



WHAT ARE THE DIFFICULTIES IN LEARNING PERCENTAGES? AN OVERVIEW OF PROSPECTIVE MATHEMATICS TEACHERS' STRATEGIES IN SOLVING PERCENTAGE PROBLEMS

Herani Tri Lestiana

Department of Mathematics Education, Institut Agama Islam Negeri Syekh Nurjati Cirebon, Indonesia

Corresponding author: herani@syekhnurjati.ac.id

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ABSTRACT

Many studies showed that teachers and prospective teachers have difficulty solving percentage problems. This research is a qualitative descriptive study that aims to investigate the prospective teachers' strategies in solving problems on the topic of percentages. A total of 250 students majoring in Mathematics Education and Primary Education at IAIN Syekh Nurjati and IAIN Pekalongan were purposively selected to participate in this study. The results showed that only less than half of the participants (40.1%) could give the correct answer. Qualitative data on the strategies used by prospective teachers on the percent question show that (1) teacher candidates ignore the importance of the % symbol and consider the % symbol only as a unit of measurement, (2) teacher candidates ignore the essential role of the reference quantity in the percent question, (3) teacher candidates are not used to solving percent problems related to determining initial values before discounts and assume that any percent problem can be solved using multiplication or division.

APA KESULITAN DALAM MEMPELAJARI MATERI PERSENTASE? SEBUAH GAMBARAN STRATEGI CALON GURU MATEMATIKA DALAM MENYELESAIKAN SOAL PERSENTASE

Kata Kunci:

Persen
Simbol persen
Calon guru
Kuantitas acuan

ABSTRAK

Banyak penelitian menyebutkan bahwa guru dan calon guru mengalami kesulitan dalam menyelesaikan soal persentase. Penelitian ini merupakan penelitian deskriptif kualitatif yang bertujuan untuk mengetahui strategi yang digunakan calon guru dalam menyelesaikan permasalahan pada topik persentase. Sebanyak 250 mahasiswa jurusan Tadris Matematika dan PGMI di IAIN Syekh Nurjati dan IAIN Pekalongan dipilih secara purposif untuk berpartisipasi dalam penelitian ini. Hasil penelitian menunjukkan bahwa hanya sebanyak kurang dari setengah peserta (40.1%) yang bisa memberikan jawaban benar. Data kualitatif strategi yang digunakan calon guru pada soal persen menunjukkan bahwa (1) para calon guru mengabaikan arti penting simbol % dan menganggap simbol % hanya sebagai satuan pengukuran, (2) para calon guru mengabaikan peran esensial dari kuantitas acuan dalam soal persen, (3) para calon guru tidak terbiasa menyelesaikan soal persen terkait menentukan nilai mula-mula sebelum diskon, dan

menganggap bahwa soal persen apa pun bisa diselesaikan dengan menggunakan perkalian atau pembagian.

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1. INTRODUCTION

Percentage topic plays a significant role in the school curriculum, in daily life application, and even in other subjects [1]. As percentages are prevalently found in newspapers, television, and other media, grasping the idea of percentages is required to be able to interpret its representations in social and science studies, in economic issues, and in other daily life contexts. However, facts revealed by several studies about percentages show either children (students) or adults (including teachers and prospective teachers) face difficulty in understanding principal insight of percentages and in applying the concept of percentages flexibly in solving problems [2]–[8]. Those studies explained that the issue related to difficulties in percentages does not only develop in elementary students, but also in secondary students, prospective teachers, and teachers.

Percentages are commonly used to represent a relationship or comparison. Percentages depict the part-whole relationship between a certain quantity out of a hundred as a whole. Percentages also describe a ratio comparison between two different quantities [3], [9]. The understanding of percentages includes the knowledge of expressions for percent, magnitude of percent, and operation involving percent. In Indonesia, the concept of percentages is first introduced in the fourth-grade elementary school. In this grade, the meaning of percentages and the relation among fractions, decimals, and percentages are presented. In the next grade, students learn some operations of percentages, including addition, subtraction, multiplication, and division, and some application of percentages in mathematical problems.

