from the connection of various elements; ideas, facts, concepts, principles, and procedures or operations. The mathematical connection process is the process of thinking in recognizing and using the linkages between mathematical ideas [1]. Mathematical connections have a very important role not only in learning mathematics and solving mathematical problems, but also in other sciences and in everyday life [2]–[4]. Mathematical connection can help students succeed with new concepts and see that maths makes sense for everyday activities [2], [5]. Exposure to this kind of connection adds interest and value to the study of mathematics and also broadens the student's preparation for future academic work.

The relationship between the elements of mathematics in the form facts, concepts, principles, operations and procedures as well between topics and mathematical processes shows that mathematics is not an isolated collection of ideas. When students can connect mathematical ideas, their understanding of these ideas becomes deeper and more durable [2], [6]. Students learn best when they make connections with ideas and transfer those ideas to long-term memory [7]. Therefore, Students should be guided and encouraged in mathematics learning to develop the habit of looking for and asking questions about how to make connections in mathematics and outside mathematics.

The process of connecting mathematics needs to be built and improved so that students can connect mathematics and other sciences or daily life. Mathematical connections can also be described as schema components or schema groups that are connected in a mental network [8]. The strength and cohesiveness of a scheme depends on the connectivity of the components in the scheme or between groups of schemes [8], [9]. Mathematical connections can be grouped into two; 1) internal connection, namely the connection between topics and elements of mathematics, and 2) external connection, namely the connection between mathematics and other subjects and

between mathematics and everyday life [2], [6], [10] all of them contribute to making mathematics understandable and meaningful. Connections also help students remember skills and concepts and use them appropriately in problem solving or problem solving tools [3], [8].

The problem solving process goes through several stages, namely understanding the problem, compiling a plan, implementing the plan and checking again [11], [12]. Build connections between problem-solving stages [13] and find the connection concepts or theorems that correspond to the problem [14] indispensable for getting the correct solution. Ability solving mathematical problems has a positive effect on the ability of mathematical connections [15].

Providing contextual treatment to students when learning mathematics will stimulate the mathematical connection process of students much better than students who do not receive contextual treatment [16]–[19] as well as with outdoor learning [20]–[23]. One of the mathematical problems that are contextual and related to everyday life is those compiled by the PISA (Program for International Student Assessment), which is an international student assessment program organized by the Organization for Economic Cooperation and Development (OECD).

Several research results indicate that the connection mathematics ability of elementary school students is still low[10, 24]. The connection ability of primary and secondary students in problem solving is influenced by mathematical abilities [25]–[27] as well as gender [28], [29]. Research on connection skills in solving math problems based on gender in universities [30], [31]which shows different results. Therefore, an effort is needed to improve students' connection skills in mathematics learning as well as further research on mathematical connections in terms of what similarities and differences occur between male and female students. So that the purpose of this study is to explore and describe the connection process of students with low math abilities in solving contextual problems based on gender in the PISA model.

2. METHOD

2.1. Research design Research design

This study is intended to explore and provide an overview of the mathematical connection process of students with low math abilities in solving contextual mathematical problems. The type of research used is descriptive exploratory with a qualitative approach [32].

2.2. Subject

The research subjects were two class X MAN MIPA concentration students with low math abilities with different gender who were selected from 32 students according to the results of the mathematics ability test. Students with low math ability if the test results are not more than 60 with a maximum score of 100 and the lowest is 0. The research subjects were male students (L) with a score of 25 and female students (P) with a score of 20.

2.3. Instrument

The main instrument in this study was the researcher, while the supporting instruments used were a recording device, a written test sheet and an interview guide sheet. The written test sheet consists of: a) adapted high school mathematics national exam questions (from multiple choice form to essay form) totaling five questions with a duration of 75 minutes completion. Mathematics national exam questions are used to determine mathematical abilities, to search for research subjects. b) PISA model contextual questions (mathematical connection test) as many as two questions related to the concept of a three-variable linear equation system with connection competence. This question is used to explore students' mathematical connection processes in solving problems.

2.4. Data Collection and Analysis

The connection process data collection procedure included a mathematical connection test and continued interviews with the two research subjects. The turnaround time is not limited in order for the subject to explore various connections. This activity was carried out twice with different questions and times. During the process of completion and interviews were recorded using a video recorder. Methods and time triangulations were used to obtain credible data [33]. Furthermore, valid data is analyzed using an interactive model which includes activities (1) data reduction, (2) data presentation, and (3) drawing conclusions [34]. As the basis for the analysis used indicators of the mathematical connection process in this research are presented in Table 1.

3. RESULTS AND DISCUSSION

3.1. RESULTS

3.1.1. Students' Mathematical Connection Process in Understanding Problems

Based on the data in the sheet answer, connection tests and interviews, the mathematical connection process carried out by female students (P) in the step of understanding the problem is by calculating the items in the problem with a variable and the package of goods in algebraic form, not equations, as shown in Figure 1.

