Received : 26 October 2018
Revised : 9 December 2018
Accepted : 31 December 2018
Published: 31 December 2018

DOI: doi.org/10.21009/1.04209

The Understanding of Pre-Service Physics Teachers on Electric Circuit Concept

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Abstract

The purpose of this research was to find out the descriptive of pre-service physics teachers understanding of the concept of electrical circuits, especially in the characteristic of series circuits and parallel circuits. The method used in this research was a descriptive method. The sample of this research was the fourth-grade students who took Basic Electronics course. The primary data of this research collected from the students' test consisted of 12 multiple choices. Data analysis concluded that the student's understanding of the concept of the electric circuit was low, with an average percentage of total indicators of 84.4%.

Keywords: pre-service physics teachers' understanding, electric circuit concept

INTRODUCTION

Teachers are professional educators who have a role to educate, teach, guide, train and evaluate their students by their competencies. The teacher is one factor in the success of education. The ability that must be possessed by professional teachers is master the material (understanding material concepts). With the ability to understand concepts, teachers can understand concepts, the relationship between related subjects, and apply scientific concepts in everyday life (Purwoko 2017). Besides, the teacher can obtain knowledge from the various information that is around him through observation (Kholidah & Sujadi 2018).

Therefore, the learning objectives can appropriately be realized, prospective teacher students, especially physics teachers, are required to master the material concepts that will be delivered to their students. These concepts and their relevance are expected to be able to be used by students in solving problems encountered in their daily lives (Pateda, Kendek, & Saehana 2015, 13-17).

Physics learning is a means to develop and train students to be able to master the knowledge, concepts, and principles of physics, and have scientific skills (Yolanda, Syuhendri, & Andriani 2016). One is the concept of electric circuits. This concept is a concept that will influence the following theories. In these concept students or prospective students tend to have difficulty understanding because the characteristics of this concept are abstract, which is difficult to be observed directly with the five senses (Falah 2018). The results of the research by Nugraeni (2013, 12-16) state that in the dynamic electrical matter, it found that 55% of students did not understand the concept of series current and 57% in the theory of parallel circuits and both on the current and voltage material (Iftitah research et al. 2017).

Based on this background, this study was conducted to determine the understanding of the concept of prospective physics students in electrical circuit material. The results of this study can become a foundation for educators in determine the learning strategies appropriately.

RESEARCH METHODOLOGY

This research uses a descriptive method. The subjects of this study were fifth-semester students who took basic electronic practicum courses for the 2017-2018 school year totaling 15 people. The research data was obtained using multiple-choice test questions accompanied by reasons. The questions given are 12 with six question indicators.

Data from student answers are then analyzed and classified into two criteria, namely understanding the concept and not understanding the concept. The criteria for students who do not understand the concept if:

a. The answer given is correct, but the reason is wrong;
b. The answer to the wrong, and the reason is right;
c. The wrong answers and reasons;
d. Not answer one or both.

After being analyzed and classified based on conceptual understanding criteria, the research data in the form of student answers then calculated the average percentage for each indicator and the overall percentage average and categorized according to TABLE 1.

TABLE 1. Level of understanding

Percentage	Category
$1 \leq 30\%$	Low
$30 \leq 60\%$	Middle
$60 \leq 100\%$	High

RESULTS AND DISCUSSION

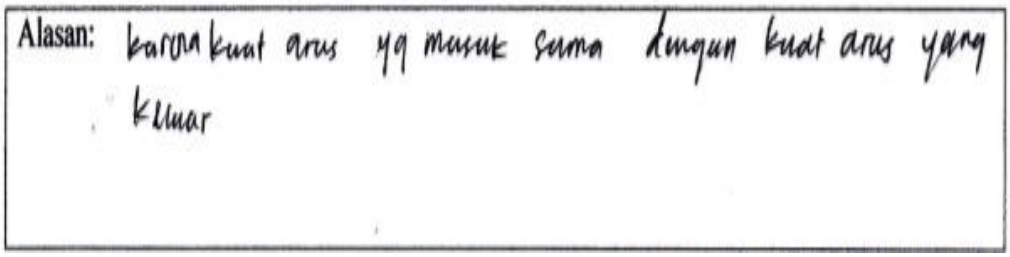
The results of the study obtained data on the category of student understanding for each indicator in detail can be seen in TABLE 2. The results of the study showed that six indicators of understanding the concepts provided by all students were in a low category.

