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Identification of Science Misconceptions Using Two-Tier Multiple Choice for Elementary School Grade IV Students

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Abstract

This study aims to identify the level of science misconceptions about plant parts and their function in fourth-grade students of Batumarta Public Elementary School. This study uses descriptive research with the quantitative method. The research was conducted at Batumarta Public Elementary School. The sampling using a saturated sampling technique. The sample of this study consisted of 28 students. The data collection instrument used two-tier multiple-choice questions that had previously been tested for construct validation with biologists, other lecturers, or supervisors. The data analysis technique uses data grouping and data interpretation. This misconception will be identified using a diagnostic test with a research instrument in the form of two-tier multiple-choice questions. Based on the results of the study, it was found that students who experienced misconceptions in the material of plant parts and their functions in the category of knowing concepts as much as 16.42%, students in the category of pure misconceptions as much as 18.03%, student category of misconceptions guessing as much as 15.88%, and students in the category of not understanding as much as 49.63%. the conclusion was that the students of Batumarta Public Elementary School experienced misconceptions in the very low category, namely as much as 18.03%.

INTRODUCTION

Background of the Study

Education is one of the components that have a very important position in life. Education is a dynamic thing so it always demands continuous improvement. Education provides a good chance for life in the future. Adi (2022) said that education is an effort made by humans to achieve maturity, noble character, thinking intelligence, safety, and perfect happiness. Therefore, education must be carried out as well as possible from the process to the result, so that all directions and goals will be achieved properly. A good learning process is a process that is by what has been planned. However, with the times, there are many problems in the world of education. One of the problems that often arises is the problem of learning. According to the opinion Ramadhani et al., (2020) that problems in the world of education are related to learning, for example, misunderstanding of concepts in the material.

The concept can be interpreted as an abstractly accepted initial understanding, the concept can also arise through a person's self-experience from all interaction activities between oneself and one's environment. This is in line with the opinion of Yuliati (2017) that a concept is an abstraction based on experience. Based on this in fact, many concepts received by students are still wrong, students find it difficult to connect concepts so an understanding of the correct concepts is needed. Irani et al., (2020) state that misconceptions are a problem that is usually called misconceptions. The opinion (Dwilestari & Desstya, 2022) is that misconceptions are one of the problems experienced by students and are often found in science learning. Meanwhile, Qian & Lehman (2017)states that in science learning, misconceptions are ideas or ideas that are wrong and often understood by students but contrary to generally accepted scientific consensus. Based on some of these opinions, it is stated that misconceptions, especially in students, often occur in science learning.

Misconceptions that occur in students can also occur from various experiences and inappropriate sources of information. In line with the opinion Haryono & Aini (2021) which states that misconceptions are also obtained from various party's experiences and sources of information that are not accurate. In addition, science learning can also occur due to teacher misunderstandings so that which also has an impact on the students they are teaching. This is opinion Sanders & Makotsa (2016) states that the misconceptions that occur in science learning due to the teacher's previous understanding have been wrong so it has an impact on the students who are taught the material.

Science learning is one of the lesson content that discusses the symptoms of nature that lie in the material. Science learning also discusses living things, the world, and all the components of the content in it. Through science learning, it is hoped that it can be a vehicle for students to learn about themselves and the surrounding environment as well as the prospect of further development Laksana (2016). Therefore, the scope of material in science learning is very wide, as well as the science concepts taught are also very diverse. In science learning in elementary schools, there are many misconceptions, including according to the results of research Munawaroh & Falahi (2016) which found misconceptions of science learning on the concept of light in class VI. The research conducted by Nasution et al., (2021) found misconceptions about the matter of force and motion that are quite high. The existence of these misconceptions results in the objectives of science learning not being achieved properly. The purpose of science learning is that students understand the concept of scientific thinking, apply concepts, connect one concept with another, and can solve life problems Supena et al., (2021). Meanwhile, the opinion Nasution et al., (2021) also states that if students can understand scientific concepts and apply knowledge in life, this is one of the objectives of science learning.

Misconceptions in the classroom will differ from one student to another. Misconceptions will arise through the provision of incomplete concepts, for example, giving concepts only using the lecture method so that the concepts received are not optimal and difficult in understanding the concepts. This resulted in misconceptions. In line with the opinion Arda & Anita (2021) states that students who have

difficulty understanding concepts will cause misconceptions. Therefore, an educator, especially a teacher, must be able to provide a whole concept to students so that misconceptions will not occur.

Problem of the Study

Based on the results of an interview by one of the teachers at Batumarta Public Elementary School, it was found that students experienced misconceptions about the content of science lessons, especially in the material of plant parts and their functions. The teacher revealed that the student's knowledge is still limited and the students still do not understand the material in detail and intact. The lack of knowledge of these students results in misconceptions experienced by students, namely in the concept of root types. In addition to the concept of root types, students' understanding of root functions is also still limited because students only understand that roots function as tree supports. But in addition to functioning as tree support, of course, the root has other functions but in reality, students do not know it.

