Analyzing the science misconception in mastery concept of ecosystem topic at senior high school

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Abstract. This study aims to determine the percentage of biology misconceptions especially in ecosystem topics at senior high school. Ecosystem topics are basic in science. But there are still many students were got difficulties in understanding the concept, that causing misconceptions. A misconception is an explanation of the phenomenon according to the experience and student's previous knowledge. This study used a descriptive statistics method. Profiling data was used to describe the percentage of mastery concept students and misconceptions. Multiple-Choice tests were chosen to measure the understanding of concept mastery and misconceptions in ecosystem topics. The results have shown the average of percentage in mastering conception is 58.65%, while the average percentage of misconception is 41.01%. It means misconceptions that are inversely proportional to the understanding of student concepts. Therefore, to reduce the misconceptions that emerge a needed an improved understanding of the concept.

1. Introduction

Nowadays development in Indonesia is directed at improving the quality of human resources. The Quality of Human Resources is necessary for nation-building, especially in developing education. In this globalization era, quality human resources will be the main foundation for a nation to compete. However, according to PISA (Program for International Student Assessment) 2018, Indonesia recorded a decline in results in science compared to the latest results in 2015 three years ago [1]. The reason for the low quality of science education, in general, is that there may be misunderstandings and learning conditions that do not pay attention to preconceptions.

Most Indonesian students have been found to have a lack of interest in their school lessons during their learning and to have an effect on their ability to master the concept [2]. Other than that, students learn the concepts of knowledge through the environment around them from the formal or informal school education system based on their experiences, which are often used to build insights with students' perspectives. Misconceptions can damage learning, especially meaningful learning. More than memorizing information, effective learning occurs when students make comparisons between prior understanding and new knowledge [3]. Using prior knowledge can help students understand their own reading experiences so that they can better understand what they are reading [4]. Misconceptions are explanations about phenomena created by students in response to students' prior knowledge and experiences. But misconceptions not only shows a lack of knowledge, factual errors, or wrong definitions. The study of students' scientific conceptions has identified scientifically correct interpretations and responses to problems that students might face because they have an alternative understanding of the phenomenon [5]. Some research on student's conceptions has developed in the last
twenty years and increases our understanding of conceptions, misconceptions, and alternative conceptions that students bring to class [6].

Students can have misconceptions in any discipline, they are often investigated in science, including biology. Biology is a science that is closely related to natural phenomena and has abstract, complex, and diverse concepts. This also causes difficulties among students in correct interpreting concepts. Difficulties in recognizing terms can lead to misunderstandings that are not in line with interpretations or perceptions agreed by scientists in their area [7]. One topic in biology is the ecosystem. Sometimes the Ecosystem and its components, which consist of plants, animals, interactions, and the environment, get misunderstandings. Students can think and assume certain characteristics of groups of organisms, and believe that only certain animals are eaten, or believe that all organisms in the ecosystem "get along". Ultimately, students do not realize that ecosystems are dynamic and changeable as a result of natural processes and can be affected by humans.

The wrong reasons usually occur because the logic in making an understanding or conclusion in generalizing it can be a misunderstanding. Therefore it is important to analyze misconceptions in the topic of ecosystems to improve quality in education. Therefore mastery of concepts is important for students because by mastering the correct concepts, students can absorb, understand, and comprehend the material learned for a long period. From the mastery of concepts, students are expected to be able to describe and connect one concept with another concept to explain natural events that occur in daily life.

The purpose of this study is to identify the percentage of common misconceptions in ecosystem topics at senior high school students.

2. Methods
The method used is a descriptive statistical method. Descriptive statistics are used to define the basic characteristics of the data in the analysis, validating the data are accurate and structured correctly and conducting statistical tests on the data. It also includes summarizing and organizing data so that they can be easily understood [8].

