

# MISCONCEPTIONS REGARDING ECOSYSTEM MATERIAL WITH THE *Certainty of Response Index* METHOD IN CLASS X STUDENTS OF SMA NEGERI 1 BAITUSSALAM

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**Abstract:** Ecosystem is one of the biology materials that has difficulty for students in understanding the concept that causes misconceptions. In students, wrong conceptual understanding can hinder the learning process. This study aims to determine misconceptions in class X students on ecosystem material using the *Certainty of Response Index* method. This method is used to determine students' misconceptions not only students' answers but also the level of students' confidence in their answers, so that they can differentiate between misconceptions, not understanding the concept, guessing and understanding the concept. This study uses a descriptive method with a quantitative approach. Respondents in this study were 50 class X students of SMA Negeri 1 Baitussalam. The data collection technique used was a *four-tier* diagnostic test instrument in the form of 20 multiple-choice questions with reasoning equipped with the level of confidence of students' answers using the CRI scale. The results of this study indicate that students' misconceptions on ecosystem material in class X SMA Negeri 1 Baitussalam were 57% in the moderate category. The conclusion of this study is that misconceptions occur in ecosystem material using the *Certainty of Response Index* method that most students answered questions with a high level of confidence, but many answered not in accordance with the correct scientific concept. This shows that there is a high level of misconception in the sub-material on energy flow.

**Keywords:** Misconceptions; *Certainty of Response Index*; Ecosystem; and Students

## 1. Introduction

The development of the 21st century demands that humans excel in all fields, one of which is through improving the quality of human resources in education. According to Alawiyah *et al.*, (2017), good human resources can be determined by the quality of education implemented. Formal education, such as in schools, plays a crucial role in developing students' potential. Formal education can improve students' ideas and thinking (Shalihah *et al.*, 2019). Teaching and learning activities are key in education, because learning is one of the human efforts to understand new things and shape and change their behavior. Learning activities are a lifelong process that will shape a person's personality and can be done anywhere, both formally and informally (Nurhidayah *et al.*, 2020).

According to Tekkaya (as cited in Nurfadilah, 2021), every student attending school has different knowledge, experiences, and perspectives. When a students' understanding of something contradicts expert opinion, it is called a misconception. Misconceptions are conceptual understandings that do not align with expert views (Alawiyah *et al.*, 2017). Misconceptions can affect anyone, whether they are intelligent or average. Students who experience misconceptions are different from those who do not understand the concept at all.

Biology is a branch of natural science that has abstract concepts (Nurlaila, 2016). Ecosystems themselves involve reciprocal relationships between organisms and the environment, influenced by biotic and abiotic components (Sholihah and Anantyarta, 2021). This ecosystem material also requires logical, analytical, systematic, critical, creative, and collaborative thinking skills. Identification of student misconceptions can be done using

various methods. One way to minimize this is by adding a *four-tier* diagnostic test to the *Certainty of Response Index* (CRI) method (Putri and Subekti, 2021). The CRI method is a tool used to measure students' level of confidence in their conceptual understanding. According to Natalia (2021), the CRI is effective in providing an overview of students' levels of misconceptions. This study combines the *Four-Tier* diagnostic instrument with the CRI method.

Based on this background, the author conducted research by analyzing misconceptions on ecosystem material at one of the schools at SMA Negeri 1 Baitussalam. The purpose of this study was to analyze the level of misconceptions of grade 10 students at SMA Negeri 1 Baitussalam on ecosystem material.

## 2. Literature Review

### 2.1 Misconceptions

Misconceptions are erroneous understandings or thought patterns that are inconsistent with scientific reality (Tekkaya, 2002). According to Brown as cited in Suparno (2005), misconceptions are incorrect explanations or ideas that do not align with scientific understandings accepted by experts. Misconceptions occur when students adapt their understanding to previous, incorrect experiences, without realizing that these experiences are inconsistent with theory (misconceptions). Therefore, students' misconceptions need to be addressed to prevent them from weakening subsequent concepts.

This is different from students who don't understand the concept at all. Students who experience misconceptions believe their understanding is correct even though it is actually incorrect (Wulandari *et al.*, 2019). According to Fitria (2019), misconceptions form in learning for several reasons:

- a. Students tend to base their thinking on what is visible in a problem situation.
- b. Using different ideas to interpret a phenomenon.
- c. Students only pay attention to certain aspects of a situation, because they interpret a phenomenon based on absolute properties rather than understanding the interactions between elements of a system.
- d. Students focus more on change than static situations.
- e. When students explain change, their thinking tends to be linear.
- f. Have ideas that are inclusive and global.