Misconceptions in the student may result in the student repeating them. In line with the opinion Kristianti et al., (2022) which says that misconceptions can cause someone to make mistakes constantly. Chen et al., (2020) said the effects of misconceptions should also decrease over time. An Incorrect understanding of concepts will hinder learning (Kaltakci Gurel et al., 2015). Therefore, to be able to prevent these problems, changes are needed by transforming the correct knowledge. In line with the opinion Potvin & Cyr (2017) states that the initial knowledge or understanding of learners can be changed by transforming new knowledge into their learning experience. In addition, according to also Dewi & Ibrahim (2019) stated that the efforts made to prevent misconceptions are the immersion of the concept right from an early age, which will later be carried over and survive to the next level of education.

Research's State of the Art

Misconceptions themselves cannot be corrected but can use various means to identify them. This is in line with the opinion Obafemi & Aderonmu (2022) which says that misconceptions cannot be corrected unless acknowledged so a way for identification is needed. Misconceptions can be identified in several ways using concept maps, multiple-choice tests with open reasons, written essay tests, interviews, discussions, and question-and-answer practicums. In this study, researchers used an identification method using a multiple choice test with a reason (two-tier multiple choice). using two-tier tests will have advantages because those tests provide students' reasoning or interpretation behind their selected responses. However, these tests have some limitations in discriminating lack of knowledge from misconceptions, mistakes, or scientific knowledge (Kaltakci Gurel et al., 2015). As is the study by Hayati et al., (2022) examined the analysis using two-tier multiple choice in the concept of sciences class IV Majalaya Public Elementary School. This research uses descriptive methods with quantitative approaches and data collection techniques in the form of tests and non-tests. Based on his research, it can be concluded that using the two-tier multiple choice test can detect misconceptions about IVA classes with a total of 28 students. In addition, the study according to Renitasri et al., (2021) also examined developing a two-tier multiple choice test for elementary schools. Based on his research, it can be concluded that using the two-tier multiple-choice diagnostic test developed to get expert validation of science material experts of 83.93. This shows that the use of a two-tier form diagnostic test for elementary school students in the science learning process is very feasible. In addition, Wahyuni et al., (2021) also examine the analysis of students' understanding of the concept of photosynthesis using a two-tier multiple-choice test. Based on his research, it can be concluded that using the two-tier multiple choice test can identify student misconceptions by 69%. This shows that the test can measure students' understanding of a concept such as the concept of photosynthesis.

Gap Study & Objective

Based on several previous studies using the two-tier multiple-choice diagnostic test, it can be concluded that the test can measure a material concept and the test is feasible to use so that it can detect student misconceptions. This is in line with the opinion of Siswaningsih et al., (2014) state that a two-tier multiple-choice diagnostic test has been developed and can identify student misconceptions. In addition, the use of the two-tier multiple choice test has the advantage that this test is declared valid (Renitasri et al., 2021). The difference from the previous study is that researchers will use a two-tier multiple-choice diagnostic test to be able to identify misconceptions of grade IV students in the content of science lessons on plant parts and their functions.

Based on this presentation, the identification of scientific misconceptions using two-tier multiple choices in the material of plant parts and their functions is very important to do so that this study will be carried out to be able to complement the previous research. Based on this background, this study aims to identify the level of misconception of science using two-tier multiple choices of material on plant parts and their functions in grade IV students.

METHOD

Type and Design

This research uses descriptive research with quantitative methods. According to Linarwati et al., (2016) which state that descriptive research is a form of research to describe natural phenomena and man-made phenomena. Meanwhile, Anam (2015) states that the quantitative method is a research procedure that produces data in the form of numbers and numbers.

The research was conducted at Batumarta Public Elementary School, Madang Suku III District, OKU TIMUR Regency, South Sumatra. The population in this study was all grade IV students of There Batumarta Public Elementary School which amounted to 28 people. The sampling technique used in this study is the saturated sampling technique. Saturated sampling technique Saturated sampling is a technique for determining a sample if the total population is relatively small, namely less than 30 people (Rahayu & Dana, 2016).

Data and Data Sources

The data used in this study were the results of a diagnostic test using two-tier multiple choices of 20 questions. Indicators about The indicators used correspond to the basic competencies of class IV by leading to the assessment of the cognitive realm of C1-C5. Furthermore, the instrument is validated by three expert lecturers in their fields so that suggestions and inputs will be obtained to be able to become a research subject. So, The two-tier multiple-choice diagnostic questions will be done by grade IV students of Batumarta Public Elementary School and then the test results will be used as research data.