Many studies have revealed that many schools put more emphasis on procedural algorithm than on conceptual understanding [1], [10]–[12]. Students do a lot more of making notes and memorizing activities than constructing a deep understanding of percentages. As a result, students find it difficult to solve non-routine percentages problems [13], [14]. The ability to perform algorithmic method of percentages does not ensure the profound understanding of the percentages knowledge. Moreover, the reliance on formal procedures can restrict students' flexible thinking in solving problems [3], [12]. Consequently, many students make mistakes in solving problems related to the facility of percentages, and count rigidly on the rules and algorithmic method in solving percentages problems [3], [7].

Studies related to percentages are not as wide-ranging as studies about fractions and decimals [15], [16]. This is quite surprising considering the significant existence of percentages in daily life contexts. The study of Yapici and Altay [17] which investigated middle school students' notion about percentages revealed that the students had a low percentage sense. They tended to apply rule-based strategies and showed weak flexibility in solving percentages problems. In addition, Koay [3] and Ngu [5] who conducted studies to examine pre-service teachers' knowledge of fractions also indicated a poor response of pre-service teachers to percentages problems. Even though they were adults, they committed many errors in solving percentages problems.

Teachers' knowledge of percentages will affect how they deliver the concept of percentages to their students. However, no studies in Indonesia examines teachers or pre-service teachers' notions of percentages. Researchers might assume that teachers and prospective teachers have learned advanced mathematics and definitely comprehend percentages concept. Thus, there is a need to investigate teachers' notion about percentages

in order to manage helpful support to them. This study aimed at investigating prospective teachers' insight about percentages through a set of problems. Compared to previous studies, most of the problems used in this study were contextual problems in order to figure out pre-service teachers' understanding and sense of the problems.

2. METHOD

This study was a descriptive qualitative study which intended to investigate prospective teachers' performance in percentages problems. According to Hancock, Ockleford, and Windridge [18], qualitative study aimed to explore and interpret data that can lead to the emergence of new theories. Dawson as cited by Putra [19] mentioned that qualitative research attempted to obtain a thorough explanation of participants' attitudes, behavior, experiences, and patterns. Purposive sampling was used in this study as purposive sampling is often associated to qualitative studies. Purposive sampling was employed to pick participants that presumably provide suitable and useful information in order to obtain an in-depth description of data [20]. A total of 250 college students in mathematics education and primary education department in IAIN Syekh Nurjati and IAIN Pekalongan participated in this study. The sample was selected purposively as the prospective teachers are projected to teach mathematics either in elementary or secondary schools. Thus, their understanding related to percentages should be confirmed.

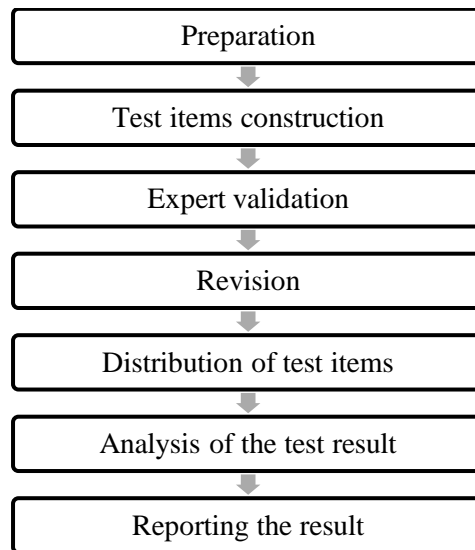


Figure 1. Scheme of this Study

This study began with the preparation stage, in which many resources related to percentages were explored to get some ideas about the test items and the data analysis. After obtaining enough references, the construction of test items began. There were five multiple choice items in the test. The test items were adapted from previous studies and developed based on the data of students' difficulties in several studies related to percentages. Before administrated to the participants, the draft of the test items was checked by several mathematics education experts regarding its content and language. Aiken's validation formula was proposed by Aiken [21] and was used to find content validity coefficient based on expert judgments toward. The formula of Aiken's validation was described below.

$$V = \sum \frac{s}{n(c-1)} \text{ in which } S = r - Lo \tag{1}$$

- V : Aiken’s validation
- Lo : the lowest rating score
- C : the highest rating score
- R : the score given by experts

The result of Aiken’s validation of the test items can be seen in table 1. The Aikens’ validation result showed that all items were acceptable. Based on notes and advices from the validators, the test items were revised. After the revision, the test items were ready to be assigned to the participants.

