Analysis of Science Misconceptions for Class VI Elementary School Using The Certainty of Response Index Method

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Abstract
Educators need to instill correct concepts in students because the concepts taught in elementary school will become the basis of thinking for students and that will underlie students' thinking at the next level. This research aims to analyze the misconceptions experienced by class VI students in Pilangkenceng District, Regency Madiun. The type of research used is quantitative descriptive with survey methods. The research subjects were class VI students in Pilangkenceng District, with a sample of 100 students selected using a simple random sampling technique. Data was collected through tests and non-tests. The test is carried out using a diagnostic instrument equipped with CRI (Certainty of Response Index) to identify misconceptions, while the non-test uses unstructured interviews. The data analysis technique used is descriptive percentage analysis. The results of the analysis show that 45% of students experience misconceptions regarding the concept of adaptation to living things. The highest percentage of misconceptions is in the sub-concept of adaptation to xerophytic plants at 65%, while the lowest percentage is in the sub-concept of adaptation to pitcher plants at 10%. The main factors causing this misconception come from students' thoughts and various learning sources. The role of educators is to provide a correct understanding of concepts from an early age to prevent misconceptions that can continue to the next level of education. Efforts to improve learning strategies and provide valid learning resources are very necessary to reduce the level of misconceptions among students.
Keywords :misconceptions, science, adaptation of living things, CRI

Abstrak
Penting bagi pendidik menanamkan konsep yang benar pada siswa, sebab konsep yang diajarkan di Sekolah Dasar akan menjadi dasar pemikiran bagi siswa dan itu akan mendasari pemikiran siswa pada jenjang selanjutnya.Penelitian ini bertujuan untuk menganalisis miskonsepsi yang dialami peserta didik kelas VI di Kecamatan Pilangkenceng, Kabupaten Madiun. Jenis penelitian yang digunakan adalah deskriptif kuantitatif dengan metode survei. Subjek penelitian terdiri dari peserta didik kelas VI di Kecamatan Pilangkenceng, dengan sampel sebanyak 100 peserta didik yang dipilih melalui teknik simple random sampling. Data dikumpulkan melalui tes dan non-tes. Tes dilakukan menggunakan instrumen diagnostik yang dilengkapi dengan CRI (Certainty of Response Index) untuk mengidentifikasi miskonsepsi, sedangkan non-tes menggunakan wawancara tidak terstruktur. Teknik analisis data yang digunakan adalah analisis deskriptif persentase. Hasil analisis menunjukkan bahwa 45% peserta didik mengalami miskonsepsi mengenai konsep adaptasi makhluk hidup. Persentase miskonsepsi tertinggi terdapat pada subkonsep adaptasi tumbuhan xerofi sebesar 65%, sedangkan persentase terendah pada subkonsep adaptasi kantong semar sebesar 10%. Faktor utama penyebab miskonsepsi ini berasal dari pemikiran peserta didik dan berbagai macam sumber belajar. Peran pendidik dalam memberikan pemahaman konsep yang benar sejak dini untuk mencegah terjadinya miskonsepsi yang dapat berlanjut ke jenjang pendidikan berikutnya. Upaya perbaikan dalam strategi pembelajaran dan penyediaan sumber belajar yang valid sangat diperlukan untuk mengurangi tingkat miskonsepsi di kalangan peserta didik.
Kata Kunci:miskonsepsi, sains, adaptasi makhluk hidup, CRI

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INTRODUCTION

Natural Sciences (IPA) is a branch of science that includes various disciplines such as physics, biology and chemistry. Science has a very important role in human life, not only in explaining natural phenomena but also in improving the quality of life. By understanding science, humans are able to develop technology, solve environmental problems, and create innovative solutions to global challenges. As stated by Wiyoko (2019), science has contributed greatly to changing human lifestyles from traditional to modern scientific-based life.

