JURNAL PELITA PENDIDIKAN VOL. 4 NO.3 ISSN : 2338 - 3003
Hutagaol, C.S. & Haarsono, T SEPTEMBER 2016
Halaman : 001 - 009

ANALYSIS OF STUDENTS' MISCONCEPTION ON THE TOPIC OF HUMAN EXCRETORY SYSTEM IN GRADE XI SMA NEGERI DISTRICT MEDAN KOTA

Carolina Savitry Hutagaol*, Tri Harsono
Jurusan Biologi FMIPA, Universitas Negeri Medan
*Email: carolsavi3@gmail.com

Abstract

The purpose of this study were to analysis the presence of misconception , concept that become misconception, percentage of concept that become misconception and the source and cause of students' misconception on the topic of human excretory system in grade XI SMA Negeri District Medan Kota. This research type was descriptive. The samples were 168 students from 2 SMA Negeri in District Medan Kota. Data collected by using diagnostic test follow with open reasoning and source of learning. The result show the students have misconception with concept function of lungs as excretory organ was concept that highest become misconception for students. Percentage of concept that become misconception was 100%. The highest source and cause of misconception in this study was book/literature. The author proposed the students to select the book/literature that use in study.

Keywords : diagnostic test, human excretory system, misconception

INTRODUCTION

In essence, the Natural Sciences is the science of natural phenomena, in the form of facts, concepts, principles and laws, the truth has been tested and achieved through the scientific method. According to Kara and Yesiyurt cited by Yusnawati (2011) the objective learning of the Natural Science is to help students develop an understanding of the concepts and know how to apply these concepts in life. Understanding the concept is very needed, help students to describe that concept and connect with the other concept then can explain the natural events around them (Winahyu, 2007). However, errors often occur where the concept received incompatible with the actual concept. The concepts that have peculiar interpretations and meanings in students' articulations that are not scientifically accurate called as misconceptions. According Suparno (1997) misconception is the concept that incompatible with the concept that recognized by the experts.

Daily used phrases, intuitional learning, misconceptions in textbooks, and teachers explanations could cause misconceptions in students minds (Tekkaya, 2002).Therefore, misconceptions can occurs at the inside and outside of the school environment. Teachers and books can be as the source of misconceptions in the school environment. Duit (2007) report his research that since 1980s the role of teachers conception in teaching and learning science has been investigated. In the result of his research, show that there are many teachers who have science concepts and teaching process which do not fit with the scientific concept and often similar with students pre-instructional conceptions. Not only the teachers, textbooks and student's daily experience also can causes misconceptions (Suparno, 2005).

Misconceptions are believed to negatively affect for students conceptual development. Bodner (1986) indicated that misconceptions would be an obstacle to constructing new knowledge regardless of the quality of teaching. It won't be easy to change or to remove the misconceptions (Sahin, 2008).

Misconceptions that occur in one topic or matter in biology can be an obstacle to understanding the other biology topic. Many concepts in biology are interrelated and they are keys to understanding the other concepts, so that misconceptions on one concept lead to misconceptions on the other concept. For example, without understanding of photosynthesis, the concepts of food chain and food web are meaningless to students. However, before

photosynthesis, students must understand the distinction between producers and consumers, as well as organic and inorganic molecules (Tekkaya, 2002).

According Din-Yan (1998) students in Hong Kong show misconception in the concept of excretion. In his research, showed that most students did not view exhalation as an excretory process. One possible reason is that many students were not able to relate the removal of carbon dioxide during exhalation to an excretory role, as exhalation was learned in the context of ventilation and not linked with excretion. These students wrongly considered the undigested waste as an excretory product. The idea of metabolic waste is a difficult and abstract concept for the average student and is not well understood even after formal instruction. It is interesting to note that this conceptual problem was shown by students of all ranks to a similar extent, which means that even some of the high ability students had difficulties in distinguishing the two processes. From the observation with biology teachers in SMA Negeri at District Medan Kota, indicates the biological misconceptions in students. The teachers say that students grade XI are often not clear in outlining the concept and give examples, students show misconception about human excretory system. Students do wrong in apply the meaning of excretion, in other words, student do wrong in distinguish which can classified into the excretion process. For example, students view CO_2 just as the result of respiration, not related with the excretion process..