Table 1. Aiken’s Validation Result

Validator	Score				
	Problem 1	Problem 2	Problem 3	Problem 4	Problem 5
1	4	4	4	4	4
2	4	4	4	4	4
3	4	3	4	3	3
4	4	3	3	3	3
Aiken’s Validation	1	0.83	0.92	0.83	0.83

The data analysis began with sorting and organizing to obtain the number of correct and incorrect answers, and the number of participants who chose each option. Thereafter, participants’ strategies in each option were categorized and compared to figure out what each participant’s strategy has in common or the dissimilarity between them. The data of participants’ strategies in each test item were interpreted and correlated to several theories and previous studies.

3. RESULTS AND DISCUSSION

A total of 250 prospective teachers solved five questions related to percentages. The summary of the result showed surprising fact that the average of correct answers was less than 50%. Merely question number 3 solved correctly by slightly more than a half of the participants. Moreover, even though the direction written in the question sheet asked the participants to write down their strategies, several participants did not recorded the approaches they applied. The table 2 showed the summary of the number of correct answers, incorrect answers, and blank answers in each question.

Table 2. Recapitulation of Correct, Incorrect, and Blank Answers

Problems	Correct	Incorrect	Blank
1	36.4%	57.6%	6%
2	32.8%	62%	5.2%
3	51.6%	42%	6.4%
4	45.6%	48.4%	6%
5	34.1%	41.3%	7.2%
Average	40.1%	50.26%	6.16%

The description below illustrates the summary of the participants’ option and their approaches in solving each problem.

3.1 Problem 1

The first problem was about multiplication of two percentages. Even though this problem was regarded as a basic problem, surprisingly 58.6% of participants picked incorrect choices and 6% of participants left this question blank. The description below depicts several examples of participants’ approaches in each option.

Table 3. Summary of Participants' Answers in Each Option in Problem 1

Problem	Option A	Option B	Option C	Blank
Which one is the result of 5% x 5%? A. 25% B. 0.25 C. 0.25%	41.2%	16.4%	36.4%	6%

Option A

$$5\% \times 5\% = 25\%$$

(a)

$$\frac{5}{100} \times \frac{5}{100} = \frac{25}{100} \quad (25\%)$$

(b)

Figure 2. (a) dan (b) Sample of Participants' Approaches in Problem 1 Option A

Option A was built on an assumption that participants might multiply merely the 5 and ignore the significance of the % symbol. In the test, some participants did as the conjecture. In total of 41.2% participants argued that 5% x 5% equals to 25% as can be seen in Figure 2(a). They seemed ignore the meaning of % sign and merely computed 5 x 5. They might assume % sign as a measurement unit (just like km, kg, feet, etc.) thus they directly put the sign after multiplying 5 and 5.

In line with the findings of Parker and Leindhart [7], students inclined to disregard the % symbol as if it was not significant. The participants abandoned the % sign when computing, and then reinserted it in the result. The study of Parker and Leindhart [7], and Jacobs Danan and Gelman [15] also showed that prospective teachers had the same concern related to percentages symbol

Several participants multiplied the fraction form (Figure 2(b)) yet they merely multiplied the numerator because they overgeneralized the addition rule in fractions. They thought that if the multipliers have the same denominators then there is no need to multiply the denominator. Thus, they still came to 25% as the answer.

Option B

$$\frac{5}{100} \times \frac{5}{100} = \frac{25}{100} = 0,25$$

Figure 3. Sample of Participants' Approaches in Problem 1 Option B

In the test, some participants converted the percentage into a fraction form and then multiplied them. However, they merely multiplied the numerator because they thought that if the multipliers have the same denominators then there is no need to multiply the denominator (as in the addition of fractions). Thus, they obtained 0.25 as the answer. There were also participants who answer $0.05 \times 0.05 = 0.25$. It might because they assumed that if the multipliers contained two decimal digits so the result would be in two decimal digits as well.

