

Errors of High School Students Solve Double Discount Problems

Lydia Lia Prayitno¹, Purwanto², Subanji³, Susiswo⁴, Ninik Mutianingsih⁵, Agus Prasetyo Kurniawan⁶

¹ Department of Mathematics, FMIPA, Universitas Negeri Malang,
Malang, Indonesia

E-mail: lydia.lia.1603119@students.um.ac.id

² Department of Mathematics, FMIPA, Universitas Negeri Malang,
Malang, Indonesia

E-mail: susiswo.fmipa@students.um.ac.id

³ Department of Mathematics, FMIPA, Universitas Negeri Malang,
Malang, Indonesia

E-mail: purwanto.fmipa@um.ac.id

⁴ Department of Mathematics, FMIPA, Universitas Negeri Malang,
Malang, Indonesia

E-mail: ninikmutia@unipasby.ac.id

⁵ Department of Mathematics, FMIPA, Universitas Negeri Malang,
Malang, Indonesia

E-mail: subanji.fmipa@um.ac.id

⁶ Department of Mathematics, FMIPA, Universitas Negeri Malang,
Malang, Indonesia

E-mail: tyo@uinsby.ac.id

Abstract

Problem-solving is an integral part of the process of learning mathematics in schools that cannot be separated in daily life situations. One of the mathematical material that is found in a daily life situation is a discount. Shopping centers often give double discounts to their customers so the buyers are interested in shopping. A double discount is one of the materials taught in social arithmetic and is an interesting topic to be studied. But the study rarely discusses giving double discounts to high school students. So the purpose of this study is to describe the errors of high school students in solving the problem of double discounts. 122 high school students in the Surabaya, Sidoarjo and Gresik regions participated in the study to solve a double discount problem. Researchers collect student answers to be grouped and analyzed based on the errors they made. The results indicate there are four errors made by students in solving the double discount problem, that is (1) misinterpretation of the problem; (2) errors using discount principles; (3) operating errors, and (4) errors giving final answers. Teachers need to create a learning environment that habituates students to express their interpretations of problems to get appropriate solutions.

Keywords: interpretation, concept, operation, final answers.

1. Introduction

The purpose of learning mathematics in schools is to prepare students to face the development of a rapidly growing industry. For this reason, students need to master science and

technology so they can be used as provisions for their lives. This is where mathematics learning has a role to equip students with mathematical concepts. The hope is that students can think critically, collaborate [1] and master critical thinking skills.

Problem-solving is an integral part of the process of learning mathematics in schools that cannot be separated [2]. Through problem-solving, the teacher teaches students to have their way of thinking, persevering, fostering curiosity, self-confidence, and having experience in new situations [3][4]. In general, new situations come from certain contexts in daily life.

If students are faced with a new situation that they do not yet know, often these students make mistakes. As a result, the final solution expected from the problem maker cannot be fulfilled. One problem that is familiar in daily life situations is the giving of double discounts at the mall.

A study about error analysis has been widely carried out by researchers, for example [5], [6], [7], [8] and many others. Each researcher has a different focus on error analysis in their study. Research focuses on errors in solving fraction problems such as [5], [8], [9], [10], [11], [12], [13], etc. The study focuses on errors in solving algebraic problems such as [6], [14], [15], while the study focuses on solving arithmetic problems such as [7].

In addition to focusing on the material, an error analysis on problem posing is discussed by [8], [16], [17], [18]. While the error analysis based on the semantic structure was carried out by [9] and [17]. From some of the studies above, there has been no study on error analysis on the issue of double discounts.

Based on the various types of study above, shows the importance of research to analyze the errors made by students in solving problems about double discounts. To analyze the mistakes made based on the steps of students in solving the discount problem. The results of this study can be used as a reference to teach about double discounts as enrichment material.

