Misconception Types Analysis on Mechanism of Evolution

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Abstract. Students' conception about the mechanism of evolution is closely related to knowledge gained from the learning environment, and from the environment outside of school which sometimes is not based on scientific knowledge and understanding. Therefore it is necessary to investigate their prior knowledge and to analyze the level of misconception, as well as the type of misconception experienced by students so that the appropriate steps can be determined to overcome them. This qualitative descriptive study was conducted to get a clear picture of student misconception on learning material of evolution mechanism and the type of misconception. A number of students from a university in Bandung, West Java Indonesia was involved as participants (N = 30). The instrument used consisted of 20 questions in the form of three tiers Diagnostic Question Cluster (DQC) assessment. Results of research based on DQC instruments at level 1 and level 2 indicate that the highest misconception is the concept about the nature of evolution. The result also shows the types of misconceptions occurred, Namely common-sense misconception (CsM), content-based misconception (CbM), nature of science-based misconception (NbM), non-scientific misconception (NsM), vernacular misconception (VcM). The highest type of misconception is CbM(36.44%), while the lowest type of misconception is VcM (11.34%).

Keyword: Analysis, Misconception, Diagnostic Question Cluster

1. Introduction

The research data on misconceptions on the theory of evolution is so widely researched by researchers who have found misconceptions based on religious point of view[1][2][3][4]. Hundreds of studies have discussed this and clearly this cannot be ignored. But it is time that we step forward and support the discussion of more urgent interests, which are related to learning and how evolution is discussed in the activities of students and teachers in schools. The misconception of the theory of evolution that occurs in the general public is quite worrying, but when misconceptions occur in the academic environment, this will be even more dangerous because educated society is a role model or example who should enlighten many people in these matters. The academic environment exposed to misconceptions is not uncommon. A small number of researchers in several countries have revealed this by ignoring or paying attention to the religious background therein. A study in Santiago revealed that 70% of teachers and students studied show that they believe in the theory of evolution as a theory that can be proven its validity as a scientific fact[5]. This discovery is certainly a fresh breeze for some
evolutionists who share the same opinion. There are, of course, many research findings that point to the opposite, for example, research conducted with results data indicating that there is still a considerable misunderstanding regarding the understanding of Lamarck's evolutionary theory which indicates that misunderstandings stem from a belief-based understanding[6]. In Indonesia, evolution is a compulsory course taught in all biology majors at the undergraduate level, although the proportion of the given course load is not large enough which is only 2 credits. The culture of Indonesian society which is the daily life of students in Indonesia is very possible to influence students' perspective on the evolution that is based on religious view. This view, if it develops without proper direction, will certainly create a permanent misconception. Quite a lot of research reveals the extent of misconceptions to the mechanisms of evolution. However, there are still very few that distinguish between the types of misconceptions experienced by students, specifically the types of misconceptions students have on the material of evolutionary mechanisms. Though disclosure of this type of misconception will be very important to help researchers and teachers to find remedies for these misconceptions. Therefore, in this study, an experiment was conducted to find out the level of student misconception and the type of misconception experienced in the material of evolutionary mechanism by using the question of three levels of Diagnostic Question Cluster.

This study aims to determine the level of misconception of prospective biology teacher students on the mechanism of evolution, and to analyze the types of misconceptions experienced by these students. Misconceptions refer to improper or false notions, non-scientific conceptions, not referring to scientific values, and incompatible with true scientific theory but believed or forming a mental structure[7]. Based on the questions on the Diagnostic question cluster assessment instrument at level 1 and 2, there are 2 things that will be analyzed, NbMely the level of understanding the concept and analysis of the level of student misconception. Form of assessment Diagnostic question cluster used adapted from Bayrak [8] can be seen in Table 1 below:

| No | Criteria | Level | Answer Choices |
|----|----------|------|----------------|
| 1  | Understood the Concept | Level 1 | Correct Answer |
|    |          | Level 2 | Certain Answer |
| 2  | Guessing  | Level 1 | Correct Answer |
|    |          | Level 2 | Certain Answer |
| 3  | Misconception | Level 1 | Wrong Answer |
|    |          | Level 2 | Certain Answer |
| 4  | Did not understand the Concept | Level 1 | Wrong Answer |
|    |          | Level 2 | Certain Answer |

To analyze the answers to level 3 reasons for selecting answers to the Diagnostic question cluster assessment, the criteria used for the types of misconceptions are as follows: a) Common sense misconception is a misconception that arises because of an individual's misunderstanding of a phenomenon, b) Content based misconception that is misconception arises because someone has an idea that goes against the concept of organic evolution, c) Nature of science-based misconception is an understanding of evolutionary material based on non-scientific explanations and rejects scientific concepts, and holds to its own unscientific understanding, d) Non-scientific misconception is a misconception derived from views based on belief rather than scientific facts, e) Vernacular misconception is a type of misconception in the form of ignorance of the scientific terms so the wrong scientific terminologies used[9].

