International Journal of Education Humanities and Social Science

ISSN: 2582-0745
Vol. 3, No. 01; 2020

STUDENT MISCONCEPTION ANALYSIS IN THE BIOTECHNOLOGY CONCEPT WITHCERTAINTY OF RESPONSE INDEX

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ABSTRACT
Various misconceptions that occur while learning biotechnology concepts can further discourage students from learning, as they consider biotechnology concepts as difficult, not prospective, and require much time in order for it to be understood. The purpose of the study was to reveal how many misconceptions experienced by students in the scope of biotechnology and recombinant DNA technology and to find out the factors that caused students to experience such misconceptions.The research apply a qualitative approach with a qualitative descriptive research method. The study population was a student of Biology Education Program in STKIP Persada Khatulistiwa Sintang, and the research participants were 37 students. The research data were collected through diagnostic tests in the form of multiple choices and interviews. The collected data were then analyzed by using Certainty Of Response Index and also descriptive anaylisis. The result of data analysis showed that the percentage of students' on the concepts of Biotechnology scope and Recombinant DNA is 26% and 40%, respectively. The results of the interview showed that students's misconception was caused by their prior knowledge regarding the concepts. For faculty members, it would be beneficial to conduct research on students misconception regarding other sub-materials. It is important for teachers to determine students level of understanding regarding the concepts that will be taught, as it will be the basis for them to construct new knowledge, particularly to apply what they already learned.

Key Words: Misconception, biotechnology, students, Indonesia.

1. INTRODUCTION
Biotechnology is a study about the application of the principles of biology, biochemistry, and engineering in the processing of materials by utilizing biological systems and their components to develop various products and services. Data of a survey conducted in STKIP Persada Khatulistiwa Sintang West Kalimantan Indonesia shows that students consider Biotechnology as one of incomprehensible course. Hence, researchers in this study are interested in assessing the students' understanding on biotechnology concepts as well as detecting their

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misconceptions regarding biotechnology.

The PISA results show that mathematics and science achievements among Indonesian students is very low. This may occur due to the lack of conceptual understanding as well as the misconceptions experienced by the students (Rachmawati *et al.*, 2017). Misconceptions can occur when students are trying to construct knowledge by translating or understanding new experiences in the form of preconception (NSTA, 2013). Conception that tends to be wrong or a conception which is inconsistent with scientifically accepted ideas is called misconception (Tekkaya, 2002). The ability of students to understand and master scientific concepts is a major problem faced by teachers. This is caused by two main factors. The first factor is because students are not accustomed to use their reasoning skills, since they are more familiar with memorizing rather than understanding the concepts contained in the subject matter (Haryono, 2013: 2). Consequently, the knowledge gained by students is only temporary. Hence, it will lead to the construction of the wrong concepts. The second factor is students' preconceptions, which is the initial knowledge or understanding that students may acquire from their experience. The experience can come from the environment or from the concepts that have been previously obtained. The initial concept can be from textbooks or from teachers (Widodo, 2012: 2).

Duda (2016) explained that misconceptions experienced by students can occur as they misinterpret natural phenomena or the events faced in their lives. Misconceptions that students obtained during high school will still remain, even after they enter college. Misconceptions usually develop along the learning process. Several other studies show that the misconceptions experienced by students are not only occur in the concepts of photosynthesis and plant respiration, but also occur in the concepts of ecology, genetics, classification of living things, and circulation systems (Tekkaya, 2002). Choirina's research (2019) also reveals that there are misconceptions in the concept of Kingdom Plantae, which include monocots and dicots; morphology of *Anacardium occidentale*, *Musa* sp. and *Solanum tuberosum*; and classification of *Anacardium occidentale* .

This research is important because misconceptions experienced by students can mislead themselves in understanding scientific phenomena and in conducting scientific explanations. If students are not aware of their misconceptions, there will be confusion and incoherence in them. If it is not immediately corrected, the misconception will become an obstacle for students in further understanding the concepts to be learned. If students' misconceptions continue to be maintained, students will pass on the wrong concept to the next generation, especially since the student is a teacher candidate. In addition, the misconceptions experienced by students will disrupt the learning process and also the application or application of the knowledge. As a result, misconception is a real barrier to students' understanding of biology. Students who are aware of the misconceptions will find it easier to change and correct their misconceptions. Moreover, they will also be able to form conceptual connections independently. In addition, students will easily decide which is right and which is wrong about a concept. Furthermore, students can also construct and reconstruct their conceptions actively. In this study, the researchers used the Certainty Of Response Index (CRI) method to reveal student misconceptions .

