The Profile of Student Misconceptions on The Human and Plant Transport Systems

M Ainiah¹, M Ibrahim², M T Hidayat³

¹,²,³Science Education Department, Postgraduate, Universitas Negeri Surabaya, Campus Ketintang Surabaya 60231, Indonesia.

Email: mujizatul.ainiyah23@gmail.com

Abstract. This research aims to identify misconceptions on the human and plant transport systems. The research was done in the 8th grade in Indonesia. Data were collected to use a three-tier test. This type of research was used survey design. Content analysis was used to analyze the misconception data. The results of this research were the location of misconception of each student is different. The highest misconceptions identified in this research, namely: a) arteries that drain blood to the heart (73.3%); b) veins that drain blood from the heart (70.0%); c) place of oxygen and carbon dioxide exchange occurs in the veins (66.7%); d) blood pressure in veins greater than in capillaries (63.3%); e) absorption of water occurs diffusion and absorption of minerals occurs osmosis (76.7%); f) transport of photosynthesis process occurs by diffusion (66.7%); g) photosynthesis process occurs during the day (63.3%); and h) process of evaporation of water through the leaves are guttation (56.7%). The results of this research show that the level of students misconceptions on the of human and plant transport systems is still high so that it can serve as a reference to improve the learning process and the reduction of student misconceptions.

1. Introduction
The learning process in several areas in Indonesia still not takes place effectively because there is still a lot of students who have not yet reached the optimal mastery learning. The learning process is said to be effective if it can find out the condition of the students for achieving learning progress optimally. Failure in learning can be caused by students learning process difficulties resulting from misconception within the students. Learning will be more effective if teachers know students learning difficulties, one of which was caused by the misconception on students, because by knowing the learning difficulties experienced by the student teachers can find solutions to the issues facing students so that learning can be effective and can reduce misconceptions experienced students.

The research that has been done researchers in the journal "Science Education" has shown that students have their own student conceptions about the phenomenon of nature [1]. Siswa came to school with early knowledge about the phenomena that will be taught in learning, but many students develop an understanding of science concepts only to a limited extent only after the learning process in school [2]. If the initial construction conflicts with scientific concepts that are accepted by the experts then students are having a misconception, it acts as a barrier and prevents success in learning [3].

The level of understanding of the ability of students in receiving the subject matter varies between one student with other students. Some students have not yet understood the concept well and
have a different concept with a concept embraced by the experts so that students have difficulty in understanding the concept to explain various symptoms of nature. Students bring the initial idea about the natural phenomenon during learning in class, but there are times when the idea is inconsistent with the idea of generally accepted by experts [4]. The discrepancy of understanding the concept of beginning students with the concept of experts is often referred to as a misconception.

The misconception is the idea or view of a concept belonging to someone not in accordance with the agreed concept and is considered correct by the experts. The views are not appropriate (wrong) it is resistant and persistent [5]. The conception of the truth is the conception that fits the scientific concept based on the consensus of the experts [6]. The misconception that occurs in students caused by several sources, including names of students, teachers, textbooks used, context, and how to teach the teacher [7].

Identification of the misconception of students in learning science is the most important part [8; 9; 10; and 11]. Identification the misconception is the first step in teaching science. The role of science teachers is to know the misconception of students and guide students towards a better understanding through direct activities, investigation, and interaction with peers and adults [12]. Investigation on children's early knowledge is essential for students and teachers [13].

Students carry misconception themselves to school when learning science and the misconception that owned these students be a hindrance in developing new concepts. This is what led to the misconception that most students due to the initial concept (preconceptions) which is then brought to a formal education. When students have a misconception on any level, the role of teachers is important because it is necessary to remove the misconception that occurs in students. If the misconception is not removed from the students, then the student will feel unfamiliar with his new knowledge because students can't afford to assimilate new knowledge to the level that exists [14].

Research on understanding the concept of diffusion and osmosis obtained the results that the degree of misconception about the movement of the particles on the concept of diffusion and osmosis is quite high [15]. Research on the misconception on photosynthesis and respiration in plants obtained the results that the process of photosynthesis as energy providers process [16].