Option C

$$5\% = 5 \cdot \frac{1}{100} = 0,05$$

$$5\% \times 5\% = 0,05 \cdot 0,05 = 0,0025$$

(a)

$$\frac{5}{100} \times \frac{5}{100} = \frac{25}{10000}$$

(b)

Figure 4. (a) dan (b) Sample of Participants' Approaches in Problem 1 Option C

Participants who picked the correct answer solved the problem by converting 5% into a decimal (Figure 4(a)) or a fraction (Figure 4(b)) and did the computation correctly.

The result in fractions and decimals form that they obtained were correct, and they succeeded in converting those results into the percentages form.

3.2 Problem 2

Besides representing discount, percentages also often appears to show the composition of several substances. In the substances-composition context, percentages do not represent a particular change yet it portrays a fixed situation as in problem 2. Problem 2 was adapted from the study of Koay [3] and Van Den Heuvel-Panhuizen [10]. This context was intended to assess if the participants notice that the ratio of substance contained in the water does not change even when the volume of the mixture changes.

Table 4. Summary of Participants' Answers in Each Option in Problem 2

Problem	Option A	Option B	Option C	Blank
A litre of juice A contains 80% of pure fruit juice, while two litres of juice B contains 85% of pure fruit juice. Which juice contains the greater proportion of pure fruit juice? a. Juice A b. Juice B c. Both juice have the same proportion of pure fruit juice	56.8%	32.8%	5.2%	5.2%

This problem essentially did not ask the participants to do numerical computation. However, most of the participants applied numerical computation to solve the problem. Problem 2 was the most incorrectly answered question, with 62% of incorrect answers. Some participants selected the correct answer, yet they employed the wrong reasoning. Some cases of participants' strategies in each option are described below.

Option A

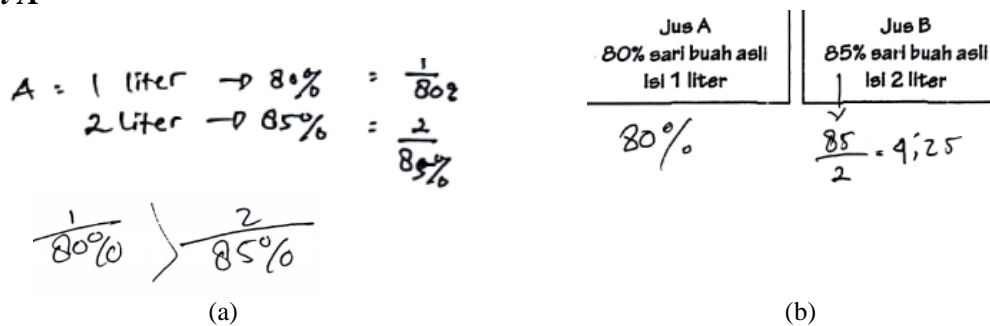


Figure 5. (a) dan (b) Sample of Participants' Approaches in Problem 2 Option A

A total of 56.8% of participants argued that juice A has greater proportion of pure fruit juice than that of juice B. Two kinds of strategies appeared in this problem. First, several participants formulated the ratio of the volume and the percentage of pure fruit juice. Then, they compare $\frac{1}{80\%}$ to $\frac{2}{85\%}$. They assumed an incorrect reasoning that $\frac{1}{80\%} > \frac{2}{85\%}$. In this case, they might disregarded the percentages symbol and considered the 80% and 85% as 80 and 85 respectively. Then, they might think that the smaller the denominator, the greater the value of the fraction, without considering the nominator.

Second, some participants argued that if the volume of juice B is equal to juice A, which is 1 liter, then the proportion of pure fruit juice in juice B would be half of the 85%, namely 42,5%. Thus, they assumed that juice A had a higher proportion of pure fruit juice.