### 2.1 CRI Method

One method used to identify misconceptions is the *Certainty of Response Index* (CRI) technique introduced by Hasan and Kelley in 1999. According to Fitria (2019), the CRI is a measuring tool to assess students' level of confidence in answering questions. The four-tier diagnostic test using the CRI method can be used to measure respondents' level of confidence and certainty in answering each question.

The CRI scale indicates the level of certainty in the answer, namely: a low CRI value indicates conceptual uncertainty, usually based on guesswork, while a high CRI indicates strong confidence in the concept, with a very small probability of guesswork. Misconceptions or conceptual ignorance in a respondent can be distinguished by comparing the correctness of the answer with the level of certainty expressed through the CRI (Hala, Mangoling, and Aarsal 2018).

### 2.3 Four-Tier Diagnostic Test

Four-tier diagnostic test is a development of the three tier test, adding a confidence level to the reasoning for answers to improve the accuracy of misconception diagnosis (Fitria 2019). This test consists of four levels: the question, the confidence level in the answer, the reasons associated with the answer, and the confidence level in providing the reasoning. This test can also identify which concepts students understand and which they do not (Zulfikar *et al.* 2017). The advantage of the four-tier diagnostic test is its ability to measure student understanding based on their confidence level. The four-tier diagnostic test also has a disadvantage: there are two possible answers: 'sure' and 'not sure', which cannot be implemented to accommodate students who are unsure or guessing (Muna 2021). This can be minimized by adding the *Certainty of Response Index* (CRI) method to the four-tier diagnostic test (Putri and Subekti 2021).

### 3. Method

The method used in this study is a descriptive method with a quantitative approach. This research was conducted at SMA Negeri 1 Baitussalam, on May 10 to May 16, 2025. The population in this study was 150 class X students. The sample in this study was class X-2 and X-3 who had studied ecosystem material with a total of 50 students using the *Purposive Sampling* technique.

The data collection technique used was a *four-tier* diagnostic test instrument in the form of 20 multiple choice questions with reasoning, which were equipped with the level of confidence in students' answers using the CRI scale and the criteria in Table 2.

Table 2. CRI Scale and Criteria

| Scale | Category             |
|-------|----------------------|
| 0     | Totally Guess Answer |
| 1     | Almost Guess         |
| 2     | Not Sure             |
| 3     | Sure                 |
| 4     | Almost Sure          |
| 5     | Certain              |

(Source: (Pebrianto., 2020)

The following table is used to differentiate the level of conceptual understanding of each respondent. Table 1 shows the assessment criteria using the CRI method.

Table 3. Interpretation of Four-tier Diagnostic Test Results

| Criteria               | Answer Pattern |        |         |        |
|------------------------|----------------|--------|---------|--------|
|                        | Tier 1         | Tier 2 | Tier 3  | Tier 4 |
| Understand the Concept | Correct        | High   | Correct | High   |
| Guessing               | Correct        | Low    | Correct | Low    |
|                        | Correct        | High   | Correct | Low    |
|                        | Correct        | Low    | Correct | High   |
|                        | Correct        | Low    | Low     | Low    |
|                        | Incorrect      | Low    | Correct | Low    |

|                               |           |        |           |      |
|-------------------------------|-----------|--------|-----------|------|
| Do not Understand the Concept | Incorrect | Low    | Low       | Low  |
|                               | Correct   | Tinggi | Incorrect | Low  |
|                               | Incorrect | Low    | Correct   | High |
| Misconception                 | Correct   | Low    | Incorrect | High |
|                               | Correct   | High   | Incorrect | High |
|                               | Incorrect | High   | Correct   | Low  |
|                               | Incorrect | High   | Correct   | High |
|                               | Incorrect | High   | Incorrect | Low  |
|                               | Incorrect | Low    | Incorrect | High |
|                               | Incorrect | High   | Incorrect | High |

(Source: (Rodhiyah 2023))

Next, analyze each student's answers to distinguish between conceptual understanding, guessing, not understanding, and misconceptions. Data from the students' test results are then processed using the following formula (Mustaqim, 2014):

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

Remarks:

F : frequency of the amount obtained

N : total number of students

P : percentage of student answers for each question item

Next, describe the data obtained from the test results. This data will lead to conclusions.

#### 4. Finding and Discussion

The interpretation of the results of the *four-tier* CRI diagnostic test for class X on ecosystem material can be seen in Figure 1 below.