Concepts in science are the concepts that are interrelated and cannot be separated so that the learning of science should be taught in an integrated to obtain the understand students are intact don't break back. The material transport system of humans and plants is a material that has a connectedness with other concepts which include the circulatory system, diffusion and osmosis, and transportation systems in plants. This material has a high level of understanding of one concept with another concept that is interconnected. An act of diagnosis by using three-tier tests need to be done to detect the misconception of students on the material transportation system of humans and plants.

Three tiered test is the most valid form of test instruments, reliability, and correct the misconception of students rather than to identify instruments that shaped one tier and two tier test [17]. The three-tiered test is a three-tier test that is composed of three levels. The first level (one-tier) in the form of multiple choice to know the content, the second level (two-tier) is the choice of reason based on answers on the first level, and the third level (three-tier) in the form of a question the assertion of belief of the answer which has been selected in the first and second level [18; 19; and 20].

From the explanation above, this research aims to identify the misconception of students on the material transportation system of humans and plants. This research is expected to know the layout of the misconception of students that cause learning difficulties and low levels of student mastery learning outcomes.

2. Research method

Type of this research is descriptive research i.e. describe or illustrate misconceptions level students on the material transportation system of humans and plants. The research was done on the 8th grade Junior High School in Indonesia amounted to 30 students. The research design used, namely the research
survey. Data collection method using three-tier-based tests. The research instrument used by researchers is the sheet three-tier test. Data analysis using quantitative descriptive. Content analysis was used to analyze the misconception data. Analysis of the level of understanding and misconceptions students can be done by looking at the results answer the student after working on the tests given. The categories that classify student answers written in Table 1. 

| First-tier | Second-tier | Third-tier | Category                      |
|------------|-------------|------------|-------------------------------|
| True       | True        | sure       | Understand concept (TK)       |
| True       | Wrong       | sure       | Misconception (MK)            |
| Wrong      | True        | sure       | Misconception (MK)            |
| Wrong      | Wrong       | sure       | Misconception (MK)            |
| True       | True        | Not sure   | Understand the concept but not sure (PKTY) |
| True       | Wrong       | Not sure   | Not understand the concept (TTK) |
| Wrong      | True        | Not sure   | Not understand the concept (TTK) |
| Wrong      | Wrong       | Not sure   | Not understand the concept (TTK) |

3. Result and Discussion
Investigation of knowledge and misconceptions of students is very important for students and teachers in learning science [8; 9; 10; and 11]. The Three-tiered test can use identify student misconceptions on the matter of human and plant transport system [17]. The profile and location of the misconception that students vary. The profile of each student's misconceptions in the transportation system of humans and plants can be presented in Figure 1.

![Percentage of Students Misconception Profiles](image)

**Figure 1.** Diagram of the percentage of student misconceptions

Description:
PK: Understand the concept
PKTY: Understand the concept but not sure
MK: Misconception
TPK: don't understand the concept

The results of each student misconceptions on the material system of transportation along with humans and plants can be known is still quite high. The layout of the misconceptions and the level of understanding of the concept that every student is different, because of the ability of each student's knowledge in a different construct. Some students have not yet understood the concept well and have a different concept with a concept embraced by the experts so that students have difficulty in understanding the concept to explain various symptoms of nature.

The misconceptions students can be caused by a few things, namely learning resources are used well students, the misconception that happens to teachers, students in the condition of incomplete
reasoning, intuition is wrong, use of learning methods that teachers are less precise, and the experience of interacting with students in daily life [7]. Misconceptions owned these students be a hindrance in developing new concepts. This is what led to the misconception that most students due to the initial concept (preconception) which is then brought to formal education [14].

The knowledge beginning of the phenomenon of students will be taught in learning, but many students develop an understanding of science concepts only to a limited extent only after the learning process in school as revealed by [2; 4]. Students who are having a misconception to occur because of imperfections in the process of constructive knowledge students with preconception, so that the students can understand the concept only partly intact and not be a barrier to students to understand the material in learning [3].