There were also participants who applied the same analogy, by making the volume of juice A equal to juice B. They assumed that with the same 2 liters volume of juice A and juice B, the proportion of pure fruit juice of juice A was 160%.

Option B

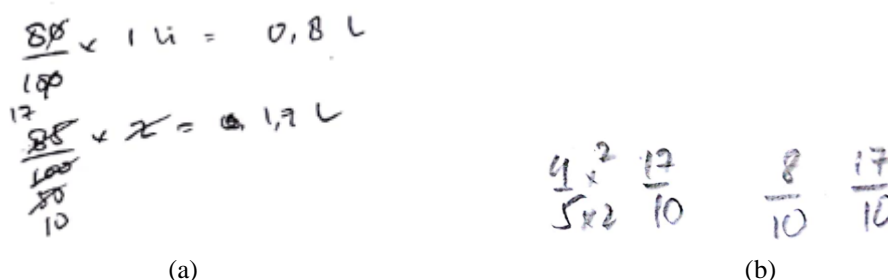


Figure 6. (a) dan (b) Sample of Participants' Approaches in Problem 2 Option B

In total of 32.8% of participants chose B as their answer with various reasons. The first reasoning was because 85% pure fruit juice in 2 liters juice B equals to 1.7 litre of pure fruit juice, while 80% pure fruit juice of a liter juice A equals to 0.8 liter. Thus, juice B has more portion of pure fruit juice that juice A. This strategy confirmed the study of Koay [3], in which the prospective teachers multiplied the percentage of real fruit juice by the volume to figure out which one contains more real fruit juice. In addition, several participants straightforwardly assumed that juice B contained bigger proportion of pure fruit juice as juice B had more volume than juice A. They might use the same reasoning as Figure 6(a).

In the second reasoning, the participants multiplied the percentage of pure fruit juice by the volume. They came to a result stated that the proportion of juice A was 80% or $\frac{8}{10}$, and the proportion of juice B was 170% or $\frac{17}{10}$. Based on this result, the participants argued that juice B had a greater proportion of pure fruit juice.

Several reasoning that emerged were similar to the study of Van Den Heuvel-Panhuizen [10], especially in option B. The participants acquainted to multiply the percentages and the quantity given without considering the sense of the context. The problem asked which juice has a higher proportion of pure fruit juice, not which juice has a greater volume of pure fruit juice. However, most of the participants did not compare the proportion of the pure fruit juice, yet compared the volume of the pure fruit juice contained in the juice.

Option C

No sample answers. Those who chose option C did not give any explanations to their answer. It might be because they were unsure which option is correct or they might assume that option A and B are incorrect thus they picked C as the last option.

3.3 Problem 3

This problem contained the idea of the addition of percentages. It examined whether the participants can perform addition of two percentages of different referent quantities. Approximately half of the participants picked the correct option. The other half of the participants either answered incorrectly or left this number blank.

Table 5. Summary of Participants' Answers in Each Option in Problem 3

Problem	Option A	Option B	Option C	Blank
Ani bought a blouse for 100,000 with a 20% discount, and a pair of shoes for 200,000 with a 20% discount. How much total discount did Ani get? a. 40% x 300.000 b. 10% x 300.000 c. 20% x 300.000	36.4%	5.6%	51.6%	6.4%

The illustration below showed some participants' methods in solving this problem.

Option A

(a)

(b)

Figure 7. (a) dan (b) Sample of Participants' Approaches in Problem 3 Option A

There were two kinds of participants' strategy appeared for option A. Most of the participants who opted A applied the strategy "add the price, add the discount". They assumed that if the price of two items were added then the discount should be added as well. They added 100,000 to 200,000, and added 20% to 20%. Thus, the total discount was 40% x 300,000.

In the second type, the participant tried to find the price after the discount, yet he/she miscalculated 20% x 200,000. He/she obtained 180,000 since he/she might be affected by the calculation of 20% x 100,000 = 20,000. Afterward, he/she subtracted the total of normal price (300,000) by the total price after the discount. He/she found out that the result was 40,000. However, he/she did another mistake by converted the discount price (40,000) directly into 40% without trying to find the percentage by performing any procedures, such as $\frac{40000}{260000} \times 100\%$.

