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MISCONCEPTION ANALYSIS USING THE FOUR-TIER TEST THROUGH TREE THINKING ON THE CONCEPT OF ANIMALIA CLASSIFICATION

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ABSTRACT

Misconceptions are knowledge possessed by students that are irrelevant or not under existing concepts. Misconceptions can affect the learning process about scientific concepts. This study aimed to find out the misconceptions that students have about the concept of Animalia classification. The method used in this research is the descriptive quantitative method. This research was conducted on one of the Madrasah Aliyah in the Sukabumi district. The research subjects were 50 students in classes X A and X B. The instrument used was a four-tier test (four-level diagnostic test) combined with tree thinking and consisted of 15 questions. The results showed that students who understood the concept (PK) in the Animalia classification material had a percentage value of 23%. Students who do not understand the concept (TPK) have a percentage value of 7%. Students who understand some of the concepts (PS) have a percentage value of 22%. Meanwhile, students who experienced misconceptions (M) in the Animalia classification material had the highest percentage value compared to other categories, namely 49%. Based on these data, the misconceptions that students have on the concept of Animalia classification are in the medium category.

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INTRODUCTION

The concept is an essential aspect for students in carrying out a lesson (Erika & Subekti, 2021). Students learn concepts through their own experiences, formal/school activities, and informal/daily activities (Soeharto et al., 2019). A concept learned by students in learning does not always stand alone but is interconnected with each other (Hanafy, 2014). However, students often do not understand the relationship between one concept and another to leads to misconceptions.

Misconceptions are knowledge possessed by individuals/students that are irrelevant or not following existing concepts. Jannah & Rahmi (2020) revealed that misconceptions are differences in conceptual understanding between the concepts possessed by students and existing scientific concepts. Students' misconceptions can affect the learning process about the scientific concepts being studied because misconceptions often occur in various fields of education, one of which is science (Gurel et al., 2015). Misconceptions tend to persist and are resistant (solid or difficult to remove) (Arslan et al., 2012 in (Ahmad & Indana, 2018). several factors can cause misconceptions, namely students, educators, daily experiences, language, culture, books, and methods used by teachers (Suhandi et al., 2020).

Misconceptions can be identified or measured using tests. Suparno (Hasanah, 2020) revealed that misconceptions could be measured in various ways, one of which is using multiple-tier choice tests and open reasoning. This multiple-tier choice test is widely used in some subjects to identify students' misconceptions. The test has also been developed into a multiple-tier test created to identify misconceptions effectively and measure the level of confidence in the answers chosen by students on the test.

Based on the interviews conducted by researchers with students and educators in one of the MA, Sukabumi district, it was stated that students had difficulty understanding the concept of classification, especially the concept of Animalia classification. Classification of Animalia has many sub-concepts that must be learned in a relatively short time (Nur'aini & Chamisijatin 2015) so that students have difficulty understanding the concept. Moreover, it is also reinforced by the results of research conducted by Henny (2011) that students experience misconceptions about the material of the animal world (kingdom Animalia). Classification of Animalia is divided into two sub-materials that must be studied, namely invertebrates (no backbones) and vertebrates (backbones) (Campbell, 2008).

With the problems above, the researcher analyzed the misconceptions that students had in the concept of Animalia classification with the help of a four-tier test combined with tree thinking. The four-tier test (four-level diagnostic test) is an extension of the three-tier test, which is added to the level of confidence in the chosen reason. With the addition of confidence in the chosen reason, it can produce a more specific and accurate answer combination analysis (Erika & Subekti, 2021). The four-tier test consists of four parts. At the first level, five multiple-choice questions are consisting of four distractors and one answer key. The second level is the level of confidence in the answers chosen at the first level, which are very sure (SY), sure (Y), not sure (TY), and very unsure (STY). The third level provides five reasons for the answers in the first level. While at the fourth level in the form of the level of confidence in the reasons chosen at the third level, the level of confidence is in the form of very sure (SY), sure (Y), not sure (TY), and very unsure (STY) (Rawh et al., 2020).

