



Analysis of Student Misconceptions of Cell Material Using Four-Tier Diagnostic Test Instruments with the CRI Method at MA Darul Muqorrobin Kendal

Enni Rodhiyah*, Ismail, Erna Wijayanti

Program Studi Pendidikan Biologi, Fakultas Sains dan Teknologi,
Universitas Islam Negeri Walisongo Semarang

*Email: enni.rodhiyah@gmail.com

Article Information	ABSTRAK
Submitted: 22 – 08 – 2023 Accepted: 20 – 07 – 2024 Published: 28 – 03 – 2024	<p>Pembelajaran biologi erat kaitannya dalam pemahaman konseptual. Pemahaman siswa yang salah jika tidak segera diperbaiki dapat menyebabkan miskonsepsi. Penelitian ini bertujuan untuk menganalisis dan mengidentifikasi penyebab terjadinya miskonsepsi siswa materi sel menggunakan tes diagnostik four-tier dengan metode CRI. Jenis penelitian ini adalah penelitian kuantitatif deskriptif. Populasi yang digunakan yaitu seluruh siswa kelas XI MA Darul Muqorrobin Kendal. Subjek penelitian sebanyak 52 siswa dengan teknik purposive sampling. Teknik pengumpulan data menggunakan tes, wawancara, angket dan dokumentasi. Hasil analisis data persentase siswa yang mengalami miskonsepsi sebesar 51%, paham konsep 22%, menebak 10% dan tidak paham konsep 17%. Sedangkan miskonsepsi paling tinggi setiap sub materinya yaitu 60% pada sintesis protein. Adapun persentase faktor penyebab miskonsepsi dari siswa 60%, guru 44%, metode pembelajaran 66%, kesalahan konteks mengajar 48%, dan buku teks 40%. Berdasarkan hasil analisis tersebut, miskonsepsi masih sering terjadi pada materi sel sehingga perlu dilakukan penelitian lebih lanjut pada materi lainnya.</p> <p>Kata kunci: Materi Sel; Metode CRI; Miskonsepsi; Tes Diagnostik Four-Tier.</p>
Publisher	ABSTRACT
Program Studi Pendidikan Biologi, Fakultas Sains dan Teknologi, UIN Walisongo Semarang	<p><i>Learning biology is closely related to conceptual understanding. Students' misunderstandings, if not corrected promptly, can lead to misconceptions. This study aims to analyze and identify the causes of students' misconceptions in cell material using the four-tier diagnostic test with the CRI method. This research is a descriptive quantitative study. The population consisted of all eleventh-grade students at MA Darul Muqorrobin Kendal. The research subjects were 52 students selected through purposive sampling. Data collection techniques included tests, interviews, questionnaires, and documentation. The data analysis results showed that 51% of students experienced misconceptions, 22% understood the concepts correctly, 10% guessed, and 17% did not understand the concepts. The highest percentage of misconceptions in each sub-topic was 60% for protein synthesis. The percentage of factors causing misconceptions was attributed to students (60%), teachers (44%), teaching methods (66%), teaching context errors (48%), and textbooks (40%). Based on these analysis results, misconceptions still frequently occur in cell material, indicating a need for further research on other topics.</i></p> <p>Keywords: Cell Material, CRI Method, Misconceptions, Four-Tier</p>

INTRODUCTION

Biology learning is closely related to conceptual understanding. Student Learning biology is closely related to conceptual understanding. Students' understanding is a crucial component that determines the success of learning concepts (Fitria et al., 2017). Students will struggle in learning if misconceptions are not promptly corrected (Solikhin, 2022). Misunderstandings by students are known as misconceptions (Putri & Subekti, 2021). Misconceptions in biology hinder students from grasping lesson materials (Fitria et al., 2017). These misconceptions are often associated with fundamental biological cell materials, which are frequently challenging to comprehend, leading students to misinterpret them (Sipahutar & Gaol, 2015). Moreover, biology education employs numerous new terms and complex language, contributing to student misconceptions (Suhermiati et al., 2015). Correct understanding of cell materials will help students comprehend subsequent topics better (Wildani et al., 2012). Suparno (2013) stated that concept mapping, concept assessment, written essays, diagnostic interviews, open-ended multiple-choice assessments (diagnostic exams), laboratory work, and classroom discussions are methods that can be used to identify misconceptions.