Data Collection Technique

The data collection instrument uses a two-tier multiple-choice diagnostic test to be able to identify student misconceptions. The instruments that will be used in this study are validated by biologists, other lecturers, or supervisors. The research instrument also conducted a construct validity test. According to Adytia (2018) the validity of the construct is in terms of presentation, graphics, and languages such as clarity of purpose, order of presentation, appearance design, layout, effective use of Indonesian, motivation, and attractiveness. In the construct validity test, researchers used qualitative studies for two-tier multiple-choice instruments.

Data Analysis

Data analysis techniques are using data grouping and data interpretation. In data grouping, namely the acquisition of student data analyzed using first-level and second-level answer guidelines. This is done to find out the percentages in the categories of knowing concepts, pure misconceptions, guessing misconceptions, and not understanding. According to Nopriyanti (2020) the formula used to calculate the percentage of answers namely:

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

Information:

P = Description being searched
F = Frequency of student responses
N = Number of students
100% = Fixed number

Then for data interpretation, namely by analyzing the item about the two-tier multiple choice instrument on concepts that have a percentage of misconceptions.

RESULTS

This research was conducted at Batumarta Public Elementary School in grade IV students with a total of 28 students. Based on research that has been carried out, researchers use misconception diagnostic questions, namely in the form of two-tier multiple-choice questions as many as 20 questions. The instrument test was developed into an indicator of questions according to basic competencies in class IV material of plant parts and their functions. The questions developed will lead to an assessment of the cognitive realm from C1 (remembering) to C5 (evaluating). The dissemination in the development of questions by leading to the assessment of the cognitive realm to be used is C1 as much as 25% or 5 questions, C2 as much as 35% or 7 questions, C3 as much as 10% or 2 questions, C4 as many as 20% or 4 questions, and C5 as much as 10% or 2 questions.

After the preparation of the instrument, the questions were validated by three expert lecturers in their fields. The lecturer provided input and suggestions for the improvement of the instrument. After being corrected by the researcher, the instrument will be used by the researcher to take data to the school that will be the place of the research subject. Based on the test results of the two-tier multiple-choice questions that have been obtained, they are then grouped into several categories. The following is a table of student answer type categories as stated in table 1 below.

Table 1. Student Answer Type Category.

Category	Student Answer Types
Know the Concept	True-Reasoned Answers Are Right
Pure Misconceptions	Right-Reason Wrong Answer
Misconceptions of Guessing	Wrong Answer-Correct Reason
Don't Understand	Wrong Answer-Wrong Reason

After categorizing the student's answer type, next look for the percentage of the category. The data on the percentage of student answer categories as stated in table 2 below.

Table 2. Percentage of Student Answer Types.

Question Item	Problem Indicators	Category (%)			
		TK (Know the concept)	MKMu (Pure Misconceptions)	MKMe (Misconception of Guessing)	TM (Don't Understand)
1.	Choosing plant parts on a flower	0	28.57	14.28	57.14
2.	Choosing plant parts on the stem	21.42	21.42	0	57.14
3.	Defining plant parts on a flower	10.71	46.42	21.42	21.42
4.	Defining plant parts on the roots	39.28	0	28.57	32.14
5.	Defining plant parts on leaves	10.71	32.14	17.85	39.28
6.	Explaining the meaning of plant parts at the root	10.71	17.85	10.71	60.71
7.	Explaining the meaning of plant parts on leaves	14.28	10.71	10.71	64.28
8.	Showing the parts of the plant on the stem	17.85	7.14	25	50
9.	Showing the parts of plants on the flower	32.14	21.42	7.14	39.28
10.	Giving examples based on the type of plant parts on the leaves	14.28	14.28	17.85	53.57
11.	Giving examples based on the type of plant parts on the stem	21.42	17.85	14.28	46.42
12.	Giving examples based on the type of plant parts on the roots	17.85	14.28	21.42	46.42
13.	Determining plant parts and their functions	7.14	17.85	10.71	64.28
14.	Determining plant parts and their functions	14.28	10.71	17.85	57.14
15.	Grouping the functions of plant parts on the stem	17.85	10.71	14.28	57.14
16.	Grouping the functions of plant parts on the roots	14.28	17.85	14.28	53.57
17.	Summing up the types of plant parts on the stem	10.71	3.57	17.85	67.85
18.	Summing up the types of plant parts on the roots	25	14.28	28.57	32.14
19.	Comparing plant parts on flowers	14.28	28.57	7.14	50
20.	Comparing plant parts at the root	14.28	25	17.85	42.85
	Average	16.42	18.03	15.88	49.63

Based on the data above, it can be grouped into student understanding categories based on each question item. The categories of student understanding based on each question can be seen in table 3 below.

Table 3. Student Comprehension Categories Based on Each Question Item.

Category	Question Item
Know the Concept	4
Pure Misconceptions	3
Misconceptions of Guessing	-
Don't Understand	1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Based on the category of students' understanding of each item, it can be concluded that misconceptions occur in question number 3 with 1 indicator. Student misconceptions on the question indicators can be seen in table 4 below.