Novick & Catley (2016) revealed that tree thinking is an essential component of scientific literacy in the 21st century. Omland et al. (2008) also stated that tree thinking is critical in almost all fields of biology. According to (Kummer et al., 2016), tree thinking is critical and is almost used in every field of research in biology. Tree thinking is learning focused on knowing the kinship relationship of an organism from its ancestors to its descendants. In addition, tree thinking can help students in interpreting branched tree diagrams or cladograms. A cladogram is a branching diagram that describes the kinship of organisms or evolutionary lines between taxa (Campbell, 2008). Cladograms can also depict phylogenetic relationships as nested taxa supported by synapomorphy. With this, the classification concept can be easily learned by using a cladogram or tree thinking, so the tests used by researchers are combined with tree thinking.

METHOD

This research was conducted on April 17, 2021. This research was conducted on students in one of the MA, Sukabumi districts. The population and sample in this study were determined using the purposive sampling technique. The sample used is 50 students in classes X A and X B. The research method used is the descriptive research method. The instrument used in this research is a four-tier test instrument combined with tree thinking. The data collection technique used is by giving online tests to students.

The research data is processed quantitatively, resulting from the four-tier test instrument combined with tree thinking. The test assessment was analyzed based on the four-tier test answer combination table. The assessment can classify students into four categories, namely, understanding the concept (UC), not understanding the concept (NUC), partially understanding (PU), and misconceptions (M). The combination of four-tier test answers presented in table 1.

Table 1. Four-Tier Test Answer Combination

Answer Combination					
No	**Category**	**Answer**	***Confidence Rating***	**Reasoning**	***Confidence Rating***
1.	Understand the concept	True	Yes	True	Yes
2.	Not	False	Yes	False	Yes
3.	understand the concept	False	No	True	Yes
4.		True	Yes	True	No
5.		True	Yes	False	No
6.		True	No	True	Yes
7.	Partly	True	No	False	No
8.	understand	True	No	False	No
9.		False	Yes	True	No
10.		False	Yes	False	No
11.		False	No	True	No
12.		False	No	False	No
13.		True	Yes	False	Yes
14.	Misconceptions	True	No	False	Yes
15.		False	Yes	False	Yes
16.		False	No	False	Yes

After that, calculations were carried out to categorize students into conceptual understanding (CU), not understanding concepts (NUC), partial understanding (PU), and misconceptions (M) using the following percentage technique. Then group the level of misconceptions that students have with the categories that have been determined in Table 2.

$$P = \frac{f}{n} x100\% \quad \text{..... (1)}$$

Note:
P = Percentage (% group)
F = Frequency (in a group)
n = total number of students

Table 2. Misconception category

Percentage	Category
0%-30%	Low
31%-60%	Moderate
61%-100%	High

RESULTS AND DISCUSSION

Description of Initial Conditions

Based on the research that has been done, the results of the misconceptions experienced by students are obtained. After the tests related to the material were carried out, the data were processed and grouped into four categories, namely understanding the concept (UC), not understanding the concept (NUC), partially understanding (PU), and misconceptions (M). The results of the analysis of understanding the overall concept can be seen in Figure 1.

Based on the diagram in Figure 1, the percentage of students who experience misconceptions (M) in the Animalia classification material is 49%. This means that the level of misconceptions students have is in the first place because they have a high percentage value compared to other categories.

