BioEdu
Berkala Ilmiah Pendidikan Biologi
Vol. 10 No. 3 Tahun 2021 Hal: 674-682
https://ejournal.unesa.ac.id/index.php/bioedu

PROFILE OF 10th GRADE HIGH SCHOOL STUDENTS MISCONCEPTION ON VIRUS TOPIC BASED ON THREE-TIER MULTIPLE CHOICE DIAGNOSTIC TEST

Profil Miskonsepsi Siswa Kelas X SMA Pada Topik Virus Berdasarkan Three-Tier Multiple Choice Diagnostic Test

Listya Eka Ningtyas

Biology Education, Faculty of Mathematics and Natural Sciences, Surabaya State University

E-mail: listya.17030204023@mhs.unesa.ac.id

Mahanani Tri Asri

Biology, Faculty of Mathematics and Natural Sciences, Surabaya State University

E-mail: mahananiasri@unesa.ac.id

Abstract

Biology learning is closely tied to concepts. Misconceptions arise within learning of several fundamental biological principles. One of the biology topics frequently faces misconceptions is viruses. To recognize misconceptions in students, the three-tier multi-choice diagnostic test method is important to be used. This research was intended to explain the misconception of students, the percentage of student misconception and the source of virus topic misconception in high school. This research was a multi-stage qualitative descriptive research, including the preparation of a three-tier multi-choice diagnostic test instrument, the validation of instruments, conducting student observations, conducting interviews with the students, the analysis of data and the assessment of outcomes. This research was performed at 10 th grade High School with as many as 36 students receiving virus topic. Results showed that 5.43% of students encountered positive misconceptions, 6.88% students encountered negative misconceptions, 30.56% students encountered misconception. Total misconceptions showed that 42.87% of students encountered misconception of virus topic. The highest misconception was found in the concept of bacteriophage reproduction, which had the largest misconception of 49.07%. The lowest misconception was found in the concept of the role of viruses, which had the smallest misconception of 36.8%. The highest misconception was found in the indicator of Identifying the way the virus lives in the host cell, which had the largest misconception of 63.89%, while the lowest was 19.44% in the indicator of identifying the role of viruses that are beneficial to human life. The aspects that contributed to the misconception were inadequate books, restricted choice of learning approaches during the Covid-19 pandemic, and context errors faced by students.

Keywords: profile, misconception, virus topic, three-tier diagnostic test.

Abstrak

Pembelajaran biologi erat kaitannya dengan konsep. Miskonsepsi muncul dalam beberapa prinsip biologi dasar. Salah satu topik biologi yang sering mengalami miskonsepsi adalah virus. Untuk mengenali miskonsepsi pada siswa, metode three-tier diagnostic test penting untuk digunakan. Penelitian ini bertujuan untuk menjelaskan miskonsepsi siswa, persentase miskonsepsi siswa, dan sumber miskonsepsi topik virus di SMA. Penelitian ini merupakan penelitian deskriptif kualitatif, meliputi penyusunan instrumen tes diagnostik pilihan ganda three tier, validasi instrumen, observasi siswa, wawancara dengan siswa, analisis data dan penilaian hasil. Penelitian ini dilakukan di kelas X SMA dengan jumlah siswa 36 siswa yang telah menerima topik virus. Hasil penelitian menunjukkan 5,43% siswa mengalami miskonsepsi positif, 6,88% siswa mengalami miskonsepsi negatif, 30,56% siswa mengalami miskonsepsi. Total miskonsepsi menunjukkan bahwa 42,87% siswa mengalami miskonsepsi virus. Miskonsepsi tertinggi terdapat pada konsep reproduksi bakteriofag sebesar 49,07%. Miskonsepsi terendah terdapat pada konsep peran virus sebesar 36,8%. Miskonsepsi tertinggi terdapat pada indikator mengidentifikasi cara hidup virus dalam sel inang sebesar 63,89%, sedangkan miskonsepsi terendah pada indikator mengidentifikasi peran positif virus bagi kehidupan manusia sebesar 19,44%. Aspek penyebab terjadinya miskonsepsi adalah buku yang tidak memadai, metode pembelajaran yang terbatas selama pandemi Covid-19, dan kesalahan konteks yang dialami siswa.

