Identification of the causes of misconception on the concept of dynamic electricity

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Abstract. This study aims to find out the causes of misconceptions on the high school students in the subject matter of dynamic circuit through mixed method. The population of this study is all students of class XII SMAN 2 Banda Aceh. The sample was chosen by random sampling, so that there were 21 students for the control class and 21 students for the experimental class. Data collection was done by questionnaire technique in the form of questionnaire about the cause of misconceptions which is called the Instrument for Identifying the Causes of Misconceptions (IICM) consisted of 35 items was developed by researchers with validity and reliability indices respectively 0.75 and 0.85. The results of data analysis show that the largest percentage of causes of misconception is by students and by context. Thus it can be concluded that the cause of misconception among high school students for dynamic electrical circuitry is caused by the student's self as well as the context. The causes of misconceptions in students are more at the stage of cognitive development of students and in most contexts caused by feelings of pleasure/displeasure or free/ depressed.

1. Introduction
Low quality higher education (PT), one of the reasons is the low ability of students to master the concept of the lecture material presented. The problem of mastery of concepts, especially science, has been investigated since the 70s [1], both related to difficulties understanding concepts, identification of misconceptions and conceptual remediation [2-6]. In general the mastery research concept only focuses on three main areas; identification of misconceptions, identification of causes of misconceptions, and remediation of misconceptions. For local scale research, especially national scale, it is rather difficult for the three main fields to be conducted in the same year. This is because it requires a longer time to develop identification instruments (misconceptions and causes), analysis of results and on the development of remediation methods. In addition, many scientific concepts that are abstract and rarely encountered phenomena in everyday life, consequently there are often difficulties and misconceptions of students in understanding them. For example the concepts of relativity and quantum phenomena (in physics), the concept of energy flows in ecosystems and cross-marriage patterns (in biology), and the concepts of reaction rates and chemical bonds (in chemistry).

These problems have been tried to overcome in various ways, including the development of diagnostic tests from one-tier to four-tier, the use of virtual labs (eg PhET), the use of Model of Conceptual Change (MCC), and the use of the approach to Children Learning in Science (CLIS) based on computer simulations [7-9]. The results obtained turned out that there was no effective method for
all concepts, but a method was only effective on certain concepts and not effective on other concepts. This means that every concept of science has a specific misconception identification and remediation method (there are characteristics of each). For example, the concept of quantum phenomena will be effectively identified using a three-tier diagnostic test and effective remediation is carried out with Model of Radical Conceptual Concepts (MRCC) [10,4,11].

One of the factors ineffectiveness of the method of remediation of misconceptions in science learning is that it is not known exactly why the occurrence of misconceptions or uncertain factors of the occurrence of misconceptions are unknown. Some research results show that the causes of misconceptions in science learning include student counseling, teacher / student handbook, and incomplete reasons [12-14]. Besides that, through the interview process shows that the causes of misconceptions can also come from the character of abstract genetic substance, the number of foreign terms, difficult language, and unpreparedness of students in receiving the material delivered by the lecturer [15].

The causes of students' difficulties and failures in understanding electrical material are the many errors experienced in developing conceptual models that are in accordance with physics learning [16]. This was also explained by [14] states that the cause of students experiencing misconceptions on electricity occurred because some students still misunderstood the voltage, current and resistance in closed circuits, many students misunderstood the bright lights in series electric circuits and there were also some students who misunderstand what makes the lamp light up in a series. So in other words the cause of students having difficulties in understanding the concept of electricity because as long as many students are taught by just learning about simple concepts without being invited to experiment in the laboratory to further explore the concepts that have been taught, so there are still many students who misunderstood the concept.

There are various ways to detect misconceptions and causes of student misconceptions, including the presentation of concept maps, multiple choice tests with open reasons, making scientific papers, using assessment concepts, and CRI by structured interviews [16]. Besides that, the cause of misconception can also be done by choosing the deceiver in multiple choice questions that can represent the causes of misconceptions [17]. Based on the results of observations that have been made there are misconceptions experienced by students, so identification because the occurrence of misconceptions in dynamic electrical circuit material needs to be done in order to know the cause. Furthermore, in this study we will examine the causes of misconceptions in the concept of dynamic electricity that occur in students, teachers, teaching methods and others.