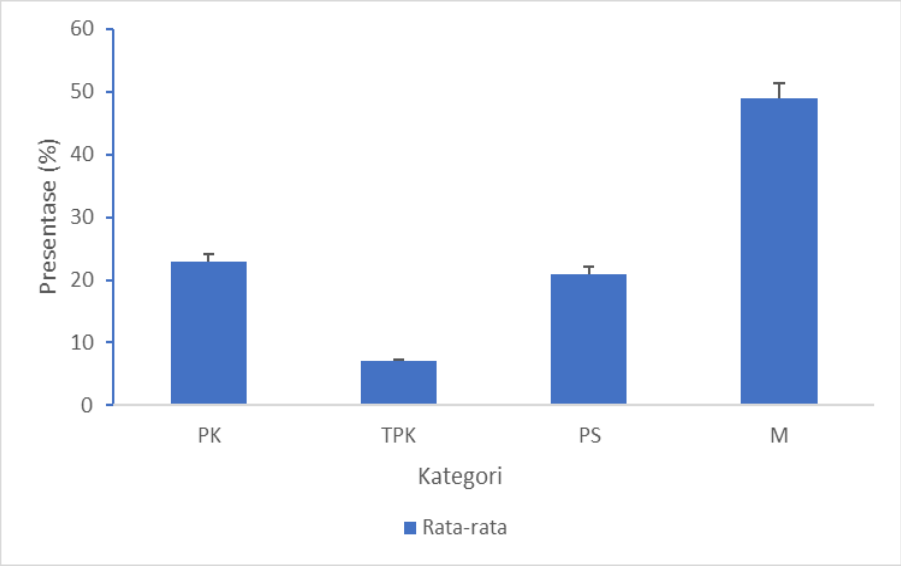

Figure 1. Diagram of the percentage of students' conceptions

Students who understand the concept (PK) have a percentage value of 23%, which shows that students only understand a few concepts in the Animalia classification material. Then students who understand some of the concepts (PS) have a percentage value of 21%. Meanwhile, students who do not understand the concept (TPK) have a percentage value of 7%. Based on these data, students experience misconceptions with a percentage level of 49%, so that students' misconceptions are included in the "moderate" category. According to Celeon & Subramaniam (2010) in Ahsin (2018), misconceptions belonging to the very low category are also considered significant if students who experience misconceptions are 10% or more of the total sample.

It is known that the standard deviation (SD) possessed by conceptual understanding (PK), not understanding the concept (TPK), understanding some concepts (PS), and misconceptions (M) based on Figure 1 are 0.286, 0.091, 0.164, and 0.223. The highest standard deviation is in the concept understanding category (PK) with a value of 0.28, while the lowest standard deviation value is in the not understanding concept category (TPK) with a value of 0.091. TPK), while (TPK) is the closest value to the average. Pay attention to table 3. below, which is the result of the analysis of students' understanding based on each indicator on the concept of Animalia classification.

Table 3. Results of Student Understanding Analysis

Indicator	Question	Percentage (%)				Category
		PK	TPK	PS	M	
1) Determine the characteristics of each phylum	1	20	2	8	70	High
	2	46	4	12	38	Moderate
	3	0	10	56	34	Moderate
2) Categorize species based on their characteristics	4	80	0	0	20	Low
	5	88	2	2	8	Low
	6	0	2	14	84	High
3) Determine the relationship between species in each class	7	12	0	4	84	High
	8	6	0	38	56	Moderate
	9	8	6	14	72	High
4) Analyze the type of branching	10	2	14	24	60	Moderate
	11	44	4	12	40	Moderate
	12	14	4	40	42	Moderate
5) Reconstruct the phylogenetic tree from diagonal to vertical	13	2	12	36	50	Moderate
	14	4	34	26	36	Moderate
	15	16	18	30	36	Moderate
Average (%)		22,8	7,47	21,0	48,7	Sedang

Students' misconceptions have been found in all sub-chapters of the Animalia classification because they have a lot of material coverage, while the learning time is relatively short (Nur'aini & Chamisijatin, 2015). The sub-concept of Animalia classification material consists of invertebrates and vertebrates. Classification of Animalia has nine phyla, namely sponges, Coelenterata, Platyhelminthes, nematodes, mollusks, annelids, arthropods, echinoderms, and chordates (Campbell, 2008). Based on table 3, the most significant percentage of misconceptions is in item number 1, with a percentage of 70%. Then it was also found in item number 6, which has a misconception percentage of 84%. It was also found in items number 7 (84%) and 9 (72%). The four items had a high percentage value, so they were included in the high category. The percentage of misconceptions in each item can be seen in Figure 2.

