

HIGH SCHOOL STUDENTS CONCEPTION PROFILE ON THE CELL MATERIAL IN TUBAN REGENCY USING THREE-TIER TEST METHOD

Profil Konsepsi Siswa SMA pada Materi Sel di Kabupaten Tuban Dengan Metode Three-Tier Test

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Abstract

Conception is a person's understanding of something being observed. Cell material is prone to misconceptions owing to the fact that the material is unable to be sensed, moreover there are many sub-concepts that need to be fully apprehended. This research aims to describe the high school students conception profile on the cell material in Tuban Regency using the Three-Tier Test method, to describe the differences in the conception of high school students on cell material in Tuban Regency, and to describe the differences in the conception profile of students by school area. This is a descriptive-quantitative research using Three-Tier Test instrument. Data collection was carried out online via google form and interviews via google meet. 60 high school students of class XI in Tuban Regency were involved as the target of the research. The results showed that the conception profile of high school students on cell material in Tuban Regency mastered the concept of 53.21%, did not master the concept of 14.01% and misconceptions 32.78%. The highest of school that did not mastering concept was High School 1 Bancar at 31.30% and the highest misconception was High School 3 Tuban at 36.48%. Students experienced the highest misconception on the endocytosis concept, which was 63.33%. The cause of misconceptions is from student itself, worksheet book, and the teacher's explanation.

Keywords: Conception Profile, Cell, Three-Tier Test.

Abstrak

Konsepsi merupakan pemahaman seseorang terhadap sesuatu yang diamatinya. Materi sel rawan miskonsepsi karena materi tersebut tidak dapat diindra dan banyak subkonsep yang perlu dipahami. Penelitian ini bertujuan mendeskripsikan profil konsepsi siswa SMA pada materi sel di kabupaten Tuban dengan metode Three-Tier Test, penyebab perbedaan konsepsi siswa SMA pada materi sel di kabupaten Tuban, dan mendeskripsikan perbedaan profil konsepsi siswa berdasarkan wilayah sekolah. Jenis penelitian ini adalah deskriptif-kuantitatif menggunakan instrumen Three-Tier Test terdiri atas tiga tier. Pengambilan data dilaksanakan online melalui google form dan wawancara melalui google meet sebagai upaya pembatasan sosial pada masa pandemi Covid-19. Sasaran penelitian ini adalah 60 siswa SMA kelas XI di kabupaten Tuban. Hasil penelitian didapatkan profil konsepsi siswa SMA pada materi sel di kabupaten Tuban menguasai konsep 53,21%, tidak menguasai konsep 14,01% dan miskonsepsi 32,78%. Sekolah yang tidak menguasai konsep tertinggi adalah SMAN 1 Bancar sebesar 31,30% dan miskonsepsi tertinggi adalah SMAN 3 Tuban sebesar 36,48%. Siswa mengalami miskonsepsi tertinggi pada konsep endositosis yaitu sebesar 63,33%. Penyebab siswa mengalami miskonsepsi yaitu siswa itu sendiri, LKS, dan penjelasan guru.

Kata kunci: Profil Konsepsi, Sel, Three-Tier Test.

INTRODUCTION

Biology is a comprehensive science built by concepts. The concept of putting up a theory, a theory that is consistently correct is law (Ibrahim, 2019), until the concept becomes one of the requirements for the validity of science.

The concept in biology is growing. The development of this concept certainly needs to be balanced with students' ability to accept various new concepts and be able to relate to the concepts that have been obtained to such an extent that continuity of thinking and learning becomes more meaningful (Siswana et al, 2017).

Comprehending the concept is referred to conception. Conception is a person's understanding of something

one's observes Ibrahim (2019), so it is suspected that differences in geographic location will cause differences in student conceptions, thus in this research, three schools were selected in the limestone mountain area, cities, and the coast.

Students' conceptions can be categorized into three (3) types, namely mastering concepts, not mastering the concepts and misconceptions. Someone is said to have mastered the concept if the conceptual understanding is correct and possess high confidence level. If the understanding of the concept is wrong and the low level of confidence in the answer, then the person fails to master the concept. Meanwhile, if the person gives an answer to the wrong concept, but the confidence level is significant; in that case that person experiences a misconception (Ibrahim, 2019).