Analysis of student answers every question on the three-tier test based on the guidelines for assessment of student answers in Table 1 [20]. The students responded with a confident in providing confidence profile high i.e CRI > 2.5. The calculation results of the percentage of the misconception that occurs on the item by using three-tiered test results that can be obtained are presented in Table 2.

| No. | Scientific Concepts                                      | The concept of Students                                      | Percentage of MK (%) (N=30) |
|-----|--------------------------------------------------------|-------------------------------------------------------------|-----------------------------|
| 1   | Booth left heart thick-walled                          | The porch right heart thick-walled                           | 50.4                        |
| 2   | A form of white blood cells irregular (ameboid) and has a core | A form of white blood cells concave discs in the middle and has no core | 46.9                        |
| 3   | Characteristics of vessels thick-walled, elastic, and is located in the body | Characteristics of vessels thick-walled, not rubbery, and located near the surface of the body | 47.8                        |
| 4   | Blood vessels vein the flow of blood toward the heart  | Blood vessels the artery the flow of blood toward the heart  | 73.3                        |
| 5   | Blood vessels the artery which drain blood from the heart | Blood vessels vein which drains blood from the heart         | 70.0                        |
| 6   | Circulatory system in humans occurs in an enclosed and double | Circulatory system in humans occur openly and double        | 42.4                        |
| 7   | Oxygen changed and carbon dioxide occurs in capillaries | Oxygen changed and carbon dioxide occurs in the venous vessels | 66.7                        |
| 8   | Blood pressure in capillaries greater                   | Blood pressure in capillaries smaller                       | 63.3                        |
| 9   | Water and nutrient transport occurs through xylem vessels | Water and nutrient transport occurs through phloem vessels  | 48.6                        |
| 10  | Factors affecting the transport of water to xylem the form of the pull of transpiration | Factors affecting the transport of water to xylem the form of the absorption roots | 49.2                        |
| 11  | The process of water absorption in soil in diffusion | The process of water absorption in soil in diffusion         | 76.7                        |
| 12  | The process of absorption of minerals from the soil in osmosis | The process of absorption of minerals from the soil in osmosis | 76.7                        |
| 13  | The time span of the process of photosynthesis occurs when there is light | The time span of the process of photosynthesis during the day | 63.3                        |
| 14  | Results of the Transport process of photosynthesis in diffusion | Results of the Transport process of photosynthesis in diffusion | 66.7                        |
| 15  | The process of evaporation of water through the leaves going through the pull of transpiration | The process of evaporation of water through the leaves occurs in guttation | 56.7                        |
The layout of the misconceptions students on the transportation system of humans and plants can be seen in Table 2. The question of the test used in this study amounted to 15 grains of matter. Misconceptions occur due to a concept belonging to someone not in accordance with the agreed concept and thought by experts [5].

The results of students misconception analysis in Table 2 that the highest misconception profiles occurred in the diffusion and osmosis process of 76.7%. The Students have difficulty in understanding the process diffusion and osmosis. Students having difficulty between dissolved substances or solvents that moved in the process of diffusion and osmosis. The results of the previous research also State that students experience the misconception is quite high on the concept of movement of particles in diffusion and osmosis [15].

The high misconception profiles can be caused by several things. The learning ethics teachers only explain the material in fragment-fragment, incomplete, and it is difficult to understand. The teachers are less familiar with the human and plants transport system because the teacher in question is having trouble physics teacher so to teach the material in integrated and teachers less understand a concept on biological material, so that in explaining the material only fragment-line. Teacher not being able to in providing integrated science materials description. This condition can cause the ability of students in construct preconception with new knowledge to form concepts whole cannot happen perfectly, so the misconception of students is high enough on the material transportation system of humans and plants.

The role of teachers very important necessary in eliminating the misconception that occurs in students. If the misconception is not removed from the students, then the student will feel unfamiliar with his new knowledge because students can't afford to assimilate new knowledge into existing levels [14]. Misconception students can be known and guide students towards a better understanding can be done through direct activities, investigation, and interaction with peers and adults as revealed by [12]. Teachers should know the knowledge preconception and the misconception that experienced by students because both of these factors is an important factor for improving student mastery learning.