TABLE 2. Concept understanding criteria

Indicator	Criteria		Percentage	Category
Indicator 1	Understand the concept		27	Low
	Not understand the concept	73		
Indicator 2	Understand the concept		7	Low
	Not understand the concept	93		
Indicator 3	Understand the concept		7	Low
	Not understand the concept	93		
Indicator 4	Understand the concept		3	Low
	Not understand the concept	97		
Indicator 5	Understand the concept		30	Low
	Not understand the concept	70		
Indicator 6	Understand the concept		20	Low
	Not understand the concept	80		
On average they don't understand the concept			84.4	Low

In TABLE 2, the percentage of not understanding the first highest concept of 97% lies in the fourth indicator of the concept of flow in parallel circuits. The concept of current flowing in parallel circuits is that the current will be divided into each branch because parallel circuits are current dividers. The amount of current flowing in parallel circuits is different depending on how much

resistance is given to each component that exists. It found that most of them did not answer and some students answered not following the questions, which can be seen in FIGURE 1a, that in a parallel circuit the inflows are the same as outflows, this concept is generally correct, but does not answer the questions given. As well as other answers are wrong in the operation of mathematics (FIGURE 1b).



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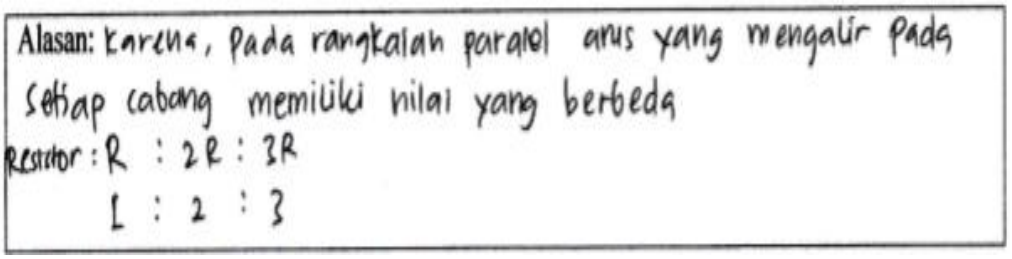
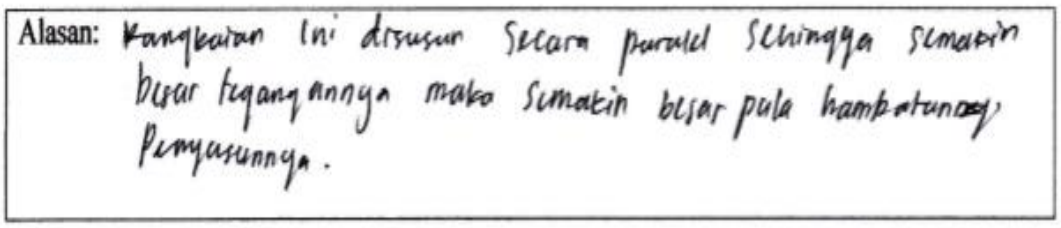


b)

FIGURE 1. The snapshot of the response for the fourth indicator.

The low understanding of the concept (not understanding the concept) is the second and third indicators of 93%. The second indicator is the concept of voltage in parallel circuits. In parallel circuits, the voltage across each branch is equal. The FIGURE 2.a, the student answers that the greater the voltage is given, the greater the resistance. In FIGURE 2b, the student answers that the stress on each obstacle is the same, but in mathematical operation add up the existing voltage. This is not following the concept.



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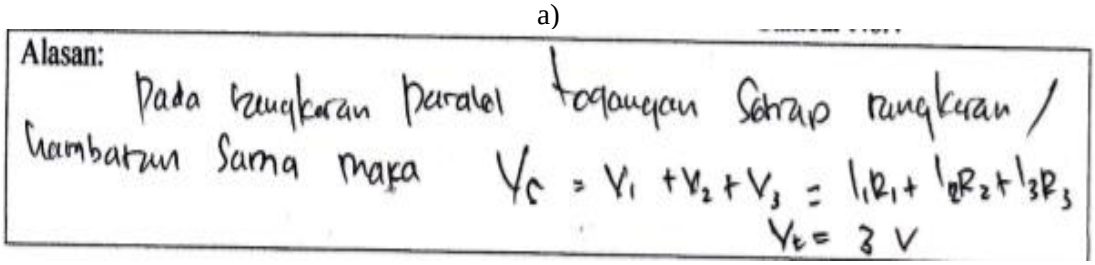

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FIGURE 2. The snapshot of the answer for the second indicator.

