Identification of students’ misconception in cell at first grade of senior high school

A F A Suhel* and L Rusyati

International Program on Science Education, Faculty of Mathematics and Science Education, Universitas Pendidikan Indonesia, Jl. Dr. Setia Budhi No. 229, Bandung 40154, Indonesia

*arlieza.fazla@upi.edu

Abstract. This study aims to identify the misconception of the students’ in biology learning especially in cell type and general characteristics of cell at senior high school level. By using data profiling, the data were collected from 31 first grade students (15-16-year old). The analysis of students’ misconception used the instrument of AAAS Science Assessment. The item consists of 31 items of multiple choices questions and one open-ended essay question. The result obtained then processed by analysing the students’ answers for each item. The results showed that 51% of students’ understanding in type of cells and its general characteristics has experienced misconception. So, we can say that students’ understanding of cell concept in first grade senior high school still low. It would be better to conduct further research to find out the causes that influence students' misconceptions in understanding cell concept.

1. Introduction

Senior High School’s students have to possessed many biology topics based on Indonesia’s curriculum. One of the topics which is need to be learned by the students is cell. Cell is also one of the abstract biology concept that is basic to the study of life. Abstract concept could be difficult to understand by students because the concepts that they learn cannot be seen directly with unaided eye. Survey data showed that students considered cell as one of difficult subjects to understand. Therefore, researchers are interested in seeing how far the depth of cell has been studied by the students [1].

One of the factors that affects the learning and student performance is misconceptions. It can be acquired prior to enrolling in any school program or it can be triggered at any stage of the formal education [2]. The misconceptions experienced by students can mislead students in understanding scientific phenomena and conducting scientific explanations. If students are not aware of the occurrence of misconceptions, there will be confusion and incoherence in students [1, 3]. If it is not immediately fixed, the misconception will be an obstacle for students to further understanding in the learning process. Misconceptions itself could be caused by teachers’ learning method [4-7], different teachers’ interpretation of the concepts [4, 8] and by the reference [9, 10, 4, 8]. If students are aware of the misconceptions that happened, it would be easier to change and improve their misconceptions. Students will be able to form concept connections by themselves too. In addition, students will easily decide which is right and wrong about a concept. Furthermore, students can also construct and reconstruct their conceptions actively.

In this study, researchers are interested raised the topic of cell, which is one of the basic concepts in biology field. Cells are fundamental to biology as well as atoms for chemistry. All organisms consist of...
cells. There are single-celled organisms such as prokaryotes, namely microorganisms and the other one is multicellular such as eukaryotic cells, namely animal/human and plants [11]. In this study, the cell concept that researched was type of cells and their common characteristics. The research is expected to find misconceptions that occur in students. Hopefully in the future can provide solutions to overcome these misconceptions. Therefore, this research can make an important contribution to improve teaching and learning process.

2. Methods

The subjects of this research are first grade students in senior high school with 31 participants (15-16-year-old). They are 15 boys and 16 girls who have had prior knowledge about cell types and their general characteristics. All of the subjects have studied about cells at the beginning of the first semester. This research was conducted on the second semester precisely on March 9th, 2020 in one of senior high school in Cimahi, West Java. The topic raised in this research is cell particularly cell types and its general characteristics.

The instruments used in data collection is written test. The type of this test is multiple choice with one open-ended question about cell, “Mention all the things you know about cell!”. The open-ended question aims to recall students’ knowledge about cell. The questions made were covering these concepts to express misconceptions from students. This type of test should be done by the students within sixty minutes. This instrument is adopted from AAAS assessment that are designed to diagnose students’ misconceptions that can be powerful for educational tools. The assessment founded in 1985 by American Association for The Advancement of Science (AAAS) to improve science education, developed the assessment items and collected data on them under a grant from the National Science Foundation [12].

The method in this research is gathering information about the condition of the subject that will be analyzed and described. The process of this research started with choosing the topic and arranging test items which has been provided on the AAAS website, translating test items from English into Indonesian since the all of the subjects learn biology in Indonesian. All translated test items were implemented to the subjects to obtain the result. The results obtained are processed with the help of Microsoft Excel to be analyzed.

One of the technique that can be used for identifying students’ misconception is data profiling. Data profiling is the process of examining the data available from an existing information source (e.g. a database or a file) and collecting statistics or informative summaries about that data [13]. In academic perspectives, applying profiles is the process of identifying and representing a specific subject or to identify a subject as a member of a specific group or category and taking some form of decision based on this identification and representation [14, 15]. Based on these thoughts, profiling senior high school students’ misconception is expected to be a best way in figuring out the current condition of student’s misconception in science.

