Enhancing students' ability to solve word problems in Mathematics

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Abstract Word problems are the most important thing in learning in Indonesia. Most of the students met the problems. This research aims to enhance the students' ability in the difficulties of students in solving word problems in social arithmetic. This research is qualitative. Researchers collected data through tests, interviews, and documentation. Data analysis techniques included data collection, data reduction, display (data), and concluding. The results showed that the difficulties in solving word problems in social arithmetic were difficulties in understanding the problems, namely the inability of students to translate the problem that is not able write down what is known and asked; difficulties in transformation, i.e. the inability of students to determine the formula for solving arithmetic problems social; difficulties in the settlement process, namely the inability of students in students perform arithmetic operations to solve the social arithmetic problem. Factors which causes students difficulty that is lazy to read too long questions, difficult to digest words in a problem, lack of student interest in learning mathematics, a way of learning for students who tend to memorize the material so the concept does not clear, students rarely practice the questions, do not understand the counting operations well, motivation low learning, a less conducive classroom, and learning strategies.

1. Introduction

Education is something that cannot be separated from life. In prepare qualified human resources and able to compete in the development of science and technology, the role of education is very important, so education must be run as well as possible to obtain results the maximum [5][13]. Education is an effort to help students in developing themselves, both intellectual, moral, and psychological [2][3][4]. The process is a thing the most important thing in education, not the result because of the process many things can be learned and understood by students. Students need the real-life problems that they met in their daily life [7][10]. Mathematics is a field of study that is studied by all students from elementary through to Senior High School and even Universities [8]. Reasons for mathematics need to be taught to students because mathematics is widely used in life, it can be used for presents information in various ways towards solving problems [1][20]. But on the side others, mathematics is still considered a difficult subject for students, this caused because mathematics has abstract properties, or because it is in learning less associated with the facts commonly found by students in life day, or because the teacher considers students as empty bottles that need to be filled and less attention that students construct their understanding for knowledge.
Teaching is not merely a matter of telling and learning is not a consequence of automatic pouring of information into the minds of students[9]. Learning requires mental involvement and work of the students themselves, in this case, student activity is very is required. Learning mathematics is the same as learning logic, because of position mathematics in science is as basic science. In the learning process Mathematics also occurs as a thought process, because someone is said to think when that person does mental activities, and people who study mathematics must-do activities mentally[4][11]. In thinking, people arrange relationships between parts information that has been recorded in his mind as meanings. Word problems also have an important role in learning mathematics because students will better know the nature of a mathematical problems when students faced with a matter of story problems [14][15][23]. Also, the story is very useful for developing students' thought processes because in solving problems contained in the stories the story requires completion steps that require understanding and reasoning[4][17]. Word Problems in mathematics are often found in the subject matter such as social arithmetic, statistics, algebra and some subject matter in subjects physics and economics [3][17][18][19][22]. Word problems in social arithmetics is very interested topic because it had a directly contact with the human daily life. So, it has a great benefit if focused in the word problems in social arithmetic. To learn about word problem questions, students are not enough to just be able and relate it to daily life and do exercises in a way constantly to be able to master the material.

Junior high school mathematics material consists of several topics as mentioned above. False one of them is social arithmetic. This material is material that is quite difficult for Middle school students, because the questions presented are usually in the form of story questions and students are difficult to understand the intent and translate story problems into mathematical form[4][22]. Students' mastery of social arithmetic is shown, among others, by their abilities to solve social arithmetic story problems correctly. But in reality, many students make mistakes in completing matter of stories, this is due to students experiencing some difficulties including difficulties in understanding the meaning of the sentences in the story problem, the lack of students' skills in translating everyday sentences into mathematical sentences and which elements must be assumed by a variable [4]. The difficulty of students in solving social arithmetic story questions needs to get attention. Difficulties experienced by students in solving these problems need to be identified to determine the factors causing it. Analysis of student difficulties in solving social arithmetic problems can be used to improve quality teaching and learning activities in mathematics and ultimately is expected to improve achievement learn math. Many efforts have been made to overcome and improve quality learning ranging from upgrading and educational qualifications for teachers to implement new learning methods applied by the government [2]. But the effort is not yet achieved optimal results due to constraints that occur in the field.