Option B

Figure 8. Sample of Participants' Approaches in Problem 3 Option B

Option B was created based on an assumption that the total discount must be smaller as it will be multiplied by the total price. In this sample answer, the participant attempted to find the discount of each item, yet he/she miscalculated it. He/she got 4,000 as the discount and thus the total price after the discount was 196,000. He/she might reason that option B is the nearest to his/her answer.

Option C

$$\begin{array}{l}
 \text{Pisip} \left\{ \begin{array}{l}
 100.000 \times 20\% \rightarrow 20.000 = 20 \\
 200.000 \times 20\% \rightarrow 40.000 = 40 \\
 300.000 - 60.000 = 240.000 \\
 240.000 = 300.000 - (20\% \times 300.000)
 \end{array} \right.
 \end{array}$$

(a)

$$\begin{array}{l}
 (100.000 \times \frac{20}{100}) + (200.000 \times \frac{20}{100}) \\
 \frac{20}{100} (100.000 + 200.000) \\
 \frac{20}{100} (300.000)
 \end{array}$$

(b)

Figure 9. (a) dan (b) Sample of Participants' Approaches in Problem 3 Option C

Participants who took option C as the answer successfully figured out how to add two percentages of something. There were two strategies emerged in this problems. In the first strategy, the participants attempted to find the discount of each item, add them, and find the suitable total percentage (Figure 9(a)). Another strategy as by utilizing distributive property as shown in Figure 9(b).

3.4 Problem 4

The context of problem 4 can be found easily in the supermarket or shopping center. Thus, it was expected that the participants come to their common sense in responding the problem. However, nearly half of the participants took incorrect options. The types of participants' answer in each option were described below.

Table 6. Summary of Participants' Answers in Each Option in Problem 4

Problem	Option A	Option B	Option C	Blank
Ani gets a 50% + 20% discount for the clothes she bought, while Feni get 70% discount in a different store for the same clothes with the same price. Who gets the greater discount? a. Ani b. Feni c. Ani and Feni got the same discount	13.6%	45.6%	34.8%%	6%

Option A

$$\begin{array}{l}
 \text{Ani } 50\% \times a + 20\% (50\% \times a) \\
 \text{Feni } 70\% \times a = \frac{7a}{100} \\
 \frac{5a}{100} + \frac{2}{100} \times \frac{5a}{100} = \frac{5a}{100} + \frac{10a}{1000} = \frac{50a + 10a}{1000} \\
 = \frac{60a}{1000} = \frac{6a}{100}
 \end{array}$$

Figure 10. Sample of Participants' Approaches in Problem 4 Option A

Most of the participants who picked option A did not record their approaches in solving the problem. Merely one strategy appeared in option A. In this strategy, the participant tried to solve the problem algebraically. Unfortunately, he/she committed some mistakes in the process. For instance, he/she wrote 20% as $\frac{2}{100}$ and $(50\% \times a)$ as $\frac{a5}{100}$. In operating $\frac{2}{100} \times \frac{a5}{100} = \frac{10a}{200}$, he/she also made a mistake in which he/she multiplied the numerators yet added the denominators. Because of those errors, the participant concluded that Ani obtains greater discount than Feni as the discount that Ani and Feni got was $\frac{10a}{100}$ and $\frac{7a}{100}$ respectively.

Option B

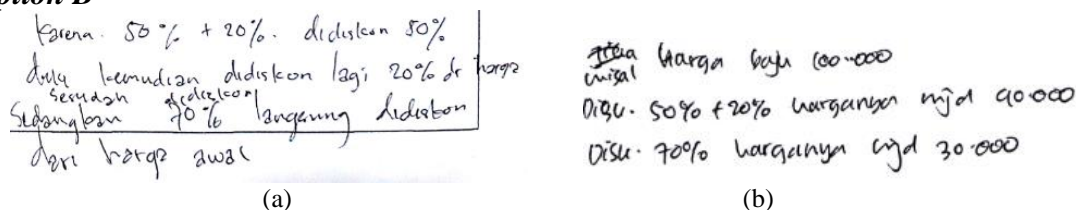


Figure 11. (a) dan (b) Sample of Participants' Approaches in Problem 4 Option B

In option B, the participants were aware of the idea behind the context of (50% + 20%). They understood that (50% + 20%) implies 50% of the initial price plus 20% of the reduced price (Figure 11(a)). Moreover, some participants took an example of the clothes price, such as 100,000 (Figure 11(b)).