Diagnostic tests are used to diagnose misconceptions in students. If misconceptions are correctly identified, they can be easily addressed, and learning acceptance will not be hindered (Nurmanita, 2020). Effective diagnostic tests can show that students not only lack understanding of concepts but also have the ability to think critically when answering questions. Diagnostic tests have evolved from 'one-tier' to 'four-tier' formats (Wilantika, Khoiri, & Hidayat, 2018). The advantage of the four-tier format is that based on their confidence levels in their answers (question and reason), it can identify which students truly understand a concept well (Muna, 2021). However, this test format has limitations in confidence levels, offering only two possibilities: 'confident' and 'not confident'. It cannot accommodate students who answer with uncertainty or guesswork. This limitation can be minimized by incorporating the Certainty of Responses Index (CRI) method into the four-tier diagnostic test (Putri & Subekti, 2021). A variety of response levels will indicate the true conditions of students when answering questions (Sholikhin, 2022).

The CRI method not only identifies misconceptions but also categorizes those who understand and those who do not understand the concept. Respondents' confidence in responding to questions can also be measured using this method (Mustaqim, Zulfiani, & Herlanti, 2014). CRI employs a scale presented alongside each answer. The 0-5 scale on CRI in each question, already answered by respondents, is adjusted according to their confidence levels (Diknasari, 2020). This research combines the Four-Tier diagnostic instrument with the CRI method, developed by Muna (2021). The diagnostic test instrument consists of 25 questions covering five subtopics, but only 20 questions were used after testing. This four-tier

diagnostic test instrument is deemed suitable for use due to its validation criteria being met.

Based on the aforementioned exposition, a preliminary research in the form of observation and interviews was conducted on February 14, 2023, at MA Darul Muqorrobin Kendal, involving respondents from Grade XI MIA students and biology teachers. Interviews with biology teachers at MA Darul Muqorrobin indicated that the typical teaching approaches used were lectures and group discussions. Insufficient time during lessons led to continuation of self-study assignments or homework. This resulted in less interactive learning between teachers and students, with students having fewer opportunities to directly express their ideas to the teacher (Suparno, 2013). According to some students, the cell material uses many difficult-to-memorize terms such as the structure and functions of cell organelles. The complex explanations of membrane transport mechanisms and protein synthesis have reduced students' interest in learning. The intricate stages of protein synthesis and the difficulty in remembering the functions of many enzymes make understanding protein synthesis substances challenging (Suhermiati et al., 2015).

From the students' learning outcomes in the first semester daily tests for Grade XI MIA, cell material had lower scores compared to other topics (tissue and musculoskeletal systems). Specifically, Grade XI MIA 2 students had the lowest daily test percentage at 75% (below the maximum passing criteria) compared to Grade XI MIA 1 students. This significant difference arose because students still struggle and have not fully grasped cell concepts.

Research on misconceptions has been conducted by Putri & Subekti (2021) on Archimedes' law in junior high school, and by Saputra et al. (2021) on cell material in senior high school and organizational life systems in junior high school (Subrata et al., 2019). Research specifically on cell material in senior high school, especially at MA level, has not been conducted; therefore, this research on misconceptions is crucial to map the profile of student misconceptions at MA level. This study aims to analyze and identify the causes of student misconceptions in cell material using the Four-Tier diagnostic test instrument with the CRI method at MA Darul Muqorrobin Kendal.

METHOD

This research employs a descriptive quantitative approach. Data collection was conducted at MA Darul Muqorrobin Kendal during May-June 2023. The study population consisted of biology subject teachers and 52 Grade XI MIA students from MA Darul Muqorrobin Kendal. The sampling method applied in this study was purposive sampling, based on heterogeneous student abilities and considerations by biology teachers. Data collection techniques included a test developed by Muna (2021) comprising 20 questions (subtopics: chemical components of cells, cell activities, structure and functions of cells, membrane transport, and protein synthesis), interviews, questionnaires, and documentation.

The data analysis in this study proceeded through several steps. First, CRI values were determined on a scale of 0-5. The confidence values were categorized into two groups: if CRI > 2.5, students were considered confident (high); if CRI < 2.5, students were considered not confident (low). Second, the interpretation of results from the four-tier diagnostic test was determined based on categories of comprehension levels derived from answer choices, reasons, and CRI values.