Based on the background that has been submitted, we can get illustration where the misconceptions have a negative effect on learning outcomes. Therefore, misconceptions must be corrected. Before misconceptions can be corrected, we need to identify the misconceptions. As the first step, researcher want to identify whether misconception on the topic of excretory system also happens to the students of SMA Negeri in Medan academic year 2015/2016.In an effort to identify the presence of misconceptions on the topic of excretory system at the students of SMA Negeri in Medan, researcher want to conduct research about Analysis of Students' Misconception on The Topic of Human Excretory System in Grade XI SMA Negeri District Medan Kota.

RESEARCH METHOD

Location and Time. This research conducted in SMA Negeri in District Medan Kota. The research conducted from March until June 2016 on the second semester academic year 2015/2016.

Population and Sample. Population in this research is all of students of class science in grade XI SMA Negeri District Medan Kota. Sample is students from two class science in Grade XI SMA Negeri District Medan Kota with total number 168 students. Determination of the schools sample defined by purposive sampling technique that is based on the willingness of the school. Class sample determined by cluster sampling technique, consist of two class science of Grade XI for each school. Students sample from class sample determine by total sampling technique.

Kind of Research. The nature of this research is descriptive, just identify phenomenon or event without give treatment or controlled it and does not intended to test the hypothesis. This research just identify or analyze the understanding of students related to the misconception in human excretory system.

Research Procedure.

As first step, researcher do observation to the school and do some interview with teacher and student also take the data of students number in class science grade XI for SMA Negeri Se-Kecamatan Medan Kota. Two-Dimensional Multiple Choice Testing used as diagnostic instrument to diagnose student's misconception for the topic Human Excretory System. Validation validated by validator for the instrument about the content and the construct. After that, instrument were given for each student to get the data. The data analyzed by using Microsoft Excel and get the conclusion based on the result. Interview also done for some students based on their result from the diagnostic test.

Research Instrument. Two-Dimensional Multiple Choice Testing used as diagnostic instrument. There are 30 questions about Human Excretory System with five choices of answer follow by question confirmation which asks the student to indicate their level of confidence in their answer and also follow up with open reason.

Table 1. Grading for Two-Dimensional Question

Answer	Level of Confidence	Score
Correct	Confidently	+3
Correct	Not Confident	+1.5
Correct	No Idea	+1
Incorrect	Confidently	-1
Incorrect	Not Confident	-0.5

Source :Klymkowsky, 2006

Although two-dimensional tests (TDTs) aim to determine students' certainty or confidence in their answer, TDTs doesn't show which grade indicate misconception. It is simply a way to help determine if the student is guessing (nothing more). To define which grade indicate misconception, the six-point scale and decision matrix of Certainty of Response Index (CRI) used as references.

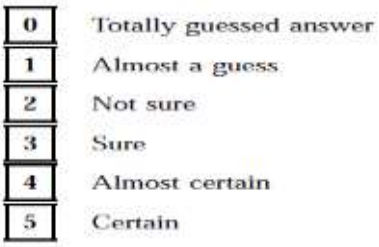

Figure 1. The six-point scale (0–5) used on Certainty Response Index (CRI) (Hasan, et al., 1999)

According the grading in CRI, in TDTs correct answer with confidently (+3) categorized know or correct concepts; correct answer with not confident/no idea (+1.5/+1) categorized lack of knowledge; wrong answer with not confident (-0.5) categorized lack of knowledge; wrong answer with confidently (-1) categorized misconception.