The location research in Bandung which is Private school “A” and Private school “B”. The population is 206 students consist of 128 students from Private school “A” and 78 students from Private school “B”. The ranges from grade 10 and grade 11.

The procedure that has been carried out, firstly collecting the data instrument. The instrument used Multiple Choices (MC) and consist of 21 test items to explore misconceptions in the students. This multiple-choice was adopted from the AAAS (American Association for the Advancement of Science) assessment, which is the assessment items on the website are the result of more than a decade of research and development under Project 2061 of the long-term science education [9]. Then, translate multiple-choice questions into Indonesian, after that the questions are checked again to sync. then the questions were spread to schools in Bandung to be filled. Finally, the answers to the questions that have been filled out by students are analyzed using Microsoft excel.

3. Result and Discussion

3.1. student performance score
An ecosystem is one of the most important and basic subjects in biology which is one of the parts in science learning, besides that it has many complicated concepts. Identification of confusion in the context of the ecosystem should be carried out to identify effective teaching and learning methods. The essence of the concept of ecosystems is the understanding that organisms exist in systems of biotic interactions and abiotic factors. Sometimes it is difficult to expect each student to be able to predict or explain in detail the changes that will occur in an ecosystem if one variable is changed. However, most environmental educators will probably agree that people must understand that all organisms live in a system and that all changes are important and have an effect on the system.

The study has used Multiple Choice tests to analyze the result of student answers in ecosystem topics. The advantages of multiple-choice tests are the test enables the researchers to explore various
subjects in a relatively short time, multiple-choice tests are flexible and can be used at various levels of instruction. Objective in assessing answers and being reliable, simple and quick to score, effective for students who have a good understanding, ideal as analytical items where different variables can be identified for the analysis process and valuable in assessing student misconceptions, then can be used on a large scale [10]. The results of the percentage of items in each student's answer per item question are shown in figure 1.

The results of the percentage of items in each student's answer per item question number are shown in figure 1. Figure 1 shows that the results of students' answers each question has a different percentage. The percentage represents the level of student understanding. The average student can answer the question from the test item correctly at the beginning of the question. The average of students who answered the correct questions as a whole was a percentage of 58.65%. it is indicated that the mastery concept of students is almost more than half the total number of students. The percentage of student answers show in results above 70% consisting of 9 test items from the total 21 test item. which means on 9 questions that almost all students can answer the question correctly. The 9 test items consisted of number 1 (82.53%), 2 (76.70%), 3 (81.67%), 4 (79.61%), and 5 (72.82%), 7 (82.52), 8 (74.27%), 10 (73.79), and 11 (78.64). The type of concept questions presented in the test item will be shown in Table 1.

**Table 1.** Results of test questions with the highest percentage of average student answers per question

| Item number | Key Ideas |
|-------------|-----------|
| 1, 7, 11    | Change in a population in a food web can affect the population of its predator (no specific organism identified) |
| 2, 3        | Changes in a population of organisms in a food web can affect other populations of organisms even if they are not directly connected in a feeding relationship |
| 4           | Changes in a population in a food web (grasshoppers) can affect the populations of both its predator (frogs) and its prey (grass). |
| 5, 8, 10    | Changes in a population may affect populations that are not directly connected by a feeding relationship even if they are several steps away in a food web (no specific organisms indicated) |
Based on Table 1, the average student can answer the same type of question, which is the population changes on the food web in a simple concept. Food webs relate to feeding exchange chains between species that co-occur within specific ecosystems. Food web work is one of the few environmental sub-disciplines that aims to quantify and examine direct and indirect interactions between different organisms, rather than concentrating on specific types of taxa [11].