Table 1. Modified Interpretation of Four-Tier Diagnostic Test Results

Criteria	Answer Pattern			
	Tier 1	Tier 2	Tier 3	Tier 4
Concept Understanding	Correct	High	Correct	High
Guess	Correct	Low	Correct	Low
	Correct	High	Correct	Low
	Correct	Low	Correct	High
	Correct	Low	Wrong	Low
	Wrong	Low	Correct	Low
Not Understood	Wrong	Low	Wrong	Low
Concept	Correct	High	Wrong	Low
	Wrong	Low	Correct	High
Misconceptions	Correct	Low	Wrong	High
	Correct	High	Wrong	High
	Wrong	High	Correct	Low
	Wrong	High	Correct	High
	Wrong	High	Wrong	Low
	Wrong	Low	Wrong	High
	Wrong	High	Wrong	High

(Source: Fariyani *et al.*, 2015)

Description:

Tier 1: question answers

Tier 2: confidence level answer the question

Tier 3: reason for answering the question

Tier 4: confidence level answer reason

Third, student responses were analyzed to differentiate between conceptual understanding, lack of understanding, and misconceptions. Fourth, percentage calculations were performed on the assessment results using the formula (Mustaqim, 2014).

$$P = f/N \times 100\%$$

Description:

N = total number of individuals

P = group percentage number

F = number of students in each group

Fifth, the responses from student questionnaires were analyzed for interpretation. Sixth, a summary of the average percentage of overall student comprehension levels was compiled based on Table 2 (Suwarna, 2013). Furthermore, the location of student misconceptions in each item was analyzed

based on the highest percentage of misconceptions. The data processing results will then lead to conclusions.

Table 2. Category of Student's Comprehension Level

Category	Value
Low	0%≤P<30%
Medium	30%≤P<60%
High	60%≤P<100%

RESULTS AND DISCUSSION

Four-tier CRI Diagnostic Test Analysis Results

Analysis of student misconceptions obtained from the results of data from the four-tier diagnostic test instrument totaling 20 questions that have been done by XI MIA class students with a duration of 60 minutes working on the problem. The number of respondents was 24 students from class XI MIA 1 and 28 students from class XI MIA 2 MA Darul Muqorrobin Kendal. The total number of students in class XI MIA is 52 students. The results of the percentage of misconceptions of cell material can be seen in Figure 1 below.

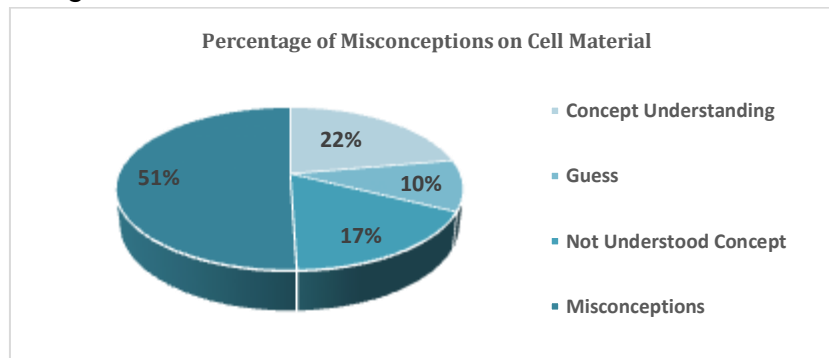


Figure 1: Percentage Chart of Misconceptions of Cell Material

Based on the results of the four-tier diagnostic test using CRI in Figure 1, it shows that 51% of students experience moderate misconceptions. Students who understood the concept were 22%, students who guessed the answer were 10%, and students who did not understand the concept were 17%. The percentage of misconceptions for each cell sub-matter can be seen in Table 3 below.

Table 3. Percentage of Misconceptions of Cell Sub-Matter

Cell Sub-Matter	Percentage	Category
Chemical components of cells	51%	Medium
Cell activities	54%	Medium
Cell structure & function	50%	Medium
Membrane transport	46%	Medium
Protein synthesis	60%	High

Results of Response Questionnaire Data Analysis

The response questionnaire consists of 5 indicators and 5 questions for each indicator. The type of questionnaire used is a dichotomous questionnaire. The questionnaire assessment is given if the score is 0 for 'no' or 'blank' answers and

score 1 for 'yes' answers. The following factors that cause misconceptions are presented in Table 4.

Table 4. Percentage of Causes of Misconceptions

Causes	Percentage of Misconceptions	Category
Students	60%	High
Teacher	44%	Medium
Learning Methods	66%	High
Teaching Context Error	48%	Medium
Textbook	40%	Medium

Results of Interview Data Analysis

Based on the results of interviews with biology teachers, learning is less conducive because some students often arrive late, pay less attention to the teacher's explanation, are sleepy and busy chatting by themselves; Learning media in the form of textbooks, LCD projectors, powerpoints, videos and microscopes; Learning approaches applied such as group discussions, practicum, and lectures; Evaluation used by teachers to determine the effectiveness of learning outcomes such as daily tests, presentations, direct discussions and independent assignments; Limited school facilities such as textbooks, LCD projectors (only 1 in school) and microscopes cause a lack of student interest in learning; Students have difficulty accessing teaching materials because textbooks are limited.