In the third indicator, which is about determining the concept of voltage in series. The characteristic of a series is a voltage divider, so the amount of voltage given will be distributed according to the amount of voltage that exists. The results of the student answer sheet analysis found that students did not answer choices or did not write down reasons. Whereas in FIGURE 3, it can be

seen that students answer the series of obstacles that flow in each series are the same. In the series, the series is not an obstacle of the same magnitude, but a large flowing current of equal magnitude.

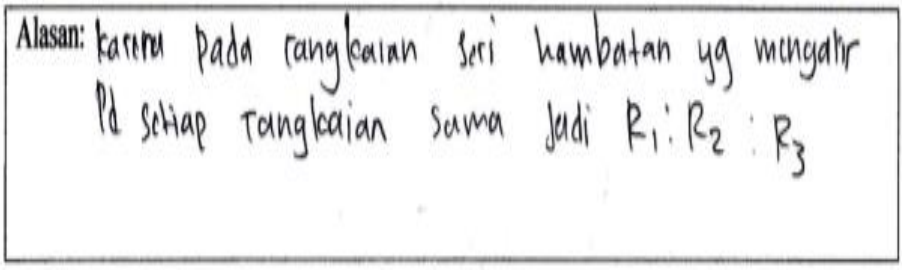


FIGURE 3. Snapshot of the answer for the third indicator

On the sixth indicator with a large understanding of the concept by 80%, which is to determine the concept of equivalent value substitute barriers in parallel circuits. To find the equivalent value in a parallel circuit using the following EQUATION (1).

$$\frac{1}{Req} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n} \quad (1)$$

The results of the answers found that most did not answer choices and also did not give reasons. Besides, as shown in FIGURE 4, students are wrong in using formulas to find the barrier resistance values in parallel circuits. Incorrect use of equations can be caused students do not understand the existing concepts nor do they understand the operation of fraction mathematics.

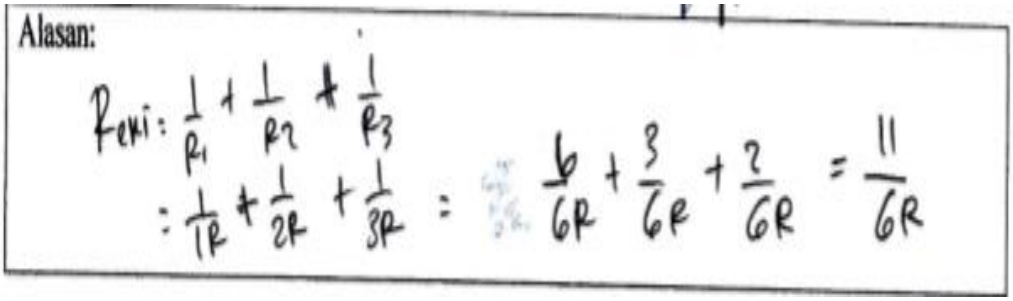


FIGURE 4. The snapshot of the answer for the sixth indicator.

FIGURE 5, is a snapshot of the response to the first indicator, which is determining the electric current in the series. The characteristics of a series are that the current flowing in each component is the same. In FIGURE 5, students see that the current strength in the series is the same, but uses the value of comparison in the operation of mathematics, so that the concept of flows of equal value is not met.