Table 1. Mathematical connection process indicator in solving problems

Mathematical connection	Polya's stages	Mathematical Connection Process Indicator
1. Connections in mathematics 2. Mathematical connection with other sciences 3. Mathematical connections in everyday life	Understanding the Problem	• Writeknown mathematical facts on a given problem • Write down what was asked • Identify mathematical concepts from the information on daily life problems to be solved
	Planning Problem Solving	• Finds the relationship in question to mathematical facts, concepts, and principles on the problem • Prescribing mathematical procedures or operations that will be used to solve the problem
	Carry out Problem Solving	• Using connect the planned principles • Apply mathematical concepts in problem solving • Write with a regular pattern in solving problems • Using procedures according to the planned strategy
	Looking back	• Examine the facts, principles, and procedures used in solving problems • Check if the steps used are correct • Check the calculations obtained

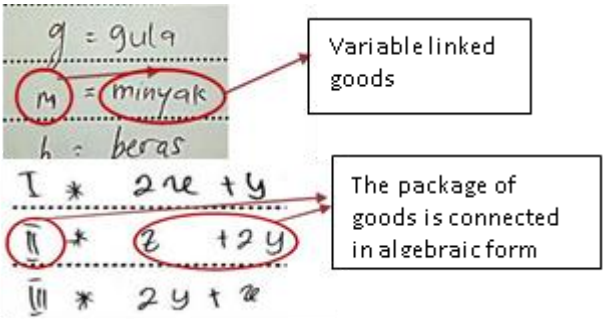

Figure 1. The process of mathematical connection P in understanding the problem

Figure 1 shows P making a mathematical connection between mathematical concepts and problems of everyday life by connecting the concept of a variable with the name of the item. This explains that the connection process carried out by P in assuming the variables is not correct, because the concept of the variable in the problem represents a price, not the name of the item P writes the aforementioned variables in some algebraic form only, not putting them into equations, linear equations. This shows that P in the process of connection between mathematical concepts that P does is not correct. The connection process P at the stage of understanding the problem can perform two components of a mathematical connection, namely the connection between mathematics and the mathematical connection in everyday life.

This connection process is also carried out by male students (L), the name of the item is connected to the variable and the item is connected in an algebraic form. Furthermore L understands thatthe purchase of goods separately will be taxed. This shows that L has connected the connection between mathematics and other sciences (economics).

3.1.2. The Process of Students' Mathematical Connection in Planning Problem Solving

The female student (P) in planning the solution relates to the strategy for solving a system of linear equations, namely by substituting even though she forgot how. This was stated by P during the interview as follows.

R : What strategy will you use in working on the problem?

P : *Do not know. I know I should use a substitution, but I am* forgot how

The interview statement above is very clear that P does not master the material well, so that P has difficulty in making problem-solving plans. However, P makes a mathematical connection internally by choosing a solution strategy with substitution. The same thing was done by the male subject (L) who carried out the connection process internally by using an elimination strategy to calculate the price of each item and L understood the chosen strategy.

3.1.3. Student Connection Process in Implementing Problem Solving

The female student (P) completion process tries to use the substitution method, such as the completion plan. However, in its implementation, it encountered obstacles, connecting the inverse addition with multiplication, not with subtraction. This can be seen in the job Figure 2 and the results of the interview.

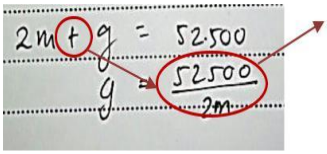

Figure 2. Mathematical connection process of P in carrying out the solution

The male student (L) in the completion stage improvises from the previous plan, namely only using the elimination method, to using the mixed method (elimination and substitution). Furthermore, L also connects the variable with the price of goods and connects the price with taxes. This was confirmed by the results of the interview. The results of the written work L are presented in Figure 3. Based on Figure 3 and the interview, L makes a mathematical connection internally by applying mixed methods, elimination and substitution. While the connection is by connecting th and the concept of tax. In a namely in calculating the tax on the price of goods, L still has an error by relating it to the addition operation which should be a multiplication operation.