The results of interviews with students show low interest in the material taught by the teacher if using the lecture method; Students have difficulty in understanding foreign terms and memorizing scientific names in biology learning, especially on cell material; Students find it difficult to access teaching materials because they are prohibited from carrying cellphones and limited package books; Students with low test scores tend to face difficulties in understanding the teacher's explanation.

The results of the interpretation of the four-tier diagnostic test on cell material for class XI MIA as a whole for more details, are presented in Table 5 below.

Table 5. Interpretation of Four-Tier Diagnostic Test Results of Class XI MIA Cell Material

Indicator	Question Number	Concept Understanding		Guess		Not Understood Concept		Misconceptions	
		Total	%	Total	%	Total	%	Total	%
Chemical components of cell	1	22	42%	7	13%	5	10%	18	35%
	2	21	40%	8	15%	4	8%	19	37%
	3	2	4%	4	8%	4	8%	42	81%
Cell activities as structural & functional unit of living things	4	19	37%	4	8%	12	23%	17	33%
	5	7	13%	5	10%	6	12%	34	65%
	6	7	13%	4	8%	7	13%	34	65%
Structure and function of cell parts	7	8	15%	1	2%	6	12%	37	71%
	8	11	21%	12	23%	12	23%	17	33%
	9	8	15%	3	6%	8	15%	33	63%
	10	20	38%	10	19%	8	15%	14	27%
Membrane transport	11	4	8%	7	13%	12	23%	29	56%
	12	9	17%	5	10%	9	17%	29	56%
	13	18	35%	7	13%	13	25%	14	27%

	14	10	19%	7	13%	14	27%	21	40%
	15	13	25%	4	8%	10	19%	25	48%
	16	2	4%	2	4%	1	2%	43	83%
	17	18	35%	7	13%	12	23%	15	29%
	18	15	29%	5	10%	12	23%	20	38%
Protein synthesis	19	4	8%	2	4%	9	17%	31	60%
	20	8	15%	3	6%	10	19%	31	60%

The percentage of student misconceptions on each item can be seen visually in Figure 2.

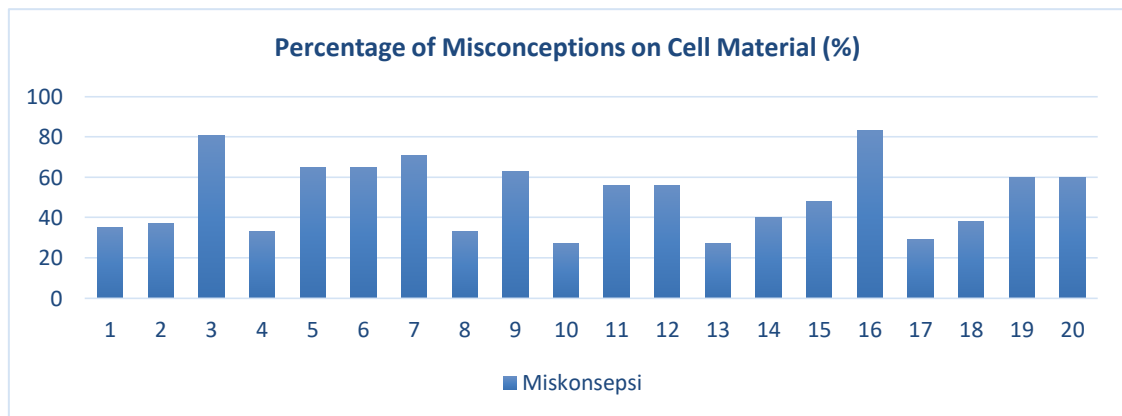


Figure 2: Percentage of Question Item Misconceptions

Each cell submaterial has different levels of misconceptions, and the factors that influence misconceptions will be discussed below.

1. Chemical components that make up the cell

The percentage of the level of understanding in the sub-material of the chemical components that make up the cell according to Table 3, found a misconception of 51% (medium category). Problem number 3 students are expected to determine the important compounds of basic metabolism, which form the organic basis of living things. The metabolic process of living things consists of the metabolism of carbohydrates, fats, proteins and other inorganic compounds. Amino acid polymers bound to the peptide bonds of living cells produce proteins, serving to maintain the normal functioning of cells. These proteins are re-synthesized after the amino acids spread through the blood and into the body tissues (Lukitasari, 2015).