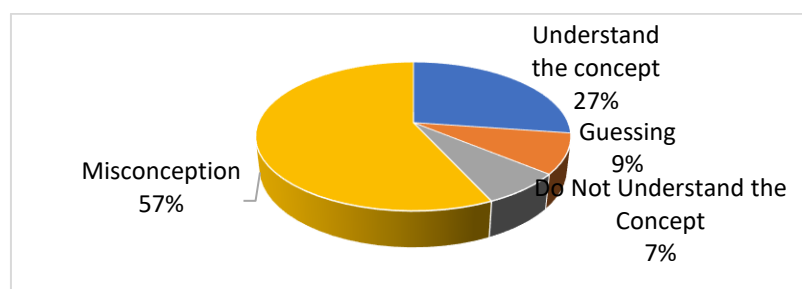


**Figure 1. Interpretation of *Four-Tier* CRI Diagnostic Test Results**

Based on the results of the *four-tier* diagnostic test using CRI (Figure 1), it shows that 57% of grade 10 students experienced misconceptions (M) and were included in the moderate category. The results also showed that 27% of students understood the concept (P), 9% of students guessed the answer (MB), and 7% of students did not understand the concept (TP). Misconceptions experienced by students can affect their understanding of the material to be studied later, this is because the concepts in biology learning are related to one another. According to Abraham, Grzybowski, Renner, & Marek (1992) in Alonemarera (2020), a student

is categorized as not understanding a concept if they do not provide an answer, write "I don't know," copy the question again, or provide an irrelevant answer. Students are considered to understand part of the concept if they are able to answer part of the concept correctly without containing misconceptions, while understanding the whole concept is characterized by correct answers to all questions according to the concept. Misconceptions are divided into two categories: partial misconceptions, where the answers demonstrate conceptual understanding but contain errors in some of the content; and total misconceptions, where all answers relate to the concept but the explanations are illogical. The study found that some students still experience misconceptions regarding ecosystems, indicating that they are not yet fully capable of constructing and understanding the concept correctly. Figure 2 illustrates the level of student misconceptions in each ecosystem subtopic.

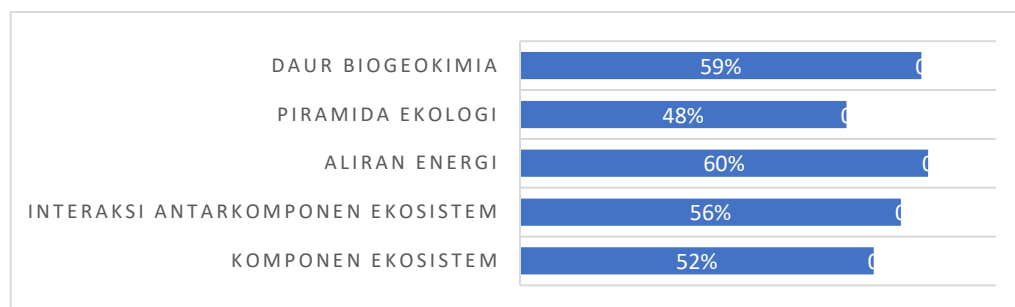


**Figure 2. Percentage of Misconceptions in the Ecosystem Sub-Material**

In Figure 2, most students still experience misconceptions in each ecosystem sub-topic. The highest misconception percentage is in the energy flow sub-topic at 60%, while the lowest misconception percentage is in the ecological pyramid sub-topic at 48%. The energy flow sub-topic is the sub-topic that is most difficult for students to understand. Eromosele *et al.* (2016) found that most students experience misconceptions in this sub-topic, especially in differentiating decomposers and detritivores, which are often considered the same. Ozata & Ozkan (2015) explained that incorrect word associations can form cognitive errors that hinder the acceptance of new information. Research by Nurhidayah *et al.* (2020) in two schools in Bandung City showed the highest misconception in this sub-topic, namely 28.13%, which was caused by the delivery of material using *PowerPoint* containing text with few images or videos and the use of language that is difficult for students to understand. Alonemarera (2020) emphasized that misconceptions easily occur if abstract material is delivered in an inappropriate manner.

## 5. Conclusion and Recommendation

Based on the research results, it can be concluded that the learning process is still not optimal in achieving learning objectives. This condition contributes to the emergence of misconceptions among students, amounting to 57%, which is considered low. The highest level of misconception among students is the concept of energy flow, at 60%. The material on energy flow is considered difficult to understand because it combines concrete concepts, such as the relationships between organisms in the food chain, with abstract concepts, such as energy transfer and the role of certain organisms in the ecosystem.

These difficulties can be exacerbated by the lack of varied delivery methods and the lack of interactive media, which hinders students from developing a correct conceptual understanding. Therefore, the results of this study can serve as an important reference for

future research, examining the causes of misconceptions and developing more effective learning strategies. This is expected to minimize misconceptions and significantly improve students' conceptual understanding.

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