Kata Kunci: *profil, miskonsepsi, virus topik, three-tier diagnostic test.*

BioEdu
Berkala Ilmiah Pendidikan Biologi
Vol. 10 No. 3 Tahun 2021 Hal: 674-682
https://ejournal.unesa.ac.id/index.php/bioedu

INTRODUCTION

Biology is the study of the living creature. Biology is a science made up of principles, laws, concepts, facts, procedures, theories and information (Ibrahim, 2012). High school biology is closely tied to certain things that need to be learned. Good mastery of concepts, broad and deep can allow a student to apply them in various abilities.

The mastering of concepts within each student appears different. It is because the initial concept (preconception) of students is in the form of assumptions, prejudices and interactions that students acquire in their daily lives (Dikmenli, 2010). If the assumptions of students difficult to be changed and students tend to adhere to their preconceptions, this is considered a misconception (Ibrahim, 2012).

Misconception is an interpretation of concepts among students different from scientific concepts (Ardiyanti & Utami, 2018). The causing factors of misconceptions in students include students themselves, teachers, textbooks and instructional techniques used in learning. Misconceptions are often induced by students having trouble interpreting concepts (Suparno, 2013).

Students mostly undergo misconceptions regarding fundamental biology principles (Tekkaya, 2002). One topic frequently found in student misconceptions is virus. Virus topic is considered challenging for students since it is abstract or difficult to be studied directly (Adriani et al., 2019). Due to its smaller size compared to bacteria and its reliance on the metabolism of its host makes, it is difficult to analyze virus topics and requires a better students' understanding (Ayu et al., 2016). According to previous study by Adriani et. al. (2019) about misconceptions virus topic, misconceptions intact amounted to 23.29%, false positive misconceptions of 6.82%, false misconceptions negative by 6.15%. According to previous study by Setyaningrum et. al. (2018), the result of diagnostic test is the understanding of concept about characteristics virus is 72,45%; virus classification is 56,93%; virus replication is 33,35%; the type and host of virus is 56,68%; characteristics of virus that cause disease is 63,19%; and understanding of concept about vaccine is 60,58%. Based on the data collected from the Education Assessment Center of the Ministry of Education in 2019, the absorption of the national test score for virus topic in the domain was still below the minimum level, at 54.72 (Ministry of Education and Culture, 2019).

Misunderstanding of topic arises in students must be detected quickly. If it is retained in students' memory, it will have a negative effect on learning other topics and concepts since biology concepts are interrelated (Khairaty et al., 2018). Identification of misconception needs to be undertaken to determine the profile of student misconception. Misconception profile can be identified using the diagnostic test method, i.e. the three-tier multiple diagnostic tests.

In comparison to the two-tier diagnostic test, a three-tier diagnostic test is preferable to the extent that it is useful for distinguishing between students who have misconceptions and students that do not grasp concepts or do not recognize the concept based on confidence level of students when answering the questions, making it more accurate to detect misconceptions (Kamilah & Suwarna, 2019.) A diagnostic multi-choice test can be utilized to assess the level of knowledge of students before and after the test (Cetin-Dindar & Geban, 2011).

This overview illustrates the degree of misconceptions that was encountered by students, the frequently recurring indicators of misconceptions, and the causes of these misconceptions. This research was intended to explain the misconception of students, the percentage of student misconception and the source of virus topic misconception in high school.

METHOD

This research was a descriptive qualitative study. Qualitative descriptive research was a research method, which gathers evidence and afterwards makes findings compared to criteria determined by experts. The data obtained in this study were in the form of student misconception profiles. Both test and non-test methods were used in this research. This research was carried out online due to Covid-19 pandemic, which demands for social distancing. Preparation, execution and completion were the stages performed in this research. The first step was the preparation, which was carried out by creating a three-tier multi-choice diagnostic test instrument by identifying main and basic competencies related to virus topics. Then test instrument validation was carried out by expert covering several aspects including material, construction, and language. The percentage value of eligibility was analyzed using the following score categories:

Table 1. Validity Score Category

Percentage (%)	Category
≤25-38	Very invalid
38-52	Invalid
53-69	Quite valid
70-83	Valid

Percentage (%)	Category
84-100	Very valid

(Source: Haris and Jihad, 2013)

The next step was the execution of the data collection, which entailing the evaluation of three tier test questions done by students. This research was conducted in January-February 2021 with the intention of examining 36 students of classes X MIA-5 and X MIA-6 State High School 1 Nglames. A multiple-choice testing method with three levels of virus material was the instrument used in this research (three tier multiple choice diagnostic test). The data analysis in this research used the student design requirements table based on the three-tier evaluation in Table 2 below:

Table 2. Three-Tier Category

Number	*First Tier*	*Second Tier*	*Third Tier*	Category
1	True	True	Sure	Understand the Concept
2	True	False	Sure	Positive Misconceptions
3	False	True	Sure	Negative Misconceptions
4	False	False	Sure	Misconception
5	True	True	Not Sure	Don't comprehend the concept
6	True	False	Not Sure	Don't comprehend the concept
7	False	True	Not Sure	Don't comprehend the concept
8	False	False	Not Sure	Don't comprehend the concept

Source: (Arslan et al., 2012)

The number of students who answered questions and their degree of self-confidence was categorized into groups of students who encountered misconception, positive misconception, and negative misconception, comprehend concept and did not comprehend the concept obtained through measuring utilizing the following formula:

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

Description:
P = Percentage of conceptual comprehension
f = Number of students in each category
n = the total number of students

The percentage of student misconception obtained was then classified into three misconception criteria, namely high misconception (61% -100%), moderate misconception (31% -60%), and low misconception (0% -30%) (Arikunto, 2010).

The interview was the last stage of the method used. This method was used to classify the factors of misconceptions among students. Interviews were performed using interview instrument to 3 students categorized as high, medium and low misconception in each sample class. The interview guide used for students contains questions related to the factors causing misconceptions. The factors of misconceptions in students were categorized into five: students, teacher, learning techniques, textbooks and context. Data analysis was carried out by making conclusions and generalizations on the grounds of the informants' responses (students).

RESULT AND DISCUSSION

This study was aimed to describe the level of students' misconceptions on virus topic and its causative factors. After analyzing the data, the percentage (%) of students' misconceptions on for each concept was obtained and presented in **Figure 1:**.

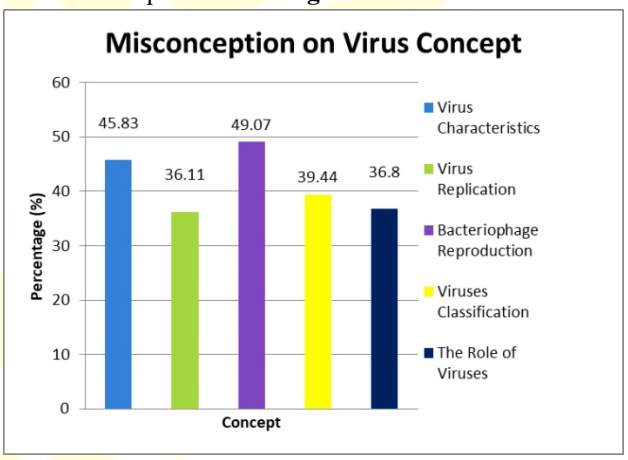

Figure 1. Percentage of students' misconceptions on for each concept

Based on percentage of students' misconceptions on virus concept it is known that 45.83% of students had misconceptions about virus characteristics. 36.11% of students had misconceptions about virus replication. 49.07% of students had misconceptions about bacteriophage reproduction. 39.44% of students had misconceptions about virus classification. 36.8% of students had misconceptions about the role of viruses.

The highest misconception was found in the concept of bacteriophage reproduction, which had the

largest misconception of 49.07%. The lowest misconception was found in the concept of the role of viruses, which had the smallest misconception of 36.8%. Ariska (2015) understands that conceptual understanding can be by internal factors such as motivation, concentration, study habits, abilities learning, as well as learning attitudes, and external factors such as the way teachers teach, tools learning, as well as the learning environment. Therefore, a learning process is needed which is more effective so that all students are helped to understand the concept with easy, one way is to improve communication between teachers and learners.

