Junior high school students’ reflective thinking on fraction problem solving: In case of gender differences

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Abstract. This study aims to describe reflective thinking of junior high school students on solving the fractions problem in terms of gender differences. This research is a qualitative approach involving one male student and one female student in seventh grade. The data were collected through the assignment of fractional problem solving and interview, then the data were triangulated and analyzed by three stages, namely data condensation, data display and conclusion. The results showed that the subjects of male and female were reacting, elaborating and contemplating at each stage of solving the fractions problem. But at the stage of devising the plan, the female subject was contemplating, relying more on their beliefs, did not consider their experience, in addition, the female subject didn’t use experience of the steps she planned to solve the problem of fractions.

1. Introduction
Reflective thinking is considered as actively, continuously and conscientiously belief or form of knowledge that is taken for granted in light with the reasons that support the inferred conclusion of the truth [1]. Students who think reflectively become aware of what is known and what is needed. It is very important to link the gap in learning situations [2]. The development of reflective thinking has become the focus and importance of mathematics education as it is the core of mathematics education[3] and it is one of the higher-order thinking skills[4]. In addition, reflective thinking is the most important element to learn effectively[5] and can be applied in mathematics learning[6]. There are three components of reflective thinking, they are: reacting, elaborating and contemplating[7]. An important role of reflective thinking is to act as a means to activate thinking during a problem-solving situation, as it provides an opportunity to use knowledge and experience related to the problem faced and devised the best strategy to achieve the goal[8]. This shows that reflective thinking of students can be seen or raised through the problem-solving process. In addition, problem solving is an important standard in mathematics learning [9]. Reflective thinking indicators of students in problem solving are based on the Polya problem-solving stages, namely understanding the problem, making a plan, carrying out the plan and looking back[10] in which it integrates the reflective thinking components of Surbeck, Han & Moyer. The problem used in this study is a fractional problem because some experts claim that the fraction is a difficult material[11], since fractions include complex and difficult material for students to learn[12] and none of the fields in school math are as complex and as difficult to teach as fractions[13]. This corresponds is one of the
important roles of reflective thinking, namely solving complex problems [14]. Gender difference is a term which is widely used in our everyday lives, including school and education [15]. The difference is likely to have an influence on learning and development in different abilities of male and female, such as research conducted by Zhu [16] and Pargulski & Reynolds [17] show that male surpasses female in problem solving. In relation to reflective thinking, the research done by Demirel, Derman, & Karagedik [18] and Tuncer & Ozeren [19] showed that they have different findings about the relationship of reflective thinking and gender differences in problem solving. Reflective thinking is a person’s mental activity to identify problems and solve problems by using knowledge and experience relating to problems encountered, and performing components of thinking Reflective, namely reacting, elaborating, and contemplating.

Research by Demirel, Derman, & Karagedik [18] showed that in the process of solving mathematical problems using the ability of reflective thinking depends on gender differences. However, the research is a case study using a scale is less in depth about the phenomenon that occurs in the subject of the research; especially the subject is too large. The study aims to examine the relationship between reflective thinking ability of 7th and 8th grade students on their problem solving and attitude toward mathematics, while research conducted by Tuncer & Ozeren [19] showed that there is no significant difference between reflective thinking of male students and reflective thinking of female students in problem solving. The study used scaling in the data collection and the subjects of the study were prospective teachers.

This study aims to describe reflective thinking of male students and female students in solving fractional problems.

2. Method
This research is a descriptive research with qualitative approach which aims to describe reflective thinking of male students and female students in solving fractional problems.

2.1. Participants
This study involves two people, one male student and one female student in seventh grader of Junior High School average 11-13 years old. Subjects were selected by giving math skills tests to choose high-ability students. After those processes, the researcher look at gender differences by taking into account the social and cultural prospects of research subjects.

2.2. Data collection
Data collection is done by assigning a fractional problem-solving task and then performing task-based interviews. The fractional problem-solving task consists of two questions in the form of a description problem. The problem is designed to express students’ reflective thinking. Afterwards, interviews were conducted to see reflective thinking of students in solving the fractional problem.

2.3. Data analysis
After the data had been collected, the triangulation process then was implemented to check the validity of the data and determine whether a data exactly describes the phenomenon in a study. After that, the data is analyzed by three stages, namely; data condensation, data display and conclusion [20].