2. Methods

This study design is qualitative research with a descriptive approach. 121 high school students in the ten and eleventh class in Surabaya, Sidoarjo, Gresik participated in this study. Participants consisted of 26 male students and 96 female students from public and private schools.

Students are given a problem with double discounts in the form of problem descriptions. The problem used was adapted from [19] that is

"A pair of shoes on Sogo and Matahari have the same price. To greet the new year, Sogo gave a 50% discount then 30% while the Matahari gave a 70% discount. If you want to buy these shoes, which store offers the lowest price? Explain your answer!"

Before being used, the problem was consulted with high school mathematics teachers to get input. In solving problems, each student is given 20-30 minutes to solve the problem.

The results of students' answers are then analyzed through four stages, that is (1) grouping students' answers based on right and wrong answers. Students are said to give correct answers if they give correct answers and the evidence

provided is also correct. Meanwhile, students are said to give incorrect answers if the answers given are wrong and the evidence provided is also incorrect. (2) Based on incorrect answers, researchers identify based on the categories of mistakes made by students. One answer given by students does not rule out the possibility of making more than one mistake. (3) Present the data from the analysis and (4) conclude.

3. Results and Discussion

Based on the student answers are then grouped and analyzed based on mistakes made by students. In the first stage, the grouping is based on the correct answers and wrong answers. The results of grouping in the first stage are presented in the following table.

Table 1. Classifying Student Answers

Category	Amount	Percentage
Right Answers	51	41,8%
Wrong Answers	71	58,2%

On table I above shows that 51 students (41.8%) gave correct answers and 71 students (58.2%) gave incorrect answers. Based on the results obtained in the first stage, 71 students made mistakes, then the researchers grouped them based on the categories of mistakes made by students.

In this stage, the results of grouping based on the category of mistakes made by students are presented in the following table.

Table 2. Students Errors

Error	Percentage
Interpretation of the problem	85,9%
Use of principles	69,0%
Operation	77,5%
Final answer	84,6%

Based on table 2 above, the most errors made by students were interpreting the problem at 85.9%. After that, students' errors in operating by 77.5%; errors using the principle of 69.0%; errors using the concept of a double discount of 59.2%, and errors giving a final answer of 89.6%. On the problem presented, students are required to interpret the meaning of the problem with giving discounts. As many as 85.9% of students make mistakes in interpreting the meaning of the problem. The student can understand the meaning of giving a single discount but is wrong in understanding the meaning of giving a double discount.

Based on the results of student work, there are two meanings of giving a double discount. The first as a sum of the two discounts given and second as a form of reducing the discounts given. One of the results of student work that gives the meaning of a double discount as a sum operation is presented as follows.

Jika dilihat dari diskon yang diberikan ketika membeli sepatu di tempat diskon yang diberikan adalah 90% + 30% jika belinya di sogo ~~adalah~~ jadinya 80% sedangkan jika beli di matahari akan mendapatkan diskon 70%

Translate

If seen from the discount given when buying shoes at the discount given place is 50% + 30% if the purchase is up to 80%, while if you buy it in the sun you will get a 70% discount.

Figure 1 Students' interpretation giving the meaning of double discount as the sum of discounts

While the results of student work that give meaning to a double discount as a reduction operation are presented as follows.

Sogo memberikan diskon 50% kemudian diskon tersebut diubah menjadi diskon 30%, sedangkan matahari memberi diskon 70%

Translate

Sogo gives a 50% discount then the discount is changed to 30%, while in the Matahari gives a 70% discount

Figure 2 Students' interpretation giving the meaning of double discount as a reduction of discounts

From the wrong student interpretation, shows that the student is not able to give meaning to the problem presented. As a result, these students make errors in interpreting the problem. Relevance with the previous study which states that the existence of incorrect language interpretations becomes a barrier in the process of problem-solving [5], [20], [21], [22]. Language interpretation that is not in relevance with mathematical concepts results in the use of incorrect mathematical concepts [5], [22]. Different interpretations are influenced by the conceptual knowledge students have regarding social arithmetic. Students who have good conceptual knowledge interpreted the problems according to appropriate mathematical concepts.