2. Methods

2.1. Sample of research
The study used a two-group posttest pre-test design on 21 students in the control class and 21 students in the experimental class randomly selected. This study uses descriptive research methods. The subjects of the study were students of class XII MIPA 4 and class XII MIPA 5, each of which amounted to 21 people.

2.2. Data collection
Data collection techniques used in this study through the provision of questionnaires to students which was developed by researchers with validity and reliability indices respectively 0.75 and 0.85. The questionnaire instrument was first validated by expert lecturers who were very understanding about the problem of misconception. The questionnaire used in this study is closed, where the alternative answers have been determined previously by the researcher.

2.3. Data analysis
The data obtained from the research results are grouped based on the students' answers that are the same in each number by tabulating it into the frequency distribution list, so that it will facilitate data processing. Separating the results of student answers based on each of the causes of misconceptions in students, then each answer is calculated as a percentage. Then calculate the average value of the
percentage of each cause of misconception, followed by a general discussion of the causes of misconception.

3. Results and Discussion
The results and discussion are shown and explained in the order of the largest percentage of causes of misconception in students, teachers and teaching methods. The discussion is described simultaneously with the results of the research shown.

3.1. Misconception is caused by students
Based on the results of data processing that has been carried out using the formula of relative frequency (percentage number), the highest percentage of the five causes of misconceptions is obtained by 30% of students and the 25% of context. Where in students the most frequent causes of misconceptions are at the stage of development of students and in the context of the frequency of the causes of misconceptions most are feeling happy/unhappy or free/depressed. Detailed distribution is shown in table 1, where the cause of the lowest misconception is the ability of students to present reasons that are incomplete and the highest stages of cognitive development. This is in line with the statement of [18] who say that, "Misconceptions originating from students themselves can occur due to student associations with everyday terms that cause misconceptions. Often students are not interested in learning physics but in the science class, if they misunderstand a concept of physics, the student is not interested in finding the right one and changing the wrong concept. As a result, errors in these students will accumulate more because the following concepts are built based on previous concept misconceptions. Furthermore, [19] stated that, "From the results of the research that has been done, there are more misconceptions experienced by students due to wrong intuition, incomplete reasoning, students' abilities, wrong preconceptions".

| Code | Special Causes of Students                        | f   | p     |
|------|--------------------------------------------------|-----|-------|
| A    | Pre-conception                                   | 25  | 59,5  |
|      | Associative thinking                             | 24  | 57,1  |
|      | Humanistic thinking                              | 19  | 45,2  |
|      | Reasoning that is incomplete / wrong             | 12  | 28,6  |
|      | Wrong intuition                                  | 27  | 64,3  |
|      | Stage of cognitive development of students       | 35  | 83,3  |
|      | Student ability                                  | 23  | 54,8  |
|      | Interest in student learning                     | 22  | 52,4  |

| Σ    |       | \( \bar{p} = 55,7 \) |

The high percentage of context as one of the factors that causes misconceptions on students because many students argue that if their moods greatly influence the desire to take lessons, and students also say they prefer to discuss with friends who are considered intelligent about dynamic electrical material if they experience confusion. This is in line with [14] statement which states that, "Many students experience misconceptions coming from discussion friends or classmates, where they learn together. Many students who lack ability, easily take the concept of a friend who is considered smart. If the clever friend turns out to have a misconception, then that mistake is taken over by a friend who lacks that ability”.

3.2. Misconception is caused by teacher
The second cause of misconception is the teacher's factor with the specific causes experienced by the teacher starting from the inability or not the competence of the teacher to master the material up to the ability of the teacher to communicate with students. In detail, it is shown in table 2.
Table 2. Distribution of answers of 42 students to teachers as a cause of misconception

| Code | Special Causes of Misconception                      | f | p  |
|------|------------------------------------------------------|---|-----|
| B    | - Not mastering material, incompetent                | 8 | 19.0|
|      | - Not a graduate from the field of physics           | 4 | 9.5 |
|      | - Does not give students express ideas / ideas       | 6 | 14.3|
|      | - Teacher and student relations are not good         | 18| 42.9|
|      | ∑                                                      | 36|  p = 21.4|

Based on the information in table 2, it can be understood that the causes of misconceptions by physics teachers are more dominant in their contribution to the relationship or communication between students and teachers is not good or less effective. Factors that are less effective communication between the two, causing students not to be brave or afraid to ask concepts that have not been understood, as a result there is a misconception. What is the cause of such misconceptions on the part of the teacher as the teaching staff.