Certainty of Response Index is one way that can distinguish between students who experience misconceptions and those who experience the lack of knowledge (Haris, 2013: 78). This is supported by the results of a study conducted by Purba and Depari (2008: 17) which shows that the use of *CRI* can distinguish between students who experience misconceptions and

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students who experience the lack knowledge. The CRI technique can measure a person's misconception by measuring a person's level of confidence or certainty in answering each question (Siwi, 2013: 26). The CRIis considered very easy to be used in revealing misconceptions as it provides a scale of respondents' level of confidence while answering the given questions. The scale at the CRI has different values according to each criterion. The CRI criteria can classify and differentiate students into three main groups, namely students who know the concepts, students who hold misconceptions, and students who do not know the concept.

In this research, biotechnology concepts being studied are the scope of biotechnology and the recombinant DNA technology. Hence, questions on these concepts were developed to reveal students misconceptions. The formulation of the research problem ishow the misconceptions experienced by students in the scope of biotechnology and recombinant DNA technology and what factors are causing students to experience these misconceptions.This research aims to reveal how many misconceptions experienced by students in the scope of biotechnology and recombinant DNA technology and also to find out the factors that caused students to experience such misconceptions.

2. METHOD

Research Design

The approach used in this study is qualitative research approach with a descriptive qualitative method that do not give treatment, manipulation or change to independent variables, but describe a condition as it is. ResearchQualitative has the characteristics of having a natural setting, meaning that research is donein a reasonable and realistic situation from a real phenomenon, settingnaturally is a source of data, the researcher himself acts asresearch instrument (Sugiyono. 2014).

Sample

The population in this study were all students who had taken biotechnology courses in STKIP Persada Khatulistiwa Sintang Kalimantan Barat, Indonesia. The sampel of this study were 37 students who were selected through puposive sampling. The diagnostic test instrument was first tested to determine its validity, reliability, level of difficulty, and discrimination power. Furthermore, a CRI analysis was conducted to distinguish students who knew the concept, students who did not know the concept, and students who experienced misconceptions based on the combination between the right or the wrong answers and the level of students CRI response.

Research instruments

The data were collected by using multiple choice diagnostic tests and interviews. On each question items of the multiple choice diagnostic tests, students were asked to choose the answer that is considered the most correct by completing the table of certainty. Respondents must also write an index of confidence regarding their answer or Certainty of Response Index (CRI) consisting of numbers 1-5 (Hasan, Bagayoko, Kelley, 1999). The number of questions for sub-concepts the scope of biotechnology is 15 questions, while the concept of recombinant DNA technology is 14 questions.Furthermore, interviews were conducted with students who experienced misconceptions to find out the cause of their misconception.

Data Analysis

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Data analysisconsisted of 4 stages, namely data collection, data presentation, data reduction and conclusion drawing / verification(Miles and Hubermen in Sugiyono. 2014). In this study using the CRI format in data collection and data analysis.Analysis of misconception data in this study was carried out according to the CRI analysis conducted by Hasan, Bagayoko, Kelley (1999). CRI is a measure of the confidence or certainty level of the respondent while answering each question given. A low CRI indicates a lack of respondents' confidence regarding the concepts they use to answer a question, whereas a high CRI reflects high self-confidence and certainty of respondent regarding the concepts they have while answering a question. CRI is developed on a scale of six (0 - 5) as in Table 1.

Table 1. CRI and its criteria

CRI	Criteria
0	(*Totally guessed the answer*)
1	(Almost guess)
2	(Not Sure)
3	(Sure)
4	(Almost certain)
5	(Certain)

In order to clarify the assessment, the following information (Table 2) will provide explanation on the provisions for distinguishing between understanding of concepts, misconception,and not knowing the concept for individual respondents.