The correct answer is B and the reason is D. The results of the question analysis, the average respondent answered incorrectly because the answers given were not in accordance with the theory (Lukitasari, 2015). The results of questionnaire and interview analysis, students find it difficult to access teaching materials because they are prohibited from bringing cellphones during the learning process and limited textbooks cause a lack of student knowledge. This is in accordance with research conducted by Mukhlisa (2021), which states that the lack of knowledge possessed by students can cause misconceptions. Based on the results of the test analysis with CRI on question number 3, students experience misconceptions because they answer questions and reasons with

'sure' but the answers are wrong. The reason 'sure' shows number 3 on the CRI scale which means that the CRI is high.

2. Cell Activities as Structural and Functional Units of Living Things

The percentage level of understanding in this sub-material is in accordance with Table 3, 54% misconceptions were found. The results of data analysis of percentages number 5 and 6 show high misconceptions of 65%. Problem number 5 and 6 students are expected to determine the characteristics of prokaryotic cells and compare the characteristics of animal and plant cells. Students answered correctly in question number 5 about the characteristics of prokaryotic cells shown in numbers 1 and 3 (E) but answered the reason incorrectly. The correct answer for reasoning is B. Students believe the concept that a rigid layer made of carbohydrates is found in the nuclear membrane sheath. The correct concept is that almost all prokaryotic cells have a cell membrane covered with a rigid layer consisting of carbohydrates or carbohydrate-protein peptidoglycan complexes. This layer is called the cell wall (Sumitro *et al.*, 2017). Whereas in number 6, students answer the question and reason with the wrong answer regarding the difference between animal cells and plant cells.

The correct answers are D and E. Students believe the concept that animal cells can experience plasmolysis like plant cells. Animal cells do not experience plasmolysis, but lysis. Lysis is the breakdown of cell membrane integrity that causes organelles to leave the cell. Animal cells will experience lysis if placed in a hypotonic solution (Huda, 2020). Test questions number 5 and 6 *four-tier* using CRI analysis, respondents experienced misconceptions. Question number 5 was answered correctly with a confidence level of 5 which means 'very sure' and the wrong reason with a confidence level of 5 which means 'very sure'. The number 5 on the CRI scale indicates that CRI is included in the high category. Meanwhile, question number 6 was answered incorrectly by not answering the reason (0). The number 5 on the CRI scale indicates that CRI is in the high category.

3. Structure and Function of Cell Parts

The percentage level of understanding on this sub-material according to Table 3, was found to be 50%. The results of the percentage data analysis in Table 5 number 7 shows a high misconception of 71%. Problem number 7 students are expected to determine the characteristics of prokaryotic cells. The cell structure that controls all cell activities is indicated by number 1, namely (A) the nucleus. The nucleus is usually oval or round and is located in the center of the cell. Inside the nucleus are nucleoli and chromosome threads, and the nucleus is enveloped by an outer and inner membrane consisting of nucleoplasm and chromosomes. The nucleus (cell nucleus) functions as a center for regulating cell activities (Tan *et al.*, 2016). The correct reason to answer question number 7 is C. Test question number 7 *four-tier* using CRI analysis, students have misconceptions because they answer the questions and reasons with 'very sure' but the answers are wrong. The reason 'very sure' shows the number 5 on the CRI scale which means that the CRI is high. The average respondent answered incorrectly because they were still confused about the names of the pictures shown and their respective functions. This can happen because students have difficulty understanding the material, especially memorizing scientific names and foreign terms, the lack of textbooks as a source of lessons and teacher learning methods that do not attract students' attention during the learning process (Suparno, 2013).

4. Membrane Transport

The percentage level of understanding on the membrane transport sub-material according to Table 3, was found to be 46%. The results of data analysis of percentage number 16 showed a high misconception of 83%. Problem number 16 students are expected to understand the principle of membrane transport. The correct answer is B with reason D. Students answer correctly and believe that the principle of active transport is used to return Na⁺ and K⁺ molecules to their initial condition after the nerve cell membrane conducts nerve impulses. The appropriate reason for the question is in option D, but the respondent answered the reason incorrectly but was 'very sure' of his choice. This can happen if students do not understand the material that has been explained by the teacher. The results of the questionnaire and interview analysis show that the highest factor causing misconceptions is the learning method factor. Teachers mostly use the lecture method and self-assignment to students if there are not enough class hours. Whereas for the membrane transport sub-matter requires a detailed explanation because the material is complex. This is in accordance with the research of Saputra *et al.* (2021), which states that misconceptions occur because membrane transport material is very complex and abstract. Therefore, in order for students to accurately and accurately predict the membrane transport mechanism that occurs in cells, students must have a broad understanding of cells. Test question number 16 four-tier using CRI analysis, students experience misconceptions because they answer the question correctly with a confidence level of 3 which means 'sure' but the reason is wrong with a confidence level of 5 which means 'very sure'. The numbers 3 and 5 on the CRI scale indicate that CRI is in the high category.