Table 1. also has classified based on the key ideas. In the number 1, 7, 11 has indicated the students have understood if the species are eaten or consumed by other organisms, there may be an impact on certain populations that are not consumed or eaten by these species. It is because if an individual organism is consumed, it is no longer available as food for other populations of species. Number 2 and 3 indicate the student has understood if the changes in the composition of the populations of species, due to changes in the size of the populations it consumes or consumes that affect the outcome. Number 4 has indicated the student understand about the population in the food web is disrupted, there will be an impact on the populations below in the food web. Numbers 5, 8, 10 explain that feeding interactions between selected populations of species in food webs can be described by diagrams with arrows from populations eaten to food-producing populations [12]. It means the student almost has an understanding of all species, both land-based and aquatic, are related to other species by their food requirements. The effect is a regional network of interconnections.

3.2. student misconception

The finding of Misconception generated by the students' answers can be seen at the end of the question. That indicates that students almost do not comprehend the content deeply. As a result data in Figure 2 shows the variation of students in misconceptions about the concept of the ecosystem. Misconceptions need to be prevented and thus do not have a significant effect on students in further learning.

![Figure 2. The percentage of student misconception per item question number in the topic ecosystem](image)

Figure 2. shows the data in measuring the percentage in a misconception of students. The data shows that there are still many students who have misconceptions about ecosystems. We can see from question number 16 up to 21. it shows that more than 65% of students with a variety of percentages. For numbers 16 (65.53%), 17 (68.45), 18 (67.96%), 19 (65.53%), 20 (62.62%) and 21 (64.56%). The type of concept is able seen in table 2. In this case in questions 17 and 18 have the highest level of misconception in students. When viewed from the overall number of percentages, the average of misconception by students is 41.01%.
Table 2. Results of test questions with the highest percentage of misconception per question

| Item number | Key Ideas |
|-------------|-----------|
| 16, 20      | Changes in a population may affect populations that are not directly connected by a feeding relationship even if they are several steps away in a food web (no specific organisms identified) |
| 17, 19      | Changes in a population may affect populations that are not directly connected by a feeding relationship even if they are several steps away in a food web. (organism identified) |
| 18, 21      | Changes in a population may affect populations that are not directly connected by a feeding relationship even if they are several steps away and not within the same chain in a food web. |

Based on Table 2. The common misconception in students in numbers 16 and 20 concerning the relationship of the population with changes that will indirectly affect. But students may find the difficult to define organisms that are not specifically identified. In this case, perhaps student thinks When the population in the food web is disrupted, there would be little or no effect on the populations below it in the food web because if the predator were removed, no effect on the prey. Then for number 17, 19 it is about population movements that affect populations that are not directly linked to a feed relationship, even if they are located several steps away from the food web. The student may think that Requiring different the population size of organisms would affect only those populations of organisms that are directly linked to it in a feed relationship, not species that are removed/separated from it by one or more measures. For number 18, 21 the misconception about Population movements that affect populations that are not directly linked to a feed relationship, even if they are several steps away from the food web and not within the same chain. Many students assume that changes in the population of the food web do not directly impact the population levels of any other food web organism [12].

A variety of strategies can be used to overcome the misconception of students, such as teacher preparation, use of innovative techniques, curriculum modification, development of enhancement materials. Identifying students’ preconceptions is also crucial to correcting misconceptions. Students' preconceptions can be gathered through literature reviews, diagnostic tests, evaluation, idea maps, and interviews [13].

4. Conclusion

Multiple choice test instruments that have been developed in the ecosystem system is appropriate and valid to be used to identify or diagnose grade 10 and 11 senior high school students’ misconceptions about ecosystems. The results have shown the average of percentage in mastering conception is 58.65%, while the average percentage of misconception is 41.01%. It means misconceptions that are inversely proportional to the understanding of student concepts. Therefore, it can be learned and implemented and this instrument can be used as an alternative teacher to find out misconceptions on students so that they can reduce or even prevent students' previous misunderstandings and the teacher can improve the teaching system to be more meaningful by explaining concepts correctly. A misconception is not only caused by students' mistakes but can also be caused by inappropriate teaching practices. So, the teacher must be updated to make a student comprehend in mastery concept.

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