



# Journal of Educational Sciences

Journal homepage: <https://jes.ejournal.unri.ac.id/index.php/JES>



P-ISSN  
2581-1657

E-ISSN  
2581-2203

## Analysis of the Misconceptions of Class XII High School Students in Pekanbaru by Using the Certainty of Response Index (CRI)

Dita Deanesia\*, Sri Wulandari, Zulfarina

Faculty of Teacher Training and Education, Pekanbaru, 28293, Indonesia

### ARTICLE INFO

#### Article history:

Received: 18 Nov 2020

Revised: 28 June 2021

Accepted: 28 June 2021

Published online: 24 July 2021

#### Keywords:

CRI

Photosynthesis

Misconceptions

Plant Respiration

### ABSTRACT

One of the misconceptions can be identified by using CRI (Certainty of Response Index). The purpose of this study was to identify the misconceptions of class XII high school students in the city of Pekanbaru on the material of Photosynthesis and Plant Respiration using the Certainty of Response Index (CRI) method. This research is a survey research. The location of this research was carried out at two high schools in Pekanbaru, namely SMA N 15 Pekanbaru and SMA IT Az-Zuhra Pekanbaru. The number of samples in this study is the total population of the two SMAs. The data collection technique was carried out using a written test instrument in the form of a multiple choice test accompanied by CRI. The average percentage of students' misconceptions of SMA IT AZ-ZUHRA and SMAN 15 Pekanbaru on the concept of photosynthesis, the highest percentage is in the sub-concept of the benefits of photosynthesis for plants by 96.15% and the lowest percentage is in the sub-concept of photosynthetic pigments at 53.19%. The average percentage of students' misconceptions at SMA IT AZ-ZUHRA and SMAN 15 Pekanbaru on the concept of plant respiration, the highest percentage is found in the sub-concept of understanding respiration in plants of 84.62%. The lowest percentage is found in the sub-concept of understanding breathing and the sub-concept of when plants breathe, each of which is 67.58%.

## 1. Introduction

The setting of standards for the content of basic education is to confirm the urgency of understanding, analyzing, and applying the principles, concepts, and laws of biology to solve real and environmental problems. Biology has a very important role in the development of science and technology. Biology is one of

\* Corresponding author.  
E-mail: deariftya018@gmail.com

the branches of science that must be studied at the elementary and secondary school levels in Indonesia. Biology is a branch of natural science that examines scientific conceptions of the life of living things and the interactions between living things. One of the concepts studied in biology is the concept of Photosynthesis and Plant Respiration. This concept is the most important concept in the study in biology because it examines the transfer of energy and matter in an ecosystem. To be able to understand the function of organisms in an ecosystem or biosphere, one must also be able to understand the concepts of Photosynthesis and Respiration in Plants well.

A study conducted by Cokadar (2012) stated that some students often experience conceptions that tend to be wrong on the concepts of Photosynthesis and Plant Respiration. Conceptions that tend to be wrong or conceptions that are different from scientific agreement are called misconceptions. There are also misconceptions among students that occur in the concepts of Ecology, Genetics, Classification of Living Things, and Circulation Systems (Tekkaya, 2002). However, students most often experience misconceptions about the concepts of Photosynthesis and Respiration in Plants, especially on the basic understanding of these concepts (Haslam & Treagust, 1987). This is also reinforced by research conducted by Dwi et al. which states that plant respiration only occurs at night and only green leaves can photosynthesize (Murni, 2013).

Misconceptions that arise continuously can interfere with the formation of scientific conceptions in students and in teachers (Chanariosi, 2014). Misconceptions usually develop along the learning process. The misconceptions experienced by students can mislead students in understanding scientific phenomena and carrying out scientific explanations. If students are not aware of the occurrence of misconceptions, there will be confusion and incoherence in students. In the end, if it is not immediately corrected, these misconceptions will become an obstacle for students in the next learning process (MURNIAT, 2013). One of the misconceptions can be identified by using CRI (Certainty of Response Index).

The existence of further misconceptions will lead to the inability to apply the concept properly or even with the wrong application. The method found by Saleem Hasan is used to identify the occurrence of misconceptions as well as to distinguish them from not knowing the concept and understanding the concept. This method is a tool used to measure the level of confidence / certainty of respondents in answering each question / question given (Hasan, 1999). CRI is usually based on a scale and is given along with each answer to a question.