Table 2. CRI Analysis Based on Answers Criteria

Criteria of Answers	Low CRI (CRI <2.5)	High CRI (CRI> 2.5)
Correct Answer	Correct answer with low CRI reflects that participants does not know the concepts (Lucky guess)	Correct answer with high CRI reflects that the participants have mastered the concepts
False Answer	False answer with low CRI reflects the participants does not know the concept	False answer with high CRI reflects that participants hold misconception

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Data on Table 2 shows that a correct answer with a low CRI reflects a lucky guess, which means that participants does not have knowledge regarding the concept being assessed. Similarly, False answer with low CRI also means the participants does not have knowledge regarding the concepts. If a correct answer is provided with a high CRI, it reflects a well understanding regarding the concepts. Meanwhile, a false answer with a high CRI means that the participants hold a misconception regarding the concepts being assessed. Subsequent to categorization, the percentage of each criterion is calculated using the following formula:

Percentage of X = X / N X 100%
Percentage of Y = Y / N X 100%
Percentage of Z = Z / N X 100%

Description :

X = Number of students who know the concept
Y = Number of students who do not know the concept
Z = Number of students with misconceptions
N = Total number of students

An analysis of students' understanding of each sub-concept was then carried out by adding up the percentage of students who knew the concept and those who did not know the concepts in each sub-concept which were assesed based on their level of confidence in each test items. In order to investigate the cause of misconception, interviews were conducted with several participants who experience misconceptions.

4. RESULTS

The following will describe the findings of misconceptions experienced by biology education students. Based on the analysis of misconceptions hold by 37 respondents regarding the scope of biotechnology and recombinant DNA technology concepts through CRI method, it is found that many participants hold different misconceptions regarding the biotechnology concepts. The following data shows the sub-materials of biotechnology concepts being observed in this study.

Table 3. Indicators of biotechnology study material being observed

No.	Study Material	Sub material
1	Scope of Biotechnology	Definition of Biotechnology History of Biotechnology Traditional and Modern Biotechnology Benefits of Biotechnology (advantages and disadvantages / impact of biotechnology)
2	Recombinant DNA Technology	Definition of recombinant DNA technology Mechanism of recombinant DNA technology Benefits / Impact of Recombinant DNA Technology

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Analyzing student misconceptions by using CRI is to scrutinize students test result by checking their answers to multiple-choice test items and the CRI scale given in each test items. The combination of students answer and the CRI scale provided by students were then compared with the provisions, in order to determine wheter or not students were experiencing misconception. The students who were categorized as experiencing misconception are those who provided false answer with a high level of CRI (CRI 3 - 5) due to the high level of confidence regarding their answer. The result of analysis on students response regarding the scope of biotechnology, several students with misconception were found (Table 4).

Table 4 The results of misconception analysis on the Scope of Biotechnology

No.	Criteria	The number of students	Number of questions	Score	Average	Percentage (%)
1	Know the concept (X)	37	15	240	16	43
2	Don't know the concept (Y)	37	15	174	11.6	31
3	Misconception (Z)	37	15	141	9.4	26
Total				555	37	100

Data on Table 4 shows that among 37 participants who were tested with 15 questions, in which score 1 was given for each correct answer, there were students who know the concepts (X), students who don't know the concepts (Y), and also students who hold misconception (Z) with the average score of 16 (43%), 11.6 (31%), and 9.4 (26%), respectively. From the data it can be seen that there are still many students who experience misconceptions and do not know the concept, where the total is 57%, while those who know the concept are 43%.

Analysis of misconception on the concepts of recombinant DNA technology which consists of 14 question items was also carried out. The result of data analysis also showed that there were students who know the concepts (X), students who don't know the concepts (Y), and also students who hold misconception (Z) regarding recombinant DNA technology (Table 5).

Table 5. The results of misconception analysis on recombinant DNA technology

No.	Criteria	The number of students	Number of questions	Score	Average	Percentage (%)
1	Know the concept (X)	37	14	162	11,571	31

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2	Do not know the concept (Y)	37	14	150	10,714	29
3	Misconception (Z)	37	14	206	14,714	40
Total				518	37	100

Data on Table 5 shows that among 37 participants who were tested with 14 questions, in which score 1 was given for each correct answer, there were students who know the concepts (X), students who don't know the concepts (Y), and also students who hold misconception (Z) with the average score of 11,571 (31,274%), 10,714 (39,768%), and 14,714 (39,768%), respectively. From the data it can be seen that there are still many students who experience misconceptions and do not know the concept, where the total is 69%, while those who know the concept are 31%.