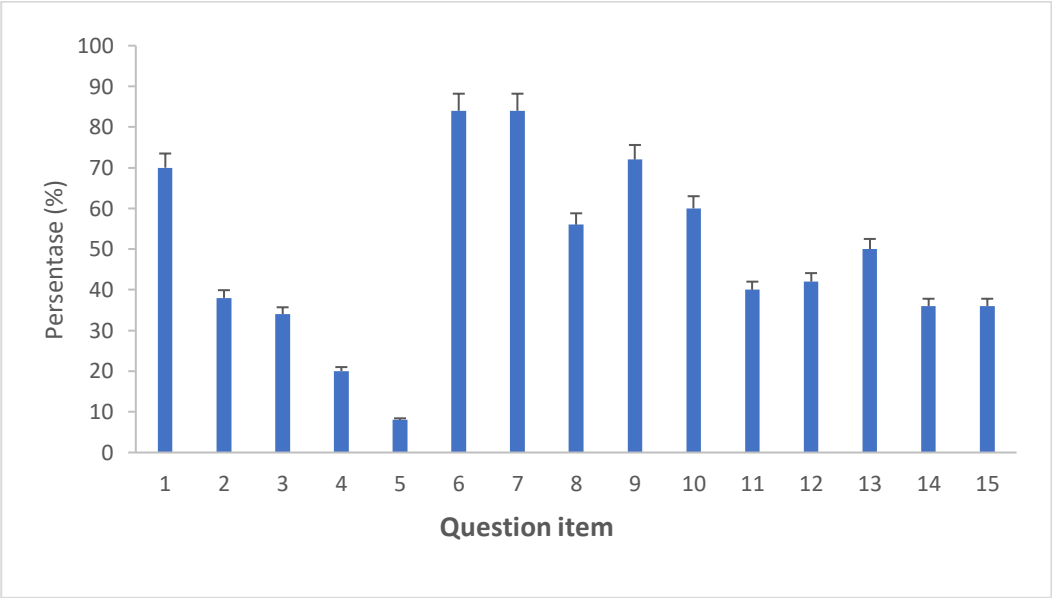

Figure 2. Percentage of misconceptions per question

In item number 1, students experience misconceptions with a percentage of 70%, which has indicators that determine the characteristics of each phylum. Many students answered that animals with bilateral, multicellular, triploblastic, coelomate, and segmented symmetry are characteristics of the phylum Arthropoda because many of the students are fooled by segmented features and assume that segments are characteristics of arthropods. Nevertheless, the fact is that arthropods have segmented, not segmented characteristics. The right concept to answer item number 1 is that Annelida owns these characteristics because the phylum Annelida owns segmented characteristics.

In item number 6, students experience misconceptions with 84%, which has indicators to determine shared characteristics between 2 species. Many students gave incorrect answers and reasons, but they believed in the answers they chose. Many students think that scales are not a shared characteristic (synapomorphy) owned by the reptile and Aves classes. However, the concept is that scales are a common feature (synapomorphy) shared by the two classes. Reptiles have scales that contain the protein keratin (Campbell, 2008). Likewise, Aves have scales on the lower legs, and their bodies are covered by feathers made of -keratin protein like reptiles (Suhaerah, 2016).

Students also experienced misconceptions in the high category on items number 7 (84%) and 9 (72%). The indicator of the two items is to determine the kinship relationship. In item 7, many students gave incorrect answers. They thought that whales and sharks were in the same grade level because they lived in seawater. The correct concept for students' answers is that whales and sharks are not at the same grade level but different grade levels because sharks belong to the Chondrichthyes class while whales belong to the mammalian class. While the right concept to answer question number 7 is snake and turtle because both have scales and belong to the reptile class.

In question number 9, many of the students answered that crabs and scorpions are at the same grade level while the correct concept is the opposite, that scorpions and crabs are not at the same grade level scorpions are included in the class. Arachnids, while crabs belong to the crustacean class, can be concluded that the two

species are not the right answer choices to answer question number 9. While the right concept to answer question number 9 is Hydra and Obelia because both belong to the class hydrozoa, which has the form polyps and medusa.

The highest standard deviation (SD) value is owned by item numbers 6 and 7 with an SD value of 0.297, the second highest is owned by item number 9 with an SD value of 0.254, and the third-highest is item number 1 with an SD value of 0.247. The standard deviation (SD) value of all items has a value of 0. This makes all items have a distribution value that is not far from the average. Bland & Altman (1996) revealed that if the standard deviation value is low, the value tends to be close to the average (mean) or the expected value. Standard deviation is a statistical value commonly used to determine how the data is distributed in a sample and see how close the data is to the mean or average of the sample. The standard deviation (SD) is used to describe the variability or dispersion in variability in distribution as well as the variability in several distributions.

CONCLUSION

The understanding of concepts possessed by the participants in the Animalia classification material is classified into four categories, namely understanding concepts (PK) having a percentage value of 23%, not understanding concepts (TPK) having a percentage value of 7%, understanding some concepts (PS) having a percentage value of 21%. In contrast, misconception (M) has a percentage value of 49%. Based on these data, it is known that the misconceptions that students have on the concept of Animalia classification are 49% and are included in the medium category.

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