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**AN ANALYSIS ON BIOLOGY EDUCATION STUDENTS' MISCONCEPTIONS ON  
CIRCULATORY AND RESPIRATORY SYSTEM IN FACULTY  
OF MATHEMATICS AND NATURAL SCIENCES  
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**Abstract**

This study was aimed to identify biology student teachers misconceptions on circulatory and respiratory system by using diagnostic test and interview. The population of this reasearch was all active biology education students in academic year 2014/2015. The diagnostic test is the multiple choice test which is modified by involving the respondents confidence level that was used to detect and identify misconceptions of biology education students related to the concepts circulatory and respiratory system. The highest score for each question of diagnostic test is +3 and the lowest score is -1. According to the result of the diagnostic test the students were grouped into upper, middle and lower group. Then two representatives students of each grouped were interviewed. The result of this study revealed that 68.81% students possed misconceptions on circulatory and respiratory system. Students' misconceptions was mostly found on the whole concepts of circulatory and respiratory system. However the highest rate of misconception was on the concept of blood circulatory process, blood vessels, circulatory of invertebrates, respiratory of vertbrates and human respiratory process. The result of interview analysis revealed that the causes of misconceptions derived from students itself, teaching methods and students' hand book.

**Key words:** Misconceptions, Diagnostic Test, Circulatory System, Respiratory System

**A. INTRODUCTION**

The study of misconception in biology are not the novel research. Misconceptions may impede the understanding of the biology concepts, because many biological concepts are closely interrelated so that misconceptions of one concept will distract the comprehension of another concept. Previous studies have investigated that many misconceptions that occur in the biology topic. A large number of prior studies reported that many conceptional problems concerning circulatory and respiratory system (Bajd, 2010; Cliff, 2006; Michael *et al.*, 2002; Tekkaya, 2002). However, detailed research related to biology student teachers' misconceptions about circulatory and respiratory system was rarely found. If higher education curriculum designers knew students' misconceptions, it might be helpful to prepare effective teaching strategies. Teachers can play an important role in teaching scientific concepts and, from a constructivist perspective, students should gain meaningful knowledge about biological concepts like circulatory and respiratory system. Biologically literate students should be able to use and apply basic biological concepts when considering biological problems or issues.

The concept of the circulatory system and respiratory system is extremely important in biology because it is the key to learning the basic life processes. The concept

of the circulatory system and respiratory system is also related one to another. The circulatory system and respiratory system work closely together within the body. Oxygen, which is an essential part of the metabolic process of nearly all cells, is gathered through the respiratory system and transported through the bodies of complex organisms, such as humans, through the circulatory system. These two systems also work together to eliminate carbon dioxide, which is a metabolic waste product (Prokop, 2006).

Biology education students of FMIPA Unimed are teacher candidates. For prospective teachers, students should be able to gather information and apply basic right concepts of biology when facing problems or issues concerning biology. Lack of knowledge and teachers' mastery on the learning concept will lead to the lack details of the lessons presentation that can lead to misconceptions when they become the teachers in the future and for their own students.

Students who have misconceptions will hold a concept which they believed to be true and this will lead to misconceptions are stable and resistant to change. Misconceptions can disrupt the learning process due to incorrect logic when studying new right concepts. Misconception is considered latent obstacles because its existence is generally not detected when it is not being challenged with other misconceptions. If misconception is not removed, misconceptions will have a negative impact on future learning especially when they learn about the fundamental topics such as circulatory system and respiratory system.

## B. RESEARCH METHODS

This research was conducted in Biology Departement of Faculty of Mathematics and Natural Sciences, State University of Medan (UNIMED) JL.Willem Iskandar Medan. This research was accomplished from February until May 2015. The population in this study was all students of biology education programs Faculty of Mathematics and Natural Sciences UNIMED on academic year 2014/2015 which amounts to 689 students. Samples of the study were the students who had taken and were taking courses *animal physiology* and *human anatomy physiology* of biology education program batch of 2012 and 2013 Faculty of Mathematics and Natural Sciences UNIMED that amount 465 students. Samples of the study were the students who had taken and were taking courses *animal physiology* and *human anatomy physiology* of biology education program batch of 2012 and 2013 Faculty of Mathematics and Natural Sciences UNIMED that amount 465 students.

