Completion of non-routine word problem of fractional topics in junior high school student

K D Djong\textsuperscript{1}, I Budayasa\textsuperscript{2} and S Suwarsono\textsuperscript{3}

\textsuperscript{1} Universitas Katolik Widya Mandira, Kupang, Indonesia
\textsuperscript{2} Universitas Negeri Surabaya, Surabaya, Indonesia
\textsuperscript{3} Universitas Sanata Dharma, Yogyakarta, Indonesia

*Corresponding author: djongdeflores@gmail.com

Abstract. This study aims at describing the completion of non-routine word problem of fractional topic in junior high school student. The completion is related to the four-step solution of Polya. The subject of the study is a seven-grade student of junior high school. The subject was given non-routine word problem of fractional topic and continued with in-depth interview. Time triangulation was done to get valid data where equal test and interview were given at different time. The result showed that the student was able to solve the problem uniquely. At the time of re-examination, the student did not recheck her work but she substituted the final answer in the problem to match with the problem.

1. Introduction
The word problem is an interesting topic in learning mathematics. It is often seen as a way to bridge the gap between real life and class math. The mathematics word problems among mathematic problems mostly deal with relating the real world situations to mathematical concepts. In fact, such problems help students to use their mathematics knowledge in solving their daily problems [1]. However, many children from kindergarten through adulthood have severe difficulties in solving word problems [2]. According to Bernando [3], “students have difficulties in word problems for they are unable to decode the words used in a word problem, comprehending a sentence, understand specific vocabulary and have confidence or the ability to concentrate when reading”. Some factors that contribute to students’ difficulties in solving word problem are lack of knowledge about problem type, lack of strategies in solving word problem and lack of skill in computational algorithms [4]. Word problem completion involves the linkage of each completion step effectively. This is the most challenging section for most students. They need to learn written language to convey their solutions or ideas. They must use correct and accurate syntax and grammar of the math language. Generally, students’ main difficulty in solving mathematic word problem lies in understanding the problem and translating it into equation. This is considered as a major obstacle in mathematic learning. Translating from words to symbols is undeniably one of the completion process that can be considered critical in solving word problem. According to Kintsch and Greeno [5], “the root of arithmetic word problem difficulty can be traced back to text comprehension”. Therefore, Gagne [6] suggests “in the process of mathematical word problem solving, student should be able to translate the concrete to the abstract and the abstract to the concrete”.

In Indonesia, students’ difficulty in word problem solving was revealed in Trends in International Mathematics and Science Study (TIMSS) 2007. For example, only eight percent of Indonesian participants could solve the following word problem “Joe knows that a pen cost 1 zed more than a
pencil. His friend bought 2 pens and 3 pencils for 17 zeds. How many zeds will Joe need to buy 1 pen and 2 pencils?” [7]. This case shows that solving the word problem still becomes problem experienced by students.

2. Research Method
This is an explorative study with a qualitative approach. Exploration was done through observation and in-depth interview. The exploration result was narrated and qualitatively described.

A male student from grade seven of junior high school was taken as the subject of the study. Data analysis was done based on the result of completion of non-routine word problem of fractional topic and interview. Time triangulation was done to get valid data where equal test and interview were given at different time. The test is Three-fifth of the seventh-grade students group VIIA are females. Three female students from group VIIA move to group VIIB and three male students from group VIIB move to group VIIA. Now, half of group VIIA students are females. How many students are in group VIIA now?

3. Results and Discussion
The research data is analyzed to see the description of completion of non-routine word problem of fractional topic based on four steps of Polya, namely: 1) understanding the problem, 2) devising a plan, 3) carrying out the plan, and 4) looking back.

a. Understanding the problem
The subject received information from the test, after reading the problem, the subject is able to retell what has been read without looking at the test. It indicates that the subject can store and recall the information received. The subject processed the information by mentioning what is known and what is being asked. It is interesting that the subject says that what is known is the things that will be used to solve problem.