After analyzing the data, the percentage (%) of students' misconceptions on for each indicator was obtained and presented in **Table 3**.

Table 3. Percentage of Students' Misconceptions on Virus Indicator

Concept	Indicator	PM (%)	NM (%)	M (%)	TM (%)
Virus characteristics	Identifying the size of the virus	5.56	5.56	22.22	33.33
	Describing the mechanism for measuring viruses	2.78	2.78	47.22	52.78
	Analyzing virus forms	11.11	5.56	27.78	44.44
	Identifying the way the virus lives in the host cell	2.78	5.56	55.56	63.89
	Classifying viruses as inanimate objects	22.22	5.56	25.00	52.78
	Identifying the characteristics of living things possessed virus	8.33	11.11	30.56	50.00
	Classifying viruses as acellular	2.78	8.33	19,44	30,56
	Identify the bacteriophage structure	2.78	0.00	33.33	36.11
	Describing the function of the bacteriophage section	2.78	5.56	38.89	47.22
	Identifying the outer, shape-giving bacteriophage	2.78	8.33	36.11	47.22
Virus Replication	Identifying the stages of replication in the virus	5.56	16.67	13.89	36.11
Bacteriophage Reproduction	Describing the stages of the lytic cycle in bacteriophages	5.56	0.00	47.22	52.78
	Describing the stages of the lysogenic cycle in bacteriophages	2.78	8.33	36.11	47.22
	Describing the different stages of the lytic and lysogenic cycle in bacteriophages	0.00	8.33	38.89	47.22
Viruses Classification	Classifying viruses based on plant host cells	0.00	2.78	19.44	22.22
	Classifying viruses based on host cells (animals)	5.56	22.22	30.56	58.33
	Classifying viruses based on host cells	2.78	8.33	11.11	22.22

Concept	Indicator	PM (%)	NM (%)	M (%)	TM (%)
	(humans)				
	Classifying viruses based on DNA	2.78	11.11	25.00	38.89
	Classifying viruses based on RNA	5.56	5.56	44.44	55.56
The Role of Viruses	Identifying the role of viruses that are beneficial to human life	0.00	0.00	19.44	19.44
	Predicting an incident due to virus infection in plants	2.78	2.78	27.78	33.33
	Identifying the role of viruses that are harmful to animals	5.56	8.33	38.89	52.78
	Identifying the role of viruses that are harmful to humans	22.22	5.56	13.89	41.67
Average		**5.43**	**6.88**	**30.56**	**42.87**

Description:
PM = Positive Misconception
NM = Negative Misconception
M = Misconception
TM = Total Misconception

Based on Table 3, it can be seen that misconceptions occur in all concepts on virus topic with an average of 42.87%. The highest misconception was found in the indicator of how the virus lives within the host cell, which had the largest misconception of 63.89%. Almost all of the students answered the question falsely and believed the answer. It is because students had a false idea that viruses are like other species. Viruses are binding intracellular parasites since viruses are highly dependent on host cells for energy, metabolic intermediates, and protein synthesis (Madigan, 2012).

The highest misconception after the definition of the mode of life of the virus was the grouping of viruses based on host animal cells, at 58.33%. The misconception on this concept seemed to due the names of viruses not familiar to students, including: *Bovine papillomavirus* and *Aphtovirus*. When learning virus material, students do not really know and are not interested in learning about the sub-concept of the role of viruses that cause different diseases in animals. This is in line with the assertion by Hasibuan & Djulia (2017) that sub-concepts in virus material are full of abstract concepts, and therefore students do not feel challenged to understand certain things.

The next misconception emerged in the indicator of RNA-based classification of viruses, which was at 55.56%. Misconceptions are generated by the abstract genetic material of the virus. Virus materials were found challenging for students due to the fact that they were abstract or could not be studied directly (Adriani et al., 2019).