This can be seen from the process of learning mathematics in schools that is not able mastering the material provided by the teacher which results in students being unable to identify and solve questions in the form of stories in mathematics. Groups the factors of student learning difficulties into two kinds namely factors from within (internal) and factors from outside of students (external)[21]. From an internal perspective, one of them is the student's intelligence. To overcome this knowledge is needed to know what factors become the causes of these difficulties so that efforts can be made to minimize difficulties experienced by students. The experience of teaching and learning activities in the field, often found students are not able to solve the problems given complete, due to the inability of students to understand concepts mathematics learned. Student weaknesses in mathematics can be seen from the test scores which is still relatively low. The goal to be achieved in this study is to describe the types the difficulty of students in solving social arithmetic story questions in class VII and analyze the factors that cause difficulties in solving problems social arithmetic stories in class VII.
2. Methods
This research is qualitative research because the analysis of the data is non-statistical [6]. Qualitative research was chosen because this form of research will be able to capture a variety of qualitative information. The subjects of this study were a class of VIIF in Public Senior High School 3 Surabaya. The determination of the subjects in this study is based on the results of tests of social arithmetic story questions. Data collection in this study was carried out by the method of tests, interviews, and documentation. Before the interview, first, a math test is done on social arithmetic material. Data analysis techniques used in this study is data analysis model which consists of data collection, data reduction. After data collected, they were reducted into several data that chosen as the subject of this study. In-depth interviews were conducted to obtain further informations, suppose to the triangulation of the data.

3. Discussion
Based on the results of student tests and interviews that have been gotten, data is obtained about the difficulties experienced by students in completing the matter of social arithmetic stories and their causal factors can be seen as follows:

3.1. Difficulty in understanding questions
The difficulty in understanding this problem is the difficulty in the form of students being able to read all words in the question, but do not understand the whole meaning of words, so students are not able to go further along with the appropriate problem-solving flow.

Results of interviews with S1
R: "Do you have difficulty working on social arithmetic problems?"
S1: "Yes ma'am."
R: "Which part is the difficulty?"
S1: "When I write what I know and what I ask, I'm confused."
R: "Confused why?"
S1: "I don't really like you about the lazy reading story, because you have to well understood to understand, so I'm confused about what to write. "
R: "That means you cannot understand the matter of this story well, so you confused with what to do with this problem?"
S1: "Yes ma'am, there are already so many formulas in social arithmetic material, so I'm confused about which formula."
R: "What is causing you trouble?"
S1: "I can't understand the problem and forget the formula, then if I can't understand it "I don't know what you have to write, ma'am."

In problem number 1 of the results of student work shows that students have difficulty in understanding the problem, ie students cannot write what is known and what is asked, students should be able to write information that is available like prices buy a car, the price of a car repair, and loss, then only students can
move to the step next and solve the problem. The results of interviews with students showed that the location of students' difficulties is in understanding the words in the problem. Besides that results in interviews with mathematics subject teachers revealed that students had difficulties in solving a story problem is to understand the problem, namely, students are less able digest story matter well so students often have difficulty in the form of difficulties understanding which results in not being able to write down what is known and what is asked. Difficulty in understanding the problem is caused by students who are lazy to read the questions which are too long and require understanding. So students cannot digest words in the story matter well.

Figure 2. Solution of S2 on the question 2.

Results of researchers' interviews with S2
R: "Do you have difficulty working on social arithmetic problems?"
S2: "It's really difficult, Mom."
R: "What's the difficulty?"
S2: "Solving the problem is not difficult."
R: "Where is the difficulty?"
S2: "You have to read a long question and continue if you use steps. That's the solution mom, it's complicated"
R: "What is causing you trouble?"
S2: "Digested the words in the questions, then many of the formulas sometimes like to forget."