Science education at the elementary school level is an important foundation in building a basic understanding of scientific concepts. One of the basic abilities that needs to be developed in students is an understanding of science concepts, principles and laws (Handayani & Rukmana, 2018). However, the low learning outcomes of students in understanding basic science concepts is a serious challenge. Factors such as the perception that science is difficult, full of complicated calculations, and requires memorization often cause students to lose interest in learning (Neta, Sahala, & TMS, 2013). This low interest in learning results in a less in-depth understanding of concepts and can even give rise to misconceptions.Miskonsepsi, menurut Suparno (2013), adalah pemahaman individu yang tidak sesuai dengan pandangan konsensus para ahli. Miskonsepsi dapat disebabkan oleh berbagai faktor, seperti pengalaman belajar yang salah, kesalahan dalam pengajaran, penggunaan buku teks yang kurang tepat, serta metode dan media pembelajaran yang tidak efektif (Wijaya, Suratni, & HP, 2013; Munawaroh & Falahi, 2016; Rahayu, 2016; Kurniasih, 2017). Miskonsepsi yang dibiarkan tanpa penanganan dapat menjadi akar masalah bagi kesalahan pemahaman yang lebih kompleks di tingkat pendidikan selanjutnya (Kurniasih, 2017). Oleh karena itu, penting bagi guru untuk segera mengidentifikasi dan menganalisis miskonsepsi yang dialami peserta didik.

Science learning is getting bigger considering its impact on the quality of learning. One effective method for identifying misconceptions is to use a diagnostic test equipped with the Certainty of Response Index (CRI). This method, developed by Hassan, Bagayoko, & Kelley (1999), allows teachers to differentiate between students who understand concepts, do not understand, and experience misconceptions (Murni, 2013). This test also helps in determining certain parts of the material that are weak points and identifying the causes of misconceptions (Septiana & Noor, 2014).

Previous research has shown that there are quite significant misconceptions in science learning, both among students and teachers. However, there are not many studies that specifically analyze misconceptions about the concept of adaptation in living things. This concept is important because it is directly related to understanding how living things survive and develop in their environment. Adaptation of living creatures is also one of the key materials in the science curriculum which requires in-depth understanding to build further knowledge about ecosystems and biodiversity.

The aim of this research is to identify and analyze misconceptions in the concept of adaptation of living things at the elementary school level. This research will involve six schools as participants, with a focus on the use of CRI-based diagnostic tests to obtain a comprehensive picture of the types and causes of misconceptions that occur. The novelty of this research lies in the integrated approach between in-depth analysis of misconceptions in the material on the adaptation of living creatures and the use of diagnostic methods that can provide more valid and reliable data.

It is hoped that this research can make an important contribution to improving the quality of science learning in elementary schools. By understanding the types and causes of misconceptions, teachers can design more effective and adaptive learning strategies. Apart from that, this research can also be a basis for developing innovative media and learning methods, thereby helping students build a better understanding of science concepts, especially the adaptation of living things. This is in line with the need

to create a generation that not only understands science conceptually but is also able to apply it in everyday life.

METHOD

This research was conducted in elementary schools spread across the Pilangkenceng sub-district, Madiun Regency. This research is a quantitative descriptive research. To find out misconceptions in fifth grade elementary school students, data was carried out using the Cri test. In addition, interviews were conducted to collect information regarding the causes of student misconceptions. The research sample was determined using a saturated sampling technique (Sugiyono, 2017).

The respondents used as samples were all class V students, totaling 100 respondents. By using the cri test, multiple choice questions on style material are used as a tool. Data from diagnostic test questions answered by respondents are analyzed, then the results will show the percentage of students' misconceptions about style material. Misconceptions can be identified using diagnostic tests that are designed and verified by experts before use.

After knowing the highest, medium and lowest misconceptions, conduct interviews to find out what causes students' misconceptions. After carrying out diagnostic tests on respondents, they are then processed using formula 1 proposed by Sudijono (Alawiyah, Ngadimin, & Hamid 2017).