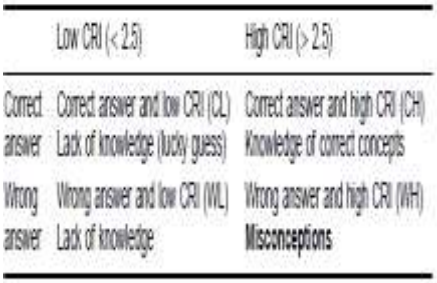

Figure 2. Decision matrix for an individual student and for a given question. Based on combinations of correct or wrong answer and of low or high CRI (Hasan, et al., 1999)

RESULT

Analysis of Students' Misconception of Each Sub-Concept

The result of diagnostic test show misconception of students for the concept on the topic of human excretory system and illustrated as in Figure 3 until Figure 5. From Figure 1. it was known number of students who do have misconceptions for each sub-concept (question) from question number 1-10, as follow: number 1 consist of 2.98% students, number 2 consist of 20.24% students, number 3 consist of 11.90% students, number 4 consist of 20.83% students, number 5 consist of 28.57% students, number 6 consist of 15.48% students, number 7 consist of 12.50% students, number 8 consist of 13.69% students, number 9 consist of 23.81% students, and number 10 consist of 33.33% students.

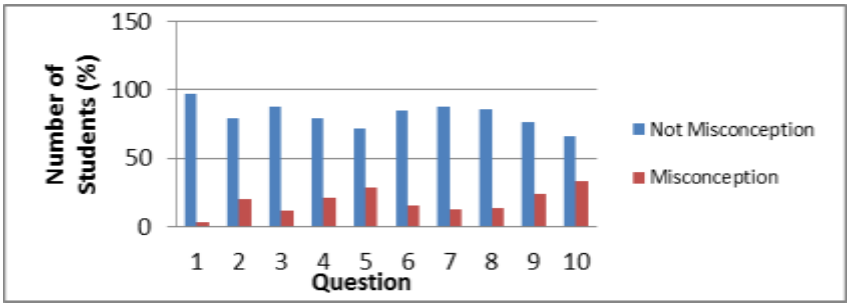

Figure 3. Number of students who do not have misconceptions and have misconceptions for each question from question number 1-10

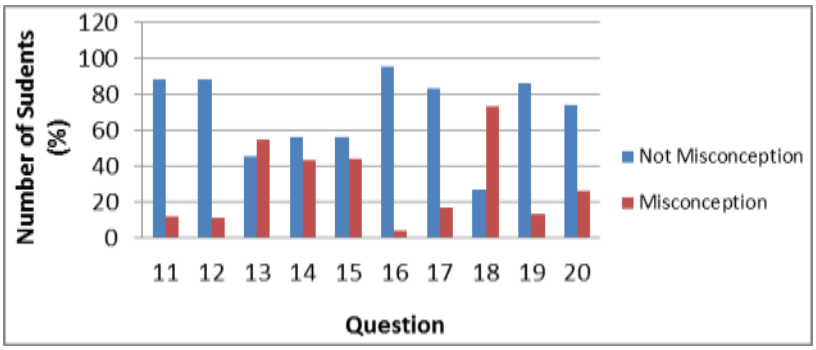

Figure 4. Number of students who do not have misconceptions and have misconceptions for each question from question number 11-2

From Figure 4. it was known number of students who do have misconceptions for each sub-concept (question) from question number 11-20, as follow: number 11 consist of 11.90% students, number 12 consist of 11.31% students, number 13 consist of 54.76% students, number 14 consist of 43.45% students, number 15 consist of 44.05% students, number 16 consist of 4.17% students, number 17 consist of 16.67% students, number 18 consist of 73.21% students, number 19 consist of 13.69% students, and number 20 consist of 26.19% students.