From the results of student work above shows that students have difficulty in understanding the problem, so students are not able to write what is known and what is asked students should write down in advance what is known in the problem, like profit, and the sale price of the wardrobe so students are able to move to the step next and solve the problem. The results of interviews with students showed that students are not happy in reading long questions so that it draws students. It is difficult to illustrate a problem or write down what is known and what is asked. From observations of student work and interviews with students, the difficulties are experienced by students in solving social arithmetic story problems is difficulty understanding the problem or interpret the words in the problem, and the complete steps that must be done too complicated. This was also expressed by the subject matter teacher VIIF mathematics that difficulties that are often experienced by students in solving story problems are the difficulty of writing down what is known and what is asked about this because students are lazy to read about the story. On the difficulty in understanding questions in social arithmetic material, lies the difficulty experienced by students is in understanding the words in the problem so that causing students to be unable to write down what is known as the price of buying a car, the price of the car repair, and the loss and what is asked is the selling price of the car.

Similar to the research conducted by [10] which concluded that the difficulty experienced by students in solving story problems is understanding the meaning of the words in the given problem. The same thing was expressed by Mathematics teacher difficulties students in solving story problems unable to write down what is known and asked, write down known and asked not in accordance with the problem, and did not know the purpose of the question [7]. Factors that cause students to experience difficulty in understanding the questions are students are lazy to read questions that are too long and are not careful in reading[2]. This matter is a difficulty learning concepts experienced by students, so students cannot digest the words in the
story matter well. This is in line with research conducted by [14] which states that the cause of difficulties is not being able to understand the concept, not being able to determine completion of the mathematical model. In addition, researchers also make use of observations to find out other factors that influence students' difficulties in learning. From the results of these observations, researchers feel one of the visible external factors is the way teacher submission of social arithmetic material that is too monotonous so that there are students who are busy alone and sleepy in class. Strengthened by the results of the study concluded that the factors that greatly influenced the difficulty learning are a lack of student interest in learning in mathematics, this difficulty arises because the teacher who is identical writes on the blackboard only, so students feel bored when taking lessons [12][13].

3.2. Difficulty in transforming questions
The difficulty in transforming the problem is the difficulty of students in determining the formula which must be used to solve the problem.

Results of researchers' interviews with S3
R: "Do you have difficulty working on social arithmetic problems?"
S3: "Yes ma'am."
R: "What difficulties?"
S3: "Determine the solution formula, mom."
R: "What is causing you difficulty in solving problems?"
S3: "Often you forget the same formula because there are too many formulas."

From the results of student work can be seen that students are mistaken in the use of formulas, even though students can understand the problems and write down what is known and asked about the problem. The results of interviews with students showed that students had difficulties in doing the transformation, students forget the formula for finding a price buy a cupboard. Students should be able to complete the same percentage profit formula with profit divided by purchase price then multiplied by one hundred percent, then substitute the information in the problem into the formula. The factors that cause students to experience difficulties are students only memorizing formulas, which results in students quickly forgetting in working on problems.

Figure 3. Solution of S3 on the question 2.
Figure 4. Solution of S4 on the question 3.

Results of researchers' interviews with S4
R: "Do you have difficulty working on social arithmetic problems?"
S4: "Little ma’am."
R: "What difficulties?"
S4: "Solving the problem, ma’am, confused the formula."
R: "Why?"
S4: "Because in this material the formula is a lot, ma’am."
R: "What is causing you difficulty in solving problems?"
S4: "Do not memorize the formulas bu."