3. Result and Discussion

There are 31 items of key ideas as knowledge that being assessed to measure the percentage of students’ misconception on cell types and its general characteristics (size, structure, and function). These items are delivered on Table 1.
Table 1. Recapitulation of students’ concept mastery and misconception on key ideas of cell types and its general characteristics

| Code | Key Ideas | Concept Mastery | Misconception |
|------|-----------|-----------------|---------------|
| 1    | Small molecules enter the cell through the cell membrane. The inside of an animal cell contains liquid water and molecular structures that provide organization and shape. | 35   | 61   |
| 2    | The inside of an animal cell contains both water and solid structures. Both plant and animal cells perform basic life functions such as making molecules for growth. | 94   | 6    |
| 3    | The inside of an animal cell contains both water and solid structures. Cells make up the basic structure of organisms and perform the basic life functions of organisms. | 71   | 29   |
| 4    | Muscle cells obtain energy from food, and they make molecules for growth. Cells are organized into the body structures and perform the basic life functions of the organism they are part of. | 64   | 36   |
| 5    | The cells of living organisms (e.g., cells of mushrooms) need water and a way to eliminate wastes to function. | 61   | 39   |
| 6    | The cells of living organisms (e.g., mushrooms) need molecules from food and water to function. | 39   | 61   |
| 7    | Both plant and animal cells perform basic life functions such as extracting energy from food. The inside of an animal cell contains water, molecules dissolved in water, and small structures that perform specialized functions for the cell. | 26   | 74   |
| 8    | The cells of living organisms (e.g., cells of mushrooms) need molecules from food and a way to eliminate wastes to function. | 55   | 2    |
| 9    | Bacteria need both molecules from food and water to function. | 35   | 65   |
| 10   | Bacteria need food and a way to eliminate wastes in order to function. | 45   | 55   |
| 11   | The inside of a plant cell contains water, molecules dissolved in water, and small structures that perform specialized functions for the cell. | 58   | 6    |
| 12   | Bacteria need food and a way to eliminate wastes in order to function. | 22   | 77   |
| Code | Key Ideas                                                                                           | Percentage (%) |
|------|-----------------------------------------------------------------------------------------------------|----------------|
|      |                                                                                                    | Concept Mastery | Misconception |
| 17   | Both plant and bacteria cells perform basic life functions such as making molecules for growth.       | 22             | 77            |
| 18   | Both plant and bacteria cells perform basic life functions such as extracting energy from food.          | 32             | 68            |
| 19   | Both plant and bacteria cells perform basic life functions such as extracting energy from food.          | 16             | 84            |
| 20   | Bacteria need both molecules from food and a way to eliminate wastes to function.                      | 39             | 61            |
| 21   | Bacteria need both water and a way to eliminate wastes to function.                                   | 39             | 61            |
| 22   | Both plant and bacteria cells perform basic life functions such as extracting energy from food.         | 2              | 8             |
| 23   | Both plant and animal cells perform basic life functions such as eliminating wastes.                    | 32             | 68            |
| 24   | Both plant and animal cells perform basic life functions such as eliminating wastes.                    | 35             | 64            |
| 25   | Both plant and bacteria cells perform basic life functions such as eliminating wastes.                  | 22             | 77            |
| 26   | Muscle cells get energy from food, and they eliminate wastes.                                        | 22             | 77            |
| 27   | Muscle cells make molecules for growth, and they eliminate their own waste material.                   | 45             | 55            |
| 28   | Nerve cells both obtain energy from food and eliminate waste material.                                 | 45             | 55            |
| 29   | Nerve cells obtain energy from food and make molecules for growth.                                    | 45             | 55            |
| 30   | Proteins needed for growth and repair of the cell are built by the cell itself.                        | 2              | 8             |
| 31   | Nerve cells make molecules for growth and eliminate their own waste material.                         | 16             | 84            |
|      | Average                                                                                              | 40             | 51            |

Based on Table 1, misconceptions experienced by the students occur in all key ideas of cell types and its general characteristics with the average percentage 51%. This basic finding is consistent with previous study from AAAS Science Assessment that have 50% average of students’ misconception in grades 9-12 with the same key ideas [16]. From 31 key ideas that being assessed to the students, most of the key ideas have above average percentage of misconception and only nine of them have below average percentage of misconception. Based on this data, the comparison of key ideas that have above average percentage of misconception can be seen in Figure 1.
4. Conclusion
Most of the students’ understanding on cell types and its general characteristics has experienced 'misconception'. The average misconception percentage is reached 51%. It indicates that first grade senior high school students held wrong conceptions about cell especially cell types and its general characteristics. 31% of students’ misconceptions occur in the key idea of bacteria cells’ characteristics. Based on these findings, it can be concluded that the students are still having difficulties in understanding characteristics of bacteria cells. Therefore, it would be better to conduct further research on the causes of misconception not only about cell types and its general characteristics but cell concept as a whole in understanding students’ concepts in various classes, especially in senior high school.

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