In addition to the use of multiple choice tests, interviews were also conducted to investigate the reasons behind students answers. Five students who were chosen to be interviewed are those who hold misconception about the scope of biotechnology and recombinant DNA technology on different question items. The result of interview showed that students' misconceptions regarding the scope of biotechnology and recombinant DNA technology were caused by several factors, including the previously obtained information from their peers, teachers, television, internet, books, or other references. The previously obtained concepts that they obtained can be persistent, despite being inconsistent with the currently accepted concepts of science.

5. DISCUSSION, CONCLUSION, RECOMMENDATIONS

The result of data analysis shows that many students experience misconceptions about the scope of biotechnology and also about recombinant DNA technology. Analysis on students answer regarding the scope of biotechnology showed that 26% students hold misconception, 31% students do not know the concepts, and 43% students know the concepts. Meanwhile, analysis on students answers on recombinant DNA technology test items showed that students who hold misconception is quite high as it reached 40%. Meanwhile, students who do not know the concepts reached a percentage of 29%. There were only 31% of students who know the concepts being assessed.

These findings are in line with the findings of other researchers about biology. Several studies shown that misconceptions experienced by students do not only occur in the concepts of photosynthesis and plant respiration. Misconceptions in students also occur in the concepts of Ecology, Genetics, Living Creature Classification, and Circulation Systems. Chrzanowski et al. (2018) also revealed that misconceptions on vernacular concepts arise when students experience problems with the use of certain scientific language phrases and they may appear to people of all ages, professions, and backgrounds.

The data in this study shows that the number of students who hold misconceptions are still high due to several several influencing factors. One of the main factors causing students'

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misconceptions is the information acquired from teachers in school or from previously used learning resources. It is in line with the assertion of Rahayu (2011) that misconception can be derived from false concepts taught by teachers at the previous level. Students' misconceptions can occur due to the limited information received, the limited chance to test the theory, errors in textbook, incorrectly delivered news by the media, the passiveness of students in accepting information from teachers without further scrutinization, the complexity of study materials which is not suitable with students' stage of cognitive development, and also due to the unfamiliarity of study materials delivered for students.

In addition there are also other factors causing misconeptions, such as the teaching materials or textbooks which contain errors. It is supported by Fitrianingrum *et al.* (2013: 78) who explained that "student misconception is largely caused by textbooks". Misconception can also occur due to previous learning resources obtained by students, for instance the learning resources obtained from school teachers during high school period. This assertion is supported by Rahayu (2011) who stated that misconceptions experienced by students can come from everyday experiences when students interact with their environment. Suparno (2013: 29) argues that "misconceptions can be caused by several factors including students, teachers, textbooks, contexts, and teaching methods." The results Saputri (2016) showed that the textbooks studied Biology class X are misconceptions which are divided into five categories, namely Misidentifications, Overgeneralizations, Oversimplications, Obsolete Concept and Terms and Undergeneralizations. Criteria misconceptions most commonly found on the virus chapter in biology textbook students grade X is Oversimplications as much as 36.73%.

In addition, there are many researchers related to misconceptions that reveal that misconceptions can be caused by various things, namely, some of which overlap: from everyday experience and observation (Strauss 1981; Viennot 1979), from the use of perceptual thinking, which is related to the previous source, and is seen in a number of studies where students' explanations of scientific phenomena are dominated by what is immediately perceptible (Driver 1985; BouJaoude 1991), from diagrams or statements in textbooks (Blosser 1987; Cho *et al*. 1985), and from teachers and student teachers (Osborne & Cosgrove 1983; Bar & Travis 1991).

Students entering the teaching and learning process in the university level with their preconceptions regarding the concepts of biology which is sometimes inconsistent with the current concepts which is accepted by science experts. Such preconceptions may be acquired during elementary school, high school, or during their observation and their experience while socializing within the society in daily life (Berg, 2004). Furthermore, the result of research from various countries show that the misconceptions experienced by students are caused by inappropriate applications and use of media that cannot describe the concepts being studied. Another assertion explains that misconception is influenced by the process of knowledge construction in the students mind. A research conducted by Taufiq *et al.* (2011) revealed that all students experience different level of misconceptions about the state change of water. Several factors causing such misconceptions including language factors, experience factors, observation factors, and thinking skills factors. The finding of misconceptions is high in the aspect of the concept of chemical change. Students assume that the wood chimney that is burned will produce. Charcoal is chemical change because the shape of wood before and after is different. The correct concept is the shape and nature of wood before and after differen Wahidah, at al (2018).

