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# Misconceptions: An Analysis of Certainty of Response Index (CRI) on Photosynthesis Materials for Junior High School Students

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## ABSTRACT

This research aimed to identify the misconceptions experienced by the eighth-grade students of junior high school in Bandar Lampung on photosynthesis material. Also, this research aimed to investigate the causes of the misconceptions. The research method was qualitative, with three schools randomly selected based on their accreditation, namely accreditation A, B, and C. The data collecting techniques used in this research were multiple choice objective tests accompanied by the reasons and column Certainty of Response Index (CRI). Furthermore, the researchers also interviewed the teachers. The analysis showed that the highest percentage of misconceptions appeared in six question indicators, with a percentage above 50%. This result showed that the percentage of students who experienced misconceptions about photosynthesis material was greater than students who understand the concept and do not know the concept.

***Miskonsepsi: Analisis Certainty of Response Index (CRI) pada Materi Fotosintesis Siswa SMP***

***ABSTRAK:*** *Penelitian ini bertujuan untuk mengidentifikasi miskonsepsi peserta didik kelas VIII SMP Negeri sekota Bandar Lampung pada materi fotosintesis, serta penyebab dari adanya miskonsepsi pada peserta didik tersebut. Metode pada penelitian ini adalah metode kualitatif. Pengambilan sampel menggunakan teknik random sampling dengan tiga tempat sekolah yang akan dijadikan bahan penelitian berdasarkan dari akreditasi sekolah SMP Negeri tersebut yaitu akreditasi (A, B, dan C). Teknik pengumpulan data yang digunakan dalam penelitian ini adalah tes objektif multiple choice yang disertai alasan dan kolom Certainty Of Response Index (CRI), dan wawancara kepada pendidik. Data hasil analisis menunjukkan miskonsepsi dengan persentase terbesar muncul pada 6 indikator soal dengan persentase di atas 50%. Hal ini menunjukkan bahwa persentase persentase peserta didik yang mengalami miskonsepsi pada materi fotosintesis lebih besar dibandingkan peserta didik yang paham konsep dan tidak tahu konsep.*

## INTRODUCTION

Misconception can be interpreted as a misunderstanding of a concept (Rachmania & Subekti, 2021). According to Fowler in Paul Suparno's book, the misconception is an inaccurate concept, wrong concepts, clarification of wrong examples, confusion of different concepts, and incorrect hierarchical relationships of

concepts (Maison et al., 2020;Suparno, 2005). In the Indonesian national dictionary, misunderstanding is a wrong and incorrect understanding of the speech, statement, or attitude of others (Hasan, 2007;Yulianti, 2017).

The cause of students' misconceptions is the wrong preconception (Mukhlisa, 2021). This wrong preconception, if left unchecked, will become misconceptions that continue to accumulate until adulthood since preconception is the beginning of the formation of the concept itself. At the beginning of concept formation, there will be a misconception if there is a wrong understanding of the concept (Komala et al., 2020). The preconceptions possessed by students show that the human mind, from birth, does not stand still. Rather, it continues to be active in understanding something. The human mind continues to adapt to the situations experienced in life. Formal education by teachers is only a small part of students' forming knowledge (Nurkamilah & Afriansyah, 2021).

False intuition is also one of the causes of misconceptions (Kefi et al., 2021). The meaning of intuition itself is a feeling to spontaneously expresses attitudes and ideas about something before being objectively and rationally investigated (Ramawati et al., 2016). The student's ability to interpret will lead to misconceptions. The student's ability to learn a concept will also have an effect. When there are students who do not like biology lessons, they will become unmotivated. Also, it can be caused by low IQ levels, so understanding the concepts tends to be winded and left behind, resulting in misconceptions (Dahar, 2011;Permatasari, 2021).

The high impact caused by misconceptions shows the importance of identifying misconceptions. The identification of misconceptions can be performed based on the level of student confidence using the Certainty of Response Index (CRI) method. Hasan, Bagayoko, and Kelley created this method. It effectively diagnoses students who understand concepts, misconceptions, and do not understand concepts (Mukhlisa, 2021).

Certainty of Response Index Section (CRI) is a technique for measuring a person's misconceptions by determining the level of confidence or certainty in answering each question given (Kusumawati et al., 2022). The Certainty of Response Index method is very easy to use in uncovering misconceptions because there is a scale of the respondent's confidence level in answering the questions. The scale on the Certainty of Response Index (CRI) has different values according to their respective criteria. From these criteria, students who understand the concept, experience misconceptions, and do not understand the concept can be grouped (Putri et al., 2021;Ulfah & Fitriyani, 2017).

Sekar Rachmawati, in her research entitled "Using the CRI (Certainty of Response Index) Method Assisted by PISA (Program of International Student Assessment) questions to Identify Science Misconceptions on Solar System Materials," identified misconceptions in science. She found many misconceptions in the learning and showed that the CRI method effectively measured misconceptions (Rachmawati, 2016).