From the results of student work can be seen that only student learning methods memorizing formulas, which results in students quickly forgetting the material presented so students cannot solve social arithmetic story problems. The difficulty of students in doing transformation is the difficulty of students in determining the formula for solving problems number 2 and 3, where the difficulty lies in the problem number 2 is students are not able to write the formula that must be used for determining the formula for the purchase price of a cabinet with the information in the problem, it should be students first write down the profit percentage formula equal to profit (selling price - purchase price) per purchase price multiplied by one hundred percent, after which students can substitute what is in the formula. While the difficulty lies in number 3 is students forget the formula that must be used to determine net from 6 bags of sugar. This is in line with research conducted by [15] which concluded that the difficulty experienced by students is lacking conceptual understanding, incorrect use of formulas, and lack of student interest in math.

Factors that cause students to experience difficulties in transformation are how to learn students who only memorize formulas that result in quickly forgetting, and lack of practice working on problems, this is in line with research that has been done by [21] which states the factors causing student difficulties are low student ability and understanding of arithmetic concepts that are still low, lack of attention and seriousness in learning, lack of practice in answering questions, lack of reading comprehension, and inability to analyze story problems.

3.3. Difficulties in the settlement process

Difficulties in the completion process are difficulties experienced by students in doing arithmetic operations. In the difficulty of performing this arithmetic operation there are some difficulties experienced by students namely in calculating the operations of reducing integers with decimal and in multiplication operations.
The results of interviews with students working on the questions above are as follows.

R: "Do you have difficulty working on social arithmetic problems?"
S5: "Yes ma'am, I can't count integers with decimals."
R: "What are the difficulties?"
S5: "Yes, confused, ma'am, there is no one in the comma, and the other one there are commas."
R: "All that's left is to count if you are confused using concatenation reduction."
S5: "Hey, it's hard to count things like that, ma'am."

In the working procedure is correct, it's just that when students are confronted with reduction of integers with decimal values students still experiencing difficulties. The student's initial step in working on changing the value of the tara (from percentage to kg form) do not experience difficulties, students can perform multiplication and count operations division well. The results of interviews with students showed that the location of the difficulty of students is to subtract integers with decimal numbers. The statement was also expressed by the teacher of mathematics subjects in class VIIIF regarding student sultans in calculating integers with decimals, be it addition, subtraction, multiplication, and division. The factors that cause students to experience difficulties are not very understanding about decimal number counting operations.

Translation:
Will be known: profit = 15%
The selling price = Rp 460,000.00
Question: the purchase price
Answer: % profit = \[
\frac{\text{profit}}{\text{purchase price}} \times 100\% = \frac{\text{selling price} - \text{purchase price}}{\text{purchase price}} \times 100\%
\]
15% \[
= \frac{460.000 - \text{purchase price}}{\text{purchase price}} \times 100\%
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Results of researchers' interviews with S6

P: "Are you having trouble doing arithmetic story problems social?"

S6: "Yes ma'am, I can't count, ma'am."

Q: "Counting which parts?"

S6: "The one who calculated the purchase price of the cupboard, ma'am."

P: "Try to tell how difficult it is? Isn't this almost done?"

S6: "Yes ma'am after the substitution known to the formula continues to be confused to count it, it's already up to 15 per 100 equal to 460,000 minus the purchase price per price. After that, I confused."

Judging from the results of the work shows that students have not finished working on the problem. From the results of interviews with students showed that students able to substitute information into formulas, only when having to do multiplication students are not able to do it so students are unable to solve the problem. The cause of these difficulties is the student's lack of practice questions and motivate student learning is still low. Another factor that causes students to experience difficulties based on the observations of researchers namely a classroom atmosphere that is less conducive and less comfortable. The VIIF Public Junior High School 3 Surabaya mathematics classes are held every day Monday and Friday. On Monday the math learning process takes place 3x40 minutes, The lesson starts after the flag ceremony every Monday at 08.00 WIB and there is a pause break to make the classroom atmosphere less conducive, whereas on the day Friday 2x40 minutes starting after the first break at 09.20 WIB. From allocation, the time spent on learning mathematics tends to be daytime cause students already feel bored and difficult in conditioning in the classroom. From the observations of the researchers in the learning process of mathematics in class VIIF using the lecture method, so that the teacher is the center of learning and results in students oversaturate the material presented. The difficulty experienced by students in the completion process is the difficulty of students in carrying out this arithmetic operation there are some difficulties experienced by students that are, in calculating the operations of reducing integers with decimals and in multiplication operation. In the workmanship procedure number 3 is correct, only when students are faced with subtracting integers with the decimal number of students still experiencing difficulties is also what causes students to not be able to step into the next step and solve the problem.