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

Information:
F: frequency of students' answers to each question item N: number of students
P: percentage of students' answers to each question item

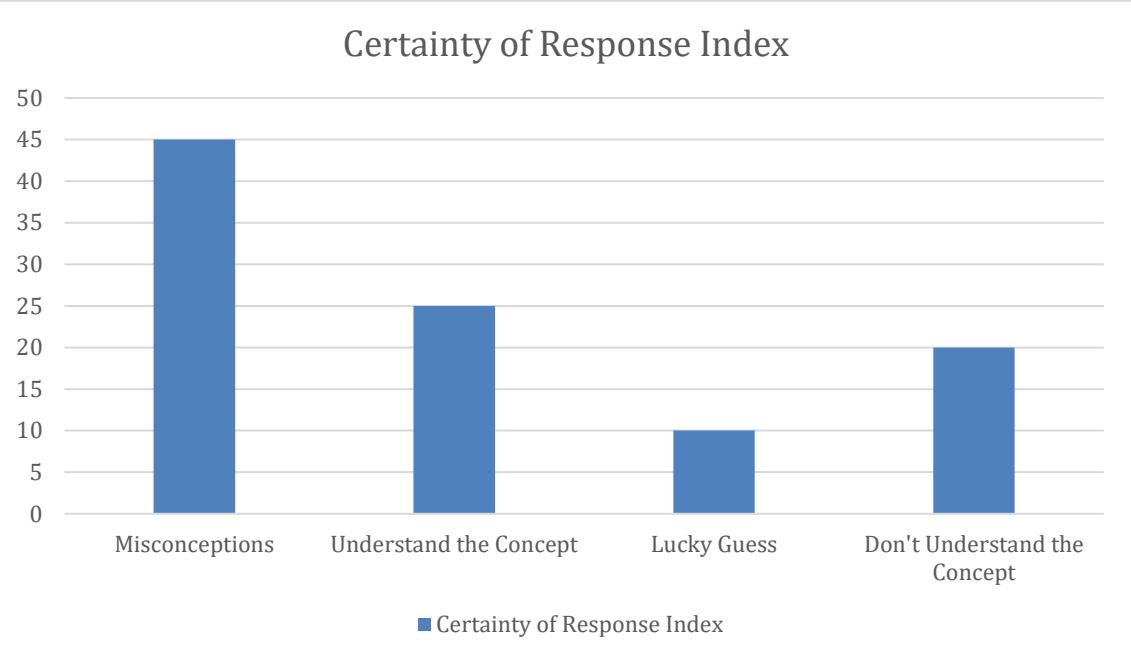
Percentage calculations are displayed in table/graph format. Then analyze which questions and sub-chapters students have misconceptions and group students' misconceptions based on Table 1 proposed by Pulu, S. R., & Amahoru, A. H. (2023), and categorize the level of misconceptions as follows:

Table 1. Category Percentage Level of Misconceptions

Persentase	Category
0-30%	Low
31-60%	Currently
61-100%	Tall

RESULT AND DISCUSSION

This research aims to analyze misconceptions in science class VI about the concept of adaptation of living things. There are ten concepts in the material for the adaptation of living creatures studied, namely the Purpose of Adaptation, Types of Adaptation (Physiology, Morphology and Behavior), Animal Adaptation, Plant Adaptation and Adaptation in Special Environments. The research began by giving diagnostic tests to 100 students.



Berdasarkan hasil analisis diperoleh data bahwa dari 100 peserta didik , 45% mengalami miskonsepsi, 25% peserta didik paham konsep, sedangkan 10% peserta didik adalah menjawab lucky gues dan 20% nya peserta didik mengalami tidak paham konsep.

Table 1 Results of Misconception Analysis

Question	Misconceptions (%)	Understand the Concept (%)	Lucky Guess (%)	Don't Understand the Concept (%)
1	40%	30%	5%	25%
2	50%	20%	10%	20%
3	35%	25%	15%	25%
4	45%	15%	10%	30%
5	30%	40%	10%	20%
6	60%	10%	5%	25%
7	20%	50%	10%	20%
8	55%	15%	5%	25%
9	25%	35%	15%	25%
10	45%	20%	10%	25%

In question number 1, there were 40 students who experienced misconceptions. Then there were 1 students who understood the concept, 5 students were lucky guessers and 25 students did not understand. A total of 40 students chose this option, which is a wrong answer in the context of adaptation. This answer shows a misconception, where most students think that adaptation aims to increase body size, even though the main aim of adaptation is to maintain survival, not merely change physical size. This indicates that many students do not understand the concept of adaptation completely and focus on visible physical changes, although adaptation also includes changes in physiology and behavior that are not always visible to the eye.