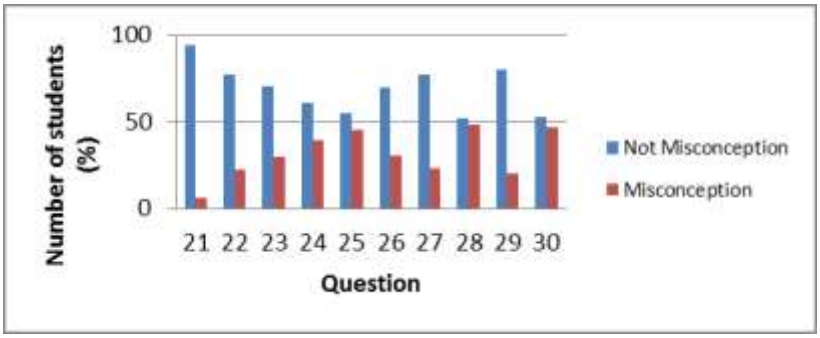

Figure 5. Number of students who do not have misconceptions and have misconceptions for each question from question number 21-30

From Figure 5. it was known number of students who do have misconceptions for each sub-concept (question) from question number 21-30, as follow: number 21 consist of 5.95% students, number 22 consist of 22.62% students, number 23 consist of 29.761 students, number 24 consist of 39.29% students, number 25 consist of 45.24% students, number 26 consist of 30.36% students, number 27 consist of 23.21% students, number 28 consist of 48.21% students, number 29 consist of 20.24% students, and number 30 consist of 47.02% students.

Analysis of Source and Cause of Students' Misconception

There were 3 source and cause of students' misconception was analyzed, they are teacher, book/literature, and environment. Source and cause of misconception calculated based on the total number of students who have misconception for each sub-concept (question). The result from students' about source and cause of their misconception for each question shown in Figure 6 until Figure 8. From Figure 6 until Figure 8, shown source and cause of students' misconception not same for all the question.

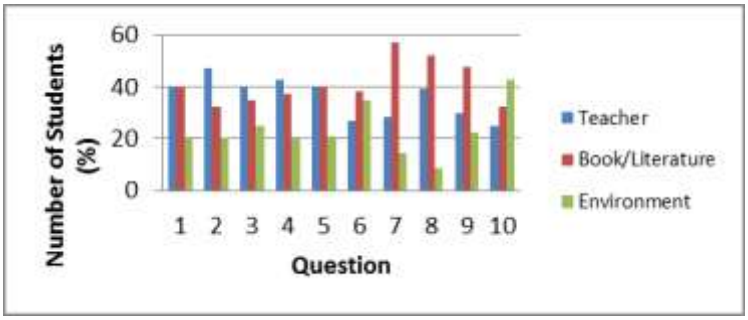

Figure 6. Source of students misconceptions for each question from number 1-10

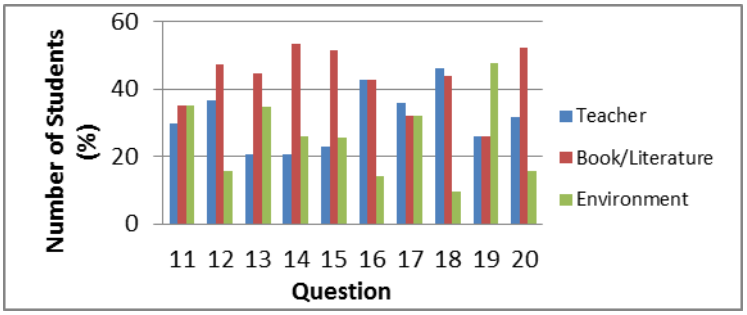

Figure 3.5. Source of students **misconceptions** for each question from number 11-20