In this study, besides students who hold misconceptions, many students were categorized

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as students who do not know the theory. This may occur due to the nature of biotechnology, particularly the recombinant DNA technology, which is difficult to be observed directly by the naked eyes or cannot be observed directly by the five senses. Consequently, the concepts is considered as incomprehensible by the students. Other factors that may cause students failed to acquire knowledge regarding certain concept including students preconceptions, abilities, developmental stages, interest, way of thinking, and friends.

There are also students who master the concepts being assessed in this study. Students ability to master scientific concepts may be influenced by several factors, including internal and external factors. Besides that, students ability to learn science by involving various senses can help them to master certain concepts. It is supported by the assertion of Rustaman (2007) in Duda *et al.* (2019) that the principle of learning is "learning by doing." It is further emphasized that learning will be more meaningful if students learn to experience or to do things themselves (not verbalistic). Learning as a process of human interaction with the environment refers to the interaction between the object being learned from the environment into the learning individual which is conducted actively with all five senses.

Based on the results of the data analysis and discussion, it can be concluded as the following: In the concepts of the scope of biotechnology, the percentage of students who were categorized as experiencing misconception, do not know the concepts, and know the concepts are 26%, 31%, and 43%, respectively. In the concepts of recombinant DNA technology, the percentage of students who were categorized as experiencing misconception, do not know the concepts, and know the concepts are 40%, 29%, and 31%, respectively. From the data on both concepts, it is seen that there are still quite high students experiencing misconceptions on the concept.

For faculty members, it would be beneficial to conduct research on students misconception regarding other sub-materials in biotechnology, in other biology concepts, or in other science concepts. It is important for teachers to determine students level of understanding regarding the concepts that will be taught, as it will be the basis for them to construct new knowledge, particularly to apply what they already learned.

Acknowledgements:

1. For DRPM, Directorate General of Strengthening for Research and Development, Ministry of Research, Technology and Higher Education Indonesia which already support the funding for this research
2. For STKIP Khatulistiwa Persada Sintang , West Kalimantan, Indonesia, which has facilitated and launched research activities on the campus
3. For LPPM STKIP Persada Khatulistiwa Sintang West Kalimantan, Indonesia, which has facilitated and launched research activities.

REFERENCES

Bar, V. and Travis, A. (1991). Children's Views Concerning Phase Changes. *Journal of Research in ScienceTeaching*, 28(4), 363-382.

Berg EVD. (2004). *Alternative Conceptions in Physics and Remediation*. Philippines: University

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of San Carlos Science and Mathematics Education Institute.

Bou Jaoude, S. (1991). A Study of Student's Understandings About the Concept of Burning. *Journal of Research in Science teaching*, 28(8), 689-704.

Blosser, P. (1987). *Secondary School Students' Comprehension of Science Concepts: Some Findings from Misconceptions Research.* SMEAC Science Education Digest No.2.Columbus, Ohio. (ERIC Documentation Reproduction Service No. ED. 286 757).

Chapbell, NA., Reece, J.B., & Mitchell, L.G. (2002). *Biology*. 5th Edition Volume 1. Erlangga Publisher.

Cho, H.H., Kahle, J.B., & Nordland, F.H. (1985). An Investigation of High School Biology Textbooks as Sources of Misconceptions and Difficulties in Genetics and Some Suggestions for Teaching Genetics. *Science Education Journal*, 69(5), 707-719.

Choirina, Y., Ramli, M., & Rinanto, Y. (2019). Conceptual Understanding Of High School Students On Plantae. *Journal of Education and Learning (EduLearn)*, 13(1), 48-56.

Chrzanowski, M.M.; Grajkowski, W.; Uchowski, S.; Spalik, K E.; Ostrowska, B. (2018). Vernacular Misconceptions in Teaching Science – Types and Causes. *Journal of Turkish Sc ience Education, 15/4, 29-54.*

Dahar, R.W. (2004). *Learning Theories*. Jakarta: Erlangga.

Driver, R. (1985). *Beyond Appearances: The Conservation of Matter Under Physical and Chemical Transformations. In: Driver, R., Guesne, E., Tiberghien, A. (Eds.) Children's Ideas in Science.* Open University Press, Milton Keynes, 145-169.

Duda, H.J. (2016) *Analysis of Genetic Misconceptions Student Biology Education at STKIP Persada Khatulistiwa Sintang*. International Conference On Education, Education in the 21st Century: Responding to Current Issues, Graduate School, Malang State University.