The initial step of students in the process of changing the value of the tara (from percentage to kg) is not difficult, students able to perform multiplication and division operations well. While the location the difficulty with question number 2 is that students can substitute information into formulas, only when having to do multiplication students cannot do it students having trouble when it reaches fifteen per hundred is equal to four hundred and sixty thousand less the purchase price per purchase price so students are not able to solve the problem. This is in line with research conducted by [12] which states that students are still experiencing difficulties in computational skills, and also concluded that students still have difficulty in calculating the addition, subtraction, multiplication and also division.

Factors that cause students to experience difficulty in solving problems is the difficulty experienced by students in arithmetic operations. The cause of this difficulty is not yet very understanding about the operations of calculating decimal numbers and students lacking practice questions and student motivation are still low. This is in line with research conducted by [10] which states the causes the difficulty experienced by students is to carry out counting operations and reduction, and lack of practice in working on problems. Another factor that arises namely from a class atmosphere that is not supportive. Mathematics in class VIIF held every Monday and Friday. On Monday the process of learning mathematics held 3x40 minutes, lessons begin after the flag ceremony every Monday at 08.00 WIB and there is a break that makes the classroom atmosphere less and less conducive, whereas on Friday 2x40 minutes starting after the first break which is
09.20 WIB. From the time allocation of learning, mathematics is inclined during the day that causes students already feel bored and bored, this causes the difficulty of conditioning students in the class. In line with the [11] who said that non-social environmental factors are the school building and its location, the home of the student's family and its location, learning tools, weather conditions and the study time used by these students is seen to have helped determine the level of successful student learning.

Difficulties of students in solving problems of social arithmetic stories Math teachers should be followed up immediately so that it does not affect the further material. The role of the teacher in helping students is needed can minimize the difficulties experienced by students. The need for evaluation and reinforcement of the material being taught to help students optimize learning outcomes.

4. Conclusion
Based on the results of data analysis and discussion above it can be concluded:

a. Types of difficulties experienced by students in solving social arithmetic story problems can be classified into 3 types, namely difficulty in understanding questions, difficulties in problem transformation, and difficulty in the resolution process.

b. Factors that cause students to experience difficulty in solving problems social arithmetic stories include: lazy to read questions that are too long, difficult interpret digest words in a problem. lack of student interest in learning mathematics, a way of learning for students who tend to memorize material so that it does not exist the concept of understanding, students lack practice exercises, do not understand arithmetic operations well, low motivation to learn, a less conducive classroom atmosphere, strategy teachers only use the lecture method.