5. Protein Synthesis

The percentage level of understanding in this sub-material according to Table 3, was found to be 60%. The results of the percentage data analysis show that numbers 19 and 20 are misconceptions including the high category of 60%. In this question, students are expected to be able to show the process of transformation and changes in energy energy in cell organelles. The correct answer to question number 19 is D and reason D while question number 20 is B and reason A. Transformation by chlorophyll, transformation by mitochondria, cell metabolism, photosynthesis, and cell respiration are some of the ways energy transformation can occur in cells. Chlorophyll is a leaf green substance found in plant cell organelles and functions in photosynthesis (Saifullah, 2020). Chlorophyll captures sunlight radiation energy and starts the photosynthesis process. This process reacts CO₂ and H₂O into glucose. This reaction also produces oxygen, which can be used by plants for activities and other living things (Santoso & Santri, 2016). Respiration is the process of releasing energy stored in energy source substances through chemical processes using oxygen. This process produces chemical energy for life functions such as synthesis (anabolism), movement, and growth. (Lukitasari, 2015).

Based on the results of interviews with students, the average respondent answered incorrectly because the process of protein synthesis was too complicated and the explanation was long, making students bored and sleepy. Misconceptions can occur in protein synthesis substance material because it consists of many complex and abstract stages and involves many enzymes that are difficult to remember their respective functions (Suhermiati *et al.*, 2015). Test

questions number 19 and 20 *four-tier* using CRI analysis, students experience misconceptions. Number 19 students answered the question incorrectly with a confidence level of 5 which means 'very sure' and the reason was wrong with a confidence level of 5 as well. The number 5 on the CRI scale indicates that CRI is included in the high category. As for number 20, the student answered the question incorrectly with a confidence level of 3 which means 'sure' and the reason answered correctly, number 4 which means 'somewhat sure'. The numbers 4 and 5 on the CRI scale show that CRI is included in the high category

Factors causing misconceptions

There are five factors that cause misconceptions discussed in this study, namely student factors, teachers, learning methods, teaching context errors, and textbooks. The first factor comes from students, which is 60% (high category). This high misconception is caused by students having low interest in learning. This is in accordance with the results of research conducted by (Afifah & Asri, 2020) which states that students who have low interest in learning will experience high misconceptions. Interest in learning is a person's desire to learn (Septiani et al., 2020). The higher students' interest in learning, the better their learning outcomes. The high misconceptions experienced by students will interfere with them receiving new knowledge (Wilantika, Khoiri, & Hidayat, 2018).

The second factor is the teacher factor. The results of the questionnaire analysis of the response to the causes of misconceptions by the teacher were 44%. The material presented by the teacher is in accordance with the book, but the concept of cell material taught has not been explained in detail. According to Suhermiati et al (2015), misconceptions caused by teachers can occur if the material is explained only in essence without a detailed and thorough explanation. Based on the results of the data, when viewed from the sub-indicators of mastery of teaching materials and relationships given to students, it shows that the teacher has conditioned the class well, providing opportunities for students to ask questions and express opinions. The relationship between students and teachers if it goes well will reduce the level of misconceptions (Suparno, 2013).

The third factor, namely the learning method, is a factor causing misconceptions with a high category, namely 66%. The use of appropriate learning methods can optimally support learning objectives. The selection of learning methods is adjusted to the characteristics of the material, learning objectives, student characteristics, time allocation, and available infrastructure. (Astutik & Wijayanti, 2020). The results of the questionnaire analysis show that teachers often use lecture methods and question and answer discussions. Practicum is rarely done, especially on cell material as well as the use of learning media (ppt or learning videos) due to insufficient school facilities. Limited school facilities such as the lack of availability of projectors as support in learning activities can reduce interest in learning. Supportive and adequate school facilities are a very important factor for the learning effectiveness process (Hapipah, 2021).