Option C

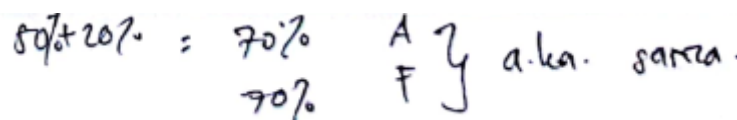


Figure 12. Sample of Participants' Approaches in Problem 4 Option C

Most of the participants who chose answer C assumed that the discount of (50% + 20%) is equal to 70%. This occurred because they interpreted (50% + 20%) of something (let say a) as $(50\%.a) + (20\%.a)$. They disregarded the context meaning of (50% + 20%) discount. In daily life context, (50% + 20%) discount represented $(50\%.a) + (20\%.(50\%.a))$.

3.5 Problem 5

Problem 5 was included as based on the study of Ngu, et al. [6], students faced difficulty in finding a quantity if the percentages of that quantity is provided. Moreover, the study of Lestiana and Wanita [23], and Van Galen and Van Eerde [24] showed that the students participated in their study struggled to find the normal price when the discount and the price after the discount was given. Unexpectedly, the prospective teachers involved in this study shared the same mistakes in this problem as students reported in Lestiana and Wanita [23], Ngu et al. [6], and Erdem, Özcelik, and Gurbuz [25]. This result also confirmed the study of Koay [3], Ngu [5], and Rianasari, Budayasa, and Patahuddin [12] that pre-service teachers need a great effort to solve find-whole-percentages problems. Even though several studies such as Baratta et al. [26], Koay [3], Rahayu and Putri [26] showed that unitary approach can be helpful to solve such problem, it can be seen from the result that no participants apply unitary approach to solve this problem. The description below presents sorts of participants' answer in each option.

Table 7. Summary of Participants' Answers in Each Option in Problem 5

Problem	Option A	Option B	Option C	Blank
A shop gives a 15% discount on the purchase of a shirt. The price of the clothes after the discount is Rp. 170,000. How much did the shirt cost before the discount?	34.1%	48.6%	10.1%	7.2%
a. 200,000				
b. 195,500				
c. 185,000				

Option A

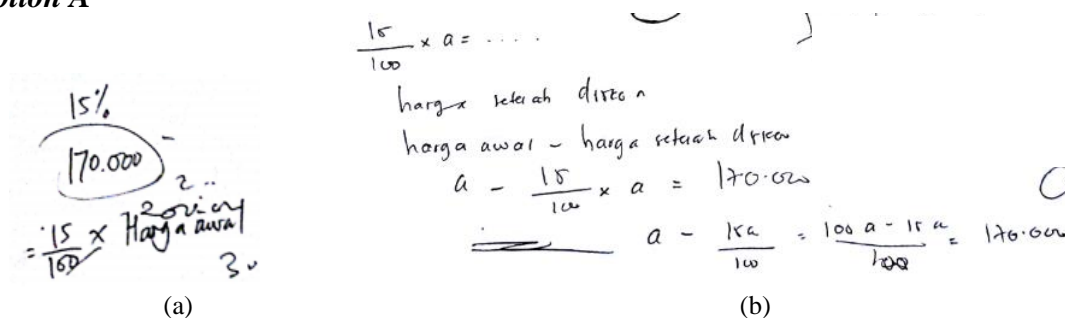


Figure 13. (a) dan (b) Sample of Participants' Approaches in Problem 5 Option A

Some participants used trial and error by looking for an appropriate value that was more than 170,000. For example, they tried the values of 180,000, 190,000, 200,000, and then multiplied those values by 15%. If the sum of the multiplication results and 170,000 was the same as the value being tested, then that value was the answer. Moreover, several participants as shown in Figure 13(b) tried to use equation approach, in which the participants tried to translate the problem into algebraic form by taking a letter to represent the unknown.