In addition, researchers also asked questions and answers with teachers who taught, he said most students were slow and difficult to be able to accept and understand the concept of dynamic electricity quickly and deeply. They have to be repeatedly explained with examples that they can see, but after that is done there are still students who experience it. Learning interest in the two classes is different, where there are classes where students learn more about playing games, and one more class is how to learn their students most seriously. The Physics teacher also said there were some students who often never entered class when the physics subjects took place, their presence in the class could be counted on the fingers. There are also students who are actually not interested in entering this school and how many in the science majors, the students enter because of coercion from parents. So that the students did not want to study seriously because they felt depressed and were less interested in participating in school learning.

3.3. Misconception is caused by teaching methods

Misconceptions caused by the teaching method applied by teachers in the local area often lead to misconceptions in students. In table 3, the distribution of the contributions of specific causes that trigger misconceptions is shown, so that as a whole the accumulation becomes the cause of the misconception because of the teaching method. Among these specific causes the biggest contribution to the trigger for misconception is the teaching method using analogy (30%), then the practicum method (22%), and the smallest contribution is the lecture and discussion method (4%).

Table 3. Distribution of relative frequency of teaching as a cause of misconception

| Code | Special Causes of misconception                      | f | p  |
|------|------------------------------------------------------|---|-----|
| C    | - Only contains lectures and writing                 | 4 | 9.5 |
|      |                                                     | 8 | 19.0|
|      | - Directly into the form of mathematics              | 10| 23.8|
|      | - Does not reveal student misconceptions             | 5 | 11.9|
|      | - Not correcting wrong PR                           | 4 | 9.5 |
|      | - Analogy model                                     | 30| 71.4|
|      | - Practice model                                    | 22| 52.4|
|      | - Discussion Model                                  | 10| 23.8|
|      | - A narrow demonstration model                      | 13| 31.0|
|      | - Non-multiple Intelligences                        | 15| 42  |
|      | ∑                                                      | 121| p = 28.8|

The results of observations that have been made by the researcher towards class XII IPA 4 and class XII MIPA 5, where it is seen that when the learning process is taking place there are some students who are not paying attention to the teacher's explanation in front of the class, even when the teacher tries to provide a lattice of learning material for exam. There are some of those who prefer to be busy with their
cellphones to play games, and will only stop if they are reprimanded by the teacher without self-awareness.

The percentage value of the number of causes of misconception in students on dynamic electrical circuit material is presented in figure 1, was showed that the results of the largest percentage figures among the five causes of misconceptions in students namely students and context.

Based on the results of these studies indicate that the results of identification because of the existence of misconceptions on dynamic electrical circuit material in SMAN 2 Banda Aceh is caused by the student's own factors and also the context. In accordance with the results of observations and interviews with teaching teachers that have been described previously, that students of class XII MIPA 4 and class XII MIPA 5 there are students who are still less interested and serious listening to the teacher's explanation of physics material and the feeling of distress and displeasure possessed by students because of the compulsion to study in the natural sciences and attend school, this results in student learning outcomes. This is consistent with the research of [20] concluding that the causes of misconceptions experienced by students come from the students themselves, from the teacher and the way to teach teachers and books. Besides that, the ability of students to solve each problem in physics also supports the emergence of misconceptions in learning physics [22].

4. Conclusion
Based on the results of research and data analysis, it can be concluded that misconceptions that occur and are experienced by students of class XII of SMAN 2 Banda Aceh are caused by student factors and context. This is obtained from the results of data processing where 30% of students as the cause of misconception and 25% of the context are the causes of misconceptions experienced by students in dynamic electrical circuit material. Where in the student the most frequent causes of misconceptions are at the stage of development of students and in the context of the frequency of the most misconceptions in feeling happy / unhappy or free.

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