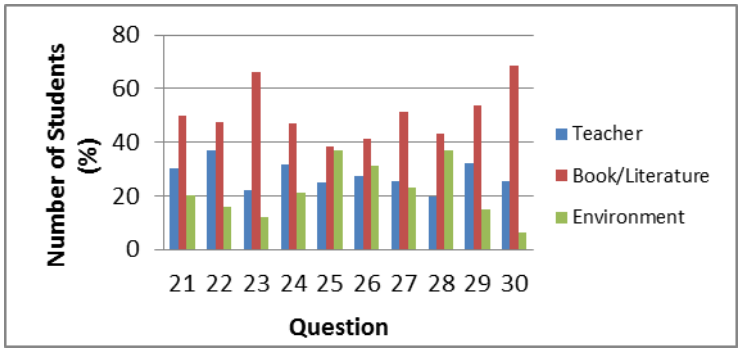

Figure 8. Source of students misconceptions for each question from number 21-30

In question number 2, 3, 4, 17, 18 was teacher as highest source and cause of students misconception. In question number 6, 7, 8, 9, 12, 13, 14, 15, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 was book/literature as highest source and cause of students misconception. Question number 1, 5, 16 was both of teacher and book/literature as highest source and cause of students misconception. While, in question number 10,19 was environment as highest source and cause of students misconception. But in question number 11 was book/literature and environment has same result as highest source and cause of students misconception.

DISCUSSION

Students in Grade XI SMA Negeri District Medan Kota indicated have misconception on the topic of human excretory system. From the result of the diagnostic test, all of the concept on the topic of human excretory system become misconception for students. It means, 100% of the concept on the topic human excretory system become misconception for the students. Percentage of misconception vary in each sub-concept (question).

In sub-concept 1 (question 1) 4.17% students have misconception. Many students wrong in define excretion because they see words “zat sisa” and related with feces where the feces related with defecation and finally make themselves choose defecation. Students also belief the process to excrete metabolic waste as secretion. In sub-concept 2 (question 2) 20.24% students indicated have misconception. Students was wrong in connecting the concept of excretion with our activity. Many of them belief that defecate as excretion activity and breathe doesn’t include into the excretion. Sub-concept 3 (question 3) 11.90% students have misconception where too many students assume the process to secrete the enzyme and hormone as endocrine because endocrine related with hormone. Sub-concept 4 (question 4) 20.83% students indicated have misconception. Some students understand the concept secretion, but when ask about the example, they answer produce of sweat as secretion because sweat still used, means students can’t connect the concept with the real example. Sub-concept 5 (question 5) 28.57% students have misconception. Some students understand the concept secretion, but when ask about the example, they answer produce of sweat as secretion because sweat still used, means students can’t connect the concept with the real example.

Sub-concept 6 (question 6) 15.48% students have misconception, too many assume the picture of proximal convoluted tubule as henle or distal convoluted tubule. Form of part number 3 which like a curve causes student assumed it as the loop of Henle. Sub-concept 7 (question 7) 12.50% students have misconception. Glomerulus assumed by students as structural and functional unit of the smallest filter because filtration occur in glomerulus. They didn’t pay attention with the word “unit”. Sub-concept 8 (question 8) 13.69% students have misconception. Students can’t defined well the stages of urine formation. Sub-concept 9 (question 9) 23.81% students have misconception. Students choose produce urine which does not contain red cells, but the protein less than 0.03% as definition of augmentation. Students know augmentation as final stages in urine formation that means the urine finished formed and then connect the word “menghasilkan” in one of choice and finally choose produce urine which does not contain red cells, but the protein less than 0.03% as definition of augmentation. Sub-concept 10 (question 10) 33.33% students have misconception. The students assume the symptom of kidney failure is the kidney doesn’t produce urine or produce lots of urine.