This research was descriptive research which investigating the biology education student respondents based on the understanding concepts and misconceptions about the topic circulatory system and respiratory system in biology education programs Faculty of Mathematics and Natural Sciences UNIMED. This research was a descriptive study because only describe what it is about a variable, symptoms or circumstances because not needed control to a treatment or not intended to test the hypothesis.

Instrument used to detect misconceptions students of biology education programs Faculty of Mathematics and Natural Sciences UNIMED to the topic of the respiratory system and the circulatory system in the form of a diagnostic test in the form of multiple choice of 40 items with five possible answers that followed the confirmation question of confidence on the selected answer each item. This test form was developed and used successfully to detect student misconceptions about the subject matter of the respiratory system and circulatory system (Klymkowsky, 2006).

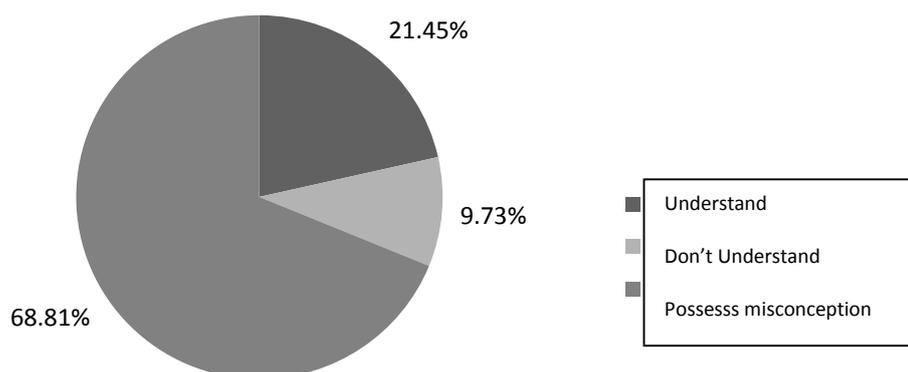
The obtained data by using two-dimensional test data which contains an objective test in the form of multiple choice with five possible answers that followed the confirmation question about the level of confidence in the answer selected on each item of question .

**Table 1.** The Assessment Rate of The Diagnostic Test (Klymkowsky,2006)

No	Answer	Confidence Level of The Answer	Score
1.	Correct	Sure	+ 3
2.	Correct	Not Sure	+ 1,5
3.	Correct	Not Knowing	+ 1
4.	Wrong	Sure (Y)	-1
5.	Wrong	Not Sure (TY)	-0,5

### C.RESULTS AND DISCUSSION

The data analysis of students' diagnostic tests revealed the overall category of misconceptions was as followed: 21.45% understand; 9,73% don't understand; and 68.81 % possess misconceptions. The total data was obtained from batch of 2012 and batch of 2013 students. The students who was categorized as "understand" achieved +3 of the diagnostic test average score, whereas the students who was categorized as "don't understand" achieved +1 or +1,5 of the diagnostic test average score and the students who was categorized as "possess misconception" obtained score below +1 of the diagnostic test averages.