Misconception is an error in comprehending concepts that a person owns and still accepted even though one's has been taught the correct scientific concepts Ibrahim (2019). According to Auwaliah and Raharjo (2017), misconceptions can occur in all biological material. There are various factors that cause students to experience misconceptions, particularly students themselves, teachers, teachers' methods in teaching, textbooks, and contexts such as experiences encountered by students (Hidayat et al, 2020; Tridayanti and Yuliani, 2017).

In foregoing studies, it became apparent that students experienced misconceptions in cell material, essentially in Fitria et al (2017), Students at State High School 2 Sabang experienced misconceptions about the concept of cells, namely 13% of the cell chemical components sub-material, 24% of cell structure and function, organelle sub material of animal and plant cells were 17% and the transport mechanism through the membrane sub material was 12%. Meanwhile, research conducted by Rafika et al (2015) showed that there were misconceptions in the sub-material structure and function of cell organelles with an average percentage of misconceptions of 17.97%.

Interviews outcome which has been conducted with the teachers and students indicate that students have problems in comprehending cell material because cell material incapable to be sensed and many sub-materials need to be understood. Students have difficulty conceiving material due to the Covid-19 pandemic which requires students to study online so they incapable to do practices with adequate tools. Students need to understand the concept completely in order to avoid misconceptions (Harahap and Ristono, 2019).

Misconceptions that occurred in students must be addressed immediately in view of the fact that they can

prevent students from grasping the concepts to be studied next and in the end, the integrity of student learning outcomes will be impossible to achieved (Ritonga et al, 2017).

Student conceptions can be identified specifically utilized the Three-tier test method which is a valid diagnostic tool consisting of questions, reasons, and the level of confidence of Milenkovic students (2016). Khairaty et al (2018) The Three-Tier Test is able to present a more realistic and valid instrument than the Two-Tier Test to identify student conceptual understanding since the Two-Tier Test has a drawback, specifically since it is incapable to distinguish incorrect student answers due to lack of understanding the concept or students undergoing misconceptions. Meanwhile, the Four-tier test requires a relatively long time for testing and correcting student answers than other instruments and is not recommended to utilize in the purpose of learning outcomes (Gurel et al, 2015).

Based on this description, it is necessary to identify students' conceptions of cell material using the Three-Tier Test method. The objectives of this study were (1) to describe the conception profile of high school students on cell material in Tuban Regency with the Three-tier test method (2) to describe the causes of differences in the conception of high school students on cell material in Tuban Regency with in-depth interviews (3) to describe the differences in conception profiles students within school area.

METHOD

The type of this research is a descriptive-evaluative. Descriptive-evaluative research is a systematic, factual, and accurate depiction of phenomena or relationships between the phenomena being investigated. This research is conducted to describe students' conception in cell material using the Three-Tier Test that includes three stages, namely the preparation stage, the data collection stage, and the final stage. The research was conducted from October 2020 to January 2021. Data collection involved 60 high school students of class XI from 3 schools namely State High School 3 Tuban, State High School 1 Rengel, and State High School 1 Bancar. Furthermore, the data were analyzed in the learning laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences UNESA.

The preparation stage includes the process of drafting the Three-Tier Test instrument through the adaptation of a validated CRI instrument in Rafika's research (2015) in the form of online questions via google form. The research instrument includes the Three-Tier Test

instrument and the interview instrument. The instrument consists of 27 questions, each of which has 3 levels. The first level is a closed-ended question with 2 answer choices, namely "Yes" or "No", the second level is open reasons and the third level is the level of confidence which has a scale of 1 to 5.

The data collection stage included giving students the Three-Tier Test instrument via google form and conducting interviews with 3 students who experienced the highest misconceptions in each school to find out the misconceptions causes in students. Students' answers in the interview will be confirmed by the source of the misconceptions.

The final stage includes data processing and analysis, then drawing the conclusion. The data obtained will be presented in the table, then processed and analyzed. The data analysis technique refers to the category of grouping students' conceptions based on the Three-Tier Test instrument which is illustrated in **Table 1**.