The grouping of concept understanding can be known using the CRI (Certain of Response Index) method (Hassan, 1999). The Certainty of Response Index (CRI) method is a method used to measure the level of student confidence in the material that has been taught by the teacher. Certainty of Response Index (CRI) is a measure of the level of confidence / certainty of respondents in answering each question given (Hasan, 1999).

---

This method is used by Saleem Hasan, Diola Bagayoko, and Ella L. Kelley to distinguish between students who understand concepts, misconceptions and do not understand concepts. Based on the results of the study they proved that CRI (Certainty of Response Index) is effective in diagnosing students who do not understand the concept and students who experience misconceptions (Hasan, et al, 1999). The CRI method compiled by Saleem Hasan was modified by Aliefman Hakim (2012) by adding open reasons to the multiple choice test so that students who understand the concept but choose a low CRI fall into the category of understanding the concept but are not sure.

The advantage of this technique is that the teacher can analyze students' misconceptions objectively because in addition to answering multiple choice questions and the level of confidence in the answers, students' reasons for answering questions can also be revealed so that students' misconceptions can be identified easily and precisely. Based on these descriptions, it is necessary to analyze the misconceptions of high school students in Pekanbaru City by using the Certainty Of Response Index (CRI) on the concepts of Photosynthesis and Plant Respiration. The purpose of the study was to identify the misconceptions of class XII high school students in the city of Pekanbaru on the material of Photosynthesis and Plant Respiration using the Certainty of Response Index (CRI) method.

## **2. Methodology**

This research is a survey research. The location of this research was carried out at two high schools in Pekanbaru, namely SMA N 15 Pekanbaru and SMA IT Az-Zuhra Pekanbaru. The time of the research was carried out in October-December 2020. The type of data required was primary data. The data collected in this study, namely the answers to the diagnostic test and the response to the confidence index to the answers obtained directly from the data source through filling out a written test. Sources of data are class XII students of SMA N 15 Pekanbaru and SMA IT Az-Zuhra Pekanbaru. The population in this study were students of class XII at SMA N 15 Pekanbaru, totaling 109 students and SMA IT Az-Zuhra Pekanbaru totaling 22 students. The number of samples in this study is the total population of the two SMAs.

The data collection technique was carried out using a written test instrument. The test instrument used is in the form of a multiple choice test accompanied by CRI. The results of the justification of the question instrument, the items used in this study were 25 items with 25 indicators for each item. In this study, researchers used questions adopted from Mustakim (2014). The data analysis used in this study was based on students' answers to the tests given. The data analysis technique of research results goes through several stages, first determining the value on the CRI scale used. The CRI scale used refers to the scale compiled by Saleem Hasan (Hasan, 1999). The CRI scale can be seen in Table 1.

---

Table 1. Saleem Hasan . CRI Scale

Scale	Category	Code
0	<i>Totally Guess Answer</i> (Benar-benar tidak tahu)	BBT
1	<i>Almost Guess</i> (Agak Tahu)	AT
2	<i>Not Sure</i> (Tidak Yakin)	TY
3	<i>Sure</i> (Yakin)	Y
4	<i>Almost Sure</i> (Agak Yakin)	AY
5	<i>Certain</i> (Sangat Yakin)	SY

Second, determine the scale value for CRI, then determine the category of students' level of understanding based on CRI and students' reasons for the choice of answers. This category of level of understanding is based on the category of level of understanding according to Aliefman. Modification of the Category of Student Understanding Levels can be seen in Table 2. Third, an analysis of the answers/students was carried out to distinguish between understanding the concept well, understanding the concept but not being sure, misconceptions, and not knowing the concept.

Table 2. Modification of Understanding Level Category

Answer	Reason	CRI value	Description	Code
True	True	> 2,5	Understanding Concepts well	PK
True	True	< 2,5	Understand the concept but not sure	PKKY
True	False	> 2,5	Misconception	M
True	False	< 2,5	Don't Know Concept	TTK
False	True	> 2,5	Misconception	M
False	True	< 2,5	Don't Know Concept	TTK
False	False	> 2,5	Misconception	M
False	False	< 2,5	Don't Know Concept	TTK

Fourth, the calculation of the percentage of students against the four assessment results in each stratum is carried out with the formula:

$$P = \frac{f}{N} \times 100 \%$$

Information :

P = group percentage number

f = number of students in each group

N = number of individuals (the total number of students who are research subjects)

Fifth, a recapitulation of the average percentage level of understanding of all students is made.