**Figure 1.** The Percentage of Students' Misconception

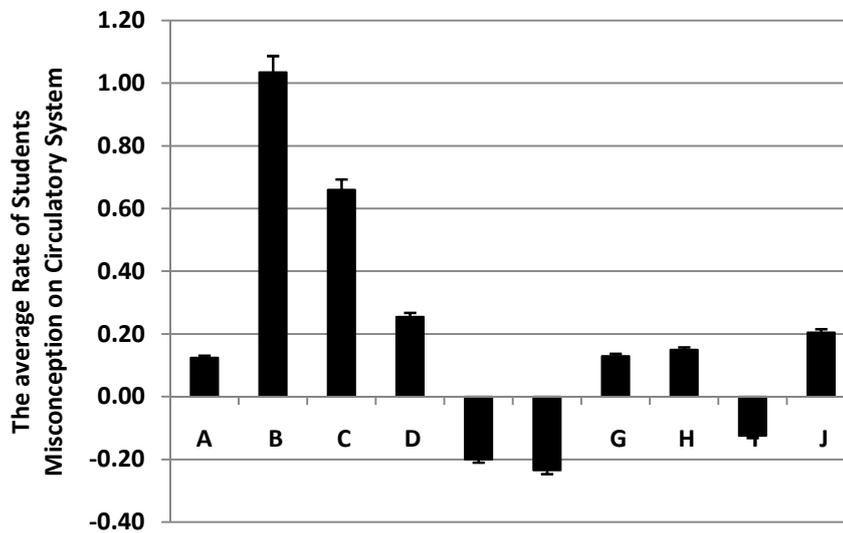
The analysis was carried out on diagnostic test administered on students of 2012 and 2013 batch revealed the average score for circulatory and the respiratory system sub topics. If a respondent got score below than + 1 was categorized into misconception. There are 40 items of questions on diagnostic test.

The result of the data revealed that almost the whole concepts circulatory system, students held misconceptions (the averages scores below +1). Misconception was mostly found on the concept of circulatory process (the closest score to -1). However students did not possess misconceptions on the concept of blood clotting (students' average score was greater than +1).

Based on the result of students average score on the diagnostic test, students held misconceptions on the whole concepts of respiratory system. Misconception was mostly found on the concept of vertebrate respiratory system (the closest score to -1). The rate of students' misconception on the concepts of respiratory system from the highest to the lowest, obtained by the average rate of diagnostic test were as followed: vertebrate respiration system (-0,21); human respiratory process (0,47); definition of breathing and

respiration (0,18); organs of respiration (0,36); invertebrate respiratory system (0,44); disorder of human respiratory system (0,47); gas exchange process (0,50).

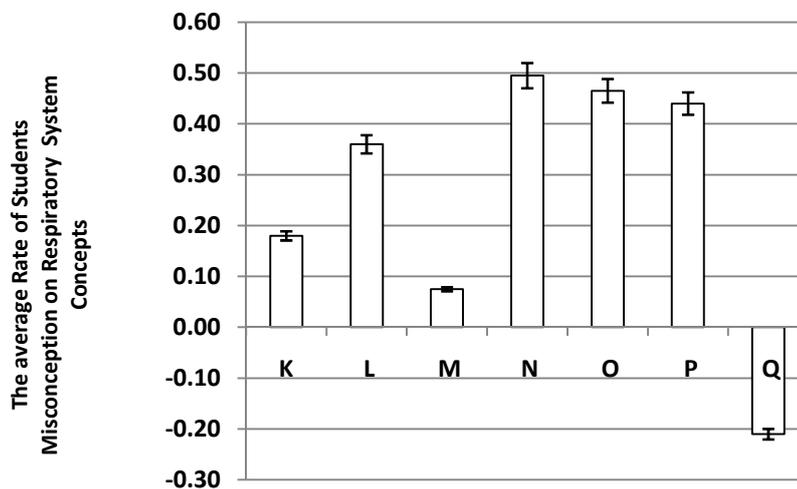
The Comparison of Student's Misconceptions on circulatory system are presented on figure as follows:



**Figure 2.** The Comparison of Students Misconception on Circulatory System

Explanation: A = Blood Components; B = The mechanism of blood clotting; C = Blood; D = Heart; E = Blood vessels; F = Circulatory Process; G = Lymphatic System; H = Disorders of Human Circulatory System; I = Circulatory System of invertebrates; J = Vertebrate Circulatory System