Option B

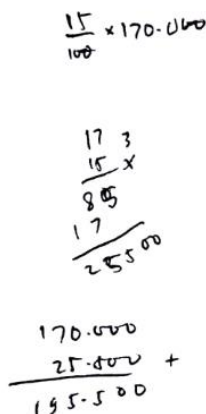


Figure 14. Sample of Participants' Approaches in Problem 5 Option B

The participants worked on the problem by multiplying the 15% discount by 170,000, then adding up the multiplication result to 170,000. This method is the same as the method used to find the amount of the discount if the discount percentage and the initial price are given. This strategy is the same as the strategy applied by the Australian students in the study of Ngu et al. [6]. The participants might get accustomed to confront percentages problems where the percentages and the normal quantity are given. Thus, in solving this problem, they oversimplified the strategy and applied the same reasoning as finding the discount price. In addition, according to Bell, Swan, and Taylor as cited in Baratta et al. [26] this error might be the effect of misconception “multiplication makes bigger, division makes smaller”. The participants might assume that multiplying the discount and the price after the discount can result the normal price which was higher than the price after the discount.

Option C

$$\begin{aligned}
 & 15\% \\
 & 170.000 \\
 & \frac{170.000}{\frac{15}{100}} = \frac{170.000}{100} \times \frac{100}{15} = \frac{170.00000}{15} = 11
 \end{aligned}$$

Figure 15. Sample of Participants' Approaches in Problem 5 Option C

Option C was built on these assumptions the participants might divide the given price by the percentages and then add the result to 170.000. In the written test result, there were several participants who solve the problem by using the conjectured approach. They might be aware that they cannot apply multiplication to solve the problem as the information given was not the initial price. Thus, the possible operation they apply is division.

4. CONCLUSION

This study aimed at investigating prospective teachers' approaches in solving percentages problems. A total of five percentages problems were provided to the participants which four of them were presented in context. As percentages appear frequently in daily life, it is expected that the prospective teachers have profound ability in solving percentages problems. However, the result exposed that the average of correct answers was less than 50%. In solving percentages problems, the participants applied various approaches of comparison, fractions, decimals, algebraic equation, and trial and error. Most of them showed preference of using algorithmic methods.

The result of this study showed that participants preferred to apply formal algorithm to solve the problems, such as equation approach and long division. As mentioned earlier that this might be the result of conventional teaching that put more emphasize on rules and algorithm than conceptual understanding. Moreover, as another effect of this teaching method was several participants overgeneralize the rules applied in whole numbers, fractions, and percentages routine problems. They seemed to show no senses of when and how to apply appropriate algorithm in appropriate problems.

Based on the result, many prospective teachers considered the % symbol as just a measurement unit (such as m, kg, feet, etc.). Moreover, the participant did not review the reasonableness of their answer by connecting it to their everyday experiences, such as in problem 2. In other words, they might know how to compute but do not know when it makes sense to do computation. Problem 3 and 4 also revealed that the prospective teachers were unable to recognize the referent quantities or the multiplicative relationship among the quantities given in the problem. They ignored the essential role of referent quantities in percentages problems. In addition, prospective performance on problem 5 indicated that they did not get accustomed to solve find-whole percentages problems. They assumed they can apply either multiplication or division to solve percentages problems without considering the sense of the context.

Even though pre-service teachers study advanced level of mathematics in the college, it cannot be a guarantee that their facility with percentages increase. Hopefully, the result of this study can be followed by a step to support prospective teachers' comprehension of basic mathematics concept such as percentages. Their understanding of percentages will

offer positive effect on how they deliver the concept to future generations. The use of learning tools can be helpful for teachers to deliver percentages concepts. Bar model, for example, can help foster individual's ability in solving percentages problems.

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