The concept of lytic and lysogenic cycle phases in bacteriophage frequently appears in misconceptions. Misconception of the lytic cycle stage had percentage of 52.78%, misconception of the lytic cycle stage 47.22%, and misconceptions of the lytic and lysogenic cycle distinctions 47.22%. The feature of the lytic cycle is that the host cell undergoes lysis and produces new virions when, in the lysogenic cycle, virus DNA is inserted into the host cell's DNA to form a profile (Madigan, 2012). Students also had misconception about this term. They found it difficult to grasp the idea of bacteriophage replication if scientific words were involved. According to Hasibuan & Djulia (2017) students found it difficult to understand virus materials owning to the fact that there are scientific words included that are difficult to understand.

The misconception on virus measurement mechanism had percentage of 52.78%. The factor for this misconception was that the textbooks used by students did not mention virus measurement mechanism. According to Tridiyanti & Yuliani (2017), textbooks are one of the sources of misconception. Many students did not know how to determine the scale of the virus. The correct concept is that viruses can be measured using an electron microscope, ultrasedimentation (ultracentrifugation) and colodionic membrane ultrafiltration with various pore diameters (Suprobowati & Kurniati, 2018).

The next misconception with the percentage of 52.78% was indicator of viruses as inanimate objects. The correct concept is that viruses should be considered as

inanimate objects for the reason that they can crystallize. Students did not know whether the virus will crystallize. Able to crystallize is a trait of inanimate objects that living things does not have (Campbell & Reece, 2016). The reason for the misconception in this concept was the initial concept (preconception) that students had before obtaining the virus information (Dikmenli, 2010). Primary preconceptions of students are difficult to change, creating misconceptions (Ibrahim, 2012).

The next misconception was the function of viruses that are dangerous to animals with the percentage of 52.78 %. Achieving comprehension of concepts as an indicator of the performance of learning outcomes is affected by student motivation during learning experiences (Setyaningrum et. al, 2018). Motivation encourages improvement in the learning process. The higher the motivation of an individual the higher the achievement of learning outcomes would be (Hermayani & Sri, 2004).

The next indicator with error percentage of 50% was the characteristics of living objects held by the virus. The correct concept is that viruses have the capacity to replicate in host cells (Suprobowati & Kurniati, 2018). The explanation for this misconception was the inadequate learning process during the Covid-19 pandemic, to such an extent that information obtained by the students was not accurate (Mustika, 2014).

Misconceptions were often identified in the concept of bacteriophage structure, bacteriophage function, and the outer part that gives the shape of bacteriophage fall with the percentage of 36.11%, 47.22%, and 47.22% of misconceptions. Students were also uncertain about the role and purpose of the bacteriophage. The right concept is that the T-shaped bacteriophage comprises sections, including the head, neck and tail. There is a base plate and tail fiber in the tail, while the outer portion of the bacteriophage that shapes the capsid is made up of protein subunits called capsomeres (Campbell & Reece, 2016). The cause of this misconception was that the teacher's learning method tends to be conventional, namely the lecturing method (Wening, 2014). The lecturing form was frequently used during the Covid-19 pandemic.

Misconception of the concept of virus replication was also found with percentage of 36.1%. The virus replication cycle consists of five stages, namely: the adhesion (adsorption) of virions to host cells; the penetration (entry, injection) of virion nucleic acids into the host cell cytoplasm; the synthesis of nucleic acid virus by host cell instruments is rearranged by the virus, then the assembly stage and finally the lysis stage (Madigan, 2012). The source of misconception in the concept of virus replication was the practice of memorizing in students. Students who learned simply by memorizing frequently had an incorrect interpretation, since they were not trying to recreate their understanding of the right idea (Setyaningrum et. al, 2018).

In terms of virus shape, percentage of students with misconcenption was 44.44%. The reasoning for this misconception was the students' practice of memorizing concepts. When students studied by memorizing, there was no process of concept assimilation, therefore students were unable to grasp the actual concept (Setyaningrum et. al, 2018). The correct concept is that viruses have five basic shapes, consisting round, stem, oval, polyhedral and letter T. (Suprobowati & Kurniati, 2018). Virus forms are determined by the capsid virus (Campbell & Reece, 2016).