Sub-concept 11 (question 11) 11.90% students have misconception. Many students assume from the question, there is substance that doesn’t reabsorbed well and finally choose the answer is proximal convoluted tubule because it as place where the reabsorption occur. Sub-concept 12 (question 11) 11.31% students have misconception. Students assume that substances which emulsify fats (bile) stored in liver not in special place (gallbladder) because the often hear the liver produce bile and finally assumed the bile stored in liver. Sub-concept

13 (question 13) 54.76% students have misconception. Students assume that urine formation just related with kidney and liver doesn't participate. Students said that in learning, kidney as an organ that more often have role in urine formation causes students thought that kidney as single organ that work in urine formation. Sub-concept 14 (question 14) 43.45% students have misconception. Too many students choose bilirubin as a residual substance produced by the liver and the reason because bilirubin more often explain when discuss about liver rather than ammonia that explained in urine formation. Sub-concept 15 (question 15) 44.05% students have misconception. Some students assumed that liver said as excretory organ because bile that produced by liver come from metabolism of amino acid. Other students think the reason of liver said as excretory organ because the bile still used in the process of digestion and produced by breakdown of erythrocytes. Students also apply concept excretion to answer the reason liver called as excretory organ, but they do mistake by assume the breakdown of erythrocytes as excretion .

Sub-concept 16 (question 16) 4.17% students have misconception. Many students didn't consider CO_2 as the result of excretion. Sub-concept 17 (question 17) 16.67% students have misconception. Students do mistake in define which has 2 lobes and which has 3 lobes. Sub-concept 18 (question 18) 73.21 % students have misconception. Most of the students belief lungs called as excretory organ because the CO_2 that excreted by lungs is the result from reaction with O_2 in lungs. Students are taught about CO_2 as a result of excretion, but release of CO_2 more linked with CO_2 as the rest of respiratory and produced from the reaction with CO_2. Students said that release of CO_2 more often associated with function of lung as respiratory organ causes some students belief that lungs didn't related with excretory system. Sub-concept 19 (question 19) 13.69% students have misconception. The students belief the picture of sweat gland as nerve. . The students wrong identify the sweat gland as nerve because when answer this question, students connect the fact that our body consist of nerve causes students choose the nerve as their answer. Sub-concept 20 (question 20) 26.19% students have misconception. Students assumed the picture of pore of sin as nerve endings.

Sub-concept 21 (question 21) 5.95% students have misconception. Many students choose oil as substance that excreted by skin. Sub-concept 22 (question 22) 22.62% students have misconception. Sweat believed by students have function to clean our skin from waste and throw away excess of water. Sub-concept 23 (question 23) 29.76% students have misconception. Too many students assume volume of water in tissue affect the volume of water that released from the body. Sub-concept 24 (question 24) 39.295 students have misconception. Students thought the word osmoregulation similar with osmosis and define the osmoregulation by connecting with concept osmosis and finally assumed one of osmoregulation phenomenon where the body fluids isotonic with the external environment. Sub-concept 25 (question 25) 45.24% students have misconception. most students thought that the reason of urine yellowish because ammonia.

In sub-concept 26 (question 26) 30.36% students wrong in define the organ of excretory and kind of metabolic waste that excrete by the organ. Sub-concept 27 (question 27) 23.21% students have misconception. Students belief urine contains high concentration of salt and the taste of urine is salty like our sweat. Sub-concept 28 (question 28) 48.21% of students have misconception. Students also thought that when our body excrete sweat too much, our urine become more aqueous and percentage of urea decrease because urea already excrete together with our sweat. Sub-concept 29 (question 29) 20.24% students have misconception. Students can't defined well the order of kidney part that passed in urine formation. Sub-concept 30 (question 30) 47.02% students have misconception. The students define the step where urine still have substances that useful such as glucose, salt, and amino acid as reabsorption.

From the result show the students wrong in explain the concept and fail in connecting one concept to answer the question. Brown (2000) stated that misconception was the wrong explanation and ideas that were inconsistent with the scientific understandings. Yip (1998) stated students' have problem in understanding the concept of excretion. In this study, students assume excretion as process that throw away unwanted materials also feces. Students also fail to relate between exhalation and concept of excretion.