In question number 2, 35% of students chose the correct answer, namely physiological adaptation, indicating that some participants understood that this is a

change in body function to adapt to the environment. However, 25% selected “morphology,” incorrectly attributing these adaptations to changes in body shape, while 30% selected “behavior,” indicating confusion between behavioral and physiological adaptations. Another 10% chose “environment,” which is not a type of adaptation, indicating a lack of understanding of the concept of adaptation as a whole.

In question number 3, 15 students had misconceptions, 20 understood the concept well, 7 answered correctly because they were lucky guesses, and 8 did not understand the question. A total of 40 students chose answers that showed an understanding that the legs of predatory animals, such as birds of prey, are used for survival. A total of 25 students chose the answer "perched on a small branch," which was relevant if the picture showed a bird's feet. Additionally, 20 learners chose “scavenging for food in the ground,” which may be appropriate if the picture shows feet suitable for digging. Only 15 students chose “catch prey in water,” indicating a low understanding of animal adaptations in the aquatic environment.

In question number 4, the highest misconception occurred in the concept of teak tree adaptation, with 42 students experiencing misconceptions and 8 not understanding the concept. A total of 60 students answered correctly that teak trees shed their leaves in the dry season to reduce water loss, showing their understanding of physiological adaptations to survive dry conditions. A total of 10 students chose the answer "dropping twigs," which is incorrect because it is not the main adaptation of teak trees. The option “dropping leaves to reduce stem temperature” was chosen by 20 learners, indicating confusion between temperature reduction and evaporation. The answer "dropping leaves to speed up photosynthesis" was chosen by 10 students, which is clearly wrong, indicating an inaccurate understanding of photosynthesis in the context of tree adaptation.

In question number 5, 16 students had misconceptions, 3 understood the concept, 2 answered correctly because they were lucky guesses, and 29 did not understand the concept. A total of 55 students chose the correct answer, which shows an understanding that webbed feet help animals such as frogs or ducks swim in water or mud. However, 20 students chose the answer “long beak shape for foraging,” indicating confusion between leg and beak adaptations. A total of 10 students chose “long necks for foraging,” which is irrelevant in the context of adaptations in aquatic environments, while 15 students chose “short legs for swimming,” which is more suitable for land animals, indicating a lack of understanding of the physical adaptations of aquatic animals .

In question number 6, 12 students had misconceptions, 14 understood the concept, 12 answered correctly because they were lucky guesses, and 12 did not understand the concept. A total of 70 students chose the correct answer that chameleons change body color for camouflage as protection from predators, showing a good understanding of survival strategies. A total of 10 students chose the answer "scare the enemy," which shows confusion about the main function of camouflage. The answer "catching prey" was chosen by 5 students, who misinterpreted the function of the chameleon's body color. Meanwhile, 15 students chose "attracting mates," which is possible, but not the primary function of camouflage, indicating an inaccurate understanding of chameleon adaptations..

In question number 7, 10 students had misconceptions, 0 understood the concept, 3 answered correctly because they were lucky guesses, and 37 did not understand the concept. A total of 60 students chose the correct answer that the air cavities in plant stems, such as water hyacinth, function to help the plant float in water, showing a good understanding of the morphological adaptations of aquatic plants. A total of 15 students chose the answer "accelerates evaporation," indicating confusion about the main function of air cavities. A total of 10 students chose "food reserves," which is wrong, and 15 chose "maintaining balance so that it doesn't tip over," which is also incorrect, indicating an incomplete understanding of the function of adaptation.

In question number 8, 13 students had misconceptions, 21 understood the concept, 9 answered correctly because they were lucky guesses, and 7 did not understand the concept. A total of 55 students chose the correct answer that plants in arid land, such as cacti, have wax-coated stems to reduce evaporation and maintain moisture, showing a good understanding of morphological adaptations in dry conditions. A total of 20 students chose "dropping leaves," which does not correspond to stem adaptation. The answer "has short roots" was chosen by 10 students, which is wrong because plants in arid land usually have long roots. A total of 15 students chose “long stems,” which is inaccurate, indicating misconceptions about appropriate adaptations in arid environments..