Saleem Hasan, Diola Bagayoko, and Ella Kelley, in their research entitled "Misconceptions and Certainty of Response Index", intended to develop a useful method to distinguish a lack of conceptual understanding from misconceptions. The certainty of Response Index (CRI) is an effective diagnostic tool for misconceptions. It is also an assessment tool to measure an achievement during the pretest and posttest. Furthermore, the Certainty of Response Index (CRI) method can be used as an effective tool to compare which learning outcomes are more effective when using different teaching methods, technologies, and approaches (Mansur & Marselina, 2019).

Tri Ade Mustaqim, Zulfiani, and Yanti Herlanti conducted research entitled "Identification of Student Misconceptions Using the Certainty of Response Index (CRI) Method on the Concept of Photosynthesis and Plant Respiration." Based on the research findings, the percentage of students who experienced misconceptions about photosynthesis and plant respiration was 37.69%, smaller than the percentage of students who did not know the concept. Many students' misconceptions occurred in determining the gas used for respiration (Mustaqim, 2014).

## METHOD

This research employed the qualitative research method. The qualitative method is used in natural objects (Sugiyono, 2014). The sampling technique used was random sampling. The schools used as research samples were based on accreditation levels A, B and C. The researchers took 10% of the existing population from each school (Aries, et al., 2022). The research objects were SMPN 12 Bandar Lampung, SMPN 28 Bandar Lampung, and SMPN 37 Bandar Lampung. The research instrument used was an objective multiple-choice test with a Certainty of Response Index (CRI) column and interviews with the teachers. According to Suryabrata, descriptive research describes situations or events (Novalia, 2014).

The data analysis technique calculated the percentage based on four degrees of understanding of each item to find the percentage of students answering the questions and the confidence level. The results are grouped into understanding the concepts, understanding concepts but not sure, misconceptions, and not understanding concepts. To find out the percentage of students misconceptions, the following formula was employed:

$$P = \frac{FF}{NN} \times 100\%$$

Description:
P = Percentage
F = Frequency of correct answers
N = Number of questions

The results of this percentage calculation were qualified into the criteria for assessing the percentage of misconceptions (Mustaqim, 2014).

**Table 1.** The Criteria for Assessing the Percentage of Student Misconceptions

| Interval | Criteria |
|---|---|
| 0-20% | Very weak/very low |
| 21-40% | Weak/low |
| 41-60% | Medium |
| 61-80% | Strong/high |
| 81-100% | Very strong/very high |

(Riduwan, 2010).

## RESULTS AND DISCUSSION

This research was conducted after the instrument used had been tested and had passed the process of calculating validity, reliability, level of difficulty, and discriminating index. The questions given to students in each school were 12. After that, the answers from students were calculated to get the desired results. Based on the calculations, the misconceptions experienced by students about photosynthesis at junior high schools in Bandar Lampung were relatively high, namely 55.804%. The following is the research data for each school:

**Table 2.** The Percentage of Students' Levels of Understanding

| Junior High Schools | Category (average%) | | |
|---|---|---|---|
| | Understand the Concept | Misconception | Do not Understand the Concept |
| SMPN A Bandar Lampung | 22.21% | 58.88% | 18.05% |
| SMPN B Bandar Lampung | 27.49% | 58.05% | 14.44% |
| SMPN C Bandar Lampung | 24.70% | 50.28% | 24.13% |

Based on interviews with a teacher at SMPN A Bandar Lampung, who teaches science, students' misconceptions might be caused by misunderstandings of concepts at the elementary school level. Therefore, their concept understanding ware considered correct for the next stage, or in other words,

the initial concept. The philosophy of constructivism asserts that students form knowledge through interactions with the environment and the materials they learn. Thus, it is not impossible that errors can occur from the beginning before receiving formal lessons about certain materials. This phenomenon is called preconception (Rochim et al., 2019).

At SMPN B, the students' misconception was 58.05%. The answers they got, on average, come from the teacher. The results of interviews with the SMPN B Bandar Lampung teacher emphasized that misconceptions occurred due to a lack of facilities. The concept of photosynthesis is better to be held as a practicum. The learning in class should use media like PowerPoints so that students can see clearly (Hapsari et al., 2020). However, at SMPN B Bandar Lampung, the laboratory facilities were used as classrooms. The teaching materials were printed books without the help of other media.

Furthermore, at SMPN B Bandar Lampung, the method used by the teacher was the lecturing method. Paul Suparno's book explains that the lecturing method that suppresses students' opportunities to ask questions and express their ideas often fosters misconceptions (Samiha et al., 2017). Students do not have the tools to check the knowledge they get and do not have the opportunity to correct their wrong answers (Aminah, 2020).