In this study, book/literature as source and cause of misconception in 19 sub-concepts (question) for students. Students said they learn not just from textbook but also from internet. Some students said the language from the internet more easy to understand and sometimes the information that given by textbook is not complete. Storey (1991) stated another factor that contributes occurrence of misconception by students is textbooks, which include many errors and incorrect information. Lack of integration among topics in textbooks influence students' further understanding. According National Research Council (NRC) (1996), textbooks play an important role in learning biology as a source of information about the basic concepts of biological, experimental and scientific research. In this case, the language used in the textbooks should can be understood by students. Teacher, teacher as source of misconception in 5 sub-concepts (question) and the students reasoned that the teacher didn't explain the concept briefly. Hiller in Hewindati and Suryanto (2004), states that there is a close relationship between quality of explanations and knowledge of teachers with student learning achievement. Environment as source of misconception in 2 sub-concepts (question) in this study and students said that the reason is their friend. When do the test, some student ask their friend because they can't remember well about the concept, but as long they ask their friend, just make them confused and finally more believe in the concept owned by their friend than themselves. For example, concept about disorder or disease of the kidney, some students though symptom of kidney failure is "present of albumin and protein in urine" but because their friend, they change their answer become "didn't produce urine".

CONCLUSION

The students in Grade XI SMA Negeri District Medan Kota have misconception on the topic of Human Excretory System. All the concept on the topic of human excretory system become misconception for the students. From the result, 100% concept on the topic of human excretory system become misconception for the students in Grade XI SMA Negeri District Medan Kota. Book/literature as highest source and cause of students' misconception.

ACKNOWLEDGEMENT

Thanks to the Father which are in heaven for his bless and love in everyday and every time. My great thanks for my family, mainly my parents, E. Hutagaol and R. Sinambela. Also thank you Drs. Tri Harsono, M. Si for his guidance and support during write this thesis.

REFERENCES

Bodner, M. G. (1986). Why Good Teaching Fails and Hard Working Students Don't Always Succeed. *Journal of Chemical Education*, 63: 873-878

Din-Yan, Y. (1998). Alternative Conceptions on Excretion and Implications for Teaching. *Education Journal*, 26 :1

Duit, R. (2007). Science Education Research Internationally : Conceptions, Research Methods, Domains of Research. *Eurasia Journal of Mathematics, Science & Technology Education*, 3(1): 3-15

Hassan, S., Bagayoko, D. and Kelley, E.L. (1999). Misconceptions and The Certainty Response Index (CRI). *Physics Education,* 34(5)

Klymkowsky, M.W., Taylor, L.B., Spindler, S.R., Garvin-Doxas, R.K. (2006). Two-Dimensional, Implicit Confidence Tests as A Tool for Recognizing Student Misconceptions. *Journal of College Science Teaching*.

Sahin, C., Ipek, H., and Ayas, A. (2008). Students' Understanding of Light Concepts Primary School: A Cross-Age Study. *Asia-Pacific Forum on Science Learning and Teaching*, 9(1): 1

Suparno, P. (1997). Filsafat Konstruktivisme dalam Pendidikan. Yogyakarta : Kanisius.

Suparno, P. (2005). *Miskonsepsi & Perubahan Konsep Pendidikan Fisika*. Jakarta: Grasindo

Tekkaya, C. (2002). Misconceptions as Barrier to Understanding Biology. *Journalof Hacettepe University Education Faculty*, 23: 259-266

Winahyu, E. (2007). Perkembangan Sains : Suatu Telaah Atas Pendekatan Paradigma Baru. *Jurnal Ilmu Hukum*, 10: 68-86

Yusnawati, D. (2011). Analisis Miskonsepsi Siswa dan Guru Biologi tentang Materi Sistem Respirasi dan Ekskresi pada SMA Negeri se-Kabupaten Labuhanbatu. Unpublished Master's Thesis. Medan : Program Pascasarjana Universitas Negeri Medan.