4. Conclusion
Identification of the misconception that occurs students on the transportation system of humans and plants shows that the overall level of student's misconception is quite high that is on average about 60%. The location of misconception of each student is different. The highest misconception profiles were the absorption of water occurs diffusion and absorption of minerals occur osmosis i.e 76.7%. The other high misconceptions related to blood vessels, blood pressure, photosynthesis process, and guttation. The misconception that the students caused by the initial knowledge of students, students ability in the constructed knowledge, learning methods used by teachers, and understanding teacher.

5. References
[1] Treagust D F 1995 Diagnostic assessment of students' science knowledge. In Learning science in the schools Glynn S M & Duit R (Eds.) New Jersey Lawrence Erlbaum Associates Publishers
[2] Duit R and Treagut D F 2003 Conceptual change: a powerful framework for improving science teaching and learning International Journal of Science Education 25 (6), 671-agricultural 688
[3] Allen M 2010 Misconceptions in Primary Science (England Open: University Press)
[4] Fach M, de Boer Tanja, and Parchmann Ilka 2007 Results of an Interview Study of u.s. Bases for The Development of Tools for Supporting Stepped Stoichiometric Problems Chemistry Education Research and Practice 8 (1) 13-31
[5] Ibrahim M 2012 A Series of innovative Learning concepts, Misconceptions, and How his education (Surabaya: Unesa University Press) p 13
[6] Novak J d and Gowin D B 1984 Learning How to Learn (Cambridge: Cambridge University Press)
[7] Paul S 2013 *The misconception and the change of concept in physics education* (Jakarta: PT Grasindo) p 82.

[8] Osborne R 1985 *The children’s own concepts. In Primary Science: Taking the plunge* D Harlen (ed) (London: Heinemann Educational) pp 75-agricultural 91

[9] Staver J R 2007 Teaching science France *International Bureau of Education*

[10] Selley N J 1999 *The art of constructivist teaching in the primary school* (Great Britain: David Fulton Publishers)

[11] Ozmen H 2004 Some Student Misconceptions in Chemistry: A Literature Review of Chemical Bonding *Journal of Science Education and Technology (JRST)* **13** (2)

[12] Yip D 1998 Identification of misconceptions in novice biology teachers and remedial strategies for improving biology teaching *International Journal of Science Education* **20** (4) 461-477

[13] Ross K, Lakin L, and Callaghan P 2000 *Teaching secondary science* (London: David Fulton Publishers)

[14] Puspa V 2015 Student Misconceptions About Plant-A Sri Lankan Transport Example *European Journal Of Science And Mathematics Education* **3** pp 275-288

[15] Louis O A, Lloyd B H 1993 Freshman Biology Majors Misconceptions about Diffusion and Osmosis *Paper Presented at the Annual Meeting of the National Association for Research in Science Teaching* (Atlants, GA, April 15-19, 1993) SE **053 672** DE 362 399

[16] Treagust D F and Haslam F 1986 Evaluating secondary students’ misconceptions of photosynthesis and respiration in plants using a two-tiered diagnostic instrument *Paper presented at the 59th annual meeting of the National Association for Research in Science Teaching* San Francisco California March 28 the use of 31

[17] Haki P and Ali E 2010 Development of a Three-tiered Test to Assess Misconceptions About Simple Electric Circuit *The Journal Of Educational Research* **103** pp 208-222

[18] Demet K Z 2014 Using Three-Tier Diagnostic Test to Assess Students’ Misconceptions of States of Matter *Eurasia Journal of Mathematics, Science, & Technology Education* **10** (5) pp 509-521

[19] Yasin K 2005 *The Diagnosis of Eleventh Grade Students’ Misconceptions about Geometric Optics by a Three-tiered Test* (Thesis: Middle East Technical University)

[20] Fatma T 2005 Developing a Three-tiered Test to Assess High School Students’ Misconceptions Concerning Force and Motion (Thesis: Middle East Technical University)

[21] Arslan H, Ozge, Ceyhan Cigdemoglu, and Christine Moseley 2012 A Three-Tier Diagnostic Test to Assess Pre-Service Teachers’ Misconceptions about Global Warming, Greenhouse Effect, Ozone Layer Depletion, and Acid Rain *Internation Journal of Science Education* **34** (11) p 1667-1686