5. Acknowledgment
The authors thank to Wijaya Kusuma University Surabaya that gave a chance to publish this research.

6. References
[1] Abdullah N, Halim L, and Zakaria E, 2014 VStops: A thinking strategy and visual representation approach in mathematical word problem solving toward enhancing STEM literacy Eurasia Journal of Mathematics, Science and Technology Education 10(3) p165-74
[2] Awofala A O A 2014 Examining Personalisation of Instruction, Attitudes toward and Achievement in Mathematics Word Problems among Nigerian Senior Secondary School Students International Journal of Education in Mathematics, Science and Technology 2(4) p273-88
[3] Capraro R M, Capraro M M, and Rupley W H 2012 Reading-enhanced word problem solving: A theoretical model European Journal of Psychology of Education 27(1) p91-114
[4] Căprioară D, 2015 Problem Solving - Purpose and Means of Learning Mathematics in School Procedia - Social and Behavioral Sciences 191 p1859-64
[5] Chen L, van Dooren W, Chen Q, and Verschaffel L 2011 An investigation on Chinese teachers’ realistic problem posing and problem solving ability and beliefs International Journal of Science and Mathematics Education 9(4) p919-48
[6] Cresswel J 2013 Qualitative, quantitative, and mixed methods approaches In Research Design chapter 9 p234
[7] Csikos C, Szitányi J, and Kelemen R 2012 The effects of using drawings in developing young children’s word problem solving: A design experiment with third-grade Hungarian students Educational Studies in Mathematics 81 p47-65
[8] Jagals D and Van Der Walt M 2016 Enabling metacognitive skills for mathematics problem solving: A collective case study of metacognitive reflection and awareness African Journal of Research in Mathematics, Science and Technology Education 20(2) p154-64
[9] Jitendra A K, Rodriguez M, Kanive R, Huang J P, Church C, Corroy K A, and Zaslofsky A 2013 Impact of small-group tutoring interventions on the mathematical problem solving and achievement of third-grade students with mathematics difficulties *Learning Disability Quarterly* 36, 1 p21-35

[10] Jupri A and Drijvers P 2016 Student difficulties in mathematizing word problems in Algebra *Eurasia Journal of Mathematics, Science and Technology Education* 12(9) p2481-502

[11] Lai Y, Zhu X, Chen Y, and Li Y 2015 Effects of mathematics anxiety and mathematical metacognition on word problem solving in children with and without mathematical learning difficulties *PLoS ONE* 10, 6 p1-19

[12] Leh J M and Jitendra A K 2013 Effects of computer-mediated versus teacher-mediated instruction on the mathematical word problem-solving performance of third-grade students with mathematical difficulties *Learning Disability Quarterly* 36(2) p68-79

[13] Lubin A, Rossi S, Lanoë C, Vidal J, Houdé O, and Borst G 2016 Expertise, inhibitory control and arithmetic word problems: A negative priming study in mathematics experts *Learning and Instruction* 45 p40-8

[14] Morin L L, Watson S M R, Hester P, and Raver S 2017 The Use of a Bar Model Drawing to Teach Word Problem Solving to Students with Mathematics Difficulties *Learning Disability Quarterly* 40(2) p91-104

[15] Ng S F and Lee K 2009 The model method: Singapore children’s tool for representing and solving algebraic word problems *Journal for Research in Mathematics Education* 40(3) p282-313

[16] Novak E and Tassell J L 2017 Studying preservice teacher math anxiety and mathematics performance in geometry, word, and non-word problem solving *Learning and Individual Differences* 54 p20-9

[17] Retnowati E, Ayres P, and Sweller J Can collaborative learning improve the effectiveness of worked examples in learning mathematics? *Journal of Educational Psychology* 109(5) p666-79

[18] Rubin J and Rajakaruna M 2015 Teaching and assessing higher order thinking in the mathematics classroom with clickers *International Electronic Journal of Mathematics Education* 10(1) p37-51

[19] Sudarsana I K, Nakayanti A R, Sapta A, Haimah, Satria E, Saddhono K, and Mursalin M 2019 Technology Application in Education and Learning Process *Journal of Physics: Conference Series* 1363 012061

[20] Van Garderen D, Scheuermann A, and Jackson C 2013 Examining how students with diverse abilities use diagrams to solve mathematics word problems *Learning Disability Quarterly* 36(3) p145-60

[21] Verzosa D B and Mulligan J 2013 Learning to solve addition and subtraction word problems in English as an imported language *Educational Studies in Mathematics* 82(2) p223-44

[22] Wong T T Y and Ho C S H 2017 Component processes in arithmetic word-problem solving and their correlates *Journal of Educational Psychology* 109(4) p520-31

[23] Zhu N 2015 Cognitive strategy instruction for mathematical word problem-solving of students with mathematics disabilities in China *International Journal of Disability, Development and Education* 61(6) p608-27