2. Methodology
This research uses descriptive qualitative method to find out the types of students’ misconceptions on the material of evolutionary mechanisms. Subjects in this study were students from a university in Bandung, West Java, Indonesia. The sample consisted of 30 students majoring in biological education in semester 4. The instrument used in this study consisted of 20 questions in 7 subtopics with the form
of three tiers (3 levels) namely the Diagnostic Question Cluster (DQC) assessment. This instrument reveals the percentage of misconceptions in each sub-topic is determined based on the number of students who misconceptions in the subtopics, reveal the mastery of students' concepts on the answers to questions at level 1, will reveal the level of understanding of concepts and misconceptions in level 2, and reveal the types of misconceptions experienced by students at level 3.

3. Result and Discussion
The results of the student answers obtained through the diagnostic question given are shown through some data from 3 levels. Data from answers to questions at level 1: shows the level of mastery of students' concepts. Level 2 data: shows the level of understanding of concepts, misconceptions, does not understand the concepts and answers to guesses of students. While the data at level 3 is taken through the question of the student's requirement to propose the reason for the answer at level 1 and level 2, the answer at level 3 is mapped based on the type of misconception experienced by the student. The overall misconceptions based on subtopics can be observed in Table 2.

| Table 2. Recapitulation of Misconception by Subtopics |
|-----------------------------------------------|
| No | Sub Topic | Percentage |
|----|-----------|------------|
| 1  | Nature of Evolution | 54.44 |
| 2  | Origin of Life | 26.66 |
| 3  | Natural Selection | 37.77 |
| 4  | HardyWeinberg’s Law | 36.77 |
| 5  | Variations of Organisms | 40.00 |
| 6  | Species and Speciation | 41.11 |
| 7  | Micro and Macro Evolution | 53.33 |

Based on Table 2, the highest misconceptions experienced by students were in the sub-topic of nature and evolutionary history that is equal to 54.44%, while the lowest topic level of misconception is the sub-topic of the origin of life, which is only 26.66%. More clearly, data by percentage can be seen in Figure 1.

![Figure 1. Graph of the misconception rate of each subtopic](image)

The difference in the level of misconception on each subtopic in the graph above shows that students have a fairly high level of misconceptions on the sub-topic of evolutionary nature, this is most likely related to the state of students who have their own understanding of the nature of evolution learned outside the academic environment, often used in solving problems or expressing opinions about evolution. Based on the students' answers to questions level 1 and 2, the results show the level of misconception, students’ understand about the concept, students guessing and students who did not
understand the concept based on the number of students from the total number \((n = 30)\) as research subjects. The data of the research on its distribution can be seen in Figure 2.

![Mastery of Student Concepts](image)

**Figure 2.** Graph of Students Concepts Mastery

Results of data on the types of misconceptions experienced by students based on answers at level 3 of the Diagnostic question cluster are shown in Figure 3.

![Total Percentage Types of Student Misconceptions](image)

**Figure 3.** Total Types of Student Misconception

The overall data in Figure 3 can be described as follows the type of misconception consists of common-sense misconception \((CsM)\) 15.38\%, content-based misconception \((CbM)\) 36.44\%, nature of Science-based misconception \((NbM)\) 18.62\%, non-scientific misconception \((NsM)\) 18.22\%, and vernacular misconception \((VcM)\) 11.34\%. Overall, the highest misconceptions experienced by students are in content-based misconception, where the misconceptions experienced by students are because students do not understand the content or have ideas that are contrary to the concept of organic evolution. The type of misconception
with the lowest percentage is Vernacular Misconception, indicating that students have no significant obstacles in understanding the terms in the mechanism of evolution. Details of the types of misconceptions in each item test can be seen in Figure 4.

Based on these findings, the highest misconception is in question number 8, which is in the subtopic about the nature of evolution, it can be said that students actually have their own understanding of several concepts in the mechanism of evolution, but it is unfortunate that the concept they have is not in line with scientific concepts. Most of the terms put forth in diagnostic matters can be well understood by students.

4. Conclusion
The data found in the study showed that students' understanding of the material of evolutionary mechanisms is low. Based on the findings data, it was concluded that the low mastery of students' concepts was the cause of high misconceptions. The most common type of misconception is Content based misconception. This research has produced fairly complete data, but for future researchers, if the Diagnostic Question Cluster will be reused to reveal similar data, then the answer to level 3 (reason) should have been determined so that the probability of the answer will be more accurate and not too wide in scope, then data retrieval is expected not only once, so that the degree of accuracy and strength of data can be higher.

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