### 3. Results and Discussion

*Average Percentage of Misconceptions on the concept of Photosynthesis at SMA IT AZ-ZUHRA and SMAN 15 Pekanbaru*

The results of the average percentage of students' combined misconceptions at SMA IT AZ-ZUHRA and SMAN 15 Pekanbaru on the concept of photosynthesis are shown in Table 3. There are 15 items represented by sub-concepts.

Table 3. Average Percentage of Misconceptions of the Concept of Photosynthesis for SMA IT AZ-ZUHRA Pekanbaru and SMAN 15 Pekanbaru

Sub Concepts	Category % IT High School Misconceptions	Category % 15 High School Misconception	Average % Misconceptions of IT SMA and SMA 15
Materials needed in the process of photosynthesis.	30.76%	93.3%	62.03%
The chemical equation for the process of photosynthesis	53.48%	90.0%	71.74%
Advantages of photosynthesis for plants	92.30%	100.0%	96.15%
Photosynthetic products	38.46%	100.0%	69.23%
Photosynthesis location in plants	46.15%	93.3%	69.73%
Photosynthetic Pigments	23.07%	83.3%	53.19%
Temporary storage of photosynthetic products	61.53%	96.7%	79.12%
Factors Affecting Photosynthesis	53.48%	96.7%	75.09%
Products of photosynthesis in aquatic plants	61.53%	96.7%	79.12%
Photosynthetic organelles	61.53%	96.7%	79.12%
	69.23%	96.7%	82.97%
Equation of photosynthesis and plant respiration	76.92%	93.3%	85.11%
	84.61%	100.0%	92.31%
Evidence for photosynthesis	53.48%	96.7%	75.09%
Difference between photosynthesis and respiration	53.48%	100.0%	76.74%

Based on Table 3, it can be seen that students of SMA IT AZ-ZUHRA Pekanbaru and SMAN 15 Pekanbaru have a high mean percentage of misconceptions in all sub-concepts of photosynthesis. The highest average percentage of misconceptions in the two high schools is found in the sub-concept of the benefits of photosynthesis for plants of 96.15% and the equation of photosynthesis and plant respiration of 92.31%. In the sub-concept of the benefits of photosynthesis for plants, students from both high schools have not been able to give the correct answers and reasons. In general, students from both high schools gave answers to produce Oxygen needed for life. The correct answer according to Mustakim (2014) is the conversion of light energy into chemical energy.

In the sub-concepts of the equations of photosynthesis and plant respiration, students from both schools have not been able to give the correct answers and reasons. In general, students from both high schools answered O<sub>2</sub> by giving reasons why plants emit oxygen. The correct answer is that the gases released by plants are oxygen and carbon dioxide. Oxygen is produced during photosynthesis and carbon dioxide is produced during plant respiration. The results of research by

Rahmatan & Redjeki (2013), show that the concept of gas produced by plants experiences misconceptions as much as 59.4%.

***Average Percentage of Misconceptions on the concept of Plant Respiration at SMA IT AZ-ZUHRA and SMAN 15 Pekanbaru***

The results of the average percentage of students' combined misconceptions at SMA IT AZ-ZUHRA and SMAN 15 Pekanbaru on the concept of plant respiration are shown in Table 4. There are 10 items represented by sub-concepts.

Table 4. Average Percentage of Misconceptions on the concept of Plant Respiration at SMA IT AZ-ZUHRA and SMAN 15 Pekanbaru

<b>Sub Concepts</b>	<b>Category % IT High School Misconceptions</b>	<b>Category % SMA 15 Misconception</b>	<b>Average % Misconceptions of IT SMA and SMA 15</b>
Definition of breathing	38.46%	96.7%	67.58%
Plant respiratory organs	46.15%	93.3%	69.73%
Time for plants to breathe	38.46%	96.7%	67.58%
Definition of respiration	38.46%	100.0%	69.23%
The chemical equation for the process of Respiration	61.53%	100.0%	80.77%
Definition of respiration in plants	69.23%	100.0%	84.62%
Location of respiration in plants	69.23%	96.7%	82.97%
Materials needed in the process Respiration	61.53%	100.0%	80.77%
Respiration products	61.53%	100.0%	80.77%
Respiratory organelles	53.48%	100.0%	76.74%

Table 4 shows that students of SMA IT AZ-ZUHRA Pekanbaru and SMAN 15 Pekanbaru have a high mean percentage of misconceptions in all sub-concepts of plant respiration. The highest average percentage of misconceptions in both high schools is found in the sub-concept of understanding respiration in plants by 84.62% and the location of respiration in plants by 82.97%.