Table 4. Misconceptions on each indicator.

No	Indicators Question	Misconceptions Student	The concept of True
1.	Presented with a picture, students define the parts of a plant on a flower	Student misconceptions occur in question number 3. Students in choosing the answer for the reason that is the pistil head which has a function as a place for the pollination of flowers.	The pistil head is the part of the flower that serves as a place where pollen is attached when pollination occurs.

DISCUSSIONS

Based on the results of the percentage of student answer categories, the data showed that the average category of understanding students who knew concepts was 16.42%, students who had pure misconceptions were 18.03%, students who had misconceptions guessed as much as 15.88%, and students who did not understand as much as 49.63% (Figure 1). The results of the student comprehension category show that students experience more of the category of not understanding concepts. Here are some analyses of the causes in the question item.

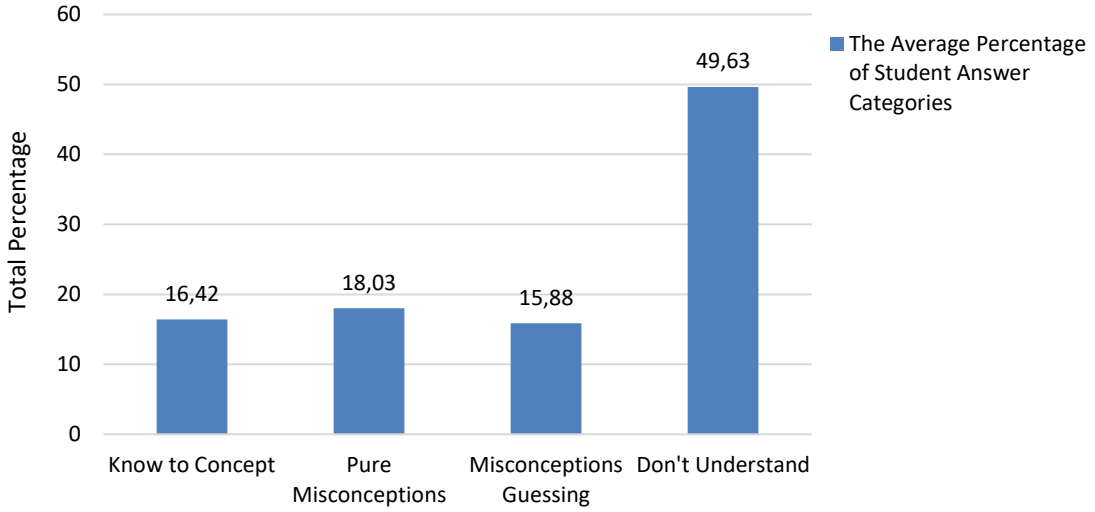

Figure 1. The Average Percentage of Student Answer Categories.

In question item number 1, the category does not understand the concept. This problem is in the cognitive realm of C1. Students do not understand the location and name of the parts on the flower. In the question asked, namely the location of the crown and its understanding, students point more to the pistil, and for understanding the students are less careful in the existing answer choices so many students are deceived. In question item number 2, students of the category do not understand the concept. This problem is in the cognitive realm of C1. In this question, students do not understand what parts are on the stem. The students' incomprehension of the stem is because the student still feels unfamiliar and lacks direct observation during learning. Susiyanti (2017) said that direct learning is the use of real objects it can facilitate understanding.

In question item number 3, students are categorized as pure misconceptions. This problem is in the cognitive realm of C1. In this question, students experience pure misconceptions about the indicators of defining plant parts in flowers. The cause of misconceptions is purely due to students not being careful or not understanding the meaning of reading the questions and their choices. According to the opinion Safitri (2023) states that reading errors are reading fluently but do not understand its meaning. In question item number 5, students of the category do not understand the concept. This problem is in the cognitive realm of C1. Students' understanding is still limited to questions with indicators defining plant parts on leaves. Students are also less careful about the relationship between level 1 and level 2.

In question item number 6, students in the category do not understand the concept. This problem is in the cognitive realm of C2. In students' answers, many students do not understand because the answer choices they think are foreign. This is also due to students' lack of knowledge and lack of critical thinking. Agnafia (2019) says that critical thinking is the ability to analyze situations based on facts as well as evidence to obtain conclusions. According to Warsah & Uyun (2021) critical thinking is solving problems brought in the learning process. In question point number 7, the category does not understand the concept. This problem is in the cognitive realm of C2. In this question, students do not understand the problem in the indicator explaining the meaning of plant parts in the outer structure of the leaves. In this question, some words are useful as deceptions so students must be careful and understand what is meant. According to R. Rahayu & Djazari (2016) who states that good deception if students who do not master the concept will feel indecisive and will eventually be fooled.