The fourth factor is Teaching Context Error. Misconceptions can be caused by teaching context errors in terms of sub-indicators of the use of everyday language and student learning experiences. This is shown in the results of the questionnaire analysis which was found to be 48% (medium category). All students have unique learning experiences, so a lack of learning experience can increase their misconceptions. (Mukhlisa, 2021). The use of language that is not in accordance with what students understand also affects misconceptions (Suparno, 2013). Teachers

who explain in local language will find it difficult for students to understand so that it can cause misconceptions. The fifth factor is textbooks. The results of the questionnaire analysis of the causes of textbook misconceptions were found to be 40% (medium category). Students as subjects in the learning process are only sourced from biology textbooks and teachers and cannot access the internet because they are prohibited from bringing cellphones during the learning process. Due to limited sources and information, students may not understand the concept thoroughly. Misconceptions that occur in students due to textbooks are in accordance with the statement by Suparno, (2013) which states that conceptual errors in textbooks will complicate their learning process, so they can cause misconceptions.

This study has limitations, namely regarding the material and place of research. The material in this study is only limited to cell material in class XI SMA. In addition, this study only reveals the profile of misconceptions and factors that influence misconceptions on cell material. The research place was only conducted at MA Darul Muqorrobin Kendal, so the results of this study only describe the misconception profile of students in class XI MIA 1 and 2.

CONCLUSION AND RECOMMENDATION

Based on the results of the research analysis that has been done, it can be concluded that the level of misconceptions of students in class XI MIA at MA Darul Muqorrobin Kendal on cell material is 51%, students understand the concept 22%, students guess 10%, and students do not understand the concept 17%. The percentage of misconceptions in each cell sub-material includes chemical components of cell preparation 51%, cell activities 54%, structure and function of cell parts 50%, membrane transport 46%, and protein synthesis 60%. Meanwhile, misconceptions that occur in students in cell material are influenced by several factors. The following are each of the factors that cause misconceptions along with their percentages, including students 60%, teachers 44%, learning methods 66%, teaching context errors 48% and textbooks 40%. Suggestions for further research are that research should be conducted on misconceptions in other learning materials so that the use of appropriate learning methods and media can be mapped as well as efforts to minimize the occurrence of misconceptions in students.

REFERENCES

- Afifah, Y. N., & Asri, M. T. 2020. Profil Miskonsepsi Pada Submateri Struktur Dan Fungsi Sel Menggunakan Four Tier Test. *BioEdu: Berkala Ilmiah Pendidikan Biologi*. 9(3):390–96.
- Astutik, F. & Wijayanti, E. 2020. Meta-Analysis: The Effect of Learning Methods on Student's Critical Thinking Skills in Biological Materials. *Jurnal Studi Guru & Pembelajaran*. 3 (3): 429-437.
- Diknasari, M. 2020. "Analisis Miskonsepsi Mata Pelajaran Biologi Pada Materi Fotosintesis Menggunakan Certainty Of Response Index (CRI) Pada Siswa Kelas VIII Di SMP Negeri Sekota Bandar Lampung". Skripsi. Lampung: Universitas Islam Negeri Raden Intan.