3. Results and Discussion
3.1. Reflective Thinking of Male Subjects in Fractional Problem Solving
The results showed that the male subjects reacting at each stage of problem solving. In the stage of understanding the problem, the male subject commented on his feelings on the experience of having related information on the issue of fractions. This is evident from the quotation of subject interviews, “This question ... on the fractional matter and the story in everyday life. The problem is easy and difficult and I am interested and challenged to solve it because there is a resemblance to the problem I have ever faced, but this matter is not known the total land area, it is difficult”. From the response, so that the male subject can identify and express return information, such as many parts of the land to plant pepper is \( \frac{1}{4} \) part, many parts of land to plant cocoa trees is \( \frac{2}{5} \) parts, the rest to plant banana trees, the land used to
plant banana trees of 140 m², and searchable area of land. In the stage plan, male subjects commented on his feelings on experience related to strategies/methods/steps that are planned to solve the problem fractions. Here is the following response of the subject, he stated, “Sir, I had never planned such a plan, but there's something like a piece of cake, I subtract a whole bunch of cakes with lots of cakes eaten to find the rest of the cake that has not been eaten...” in the stage of carrying out the plan, the subject commented on his feelings about the experience he has with the strategy/methods/steps that have been done with that have been prepared in solving the fractional problem. Here is the following subject piece of interview, “first, I searched a lot of land for a banana tree and “I” this means an entire field, Sir. Then the subject commented again, “These steps/strategies in my experience are correct and this way I have done before”. In the next step, the looking back stage, where the male subject commented on his feelings about the experience he had about examining the solution which is derived from the final answer of the fractional problem. Thus quotation of subject interviews by stating the need to look back at his work, namely “Need Sir, so that no errors in the calculations that I did and first often wrong in the calculation”.

Male subject was elaborating at each stage of problem solving. In the stage of understanding the problem, the male subject comparing the reactions to the experiences of information on fractional issues related to the use of concepts and the relationship between information obtained. As the subject mentions the similarity with his experience, “As the fractions are the same... and equally asked the area of land used”. Furthermore, the subject also mentions the difference, “That Sir, if now is not known the total land area and how to look for”. In the planning phase, the male subject compares the reactions to the experiences of related strategies/methods/steps planned to solve the fractional problem. As the excerpt of a subject interview about the similarities to his experience, “If you are looking for a lot of land that is used to plant banana trees by subtracting the whole lot of land with lots of parts of the land used for growing pepper and cocoa trees. Then to find the area of land used to grow pepper by multiplying many parts of the land to plant pepper with the total land area”. Then the subject mentions the difference with his experience, “It is...Sir, looking for the whole land area. In the past, usually it was known in the matter”. In the stage of carrying out the plan, the male subject compares the reaction to the experiences of related strategies/methods/steps that have been done in solving the fractional problem. The subject mentions the similarities with his experience, such as one to find the remaining land by subtracting the overall land with many parts of the land used. The difference with his experience is to find the total land area. Then, in the looking back stage; the male subject compares the reactions to the re-examining experiences and the suitability between the fractional problem-solving results to the given fractional problem and finding the best problem-solving solution. The following is a piece of subject interview about his similarities to his experience, “The similarities are to look at each calculation, the formulas too. And usually if a lot of my time write-off back”. The difference is that if this problem I write-off by recalculating the total area of land by finding the area of land to plant cocoa trees, I just sum with the area of land to plant pepper, cocoa trees, and banana trees. I get fixed 400 m².”

Male subject was contemplating at each stage of problem solving. In the stage of understanding the problem, the male subject considering and believing that the information provided is enough to solve the problem of fractions. Like the excerpt of a subject interview, “Yeah sir, I'm sure and I've noticed and thought about it based on my experience”. The planning phase, the male subject considers and believes that the planned strategy/method/steps can solve the fractional problem and it is correct based on the mathematical concepts. Like the response of the following subject, “Yes sir, I am sure...because I used to do something similar like this Sir and it is true”. In the stage of carrying out the plan, the male subject considers and believes that the strategy/methods/steps that have been done are correct in solving the fraction problem and evaluating the error and fixing it immediately. The subject's mistake, i.e. excessive “=“ writing. Then at the looking back stage, the male student can determine and believe in the conclusions obtained after solving the fractional problem.

3.2. Reflective Thinking of Female Subject in Fractional Problem Solving
The results showed the female subject reacting at each stage of problem solving. In the process of understanding the problem, she commented on her feelings about the experience she had in relation to information on fractional issues. As the following interview quotes, “This question is in the form of a story in everyday life in which there is fractional problems to be solved and I think this problem is a bit difficult but I am challenged to finish it because I enjoy learning fractions”. Furthermore, the subject identifies and reveals the information of the given problem. In the planning phase, this subject commented on his feelings about the experience she had about strategy/methods/steps planned to solve the fractional problem. For example the subject revealed that she had never worked out a plan like this, but there were similarities to the problem she had ever done. The remaining part of the land planted with banana trees and look for the area of land used. The stage of carrying out the plan, the subject was commenting on her feelings about the experience she has about the strategy/methods/steps she has done with the ones that have been devised in solving the fractional problem. Next to the looking back stage, she commented on her feelings about the experience of examining the solutions obtained from the final answer to the fractional problem.