Table 1 Categories of student conceptions based on the Three-Tier Test instrument (Ibrahim, 2019)

Tier 1 (Conception)	Tier 2 (Reason)	Tier 3 (Confidence level)	Category
True	True	High (>2.5), very confident	Mastering concept
True	False	High (>2.5), very confident	Misconception
False	True	High (>2.5), very confident	Misconception
False	False	High (>2.5), very confident	Misconception
True	True	Low (≤2.5), very confident	Not mastering concept
False	True	Low (≤2.5), very confident	Not mastering concept
False	False	Low (≤2.5), very confident	Not mastering concept

The students' conception categories are processed in percentage form, to find out the percentage of each category, the data calculated using the following formula:

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

Description:

P = groups percentage

F = Number of students in the group

N = Total sample of students

The percentage results obtained were then grouped into three categories as in Table 2 (Didik, et al, 2020).

Table 2 Category Percentage of Misconceptions

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

FINDINGS AND DISCUSSION

Data collection using the Three-Tier Test instrument was conducted involving 60 students from 3 schools, namely State High School 3 Tuban, State High School 1 Rengel, and State High School 1 Bancar. The data then analyzed and processed in order to obtain the conception profile of high school students on cell material in Tuban Regency which is presented in **Figure 1**, the difference in the percentage of cell material conceptions in each school is presented in **Table 3**, and the percentage of student conceptions on each item of cell material is presented in **Table 4**.

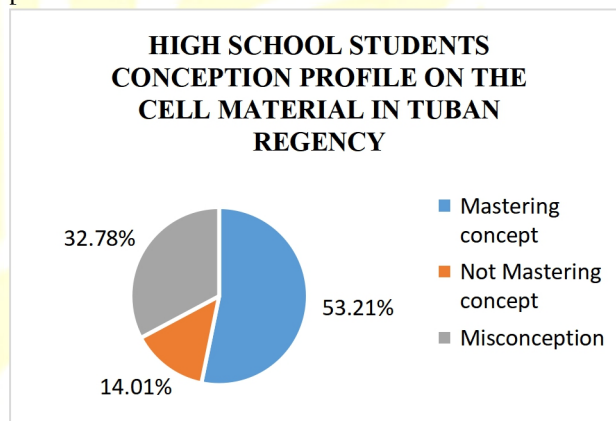


Figure 1. Conception Profile Diagram of High School Students on Cell Material in Tuban Regency

Based on Figure 1, it can be seen that there are still high school students in Tuban Regency who incapable of mastering the concept and undergo misconceptions on cell material, respectively, 14,01% and 32,49%. Based on the percentage category of Didik et al. (2020), the misconceptions that occurred in Tuban were in the moderate category. This can hinder students from learning about other materials and its implementation in everyday life (Duda et al, 2020).

Table 3 Differences in the percentage of cell material conceptions in each school

School name	MC (%)	NMC (%)	M (%)
State High School 3 Tuban	58,33	5,19	36,48
State High School 1 Bancar	42,41	31,30	26,29
State High School 1 Rengel	58,89	5,56	35,55

Description:

MC Mastering concept

NMC: Not mastering concept

M: Misconception

It is shown that State High School 3 Bancar has the highest percentage for not mastering the concept at 31,30%. The thing indicated based on the result of the interview, during the learning of the cell material, students constraint to do practice and barely have worksheets for them to study. The worksheets contain pictures of cell material, but the pictures are colorless and some are unclear in such a way that students find it difficult to comprehend the material as a whole.

The highest percentage of misconceptions was found in State High School 3 Tuban with a percentage of 36,48%. Based on the results of the interview, this could happen as a result of the unclear teacher's explanation, teachers leaving assignments to do yet they don't provide discussion, and during online learning, students preferred to learn using worksheets which had pictures about cell material that were colorless and unforeseeable. Moreover, students read articles on the internet which lacking reliable sources. The conception profile in each school is different, this is in accordance with Ibrahim (2019), the difference in learning experiences encountered by students of State High School 3 Tuban, State High School 1 Rengel, and State High School 1 Bancar generate in a different conception profile of students on cell material for each school.