In question number 8, the category students do not understand the concept. This problem is in the cognitive realm of C2. Students do not understand the indicators of the problem of showing plant parts on the stem. The incomprehension of this matter is also due to the lack of activities to explore the material widely. As per the opinion Anidar (2017) states that student exploratory activities involve cognitive and intellectual students. In question number 9, students of the category do not understand the concept. This problem is in the cognitive realm of C2. This question, many students do not understand and are careful about the indicators of plant parts in flowers. Students also lack understanding of some of the answer choices on the questions. If the student understands it and carefully reads the passages on the flower then the student will be correct in answering them.

In question number 10, the category students did not understand the concept. This problem is in the cognitive realm of C2. In this question, students are not careful in understanding a picture in the question. With the image, students should find it easier to answer the question. This is in line with the opinion of Agustina et al., (2017) saying that images as visualization can explain something to be more concrete and realistic. The following is a picture used in item number 10 (Figure 2).

Figure 2. Picture in Item Number 10.

In question number 11, the category students did not understand the concept. This problem is in the cognitive realm of C2. In this question point, students also do not clearly understand the picture. Students do not understand that is to give examples based on the type of plant part on the stem. In the question of the type of reason, students also do not know the properties of the stem so many students answer perfunctorily. The following is a picture used in item number 11 (Figure 3).

Figure 3. Picture in Item Number 11.

In question number 12, the students of the category do not understand the concept. This problem is in the cognitive realm of C2. The indicator of this problem is to give an example based on the type of part on the root. Based on these indicators, this problem also presents a picture of the root type. Students are asked to understand the image and mention the name of the root type on the image. But in reality, students are still wrong in answering them. The following is a picture used in item number 12 (Figure 4).

Figure 4. Picture in Item Number 12.

In questions number 13 and 14, the students of the category do not understand. Both of these questions are in the cognitive realm of C3. On this matter, a statement was presented. Students are asked to choose a statement that is one of the meanings of the root parts, but students do not understand much about it. Students tend to be confused by the form of the questions presented because this question is presented with a statement that is used to answer questions number 13 and 14. This results in students answering the wrong questions.

In question number 15, the category students did not understand the concept. This problem is in the cognitive realm of C4. In this question, students do not understand the indicators of grouping the functions of plant parts on the stem. In this question, students who do not understand the concept are quite high. The reason why students are wrong in answering is that students are lacking in associating the answers at level 1 with the answers at level 2. In question number 16, the students of the category did not understand the concept. This problem is in the cognitive realm of C4. An indicator of this problem is grouping the functions of plant parts on the roots. The lack of understanding of the material and thinking critically about the functions of the roots so that many students are wrong in answering. According to Agnafia (2019) said that critical thinking is the ability to analyze situations based on facts as well as evidence to obtain conclusions.

In question number 17, the students of the category did not understand the concept. This problem is in the cognitive realm of C4. The indicator in this question is to infer the type of part on the stem. As in some of the previous questions, students still lack material about stems. Therefore, this is the cause of the high error of students in answering this question. In question number 18, the category students did not understand the concept. This problem is in the cognitive realm of C4. The indicator in this question is to infer the type of plant part at the root. In this question, students do not understand the images that have been presented and do not understand what are the types of roots. The following is a picture used in item number 18 (Figure 5).

Figure 5. Picture in Item Number 18.

In questions number 19 and 20, the students of the category do not understand the concept. This problem is in the cognitive realm of C5. The indicator in this question is to compare plant parts on flowers and roots. In this question, students are not able to know and understand similarities or differences so many students are wrong in comparing them.

Based on the explanation above, the analysis of questions in general students falls into the category of not understanding because many students still have limited knowledge about the concept of material in plant parts and their functions. The average result of the percentage of student answer categories can fall into the category of misconceptions. Some categories of student misconceptions are very low, low, medium, and high.

Based on the average results, the percentage of student answer categories can fall into the category of misconceptions. Some categories of student misconceptions are very low, low, medium, and high. The following is a table of misconception categories according to Sihaloho et al., (2021) as stated in table 5 below.

Table 5. Student Misconception Category.

Misconceptions (%)	Category
0 - 45	Very Low
46 - 55	Low
56 - 65	Keep
66 - 79	Tall

Based on the student misconception category table above, it can be concluded that the average score on pure misconceptions of 18.03% falls into the category of very low misconceptions. This is because the value of 18.03% is between 0-45% so it is included in the category of very low misconceptions.

Previous studies related to the student misconception of plant parts and their function are limited to essay questions and only provided one question so it hasn't revealed student misconception deeply (Ariyastuti & Yuliawati, 2017). Another research found the students' achievement of science in fourth grade, including the material of plant parts and their function, wasn't good, but it didn't reveal student comprehension but teacher comprehension Mieke et al., (2019) so it hasn't able to get holistic information about students' comprehension in that material. Jančaříková & Jančařík (2022) found that misconceptions adopted in childhood are powerful and often persist into adulthood and its point of view was from a review of previous academic research. The present study revealed student understanding and misconception comprehensively. The present study's findings would be essential for all elementary education parties to reveal student misconceptions as an effective solution for this issue.