At SMPN C, there were 50.28% misconceptions among students. The interviews with the SMPN C Bandar Lampung teacher showed that misconceptions could occur because of the students and the lack of facilities and infrastructure that support learning, such as the laboratories. The teaching materials were less supportive because the learning only used printed books. They can only imagine without being able to witness the process of photosynthesis directly. In his cognitive theory, Piaget describes the stages of children's cognitive development, starting from the sensorimotor to the formal stage. Because students' thinking is from concrete to abstract, in the activity of understanding a material, students in the concrete stage will be limited to forming their knowledge, especially abstract ones (Bujuri, 2018). They cannot generalize, abstract, and think logically. In this stage, their concept of the material is incomplete or even misconceived. Therefore, teachers need to choose lesson materials that are adapted to the development of students' thinking. In learning photosynthesis, teachers cannot only rely on the lecturing method and printed books because the concept of photosynthesis emphasizes learning or observing directly so that students can clearly understand the stages. Photosynthesis, if only based on printed books, can cause students to misunderstand and capture the intended concept because they will interpret the theory differently (Wahidah et al., 2018).

## Recapitulation of the Average Percentage of Misconceptions

After obtaining the results of the calculation of misconceptions in three schools based on accreditation A, accreditation B, and accreditation C, the results of the calculations are recapitulated in the table below:

**Table 3.** The Recapitulation of the Average Percentage of Students' Level of Photosynthesis Concept Understanding

| Indicator Questions | Category (average%) | | |
|---|---|---|---|
| | Understanding the Concept | Misconception | Do Not Understand the Concept |
| 1. Knowing the meaning of photosynthesis. | 20.224% | 74.157% | 5.617% |
| 2. Determining the factors that affect photosynthesis. | 16.853% | 74.157% | 8.988% |

| Indicator Questions | Category (average%) | | |
|---|---|---|---|
| | Understanding the Concept | Misconception | Do Not Understand the Concept |
| 3. Knowing the meaning of light reactions in photosynthesis. | 53.932% | 29.213% | 16.853% |
| 4. Knowing the understanding of dark reactions in photosynthesis. | 32.584% | 49.438 % | 17.977% |
| 5. Knowing the chemical reactions in photosynthesis. | 35.955% | 47.191% | 16.853% |
| 6. Knowing the function of chlorophyll. | 16.853% | 61.797% | 21.348% |
| 7. Knowing the advantages of photosynthesis. | 13.483% | 62.921% | 23.595% |
| 8. Knowing the location of photosynthesis. | 21.348% | 49.438% | 29.213% |
| 9. Determining the parts of the chloroplast. | 34.831% | 29.213 % | 35,955% |
| 10. Determine factors that do not affect photosynthesis. | 8.988% | 77.528% | 13.483% |
| 11. Knowing the experimental proof of photosynthesis on Hydrilla sp. | 34.831% | 44.943% | 20.224% |
| 12. Knowing the location of CO2 binding in photosynthesis. | 7.865% | 69.662% | 22.471% |
| **AVERAGE** | **24.812%** | **55.804%** | **19.381%** |

Based on the table, the level of conceptual understanding of photosynthesis is dominated by the misconception category, with an average of 55.804%. The lowest percentage was those who did not understand the concept, with an average of 19.381%. The average category of understanding the concepts was 24.812%. The items with the highest percentage, above 50%, were misconceptions, which consisted of six items (1, 2, 6, 7, 10, 12).

Students who experienced misconceptions based on data analysis using CRI were students who answered the questions incorrectly with high confidence. Based on the analysis of the students' reasons, some students revealed that the reasons came from the educators. This can be one of the causes of misconceptions because the learning method provided by educators only emphasizes one aspect of the concept being studied. Tanwil stated that the nature of learning biology contains attitudes and curiosity about objects, natural phenomena, living things, and causal relationships that cause new problems that can be solved through the right procedures. From the results of the identification of student misconceptions, SMPN A Bandar Lampung had the highest percentage of misconceptions, which was 58.88%, compared to SMPN B and SMPN C Bandar Lampung.

## CONCLUSIONS AND SUGGESTIONS

Based on the analysis, the percentage of students indicated a misconception about the photosynthesis concept was 55.804%. This percentage was greater than the percentage of students who understand the concept and do not know the concept. The students' misconceptions occurred in determining the factors affecting photosynthesis, determining the factors that do not affect photosynthesis, knowing the meaning of photosynthesis, and the location of $CO_2$ binding in photosynthesis. The cause of the misconception can come from students, the methods used by teachers, and teaching materials.

The suggestion that the author can convey is that further research should be carried out on the causes of misconceptions so that they can be used as reflections for teachers in carrying out learning, for educators to carry out apperception related to the concept of learning so that students can catch the image of the correct initial concept.

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