Table 4 The percentage (%) of students' conceptions on each questions about the cell material

Concept	Question number	MC (%)	NMC (%)	M (%)
Definition of cell	1	80	5	15
Chemical components of cells	2	63,33	8,33	28,33
	3	41,67	21,67	36,67
	4	50	16,67	33,33

The differences between prokaryotic cells and eukaryotic cells.	5	48,33	11,67	40
	6	61,67	8,33	30
Prokaryotic Cells and Eukaryotic cells Examples	7	20	18,33	61,67
	8	48,33	11,67	40
The differences between plant and animal cells	9	53,33	10	36,67
	10	30	18,33	5
Structure and function of plant and animal cells	11	60	21,67	18,33
	12	58,33	10	31,67
Cell organelles function	13	56,67	15	28,33
	14	41,67	13,33	45
The connection of organelles structure and its function	15	63,33	13,33	23,33
	16	53,33	13,33	33,33
Diffusion	17	86,67	10	3,33
Osmosis	18	35	13,33	51,67
	19	55	15	30
	20	65	16,67	18,33
Active transport	21	40	13,33	46,67
	22	68,33	13,33	18,33
Endocytosis	23	18,33	18,33	63,33
	24	41,67	16,67	41,67
Exocytosis	25	66,67	18,33	15
	26	68,33	11,67	5
The differences of diffusion and osmosis	27	61,67	16,67	21,67

Description:

MC Mastering concept

NMC: Not mastering concept

M: Misconception

Cell material is unable to be sensed, moreover there are many sub-concepts that need to be fully apprehended,

including the structure and function cell parts, The differences between prokaryotic cells and eukaryotic cells, The differences between animal cells and plant cells, and membrane transport.

Table 3 indicates that students encounter misconceptions about all topics that occur in cell material. The highest number of misconceptions was seen in the endocytosis concept, which was 63,33%. Students responded incorrectly and assumed that the mechanism of bacterial cells invading the cell was a pinocytosis. The right definition will be that the process of penetrating bacterial cells into cells is phagocytosis and the two processes have variations in the form of substance that reaches the cells (Campbell et al, 2016). Students may have incorrect ideas about this concept, since pictures became less clear and colorless in worksheet books and misinformed concepts read from the internet often difficult to comprehend.

The second highest misconception was seen by the case of prokaryotic cells and eukaryotic cells, which was 61,67%. Students responded incorrectly and claimed that the unicellular prokaryotic cell representation included in the questions was unicellular eukaryotic cells, and the students argued that the cells seen in the image are typical of unicellular eukaryotic cells. The right definition here was that prokaryotic cells lacking on membrane organelles like eucaryotic cells, apart from ribosomes (Mader, 2014). Students may encounter misconceptions about this concept owing to the fact that students tend to learn from the Internet, the source they seek is a source that may not be reliable, such as brainly and blogs, and uncertain explanations from teachers.

The third highest misconception is indicated by the concept of Osmosis, which is at 51,67% Students responded incorrectly and claimed that osmosis was a process of transferring solvents from high concentrations to low concentrations through the use of a semipermeable membrane. The right definition seems to be that osmosis is the movement of solvents from low to high concentrations through semipermeable membrane to an equivalent concentration on both sides of the membrane (Campbell et al, 2016). Students would encounter misconceptions regarding this concept when two out of three schools incapable of conducting practice, students misinterpret the concepts from books and the internet.

The active transport concept corresponds to 46,67%. Students responded incorrectly and claimed that active transport incapable to require the release of energy in the form of ATP to counteract the concentration gradient. The right concept is that active transport involves the release of energy in the form of ATP to against the

concentration gradient (Campbell et al, 2016). There are three other students in this same school who claim the concept has not yet been learned, but after investigating it along with the biology teacher it appears that the concept has been introduced. The student may have misconceptions about this concept in view of the fact that students refer to the Internet as a source that might not be reliable. So it can clearly be shown by these students that they neglect the subject that has already been taught.

There has been 36,67% misconception of the concept in cell chemical components and the distinction between plant and animal cells. Students are incorrect in the concept of the chemical component of cells and assume that lipids unable to gives a signal to the nucleus that membrane damage occur. The correct approach is that lipids have several functions, one of them is to give the nucleus a signal that the membrane is damaged (Campbell et al, 2016). Students may encounter misconceptions upon the concept of the chemical components of cells when students misinterpret the concepts from books and learn from classmates who may have misconceptions. The students claimed incorrectly that organells of plant cells not owned by animal cells are mitochondria in the concept of discrepancies in plant cells and animal cells. The right concept is that chloroplast, cell walls and glyoxysomes are organelles in plant cells that were not owned by animal cells (Campbell et al, 2016). Students may encounter misconceptions on this concept as students get information about the concept from the internet which suggests that animal cells lack vacuoles, even but not all of them are the same, there are certain animal cells that seem to have vacuoles but in a small size. (Campbell, et al, 2016).

