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Construction Representations of Student on Solving Word Problems Inconsistent Comparison

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ABSTRACT
This study investigates the use of representation of middle and high school students in solving inconsistent additive comparison problem word problems. The study was conducted by analysing the answer to the task of solving word problems and the results of interviews of 5 students aged 12-16 years to identify and categorize their representations. The results obtained by four types of representation that students use to represent inconsistent additive comparison word problem problems. Students are not familiar with constructing representations that integrate existing relationships in word problems.
Keywords: *representations, word problems, inconsistent comparisons*

1. INTRODUCTION

The mathematical ability that students must possess is to be a good problem solver. Learning mathematics is to develop these abilities [1]. Problem solving is an important part that is inseparable from all mathematics learning. Problem solving is not only as a goal of learning mathematics, but is also a major tool for learning mathematics [1].

Math problems are different from math problems. Math problems are not always a problem. To solve problems, one can directly use routine procedures to get an answer. Meanwhile, to solve a problem, a person must pause, reflect, and maybe take a few steps to get an answer. [2] States that a problem is more complex because the strategy to solve it cannot be seen immediately; solving problems requires creativity or originality in the students who work on them.

Problems associated with students' mathematical knowledge of verbally described situations where the relation between quantities is explained, asks for a value discovery that includes a comparison between two quantities called the word problem. Solving word problems involves more than basic computing skills. Effective word problem solvers are able to understand the purpose of word problems by demonstrating their ability to explain word problems in their own words. Learning how to find key words in a word problem is the key to success in becoming a word problem solver and must be modelled in a math class [3].

[4] Stated that many students from elementary school to adulthood had difficulty in solving arithmetic word problems that contained relational statements. This statement can be a consistent and inconsistent relationship. Consistent relations are statements that require arithmetic operations, for example, "more" when an addition operation is needed. Whereas inconsistent relations, if the relational keywords are "more" while arithmetic operations are used are subtraction [4]. In one relational assignment, students are presented with inconsistent relations whose mathematical operators are needed the opposite of what is usually required, for example, a reduction when an over-established relationship [5].

Some researchers revealed the difficulty of solving word problems. [6] Revealed that almost half of the teachers said their students struggled with representation and understood word problems. [7] Found that junior high school students could not find a solution because of their inability to interpret word problems into mathematical representations. [8] Found that students' failure to solve word problems begins with their inability to construct the right representation.

[9] States, if students are encouraged to represent mathematical word problems rather than directly

translating word problem elements in appropriate mathematical operations, they may be more successful at solving word problems and better understand mathematical concepts embedded in them. [10] Stated that a successful solver is impossible without first representing the right word problem. Appropriate word problem representation shows that the solver has felt the word problem and serves to guide students towards a solution plan. The first attempt to solve the word problem is to build a representation by connecting to prior knowledge [11]. Students are able to solve word problems by representing them [12].

In Indonesia problem solving is usually not treated explicitly as a school assignment. Thus students are not influenced by the learning received. Very useful for detecting student activities that are not related to previous learning. In this article, we will examine how students use representations in solving inconsistent additive comparison word problem solving.

Using pictures or diagrams to solve word problems sometimes helps and others are difficult to find solutions. Representation is considered as one of the effective heuristic strategies in solving word problems. There are two different ways to represent a word problem: schematic and pictorial representation [13]. Schematic representation includes relevant information contributing to the solution, in the form of a schematic relation between quantities. Schematic drawing is a type of graphical representation showing the many quantities of relationships that are established between them in this word problem. On the other hand, pictorial representations direct attention to the insignificant word problem details and then shift students' consideration to the key elements of the word problem.

[13] Examined the types of visual representations relating to students' success in solving mathematical word problems. The use of schematic representation is positively related to the success of solving mathematical word problems, whereas the use of pictorial representations is negatively related to the success of solving mathematical word problems. Two types of visual-spatial representations of [13] are: (a) pictorial representations, which display visuals of the objects or people described, and (b) schematic representations, which describe spatial relationships in word problems.

[14] Examines diagrams as a way of representing mathematical relationships by 8th grade junior high school students. Diagram categories are produced by students, as follows: (a) without diagrams, reformulation of statements/schematic expressions, (b) qualitative diagrams, pictures of people or objects which refers to the topic or context of the statement, and (c) quantitative diagrams, pictures representing two quantities included in the comparison scheme, and the multiplication relationship between them.

The purpose of this study is to analyse the construction of representations used by students in solving word problems that involve the comparison of additives with inconsistent relations. We will focus on the following questions: a) Do students use several types of representations to solve word comparison problems? b) What type of representation do they construct?