In question number 9, 8 students had misconceptions, 29 understood the concept, 11 answered correctly because they were lucky guesses, and 9 did not understand the concept. A total of 70 students chose the correct answer that pitcher plants catch insects to obtain nutrients, especially nitrogen, which shows a good understanding of plant adaptation in nitrogen-poor environments. A total of 15 students chose the answer "store water in their pockets," which does not correspond to the function of pockets in catching insects. The answer “flowers in certain seasons” was chosen by 10 students, which is not relevant to the context of nutritional adaptation. Meanwhile, 5 students chose “rolling the leaves,” which is more related to reducing water loss, indicating a lack of proper understanding of pitcher plant adaptations.

On this concept, 15 students experienced misconceptions, 11 understood the concept, 2 answered correctly because they were lucky guesses, and 28 did not understand the concept. Students misunderstand that the digestive system only consists of the mouth, esophagus, stomach, intestines and anus, without including the role of the liver and pancreas. A total of 60 students chose the correct answer that coastal plants such as mangroves have supporting roots for stability in soft soil, showing a good understanding of morphological adaptations. A total of 25 students chose “hollow stem,” which is inappropriate in a coastal context, indicating a lack of understanding of specific adaptations. A total of 10 students chose “thin and broad leaves,” and 5 chose “drops leaves,” both of which are not relevant in the context of coastal plants, indicating further misconceptions about plant adaptations.

Based on the results of the research analysis above, students in Pilangkenceng District experience misconceptions about each sub-concept of adaptation to living things. This can be seen from the percentage of analysis results which show that many students do not understand the relationship between morphological, physiological and behavioral adaptations. Understanding how living things adapt to their environment, either through changes in form, function or behavior, is a basic concept that is very important to master. This misconception can have a significant impact on students' ability to understand advanced material, such as the interaction of organisms with the environment and survival mechanisms in ecosystems. With a wrong understanding of adaptation, students will have difficulty analyzing the interaction processes between organisms and adaptation strategies in facing environmental changes.

These results are in line with findings from several previous studies in elementary schools which also identified similar misconceptions. Research by Suryani et al. (2020) identified misconceptions of 5th grade elementary school students regarding morphological adaptations in animals. The results show that more than 65% of students understand adaptation only as a change in body shape without linking it to a specific function. This research recommends the use of interactive visual media to improve student understanding. The study by Prasetyo and Anindita (2021) focuses on misconceptions about physiological adaptation in plants. Most 4th grade elementary school students do not understand the concept of stomata as a plant adaptation tool to reduce evaporation

Use simple experiments in class to strengthen understanding of this concept. Haryanto and Kusuma's research (2022) highlights misconceptions about behavioral adaptation, especially in animals. It was found that students often viewed bird migration as simply a seasonal behavior without understanding its link to survival needs. Story-based learning methods are recommended to clarify this concept. Nuraini et al. (2023) reviewed 6th grade elementary school students' understanding of the relationship between morphological, physiological and behavioral adaptations. As many as 70% of students had difficulty linking these three types of adaptation as an integrated survival mechanism. This research recommends a project-based learning approach. Recent research by Santoso and Indriani (2024) highlights the use of teaching aids in reducing misconceptions about adaptation. Research was conducted on 5th grade elementary school students with results showing that real environment-based teaching aids were able to increase understanding by up to 85%.

Misconceptions about the concept of adaptation to living things are a common problem experienced by students at various levels of basic education. Intervention through interactive learning media, simple experiments, story-based learning, and the use of real environment-based teaching aids can be an effective solution. Therefore, teachers need to choose the right learning strategy to help students understand the concept of adaptation comprehensively

Based on interviews conducted, it was revealed that the misconceptions experienced by students in elementary school were caused by intuition or personal thinking. They often rely on everyday experiences and less valid learning sources, such as unverified information from the internet, thus forming erroneous understandings. This finding is in line with research by Hartanti et al. (2024), which states that misconceptions in science learning in elementary schools can be caused by students' lack of interest and motivation in learning, as well as the use of monotonous learning methods.