Connect the inverse of addition to division

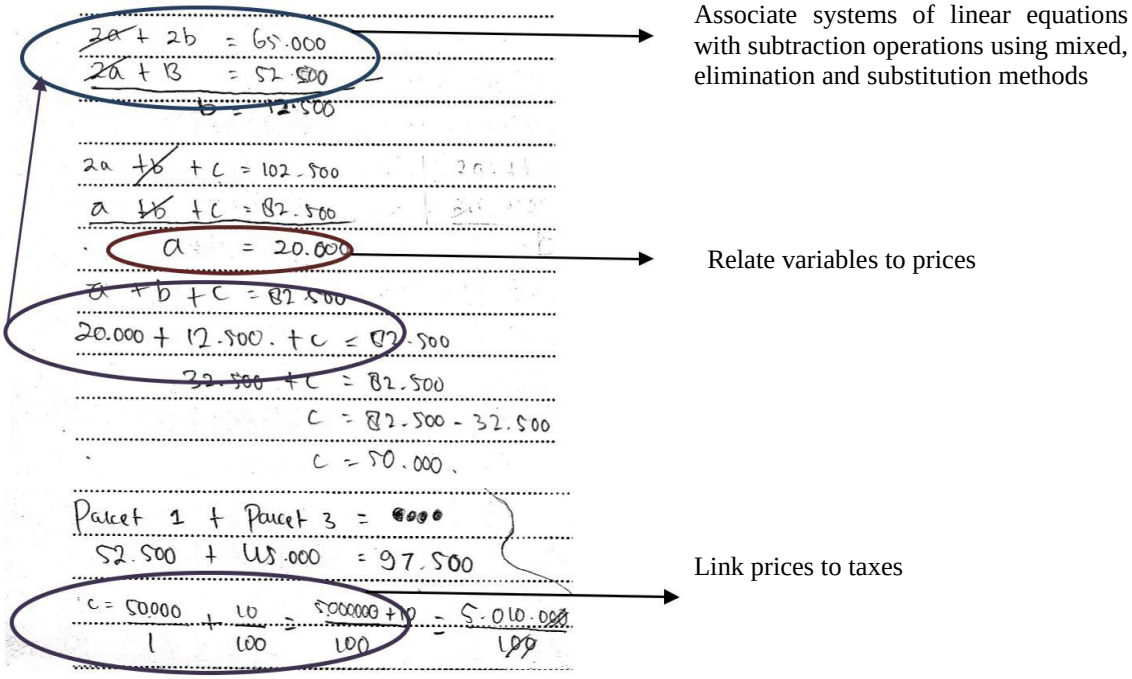

Figure 3. Mathematical connection process of L in carrying out the solution

3.1.4. Student Math connection process when Looking Back

The next stage is to re-examine the results of the work carried out. In this stage, P does not seem to have checked again, because P has not been able to complete it properly or completely. Likewise male students, although they can solve the problem. This was confirmed at the time of the interview, it was seen that P was afraid and had given up, as in the following interviews with P and L.

R : The work is not finished huh. Haven't you tried any other method besides substitution?
P : *No, I'm afraid I wrote it wrong*
R : Why not give it a try first?
P : *Just forget.*
R : Are you sure the price you are getting is a high price cheapest?
L : *Not sure.*
R : Why aren't you sure?
L : *Because I'm out of focus*

Based on this interview, it shows that female (P) and male (L) students did not make any mathematical connections when checking their answers. Student P cannot make a mathematical connection because he cannot solve the problem, while student L does not focus on the process of checking again and is not confidentwith the results obtained.

3.2. DISCUSSION

In general, the process of internal and external mathematical connections has been carried out by male and female students with the ability to solve problems [14,35,36] although it did not happen at the recheck stage. It also illustrates that the connection is a tool in solving mathematical problems [37,38]. When they solve problems happen toothe connection between the troubleshooting stages [13].

The stage of understanding the problem, male and female students make mathematical connections internally and externally. These results are in line with[30], [39]which states that there are no differences in mathematical connections and in doing math between men and women. Male and female students communicating a mathematical idea into symbols and algebraic forms to explain the relationship between mathematics and problems [40]. However, both are still wrong in relating the meaning of the variable, because it is associated with the variable with many items or the name of the goods is not the value of the goods. This is consistent with research which states that some students are still wrong in calculating variables[41]

The completion planning stage, the process of connecting the mathematics of female and male students internally is connecting with the procedure for solving the three-variable equation system, namely the elimination method (male students) and the substitution method (female students). At the implementation stage of the completion of the female subject, she connects it to the planning stage, namely carrying out a substitution strategy to find the cheapest price and still experiencing difficulties. Students' memory is one of the reasons students have difficulty linking problem problems with the mathematical concepts to be used[42]. Meanwhile, male students in the implementation of completion make mathematical connections internally and externally. Internal connection by applying mixed, elimination and substitution methods. While the external mathematical connection is by connecting the variables with prices (connections in everyday life) and the concept of tax (connections with economics). There are differences in the process of connecting male and female students in solving problems [43], [44]. Differences in the process of mathematical connection between male and female students in the external mathematical connection [28], [30] and shows that gender differences in solving math problems are an important factor [45–47]. In the stage of checking again, male and female students have not yet made a mathematical connection.

4. CONCLUSION

The process of connection in problem solving occurs between the stages of solving Polya by female and male students with low abilities. The process of internal and external mathematical connections is carried out by male and female students when they understand the problem. At the planning stage, they carry out a mathematical connection process internally by selecting a solution strategy. This internal connection is also made by female students at the problem solving stage. Meanwhile, at the stage of solving problems, male students made the connection process internally and externally.

This study was limited to subjects with low math proficiency with different genders and mathematical connections in solving PISA problems. So that it is still very open to connections in mathematics with other form of problems or in learning mathematics with various characteristics of the subject, such as learning styles, cognitive styles, and spatial abilities.

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