Footage interview is follow:

P101 : Good morning, here is the pack, please read it first!
LS101 : (reading the matter in the heart)
P102 : have you read?
LS102 : done?
P103 : please tell me what you read.
LS103 : (without seeing the test) three-fifths of the seventh-grade students group VIIA are females. Three female students from group VIIA move to group VIIB, and three male students from group VIIB move to group VIIA. So what happened…. Half of the class was female students. Keep counting the number of students (while moving/rotating his finger)
P104 : have you understood this yet?
LS104 : Yes
P105 : what is known about this?
LS105 : (silent while occasionally looking at the test) three-fifths of group VIIA were females. Three females moved to VIIB, three males from group VIIB moved to VIIA. So, half of the class is what… half of group VIIA students were females which was automatically half of them were males. It is asked to find the total of the students.
P106 : why are these things known?
LS106 : because it will be used to solve the problem
P107 : what does that mean?
LS107 : … later it will be used to find a solution.
P108 : what does this question ask?
LS108 : number of grade VIIA students now
P109 : why is that asked?
LS109 : because here…..it is written here (pointing).
b. Devising a plan

The subject plan the completion by first finding male students’ composition before moving. The subject considered one class to be one in finding the male students composition where two-fifths got by subtracting three-fifths from one. Considering the composition after moving, the subject changed three-fifths and two-fifths to six-tenths and four-tenths to find value of the three males moved.

Footage interview as follows:

P118 : how will you plan to solve the problem?
LS118 : E… find the number of male students first e….. two-fifths, the number of female students was three-fifths multiplied by two is six-tenths, and the males was four-tenths. It is easier to find its half subtracted by one-tenth, it is five-tenth…. (silent)

P119 : that two-fifth male from where?
LS119 : one class is one, and the number of females was three-fifths, so the number of male students was two-fifth.

P120 : finished?
LS120 : (while looking at the test)…. Half is multiplied by three is one point five ….and it …. (while scribbing)…. 

P121 : how can your plan be retold?
LS121 : so…e… that one means five-fifths. Five-fifths minus three-fifths…. Two-fifths or.. not multiplied by two is six-tenths four – tenth and if three females out, it is half which means if one is three. So five-tenths went on to five again. So five… five will be half… The three of them we fifteen.

P121 : done?
LS121 : done.

c. Carrying out the plan

After making the plan, the subject started completing the test by writing six-tenths and four-tenths as composition of the number of female and male students. Then on the basis of the transfer of three female students and three male students, the subject wrote five tenths and five-tenths of the composition of women and men and found three students to be one-tenths. Here the subjects linked the initial composition of female and male students (six-tenths and four-tenths) to the final composition of them (five-tenths and five-tenths) with three female students who dropped out of the VIIA class and three males went to class VIIA.

The subjects then used a ratio of one tenth as three students to find the value of six-tenths and four-tenths and then look for the number of students in the class VIIA. The subject did not use the composition after the displacement because according to him the number of students in the class VIIA before and after the displacement was the same.

Footage interview as follows:

P123 : please do it
LS123 : ...(working on completion)…. 

P124 : done?
LS124 : yes

P125 : what is D1? (while pointing to work)
P128 : what does this mean? (while pointing)
LS128 : it means three females are out and three males are in

P129 : can you explain?
LS129 : these three female students moved from grade VIIA and three males moved to grade VIIA,
half of the students in grade VIIA is females, so half of them is males.

P130 : what is D2?
LS130 : asked
P131 : what is being asked?
LS131 : the number of all VIIA grade students
P132 : what is D3?
LS132 : completion way
P133 : what is six tenth comma four-tenth?
LS133 : comparison of females and males
P134 : which comparison?
LS134 : three-fifths which is multiplied by two (while pointing to the work). So, it is three-fifths plus three-fifths
P135 : what is the result of three-fifths plus three-fifths?
LS135 : the score is changed… three-fifths is the same as six-tenth.. and two-fifths is the same as four-tenth.
P136 : where is it from?
LS136 : if the numerator is multiplied by two, the denominators are also multiplied by two.
P137 : what is the point if three out come out to be five-tenths point five-tenths?
LS137 : so the three out will be half and half equal. It's five-tenths half. So the five-tenths are five-tenths.