In the sub-concept of understanding respiration in plants, students from both schools have not been able to give correct answers and reasons. In general, students from both high schools answered that the process of respiration in plants is a chemical process that occurs to make food from water and carbon dioxide. Carbon dioxide, water, chlorophyll and light produce glucose and oxygen.

In the sub-concept of the location of respiration in plants, students from both schools were able to give correct answers and reasons and had a high level of confidence in answering this question. In general, students from both high schools answered that respiration occurs in all parts of the plant body, in higher plants respiration occurs in roots, stems, leaves, respiration points in plants, the procedure for chemical energy to be the energy needed for plant life activities. However, each student has not been able to give their own reasons according to scientific concepts. The reasons for students are the same and use the same writing. In a study conducted by NW et al. (2017) students experience

misconceptions, because students assume that respiration in plants is only found in leaves. Meanwhile, the actual concept is that respiration occurs in every plant cell, because in every plant cell there are mitochondrial cell organelles that function as cell organelles for cellular respiration (Mustakim, 2014).

The sub-concept where photosynthesis occurs in plants, the students give answers that the process of photosynthesis lies in the leaves. Because the leaves consist of parenchyma tissue that contains a network of poles and sponges. The correct answer is that photosynthesis occurs in parenchyma cells, namely palisade parenchyma because palisade parenchyma contains a lot of chlorophyll and is located close to the epidermis so it is very possible. The students' answers are correct, but the reasons given are not correct and the reasons between students are the same as using the same writing but the students' beliefs are so high that they are identified as misconceptions. The students answered the reasons that were not in accordance with the actual scientific concept, it was seen that the students did not fully understand where the chlorophyll is located in plants. In this answer, students have an understanding that the location of chlorophyll in the body is only in the leaves. This reason is also supported by research conducted by Puspitayani et al (2017) and Kose (2008) that some students assume that it occurs in plant parts that have chlorophyll, especially in the leaves. While the scientific concept according to Reece (2008) chlorophyll is a green pigment found in chloroplasts. Chloroplasts are the site of photosynthesis in plants. All green parts and immature fruit have chloroplasts, but leaves are the main site of photosynthesis in most plants.

The sub-concept of photosynthetic products in aquatic plants gave answers. Photosynthesis takes place in chloroplasts, while respiration occurs in mitochondria and cell cytoplasm. The correct answer is carbon dioxide gas is not produced from this event. The answers and reasons given by students are not correct. In addition, the reasons given between students are the same as using the same writing but the students' beliefs are so high that they are identified as misconceptions. The students have not been able to write their own reasons according to scientific concepts. It is suspected that the students did not understand well the sub-concept of photosynthetic products in aquatic plants. In a study conducted by Puspitayani et al. (2017). Students experience misconceptions, because students assume that the glucose produced is stored in the form of electrons. The real concept is that the energy source produced from the photosynthesis process is not always ready in the form of glucose but is still in the form of food reserves in the form of sucrose or starch (Reece, 2008).

The average percentage of students' misconceptions at SMA IT and SMAN 15 Pekanbaru is quite high in all sub-concepts of photosynthesis and plant respiration. This is supported by Cokadar's research (2012) which states that some students often experience conceptions that tend to be wrong on the concepts of photosynthesis and plant respiration. From the results of the analysis of answers, each IT high school student can give their own reasons but it is not in accordance with scientific concepts. Misconceptions that occur in each individual high school IT student. Overall SMA 15 students have not been able to give their own reasons

---

for the questions given but have a high level of confidence. Only 1 or 2 students have a good understanding of the concepts of photosynthesis and plant respiration.

Based on a short question and answer session by the teacher at the two high schools, the material for photosynthesis and plant respiration is quite difficult because it is abstract and there are many chemical formulas so that there are many misconceptions among students. The meaning of misconceptions according to these teachers is a wrong concept, a wrong understanding of the concept from the truth. One example of students' misconceptions on the concept of photosynthesis and plant respiration is that photosynthesis only occurs in leaves. The correct answer is that photosynthesis occurs in all parts of the plant that have photosynthetic pigments. In addition, the concepts of photosynthesis and plant respiration have a high KKM, which is 80. Many students have not reached the KKM and to achieve it, remedial measures are carried out until the KKM is achieved. The teacher's tips to eliminate students' misconceptions are that the teacher must understand the concept well and the students must increase the number of reading sources.