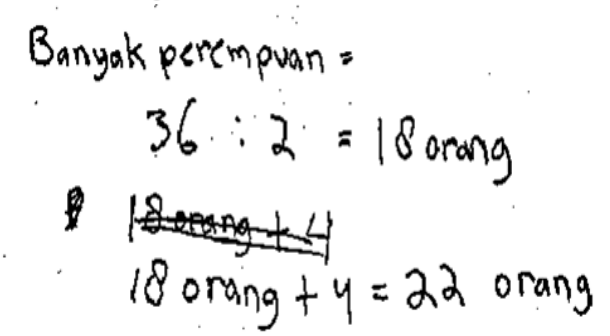
2. RESEARCH METHODS

This study observes the representation of middle and high school students of grades 7-11 in solving inconsistent comparison word problems. Students work on word problem solving tasks, then are interviewed to find out the representation students use. This research was conducted on students of SMPN 1 Sampit, and SMAN 2 Sampit. From the task of solving inconsistent additive word problem comparison students were interviewed. Word problems that are used in this article are as follows: Do whatever will help you to solve the problem below; there are 36 students in the class. If there are four female students than men, how many women are there in the class?

3. RESULTS AND DISCUSSION

In doing word problem solving assignments, students represent specific word problems. The following are presented representations generated by students on word problems with the semantic structure of comparison and inconsistent relations as follows.

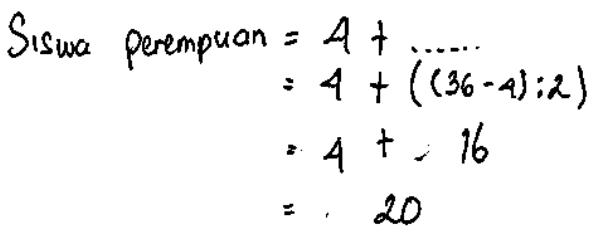
1. SR 7th grade students answer as follows:



Interview result
I : What occurred to you the first time you read the problem?
SR : Initially it was 36 there were 4 more women, confused how to do it?
I : What makes you confused?
SR : This sentence (refers to a relational sentence) so it takes some time to think, while imagining students in class.
I : When you answer this your mind is like what? (Pointing answer).
SR : My thoughts were like this, to balance them out first, so 36 divided by 2 is equal to 18, because here there are 4 more so 22 people. 22 plus 18 is more than the result 36, this will be 40.

SR balances between many female and male students by imagining students in their class. He focused on the quantity of details in the word problem. Then answer 36 ÷ 2 = 18, 18 + 4 = 22. SR does the division and then the addition. It constructs a detailed picture of quantity but does not regulate the additive relationship between quantities. SR constructs pictorial representations. [14] Stated pictorial representations direct attention to the detail of insignificant word problems and student considerations to the key elements of word problems. Pictorial representations can produce the wrong solution, if the relationship between the parts is not successfully reflected in the representation, in other words, the representation does not satisfy the logical relationship in the word problem, the representation cannot lead to the right solution [15].

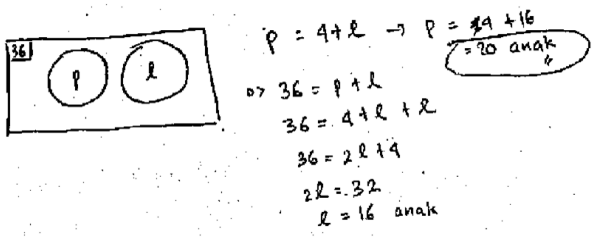
2. RN 8th grade students, answer as follows,



Interview result,
I : What do you think about when answering the questions above?
RN : There are 36 students in the class, if there are four female students more than men, that means 36 minus 4, then the rest is divided by 2, that's the result of the female students. Meaning 4 + (36 -4): 2 the result is 4 plus 16 is equal to 20.
I : What do you think before answering the questions?
RN : Because there are 4 more female students, so set aside 4
I : Why set aside 4 first?
RN : Because there are more female students 4.

RN sets aside 4 first by subtracting 4 from many students in the class. Then halve many students. RN describes the spatial relationship and regulates the additive relationship between the two quantities to solve the word problem. [15] States creating representations that emphasize spatial relationships in the process of solving mathematical problems can contribute to successful problem solving. RN successfully solved the inconsistent comparison word problem, because it constructed a schematic representation.