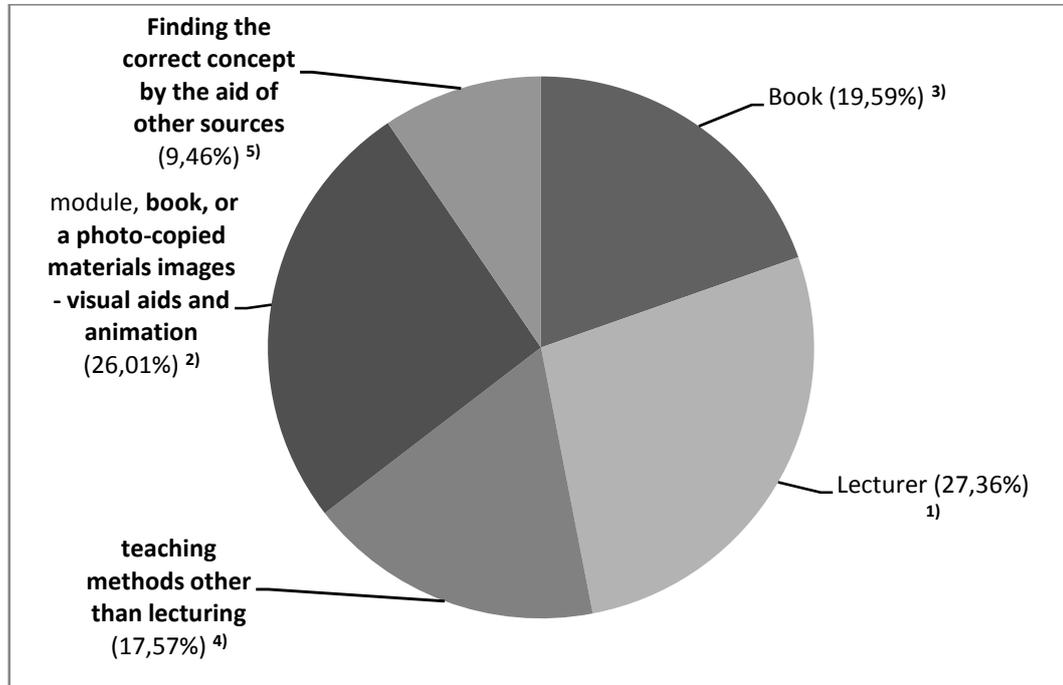
The Comparison of Student's Misconceptions on respiratory System are presented on figure 3.



**Figure 3.** The Comparison of students misconception on Respiratory System

Explanation: K = Definition of Breathing and Respiration; L = Organs of Respiration; M = Human Respiratory process; N = Gas Exchange; O = Disorders of Human Respiratory System; P = Invertebrates Respiratory System ; Q = Vertebrate Respiratory System

The interview was accomplished to find out the main causes of students' misconceptions on circulatory and the respiratory system topics based on the way of students acquired the learning concepts.



**Figure 4.** The Proportion of The Students Concept Sources obtained by Interview

Based on the results of the interview above, it showed that the concept of circulatory and respiratory system subtopics were mostly acquired from module, book, or a photo-copied materials images - visual aids and animation but it is found that students were less interested in enriching knowledge on biological concept by finding the correct concept using the aid of other sources. So that students in answering the diagnostic tests that are given to answer for the wrong reasons or not with a true scientific concept. It affects students' ability in diagnostic test, as they answer with incorrect reason or wrong scientific concepts

#### D. CONCLUSION

Based on the results of the study, the conclusions as follows :

1. The percentages of biology education students' misconceptions respectively found: 68.81% students possess misconceptions
2. The misconceptions of sub topics on circulatory system that were found as follows : blood components, blood clotting mechanism, blood types, hearts, blood vessels, blood circulation process, lymphatic system, human circulatory system, invertebrates and vertebrates circulatory system on students exclude blood clotting mechanism and blood types. Misconceptions of sub topics on respiratory system that were found as follows : definition of breathing and respiration, respiratory organs, human respiration mechanism, gas exchange process, the disorders of human respiratory system. Invertebrates and vertebrates respiratory system.
3. The causes of misconceptions come from : students itself, learning methods, and learning sources such as modules, books, or copies of learning matters

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