Apart from that, learning resources such as textbooks can also cause misconceptions. Research by Prastika (2017) found that the textbooks used by teachers in class V contained misconceptions about several science materials, such as animal respiratory organs and the photosynthesis process.

This misconception can have a significant impact on students' understanding of scientific concepts and hinder the further learning process. Therefore, strategies are needed to reduce these misconceptions. Hartanti et al. (2024) recommend using varied learning methods, such as mindscaping, to increase understanding of concepts and reduce misconceptions.

Overcoming students' misconceptions requires an approach that is structured, repetitive, and based on scientific evidence so that it can be logically accepted by those who experience misconceptions (Rohani, R. (2023)). Several recent studies in the last five years have explored various methods to remediate these misconceptions.

Rahmita and Wasis (2020) developed a Student Worksheet (LKPD) with a guided inquiry learning model supported by PhET simulations on dynamic fluid material. This approach proved effective in reducing students' levels of misconception, demonstrated by a significant increase in concept understanding after the intervention.

Mayasri, Reza, and Nasir (2023) applied a conceptual change approach to identify and remediate misconceptions in chemical equilibrium material. By using a four-level diagnostic test based on the Certainty of Response Index (CRI), they succeeded in reducing students' misconceptions significantly, especially in the equilibrium constant sub-material.

Damayanti, F., & Yulistiana. (2021). uses the Think-Pair-Share learning model combined with Word Square to remediate students' misconceptions about the concept of heat transfer. The research results show a reduction in misconceptions of 31.2% after implementing this model, with high effectiveness based on the effect size value.

Budi (2015) examined the use of refutation texts as reading to remediate students' misconceptions about the concept of acids and bases. This approach was effective in reducing misconceptions, with a significant decrease in the average percentage of misconceptions after the intervention.

These approaches show that the use of appropriate methods, models, media or teaching aids can significantly reduce students' misconceptions. The implementation of learning strategies that are interactive and based on conceptual change, such as guided inquiry with simulations, refutation texts, and the Think-Pair-Share model, has proven to be effective in increasing students' conceptual understanding.

CONCLUSION

Based on the research results, several recommendations can be given to overcome the high percentage of students' misconceptions regarding the adaptation of living things, especially the adaptation of xerophytic plants which reaches 65%. First, teachers are advised to apply inquiry and experiment-based learning methods. With this approach, students can observe and explore the concept of adaptation directly through learning media such as digital simulations, videos, or field observations. Second, it is important to ensure that the learning resources used are valid and relevant. The use of teaching materials that are research-based and according to the curriculum can help reduce misinformation that affects students' understanding. Third, teachers need to receive special training to increase competence in teaching the concept of adaptation, especially more complex material such as the adaptation of xerophytic plants. In addition, initial diagnostic tests can be carried out before learning begins to identify existing misconceptions and adapt learning strategies to student needs.

The implications of this research indicate the need to develop special learning modules that focus on the concept of xerophytic plant adaptation, complete with illustrations, simulations and interactive exercises to reduce misconceptions to below 20%. Apart from that, a change in students' independent learning paradigm is also needed by increasing their literacy in choosing credible learning sources. On the other hand, the curriculum also needs to pay more attention to adaptation concepts that are difficult to understand through a contextual and fun learning approach. Further research is also recommended to evaluate the effectiveness of new learning strategies while exploring other factors that may contribute to misconceptions, such as the learning environment and student learning styles. By implementing these recommendations, it is hoped that students' level of understanding of the concept of adaptation to living things can increase significantly.

After conducting research, the suggestions that can be recommended are: (1) Teachers explore their students' preconceptions before new concepts are given. (2) Teachers can consider this CRI method to identify other concepts at the end of each learning process. (3) Teachers carry out remediation to reduce and prevent ongoing misconceptions about the concept of adaptation of living things by using effective learning strategies.

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