3. AY grade 9 students answer as follows.

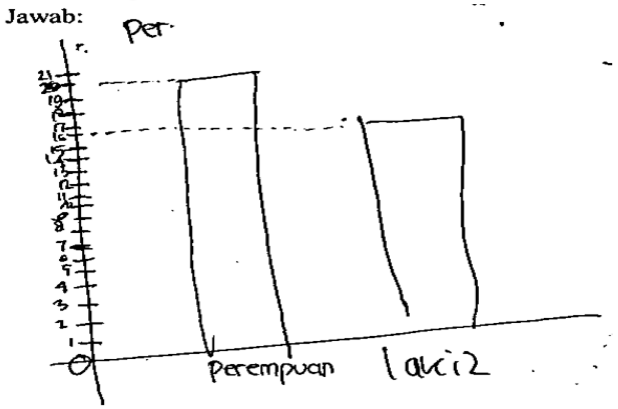


Interview result
I : What do you know from that problem?
AY : There are four more women than men in this class. It means that the number of women is the same as the number of men plus four. The number of women is four more than men. The number of women

was given the variable p and the man l, written p = 4 + l.

AY draws Venn diagrams to group male and female students. He also wrote the algebraic expression "p = 4 + l" to show the relationship between quantities. AY displays objects from those described in the word problem that describe spatial relationships and regulate additive relationships between two quantities. This is in accordance with the statement of [14], which states that schematic drawing is a type of graphical representation showing the quantity of relationships established between them in this problem. AY makes pictorial and schematic representations separately.

4. NR 10th grade students, answer as follows



Interview result,
I: What do you think about when answering the questions above?
NR: In that class there are 36, if there are more female students than boys, how many women are there. So 36 is a comparison with the difference of 4. Divided by women by 4 more than men.
I: Try to explain how?
NR: 36 = 18 + 18
+ 19
16 + 20, the result is 36 with a difference of 4, so the woman is 20.
I: What picture is this?
NR: Bar chart.
I: What does this picture mean?
NR: To present more than 4 women than men, thus 20 women and 16 men.

NR think of a comparison with the difference 4. Women 4 more than men. He then uses a guessing and checking strategy to find the right answer. Next he shows the results by making a bar chart. NR describes the spatial relationship that governs the additive relationship between two quantities and displays objects in the form of bar charts to solve inconsistent comparison word problems. This is consistent with the statement of [14], which states that schematic drawings are not always simple drawings. Schematic drawing is a type of graphical representation showing the quantity relation established between them in this word problem. [16] Also state that schematic drawings are not realistic; they use simple shapes to represent objects and images suggested by the word problem. Thus NR constructs schematic representation of images.

5. AS 11th grade students, answer as follows.
Many students total = 36 people.
p> l
18 + 18 = 36
22 + 14 = 36 (plus 4 on p and minus 4 on l)
Many women are 22 people

Interview result.
I : What do you know from that problem?
AS: There are a total of 36, many women have 4 more than men, who are asked how many women there are. If for example there are 36, divided by two it becomes 18 and 18. Previously it was found that the number of women was 4 more than the number of men, the number of men was reduced by 4 and given to women, and thus the result was many women 22 and many men male 14.

The AS makes a "p> l" representation that refers to the context of the statement, but is incomplete. AS displays pictorial representations that do not regulate additive relationships between quantities, so AS fails to solve word problems. [14] States pictorial images focus on qualitative aspects that visually reflect what is needed to solve word problems. This representation produces the wrong solution, if the relationship between quantities is not successfully reflected in the representation [13].
It was concluded that the representation construction of middle and high school students on inconsistent comparison word problems is as follows:
Pictorial representation, the picture does not regulate the additive relationship between quantities.
Schematic representation, describing spatial relationships and regulating additive relationships between two quantities to solve word problems.

Schematic representation, drawing and describing spatial relationships and regulating additive relations between two quantities.
A schematic representation of a picture, describing the spatial relationships that govern the additive relationship between two quantities and displaying objects in the form of bar charts to solve inconsistent additive comparison word problems.

4. CONCLUSIONS

The observation results show that some students are not familiar with the construction of representations that integrate the relationships that exist in the word problem. This observation produces the type of representation students use to solve inconsistent comparison word problem problems. Some students construct pictorial representations that do not regulate additive relations between quantities, others construct schematic representations describing spatial relationships and regulate additive relations between two quantities in 3 ways.
Regardless of students' abilities, it is possible to teach students how to productively represent word problems. Instructing students to try to "represent" the word problem might not work. Instead, instruction must encourage students to construct representations of relationships between objects in word problems and prevent them from representing irrelevant details.

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