In terms of distinctions in prokaryotic cells and eukaryotic cells, students perceive a 40% misconception. Students responded incorrectly and assumed that the do not have nucleus membrane and endomembrane structures were the characteristics of eukaryotic cells. The correct concept that these traits are the characteristics of prokaryotic cells, in addition to the fact that prokaryotic cells do not have organelles that surround with membrane (Madigan et al, 2012). Students may face misconceptions as students are unable to comprehend the teacher's explanations and choose to learn this concept through the internet.

In terms of the attachment structure and function of the organelles, students encountered a misconception of 33,33%. Students are incorrect and assume that the lysosome has insufficient membrane-like structure that contains the hyrolase enzyme. The correct approach is

that the lysosome has a membrane bag-like structure and carries the hydrolase enzyme which effective in degrading the cell substrate.

There was a misconception of 45% on the concept of cell organelles functions among students. Students were incorrect and assume that cell respiration is done by organelle number 2, namely, RE. The correct concept is that the cellular respiration undertaken by mitochondria, which is number 5 in the question (Campbell et al, 2016). Students may have misconceptions about this concept as the pictures in the book are not clear since the students misinterpret the pictures on the internet.

In terms of the composition and function of plant and animal cells, students encountered a misconception of 31,67 % Students reacted incorrectly and assumed that the cell membrane did not serve as a barrier between cell content as well as the environment. The correct concept is that a cell membrane has several functions, and one of them is become barrier to cell content in the environment (Campbell et al, 2016). Students may experience misconceptions about this concept as students tend to forget about topics that were already taught in books.

In terms of variations in diffusion and osmosis, students have encountered a misconception of 21,67%. Students responded incorrectly and assumed that in different forms of transport, diffusion is passive transport and osmosis is active transport. The correct concept is that osmosis is a passive transport, as it does not entail the release of energy in the form of ATP, osmosis is the diffusion of solvents through a semipermeable membrane (Campbell et al, 2016). Students can encounter misconceptions because students unable to comprehend the topic as a whole.

Students encounter 15% misconceptions that are categorized as low in the concept of cell definition and exocytosis. Students responded correctly to the concept of cell classification but the reasoning given was not accurate, namely, the cell is part of the function of all small human body's functions. The proper explanation is that cells have a certain form and function to consider them structural and functional (Goldstein et al, 2010). Students may experience misconceptions about this principle as they unable to comprehend the concept as a whole. Additionally, students responded incorrectly to the concept of exocytosis, claiming that the release of secretive compounds outside the cell was not an exocytosis. The correct concept is that exocytosis is the secretion of such biological molecules by the merger of the vesicles with the cell membrane (Campbell et al, 2016). Students may encounter misconceptions about this

concept since the worksheets which students utilize unable to describe this concept in depth.

In the diffusion concept, students encounter a misconception that was classified as low, at 3,33%. Students responded incorrectly and assumed that the concept of diffusion was the movement of solutes from hipotonic to hipertonic. The correct concept of diffusion is the movement of solutes from hipertonic to hipotonic (Campbell et al, 2016). Students may encounter misconceptions as students tend to forget about the content being taught.

The concepts of endocytosis and osmosis include submaterial membrane transport. In the research of Fitria et al (2017) revealed that students experienced a misconception of membrane transport submaterial by 17%, this result was lower than the findings in this research which showed that students experienced the highest misconception on endocytosis concept which is 63,33% and osmosis 51,67%.

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CONCLUSION AND SUGGESTION

Conclusion

It has been observed that in the Tuban Regency, the conception profile of high school students was mastered by 53,21%, 14,01% has not mastered the concept and a percentage of misconception was 32,78%. State High School 1 Bancar is the school that posses the highest in not mastering the concept at 31,30%. Meanwhile, State High School 3 Tuban encountered the highest misconception at 36,48%. Students experienced the highest misconception on the concept of endocytosis, which was 63,33%. Students with misconceptions emerge from when students misinterpreted and conveniently forgot the acquired concepts, the descriptions and pictures in the worksheet are unclear, the teacher's explanation difficult to comprehend.

Suggestion

Further analysis should be undertaken on a model, method, or media capable of addressing a lack of

comprehension of definitions and misconceptions during the Covid-19 pandemic.

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