#### 4. Conclusion

The results showed that the average percentage of students' misconceptions in SMA IT AZ-ZUHRA Pekanbaru and SMAN 15 Pekanbaru on the concept of photosynthesis, the highest percentage was in the sub-concept of the benefits of photosynthesis for plants of 96.15% and the lowest percentage was in the sub-concept of photosynthetic pigments of 53.19%. The average percentage of students' misconceptions at SMA IT AZ-ZUHRA Pekanbaru and SMAN 15 Pekanbaru on the concept of plant respiration, the highest percentage is found in the sub-concept of understanding respiration in plants at 84.62%. The lowest percentage is found in the sub-concept of understanding breathing and the sub-concept of when plants breathe, each of which is 67.58%.

#### References

- Chaniarosi, L. F. (2014). Identifikasi miskonsepsi guru biologi SMA kelas XI IPA pada konsep sistem reproduksi manusia. *Jurnal EduBio Tropika*, 2(2).
- Cokadar, H. (2012). Photosynthesis and Respiration Processes: Prospective Teachers' Conception Levels. *Education & Science/Egitim ve Bilim*, 37(164)..
- Hakim, A., & Kadarohman, A. (2012). Student Concept Understanding of Natural Products Chemistry in Primary and Secondary Metabolites Using the Data Collecting Technique of Modified CRI. *International Online Journal of Educational Sciences*, 4(3).
- Hasan, S., Bagayoko, D., & Kelley, E. L. (1999). Misconceptions and the certainty of response index (CRI). *Physics education*, 34(5), 294-299.
- Haslam, F., & Treagust, D. F. (1987). Diagnosing secondary students' misconceptions of photosynthesis and respiration in plants using a two-tier
-



- multiple choice instrument. *Journal of biological education*, 21(3), 203-211.
- Köse, S. (2008). Diagnosing student misconceptions: Using drawings as a research method. *World Applied Sciences Journal*, 3(2), 283-293.
- MURNIAT, I. V. V. D. A. (2013). Penerapan Pendekatan Contextual Teaching and Learning (Ctl) Untuk Mengatasi Miskonsepsi Siswa SMP Pada Materi Fotosintesis. *PENSA: E-JURNAL PENDIDIKAN SAINS*, 1(02).
- Murni, D. (2013). Identifikasi Miskonsepsi Mahasiswa Pada Konsep Substansi Genetika Menggunakan Certainty of Response Index (CRI). *Prosiding SEMIRATA 2013*, 1(1).
- Mustakim, T. A., Zulfiani, Z., & Herlanti, Y. (2014). Identifikasi miskonsepsi siswa dengan menggunakan metode certainty of response index (cri) pada konsep fotosintesis dan respirasi tumbuhan. *Edusains*, 6(2), 145-152.
- NW, N. H., Jalmo, T., & Yolida, B. Identifikasi Miskonsepsi Siswa pada Materi Fotosintesis dan Respirasi Tumbuhan.
- Penyusun, T. (2013). Peraturan Menteri Pendidikan dan Kebudayaan Nomor 69 Tahun 2013 Tentang Kerangka Dasar dan Struktur Kurikulum Sekolah Menengah Atas/Madrasah Aliyah. Jakarta: Kemdikbud.
- Puspitayani, D., Jalmo, T., & Marpaung, R. R. T. (2017). Identifikasi Miskonsepsi Siswa Pada Konsep Fotosintesis dan Respirasi Tumbuhan. *Jurnal Bioterdidik Wahana Ekspresi Ilmiah*, 5(2).
- Reece, C. (2008). *Biologi Edisi Kedelapan Jilid 1*. Jakarta: Erlangga.
- Rahmatan, H., & Redjeki, S. (2013). Pembelajaran Berbasis Multimedia Interaktif Pada Topik Katabolisme Karbohidrat Untuk Meningkatkan Penguasaan Konsep Mahasiswa Calon Guru Biologi. *Jurnal Pendidikan IPA Indonesia*, 2(1).
- Tekkaya, C. (2002). Misconceptions as barrier to understanding biology. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 23(23).

How to cite this article:

Deanesia, D., Wulandari, S., & Zulfarina. (2021). Analysis of the Misconceptions of Class XII High School Students in Pekanbaru City by Using the Certainty of Response Index (CRI). *Journal of Educational Sciences*, 5(3), 439-447.

---