The present study has several limitations. At first, it only revealed student misconceptions in one school that hasn't revealed all students in fourth grade in Indonesia. Second, the study duration was less than a year, so the data was not entirely comprehensive. At last, it still used two-tier questions which overestimated students' answers because they cannot judge a student's lack of knowledge of reasoning questions (Soeharto et al., 2019). Future studies about student misconceptions of plant parts and function would be better with a more complicated form Kaltakci Gurel et al., (2015) and can reveal more students in a wider scope and longer time duration.

This study has three suggestions. First, the elementary school headmasters in Indonesia should enrich the teachers' knowledge and insight related to social attitude assessment. Enrichment can be in the form of the following workshops or reading the up-to-date scientific paper or assessment guidelines. Second, elementary school teachers in Indonesia have to employ PA more seriously. The last one, the government, supported by researchers, has to design an excellent assessment system to solve time limitations.

CONCLUSION

The results of this study prove that the identification of student misconceptions can use a two-tier multiple-choice diagnostic test. This research revealed that more students were identified as not understanding the concept of plant parts and their functions. These findings will be important for identifying the causes of the problem of student incomprehension. This study has some limitations. First, researchers are still minimal in exploring the material that will be used to retrieve data. Second, instrument trial analysis does not conduct tryouts to find out whether it is valid and reliable but only uses validation tests by experts, and lecturers and constructs validation tests are carried out. The study has three suggestions. First, researchers must be able to dig wider into the material that will be used as a source of research. Second, researchers can then use higher-level diagnostic tests so that they will be more effective at detecting misconceptions. Third, preferably the instrument to be used in empirical trials with tryouts to obtain a valid and reliable instrument.

REFERENCES

Adi, L. (2022). Pendidikan keluarga dalam perspektif Islam. *Jurnal Pendidikan Ar-Rasyid*, *7*(1), 1–9. https://www.journal.staisyarifmuhammad.ac.id/index.php/jp/article/view/11

Adytia, P. F. (2018). Pengembangan Lembar Kegiatan Siswa Berorientasi Literasi Sains Pada Materi Ikatan Kimia. *UNESA Journal of Chemical Education*, *7*(3). https://doi.org/10.26740/ujced.v7n3.p%25p

Agnafia, D. N. (2019). Analisis kemampuan berpikir kritis siswa dalam pembelajaran biologi. *Jurnal Biologi dan Pembelajaran.* 6(1). 45-53. http://e-journal.unipma.ac.id/index.php/JF/article/view/4369/2130

Agustina, D. Suyatna, A. Suyanto, E. 2017). Perbandingan hasil belajar siswa menggunakan media gambar bergerak dengan gambar diam. *Jurnal Pembelajaran Fisika Universitas Lampung. https://www.neliti.com/publications/117816/perbandingan-hasil-belajar-siswa-menggunakan-media-gambar-bergerak-dengan-gambar*

Anam, K. (2015). Pengaruh media pembelajaran terhadap minat belajar siswa pada mata pelajaran pai di smp bani muqiman bangkalan. *Tadarus: Jurnal Pendidikan Islam*, *4*(2), 1–17. http://download.garuda.kemdikbud.go.id/article.php?article=641778&val=11050&title=Pengaruh%20Media%20Pembelajaran%20Terhadap%20Minat%20Belajar%20Siswa%20%20Pada%20Mata%20Pelajaran%20PAI%20Di%20SMP%20Bani%20Muqiman%20Bangkalan

Anidar, J. (2017). Teori belajar meurut aliran kognitif serta implikasinya dalam pembelajaran. *Jurnal Al-Taujih.* 3(2). https://ejournal.uinib.ac.id/jurnal/index.php/attaujih/article/view/528/445

Arda, A., & Anita, A. (2021). Analisis miskonsepsi peserta didik smp it al fahmi pada mata pelajaran ipa. *Koordinat Jurnal MIPA*, *2*(1). https://doi.org/10.24239/koordinat.v2i1.20

Ariyastuti, Y., & Yuliawati, F. (2017). Identifikasi miskonsepsi ipa menggunakan soal esai bagi siswa cerdas istimewa di SD muhammadiyah condongcatur sleman. *Jurnal JPSD*, *4*(1), 27–37. https://garuda.kemdikbud.go.id/documents/detail/988916

Chen, C., Sonnert, G., Sadler, P. M., Sasselov, D., & Fredericks, C. (2020). The impact of student misconceptions on student persistence in a MOOC. *Journal of Research in Science Teaching*, *57*(6). https://doi.org/10.1002/tea.21616