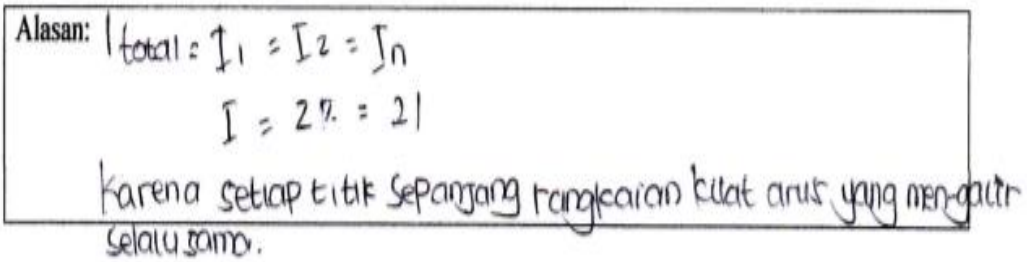
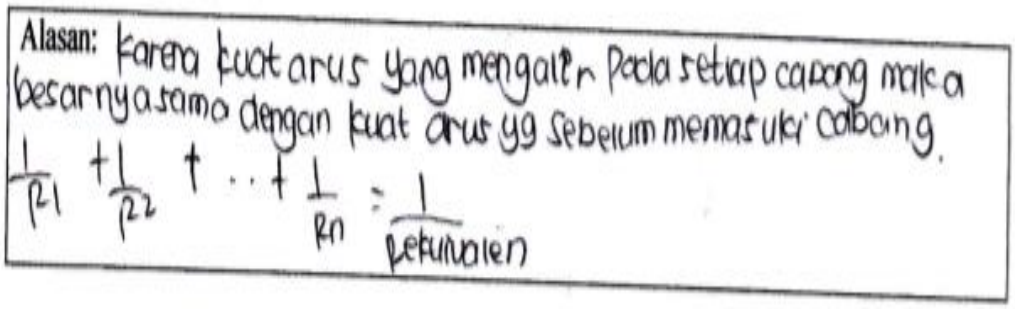


FIGURE 5. The snapshot of the answer for the first indicator.

In FIGURE 6, you can see a snapshot of the student's answer to the fifth indicator, determining the concept of equivalent values of substitute barriers on the series sequence. To find a substitute (equivalent) value in a series, EQUATION 2 can be used as follows:

$$R_{eq} = R_1 + R_2 + \ldots + R_n \quad (2)$$

The results of the student answers were obtained that students could not understand the concept of the series resistance correctly, so it was still wrong to find the equivalent value in the series. Both images (FIGURES 6a and 6b), the two images are formulas to find equivalent values in parallel sequences.



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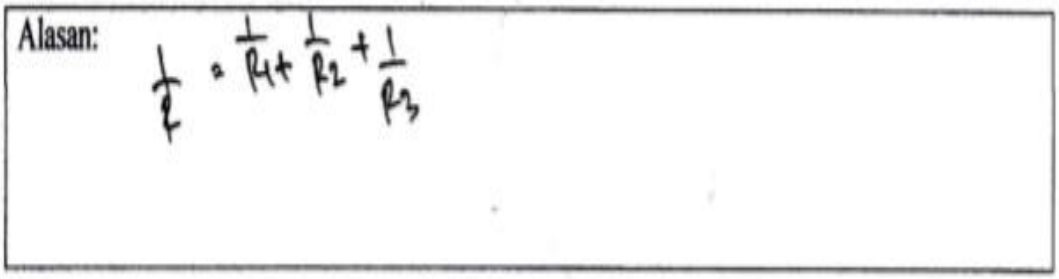

b)

FIGURE 6. The snapshot of the answer for the fifth indicator.

The ability to understand concepts is needed by prospective teacher students to achieve educational goals in the learning and learning process. If the prospective teacher does not master the concept correctly, it will certainly have an impact on the students later.

In this study, prospective teacher students are said to understand the concept being tested if the answers and reasons given are correct. This is because if students understand the concept, they can correctly re-explain the concepts in their own words and be able to associate with other related concepts. The results of the analysis obtained that the ability to understand the concept of electrical circuits of prospective physics teacher students is low.

Data from the research on the understanding of the concept of student physics teacher candidates in the concept of electric power is in the basic electronics course. Mastery of concepts is the ability to explain, interpret, analyze, and apply physical concepts in solving problems of physics (Iftitah et al. 2017). So that when the student answers not by the question or does not answer, it is assumed that the student does not understand the concept being tested.

CONCLUSIONS

Based on the results of the analysis of the test of the ability to understand the concept of electrical circuits of prospective physics teacher students, it can be concluded that the understanding ability of the concept of physics teacher students to the concept of electrical circuit characteristics is still low with an average percentage of 84.4%. The percentage of conceptual understanding for each indicator is:

a. Determine the electric current in the series circuit by 73%
b. Determine the voltage on the parallel circuit by 93%
c. Determine the voltage in the series circuit by 93%
d. Determine the electric current in a parallel circuit of 97%
e. Determine the equivalent value of the replacement obstacle in the series of 70%
f. Determine the equivalent value of substitute barriers on parallel sequences 80%

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