Widower, H.J., Susilo, H., & Newcombe, P. (2019). Enhancing Different Ethnicity Science Process Skills: Problem-Based Learning Through Practicum and Authentic Assessment. *International Journal of Instruction*, 12(1), 1207-1222.

Fitrianingrum, N., Sunarno, W., & Harjunowibobo, D. (2013). Misconceptions of Circular Motion Analysis in the School of Electrical (BSE) Physics High School Class X Semester I. *Journal of Physics Education,* 1(1), 73-80.

Haris, V. (2013) Identification of Misconceptions of Mechanic Material by Using *CRI (Certainty of Response Index).Ta'dib Journal,* 16(1), 85.

Haryono. (2013). The Influence of Video Media on Increasing Understanding of Biology Concepts in Class XI Students of SMK Negeri 1 Kalibagor. *Thesis*at Muhammadiyah University in Purwokerto. Purwokerto.

ISSN: 2582-0745
Vol. 3, No. 01; 2020

Hasan, S., Bagayoko, D., & Kelley, E.L. (1999). *Misconceptions and the Certainty of Response Index (CRI). Phys.Educ. 34 295* : [online]. Available: http://iopscience.iop.org/0031-9120/34/5/304 [February 4, 2013].

Mbulu, Joseph & Suhartono. (2004). *Development of Teaching Materials*. Malang: Elang Mas Publisher.

National Science Teachers Association. (2013). *4th Edition Biology Teacher's Manual*. West Jakarta. PT. Index.

Osborne, R. & Cosgrove, M. (1983). *Students' Conceptions of The Changes of States of Water. Journal of Research in Science Teaching*, 20(9), 825-838.

Purba, J.P & Depari G. (2008). Search for Student Conceptions About Concepts in Electrical Circles Using Certainty of Response Index (CRI) and Interview. *Jurnal Jurusan Pendidikan Teknik Elektro, Universitas Pendidikan Indonesia.*

Rachmawati, S., Susanto, H. & Fianti. (2017). The use of the CRI (*Certainty Of Response Index*) Method Assisted by the PISA Problem (*Program Of International Student Assessment*) to Identify the Misconception of IPA Material Science. *Unnes Physics Education Journal*, 6(3), 26-31.

Rahayu, A. A. (2011). Use of Concept Maps to Overcome Student Misconceptions in The Concept of Plant Networks (Class Action Research in MAN 10 Jakarta). Biology Education Study Program, Department of Natural Sciences, Faculty of Tarbiyah and Teacher Training, Syarif Hidayatullah State Islamic University, Jakarta.

Saputri, D.A.F & Widyaningrum, T. (2016). Misconceptions Analyis on The Virus Chapter in Biology Textbooks for High School Students Grade X. *International Journal of Active Learning*, 1(1), 31-37.

Siwi, DAP. (2013). Identification of Misconceptions of Class VIII Students on the Concept of Digestive and Respiratory Systems. *Essay* at the Syarif Hidayatullah State Islamic University. Jakarta.

Sugiyono. 2014. *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.

Suparno, P. (2013). *Misconceptions and Changes in Concepts in Physics Education* . Jakarta: Grasindo.

Strauss, S. (1981). Cognitive Development in School and Out. *Cognition*, 10, 295-300.

Tauf iq, M., Hindarto, N & Khumaedi. (2011). Student's Science Misconceptions Concerning The State Changes Of Water And Their Remediation Using Three Different Learning Models In Elementary School, *Indonesian Physics Education Journal*, 7/1, 74-79.

Tekkaya C. (2002). Misconceptions as Barrier to Understanding Biology. *Journal of Ankara Hacettepe University*, 23/1, 259-266.

ISSN: 2582-0745
Vol. 3, No. 01; 2020

Viennot, L. (1979). Spontaneous Reasoning in Elementary Dynamics. *European Journal of Science Education*, 1(2), 205-221.

Wahidah, N., Saptono, S., & Wiyanto. (2018). The Development of Three Tier Multiple Choice Test to Explore Junior High School Students' Scientific Literacy Misconceptions. *Journal of Innovative Science Education*, 7(2), 434-442.

Widodo, S.P. (2012). Misconception Evaluation Instrument Development Physics Students Using *Certainty of Response Index (CRI)* Based *CAA (Computer Aided Assessment).Thesis* at Sunan Kalijaga State Islamic University. Yogyakarta.