Female subject was elaborating at each stage of problem solving. The stage of understanding the problem, she compares the reaction to the experiences of information on fractional issues related to the use of concepts and the relationship between information obtained. The subjects mention the similarities and differences in their experience, as in the interview that, “If it's Sir, like the division of land, equally look for the rest of the land and look for the area to be used for growing rice. In addition, it also uses addition and subtraction operations. The problems I have worked on before, on the matter is already known the total area of land so that can be searched area of land in question such as the area of land to be planted with rice. But on this matter is not known sir, it is too hard Sir”. In addition, the subject mentions the concept of addition and subtraction of fractions. In the planning stage, this subject compares the reactions to the experiences of related strategies/methods/steps planned to solve the fractional problem. The subject compares by mentioning the similarities and differences with the experience, as in the interview quote, “Equation, if we look for the remaining part of the land that is subtract many parts of the land with the result of the number of parts of land used or known. It can also with a picture, Sir. If the first problem I ever did Sir, after acquired the remaining lots of land, then multiplied by the total area of land if we want to find the area of land to be used. But this is the problem; it is unknown to the overall size of the land”. In the stage of carrying out the plan, she compared the reaction to the experience of doing strategy/methods/steps that have been done in solving the problem fractions. The subject states that the equation of this matter with her experience, that is, both of cases use the addition operation and the reduction of fractions to know the remaining part of the land. Meanwhile, the difference is to look at the stage of land overall. Then checked again, this subject compare the reaction of the experiences to the check and the correspondence between the results of problem solving fractions with fractions given problem and find the best solutions to solve the problems. The Subjects revealed that the expression with their experience of looking back at the formula, the steps and calculations that they did and where the error is usually on multiplication errors or sums. In addition, the subject writes another way using representations with images.

In the next step, the female subject was contemplating at each stage of problem solving. In the stage of understanding the problem, she considered and believed that the information provided was enough to solve the problem of fractions by stating that all information on the matter is important and necessary, and then convinced that the information is sufficient to solve the problem. In the planning stage, the female subject believes that the planned strategy/method/steps can solve the fractional problem and it is correct based on the mathematical concept. In the stage of carrying out the plan, the female subject believes that the strategy/methods/steps that have been done is correct on solving the problem of fractions and evaluates the error and immediately fix it. In addition, the subject reveal a mistake that they made on the writing of the unit area. Then at the looking back stage, the female subject can determine and believe in the conclusions obtained after solving the fractional problem.

Based on the results of the study it can be concluded that the subject of male and female subjects in conducting reacting, elaborating and contemplating using previous experience that has been related
to the issue of a given fraction. This is in line with Rodgers argued that reflective thinking is a meaningful process that moves students from one experience to the next with a deeper understanding of their relationship to other experiences and ideas [21]. In addition, based on this experience, the male and female subjects can identify and recount information from the given fractional problem. In line with Sezer opinion, students who think reflectively become aware of what they know and what they need [2]. In addition, the male and female subjects are re-evaluating the results of their work and if any errors are found then immediately fix them. This is a characteristic of someone who thinks reflectively. As Taggart & Wilson argue, reflective thinking means a person logically deciding something and assessing the consequences of decisions made [22]. In addition, in accordance with the findings of Gurol suggested that, reflective thinking as a process of directional and precise activity in which individuals analyze, evaluate, motivate, get deep meaning and use the right strategy [23].

In general, reflective thinking of male subjects and female subjects have no significant difference, it only differ in the contemplating component for the planning stage. The female subject is limited to belief in what she planned without considering based on her experience. Thus, reflective thinking in problem solving does not depend on gender differences. This is in line with the results of Tuncer & Ozeren research, but unlike the results of Demirel, Derman, & Karagedik research which shows that in the process of solving mathematical problems using reflective thinking skills depends on gender differences.

4. Conclusion
The male and female subject perform all reflective thinking components, namely: reacting, elaborating, and contemplating in solving fractional problems. However, the female subject in drawing up plans, relies more on her beliefs without considering her experience to solve fractional problems. These results indicate the importance of reflective thinking for students, especially helping them in solving math problems, because they can use their experiences related to the problems faced. The finding of this research assumes that little significant difference found in reflective thinking ability of male subject with reflective ability of female subject. Thus, reflective thinking in the fractional problem-solving process does not depend on gender differences.

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