Dewi, S. Z., & Ibrahim, T. (2019). Pentingnya pemahaman konsep untuk mengatasi miskonsepsi dalam materi belajar IPA di sekolah dasar. *Jurnal Pendidikan UNIGA*, *13*(1), 130–136. https://dx.doi.org/10.52434/jp.v13i1.823

Dwilestari, D., & Desstya, A. (2022). Analisis Miskonsepsi pada Materi Fotosintesis dengan Menggunakan Peta Konsep pada Siswa Sekolah Dasar. *Jurnal Basicedu*, *6*(3). https://doi.org/10.31004/basicedu.v6i3.2611

Haryono, H. E., & Aini, K. N. (2021). Diagnosis misconceptions of junior high school in Lamongan on the heat concept using the three-tier test. *Journal of Physics: Conference Series*, *1806*(1), 012002. 10.1088/1742-6596/1806/1/012002

Hayati, N., Adriana, E., & Syachruroji, A. (n.d.). Analisis miskonsepsi siswa pada konsep ipa kelas iv di sd negeri majalaya (Kecamatan Tunjungteja, Kabupaten Serang). *Jurnal Handayani Pgsd Fip Unimed*, *13*(1), 146–152. Retrieved January 4, 2023, from https://doi.org/10.24114/jh.v13i1.36842

Irani, N. V., Zulyusri, Z., & Darussyamsu, R. (2020). Miskonsepsi Materi Biologi SMA dan Hubungannya dengan Pemahaman Siswa. *Jurnal Biolokus: Jurnal Penelitian Pendidikan Biologi Dan Biologi Vol*, *3*, 2. https://scholar.archive.org/work/yxnvb3dnkvdi7arflc2gygawom/access/wayback/http://jurnaltarbiyah.uinsu.ac.id/index.php/biolokus/article/download/823/pdf08

Jančaříková, K., & Jančařík, A. (2022). How to Teach Photosynthesis? A Review of Academic Research. *Sustainability*, *14*(20), 13529. https://www.mdpi.com/1894946

Kaltakci Gurel, D., Eryilmaz, A., & McDermott, L. C. (2015). A Review and Comparison of Diagnostic Instruments to Identify Students' Misconceptions in Science. *EURASIA Journal of Mathematics, Science and Technology Education*, *11*(5). https://doi.org/10.12973/eurasia.2015.1369a

Kristianti, R., Muchyidin, A., & Manfaat, B. (2022). Exploration of Vocational School Students' Misconceptions of Circle Material. *Journal of General Education and Humanities*, *1*(2), 47–57. https://doi.org/10.58421/gehu.v1i2.19

Laksana, D. N. L. (2016). Miskonsepsi dalam materi ipa sekolah dasar. *JPI (Jurnal Pendidikan Indonesia)*, *5*(2). https://doi.org/10.23887/jpi-undiksha.v5i2.8588

Linarwati, M., Fathoni, A., & Minarsih, M. M. (2016). Studi deskriptif pelatihan dan pengembangan sumberdaya manusia serta penggunaan metode behavioral event interview dalam merekrut karyawan baru di bank mega cabang kudus. *Journal of Management*, *2*(2). http://jurnal.unpand.ac.id/index.php/ms/article/view/604

Mieke, L. T., Sari, W. W., & Winarti, E. (2019). Miskonsepsi IPA biologi pada guru kelas IV sekolah dasar. *Symposium of Biology Education (Symbion)*, *2*. https://doi.org/10.26555/symbion.3524

Munawaroh, F., & Falahi, M. D. (2016). Identifikasi Miskonsepsi Siswa SDN Kemayoran I Bangkalan pada Konsep Cahaya Menggunakan CRI (Certainty Of Response Index). *Jurnal Pena Sains Vol*, *3*(1), 69–76. https://core.ac.uk/download/pdf/304219421.pdf

Nasution, R. H., Wijaya, T. T., Putra, M. J. A., & Hermita, N. (2021). Analisis miskonsepsi siswa SD pada materi gaya dan gerak. *Journal of Natural Science and Integration*, *4*(1), 11–21. http://dx.doi.org/10.24014/jnsi.v4i1.10851

Nopriyanti, W. (2020). Efektivitas Pembelajaran Pendidikan Agama Islam Di Sd Negeri 001 Pasar Baru Pangean. *AL-HIKMAH (Jurnal Pendidikan Dan Pendidikan Agama Islam)*, *2*(2), 184–201. https://doi.org/10.36378/al-hikmah.v2i2.775

Obafemi, D. T. A., & Aderonmu, T. S. B. (2022). Identification and sources of misconceptions held by secondary school physics students in heat energy in rivers state, nigeria. *European Journal of Education Studies*, *9*(4). http://dx.doi.org/10.46827/ejes.v9i4.4241

Potvin, P., & Cyr, G. (2017). Toward a durable prevalence of scientific conceptions: Tracking the effects of two interfering misconceptions about buoyancy from preschoolers to science teachers. *Journal of Research in Science Teaching*, *54*(9). https://doi.org/10.1002/tea.21396