In the learning problem-solving process, students should be wanted to writing down their understanding of the problem presented. If students are wanted to writing their understanding, of course they will also practice their communication skills [23]. This is because reading and understanding problems are one of the important processes in problem-solving [24], [25].

The second error made by students is a error in operating which is 77.5% and the third error is error using a principle which is 69%. Most of these students are not careful in carrying out a counting operation which results in errors in giving results from the operation. Examples of the results of the work of students who made mistakes in carrying out the calculation operation and using principles are as follows.

$$\text{Sogo} \rightarrow 150.000 - \frac{50}{100} = 135.000 \rightarrow \text{diskon } 50\%$$

$$135.000 - \frac{30}{100} = 40500$$

Figure 3 Students' error in operating calculation and use of principles

From Figure 3 above, it shows that students also made a error in principle, which is using the rules for giving discounts, both for single discounts and double discounts. Here it appears that students understand that the initial price is reduced as the price that must be paid when buying shoes. The student did not explain that 50% was the first discount on the initial price of shoes but instead explained directly as a result of the operation of two numbers that produced 135,000. Errors are also made when calculating a single discount.

These errors are also made by students in giving the meaning of the results of the multiplication between the initial price and the discount, understanding the multiplication process with two numbers, and not providing proof of calculation. The errors made by these students relevance with previous research conducted by [7] and [15] which is a calculation error.

Another principle error is that students explain that the initial price of a shoe for multiplication with a discount given is the price to be paid. And another error is error counting calculation The results of student work can be seen in the

Jika harga sepatu yang ditawarkan adalah 100.000

Sogo	:	100.000 x 80%	=	80.000
Matahari	:	100.000 x 70%	=	70.000

Translate

If the price of shoes offered is 100,000
 Sogo : 100,000 x 80% = 80,000
 Matahari : 100,000 x 70% = 70,000

Figure 4 Students' error in operating calculation and use of principles

Principal errors in determining the price to be paid cause students to make errors in the final answer. The existence of this principle error is relevance with the research of [7] where the research subjects also made an error in principle.

As a result of these errors, students also make errors in providing the final solution to the problem that is equal to 84.6%. This is in relevance with research [7] in which the subject also made an error in providing the final solution of the problem.

The results of this study, shows that interpretation is one of the important components in the problem-solving process. This is because determining and interpreting keywords is a capital to start solving problems. For this reason, further research needs to be done on the process of student

interpretation when solving problems to determine the final solution of a given problem. The limitation of this study is the researchers do not discover deeper into the factors that cause students to make errors. Besides, researchers did not explore the background knowledge of students who are disposed to take this study. It is necessary to do the further study that pays attention to the background of students' knowledge, the factors causing it so that it can produce alternative solutions to overcome the errors students have made. In this case, it cannot be separated from the role of the teacher in the learning process, namely designing learning that requires students to think critically about a problem. Its implementation can be through project-based learning so that it can train students to think critically [1].

4. Conclusion

From the results and discussion above, it can be concluded that the four groups of errors made by students in solving the discount problem are errors in interpreting the problem. Misinterpretation of the problem results in students making a concept error of giving a double discount. The second error is an error using the principle of one of them determining the price to be paid as a multiplication of the initial price of shoes with a discount given. The third error is an error in operating calculation. Students who make errors determine the results of a counting operation. The fourth error is the error in giving the final answer. This error is an error made by students as a result of the first to third error. The limitation in this study is that researchers do not conduct in-depth interviews with subjects who make errors. For this reason, further study can be done to find out the causes and reasons for students to make errors. Besides, teachers need to create an atmosphere of learning that accustoms students to express their interpretation of the problem to determine the appropriate strategy in the problem-solving process, especially about double discount.

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