- Fariyani, Q., Rusilowati, A., & Sugianto. 2015. "Pengembangan Four-Tier Diagnostic Test Untuk Mengungkap Miskonsepsi Fisika Siswa Sma Kelas X." *Journal of Innovative Science Education* 4(2):41–49.
- Fitria. 2019. "Identifikasi Miskonsepsi Peserta Didik Menggunakan Four-Tier Diagnostic Test Disertai Certainty Of Response Index (CRI) Pada Materi Usaha Dan Energi". Skripsi. Lampung: Universitas Islam Negeri Raden Intan.
- Hapipah, R. 2021. *Pengaruh kurangnya fasilitas belajar mengajar untuk siswa dalam mengembangkan pendidikan*. Skripsi. Banjarmasin: Universitas Lambung Mangkurat.
- Huda, K. 2020. *Modul Pembelajaran SMA BIOLOGI Kelas XI*. Lamongan: Kemendikbud Direktorat SMA.
- Lukitasari, Marheny. 2015. *Biologi Sel*. Malang: Universitas Negeri Malang.
- Mukhlisa, N. 2021. Miskonsepsi Pada Peserta Didik. *Journal of Special education*. 4 (2): 66-76.
- Muna, H., F. 2021. "Pengembangan Instrumen Tes Diagnostik Four-Tier Dengan Metode Cri Untuk Mengidentifikasi Miskonsepsi Siswa Pada Materi Biologi Sel Di MA l'anatuth-Thullab". Skripsi. Semarang: Universitas Islam Negeri Walisongo.
- Mustaqim, T., A. 2014. *Identifikasi Miskonsepsi Siswa Dengan Menggunakan Metode Certainty Of Response Index (CRI) Pada Konsep Fotosintesis Dan Respirasi Tumbuhan*. Skripsi. Jakarta: UIN Syarif Hidayatullah.
- Nurmanitasari, P. 2020. "Identifikasi Miskonsepsi Menggunakan Three-Tier Diagnostic Test Berbasis Google Form Materi Tekanan Zat Dan Penerapannya Pada Masa Pandemi Covid-19 Di SMP Negeri 4 Salatiga". Skripsi. Salatiga: Institut Agama Islam Negeri Salatiga.
- Putri, R. E. & Subekti. 2021. Analisis Miskonsepsi Menggunakan Metode Four- Tier Certainty Of Response Index: Studi Eksplorasi Di SMP Negeri 60 Surabaya. *Pensa E-Jurnal: Pendidikan Sains*. 9 (2): 220-226.
- Saifullah. 2020. *Modul BIOLOGI Kelas XI*. Lamongan: Kemendikbud Direktorat SMA.
- Santoso, L. M., & Santri, D. J. 2016. *Biologi Molekuler Sel*. Jakarta Selatan: Jagakarsa.
- Saputra, N. R. Safilu & Munir, Asmawati. 2021. Diagnostik Miskonsepsi Siswa Pada Materi Sel Di SMA Negeri 1 Wakorumba selatan Kelas XI IPA. *AMPIBI: Jurnal Alumni Pendidikan Biologi*. 6 (2): 80-89.
- Septiani, I., Lesmono, A. Djoko & Harimukti, A. 2020. Analisis Minat Belajar Siswa Menggunakan Model Problem Based Learning Dengan Pendekatan STEM Pada Materi Vektor Di Kelas X MIPA 3 SMAN 2 Jember. *Jurnal Pembelajaran Fisika*. 9 (2): 64-74.
- Sholikhin, A., I. 2022. *Analisis Miskonsepsi Siswa Dengan Menggunakan Four-Tier Certainty Of Response Index Pada Materi Asam Basa*. Skripsi. Semarang: Universitas Islam Negeri Walisongo.
- Sipahutar, Herbert & Gaol. Adriana Y. D. Lbn 2015. *The Correction of Students' Misconception In Cell Biology Concepts Using Video-Based Learning Media*. Prosiding Semirata. 471-481. Pontianak: UNTAN.
- Subrata, Y., Kurniawan, A. D., & Qurbaniah, M. 2019. Analisis Miskonsepsi Siswa pada Materi Sistem Organisasi Kehidupan Kelas VII SMP Negeri 14 Pontianak. *Pena Kreatif: Jurnal Pendidikan*. 8(2): 125-142.
- Suhermiati, I., Indana, S., & Rahayu, Yuni, S. 2015. Analisis Miskonsepsi Siswa Pada Materi Pokok Sintesis protein Ditinjau Dari Hasil Belajar Biologi Siswa. *BioEdu: Berkala Ilmiah Pendidikan Biologi*. 4 (3): 985–990.

- Sumitro, S. B., Widyarti, Sri, & Permana, S., 2017. *Biologi Sel: Sebuah Perspektif Memahami Sistem Kehidupan*. Malang: UB Press.
- Suparno, P. 2013. *Miskonsepsi dan Perubahan Konsep dalam Pendidikan Fisika*. Jakarta: PT. Grasindo.
- Suwarna. 2013. *Pengembangan Tes Diagnostic Dalam Pembelajaran*. Yogyakarta: Pustaka Pelajar.
- Tan, M., I., Barlian, A., & Ernawati. 2016. *Biologi Sel Dan Terapannya*. Bandung: ITB Press.
- Wilantika, N., Khoiri, N., & Hidayat, S. 2018. Pengembangan Penyusunan Instrumen Four-Tier Diagnostic Test Untuk Mengungkap Miskonsepsi Materi Sistem Ekskresi Di SMA Negeri 1 Mayong Jepara. *Jurnal Phenomenon* 8: (2).
- Wildani, N., Pratiwi, R., & Budiono, J. D. 2012. Profil Media E-Learning Berbasis Web Pada Materi Struktur Dan Fungsi Jaringan Tumbuhan. *BioEdu: Jurnal UNESA*. 1 (3): 51-56.
- Yunita, O. 2016. *Biologi Sel: Pendekatan Aplikatif Untuk Profesi Kesehatan*. Jakarta: Erlangga.