P138 : what does it mean?
LS138 : three female students from grade VIIA moved, and half of the class was females, so half of
the class is males.
P139 : is it because only three students moved?
LS139 : it is also because three males came in
P140 : does it mean three is the same as one-tenth?
LS140 : it means three students moved is the same as one in comparison
P141 : the same as?
LS141 : it is the same as one in its comparison.
P142 : What does it mean?
LS142 : Three students are equal to one (while pointing to the work), one…. the denominator is reduced
when the denominator is reduced by one, entering the denominator added one
(pointing six and four to six- and four-tenths)
P143 : Is that the denominator?
LS143 : I mean the numerator
P144 : what does three equals one mean?
LS144 : Three equals one tenth …. So the three disciples were worth a tenth
P145 : how did you get it?
LS145: three females moved, and two males came in, so half of them females and males.
It means……what is that?…. if we use logic …. it's half that's five to ten. So three is one-tenth.
P146: say it again!
LS146: if we use logic, it is six……three females are out, three males are in, it is half when the males came … so first there were three more females, so we had less three. keeps the girl who came out with the guy who entered half-semi-automatic right …. half that's five-tenths … so six-tenths minus how many five-tenths continued to be changed … moved to tenth
P147: the males?
LS147: the males are four-tenth…. (silent) four-tenths plus dots equal to five-tenth.
P148: you wrote six times three plus four times three. What does it mean?
LS148: That's it … from the unknown … so that's like the comparison is six appeals four. If one comparison is three means six times three plus four times three
P149: where is six to four from?
LS149: from this Dari ini (while pointing six-tenths and four-tenths in his work)
P150: why not use five-tenths and five-tenths?
LS150: … e … the number of students is the same … that came out of VIIA three, which entered as well
P151: why should be multiplied by three?
LS151: (while pointing three equal to one-tenth in his work) Due this one is three, one to three
P152: what is the result?
LS152: eighteen plus twelve is thirty.

d. Looking back

The subject re-examines the work by returning the final answer to the problem and finding the state corresponding to what is known in the question. This makes the subject sure of the truth of the answer.

Footage interview as follows:
P154: pleas recheck
LS154: (rechecking the work)…. Yes,
P155: are you sure thirty students is the answer?
LS155: yes
P156: why are you sure?
LS156: the question is three-fifths multiplied by thirty is eighteen, the male is two-fifths multiplied by thirty is twelve. Three females are out equals to eighteen subtracted by three equals fifteen… three males are in equals fifteen. It is half. It is the same as the question.
P157: what is the question?
LS157: how many students in grade VIIA?
P158: what is the result?
LS158: thirty
P159: are you sure?
LS159: yes.

From description 3.1 to 3.4 it is seen that after receiving information from reading questions, subjects take note of the fragments that exist in the matter and perceive them as part of the whole. Translation from words to symbols is undeniably one of the solution processes in solving word problems that can be considered critically [8]. The subject then plans and executes the settlement by first changing the composition of the number of female and male students before and after the transfer with a fraction of the value in order to facilitate the search for the value of three students who move. The subjects found that one tenth of the three students moved, the subjects used it to look for the number of students before the displacement on the grounds that the number of students before and after the transfer was the same. The subject’s ability to solve non-routine word problem of fractional topic also contradicts Hannula's opinion that seventh grade students are still weak in understanding the concept of fractions [9].
4. Conclusion
From the result of research, it can be seen that the subjects are able to solve non-routing problem using unusual method. The subject begins to translate words into mathematical symbols to make it easier to find solutions. These results indicate that junior high school students can manipulate algebraic symbols to solve a word problems.

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