Qian, Y., & Lehman, J. (2017). Students' misconceptions and other difficulties in introductory programming: A literature review. *ACM Transactions on Computing Education (TOCE)*, *18*(1), 1–24. https://dl.acm.org/doi/abs/10.1145/3077618

Rahayu, N., & Dana, I. M. (2016). Pengaruh Eva, Mva Dan Likuiditas Terhadap Harga Saham Pada Perusahaan Food And Beverages. *E-Jurnal Manajemen Unud*, *5*(1), 443–469. https://ojs.unud.ac.id/index.php/Manajemen/article/download/16096/11541

Ramadhani, Y. R., Masrul, M., Ramadhani, R., Rahim, R., Tamrin, A. F., Daulay, J. S., Purba, A., Tasnim, T., Pasaribu, A. N., & Agustin, T. (2020). *Metode dan Teknik Pembelajaran Inovatif*. Yayasan Kita Menulis. https://books.google.com/books?hl=id&lr=&id=XZX-DwAAQBAJ&oi=fnd&pg=PA117&dq=Metode+dan+Teknik+Pembelajaran+Inovatif&ots=KOAurK3kSX&sig=tHOiU0pxoQ6JSYdVbSRmwc7V7Ds

Renitasri, R., Firman, F., & Efendi, J. (2021). Pengembangan Model Instrumen Tes Diagnostik Bentuk Two-Tier untuk Siswa Sekolah Dasar. *EDUKATIF: JURNAL ILMU PENDIDIKAN*, *3*(4), 2351–2358. https://doi.org/10.31004/edukatif.v3i4.1211

Safitri, W. (2023). Kesulitan belajar siswa dalam berpikir Tingkat tinggi berdasarkan teori newman. *Journal Tunas Bangsa.* 10 (1). 48-59. https://doi.org/10.46244/tunasbangsa.v10i1.2020

Sanders, M., & Makotsa, D. (2016). The possible influence of curriculum statements and textbooks on misconceptions: The case of evolution. *Education as Change*, *20*(1), 1–23. http://dx.doi.org/10.17159/1947-9417/2015/555

Sihaloho, M., Hadis, S. S., Kilo, A. K., & la Kilo, A. (2021). Diagnosa Miskonsepsi Siswa SMA Negeri 1 Telaga Gorontalo pada Materi Termokimia. *Jambura Journal of Educational Chemistry*, *3*(1). https://doi.org/10.34312/jjec.v3i1.7133

Siswaningsih, W., Anisa, N., Komalasari, N. E., & Indah, R. (2014). Pengembangan tes diagnostik two-tier untuk mengidentifikasi miskonsepsi pada materi kimia siswa SMA. *Jurnal Pengajaran MIPA*, *19*(1), 117–127. https://doi.org/10.18269/jpmipa.v19i1.36164

Soeharto, S., Csapó, B., Sarimanah, E., Dewi, F. I., & Sabri, T. (2019). A review of students' common misconceptions in science and their diagnostic assessment tools. *Jurnal Pendidikan IPA Indonesia*, *8*(2), 247–266. http://publicatio.bibl.u-szeged.hu/16272/1/2019_Soeharto_Csapo_Sarimanah_Dewi_Sabri.pdf

Supena, I., Darmuki, A., & Hariyadi, A. (2021). The Influence of 4C (Constructive, Critical, Creativity, Collaborative) Learning Model on Students' Learning Outcomes. *International Journal of Instruction*, *14*(3), 873–892. https://eric.ed.gov/?id=EJ1304598

Susiyanti, E. (2017) Penggunaan metode demonstrasi dan media nyata untuk meningkatkan hasil belajar ipa tentang struktur akar pada siswa kelas iv sdn 11 tebatkarai kabupaten kepahiang. *Jurnal PGSD: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar.* 4(1), 9-15. https://doi.org/10.33369/pgsd.10.1.18-21

Wahyuni, S., Marfilinda, R., & Gusti, R. S. (2021). Analisis pemahaman siswa pada konsep fotosintesis menggunakan tes diagnostik bertingkat dua (two tier diagnostic test) di kelas iv sd 08 enam lingkung. *Jurnal Ilmiah Aquinas*, *4*(1), 65–71. https://scholar.archive.org/work/uonw2x3hmjhvxfvzvk35fe2kru/access/wayback/http://ejournal.ust.ac.id/index.php/Aquinas/article/download/981/pdf1

Warsah, Idi. Uyun, Muhamad (2021). Psikologi pendidikan . CV Budi Utama.

Yuliati, Y. (2017). Miskonsepsi siswa pada pembelajaran IPA serta remediasinya. *Bio Educatio*, *2*(2), 279470. https://core.ac.uk/download/pdf/228883658.pdf