The concept that also found to be misconcepted was the role of viruses in damaging human, at percentage of 41.67%. The cause of the misconception of this definition was the poor interest of students to research the different functions of viruses dangerous to humans. Motivation encourages improvement in the learning process. The higher the motivation of an individual, the higher the achievement of learning outcomes would be (Hermayani & Sri, 2004).

The DNA-based grouping of viruses also encountered a misconception with the percentage of 38.89%. Students were less familiar with viruses with DNA genetic material. As Adriani et al. (2019) previously noted, students were less interested in researching virus materials since it is abstract.

The definition of virus grouping based on plant and human host cells had misconception percentage of 22.22%. The reasoning for the misconception of this concept was that students were less interested in studying the classification of viruses. It was because they did not have enough motivation to study. Motivation of the student impacts the achievement of academic tasks (Setyaningrum et. al., 2018).

The next concept that met misconception was that the virus was labeled as acellular with the percentage of 30.53%. Viruses do not possess cell building blocks and do not metabolize in the host cell. The features of virus particles unable to be seen by naked eyes without special instruments resulted in the formation of abstract reasoning by students that evolved into misconceptions (Güne, Güne, & Hoplan, 2011).

The next misconception with the percentage of 33.33% was on the size of the virus and predictive rate of virus transmission in plants. The right concepts of virus

have the size of 20 nm or less than ribosomes. The largest virus is 1500 nm (1.5 µm). Usual signs of a plant-damaging virus infection are infected flowers or roots, both of which result in decreased yield and quality of the crop (Campbell & Reece, 2016). The reasoning for the misconception of these two concepts was traditional teaching techniques. Teachers typically asked questions at a low level of thought since they had preference to student memory exploration. It was not unprecedented for teachers to frequently place limitations on material that they were more familiar with and exclude material that they were less familiar with (Beals et. al, 2012).

The lowest misconception was observed in the concept of the function of the virus that was beneficial to humans with the percentage of 19.44%. One of the positive functions of the virus is that the attenuated virus can be used as a vaccine (Suprobowati & Kurniati, 2018). The source of this concept's misconception was an outdated textbook. Student textbooks did not provide a helpful function for viruses. Textbooks are a factor in creating misconception of the concepts within students (Setyaningrum et. al, 2018).

Based on the findings of the study it was found that students' misconceptions on virus material in class X MIPA-5 and X MIPA 6 State High School 1 Nglames had average percentage of 42.87%, not understanding the concept of 17.39%, and already understanding the concept amounted to 39.97%. Misconception of virus materials for class X MIPA-5 and X MIPA-6 State High School 1 Nglames in each category are presented in the **Figure 2**:

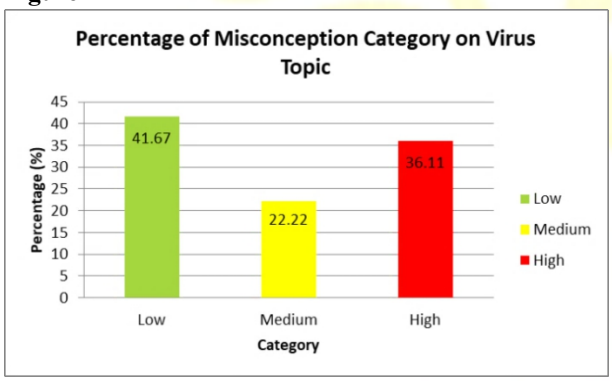

Figure 2. Percentage of misconception category on virus topic.

The proportion of each type of misconception was different regardless of the different academic ability of each student. The lower the student's interest in the material, the higher the number of misconceptions encountered (Puspitasari, et al., 2019). Misconceptions can also arise when students are misled when answering a question. This can be seen as an indication that students are incorrect to analyze questions (Auwaliyah & Raharjo, 2017).

Based on the previous explanation, misconceptions in students was caused by several factors, including students, teachers, teaching methods, and textbooks, and context. To identify the causes of misconceptions, interviews were conducted with 3 students with high, low and medium misconceptions. The results of interviews with resource persons are listed in **Table 4.**

Table 4. Results of Interview

Factors Causing Misconceptions	Respondent's Response
Students	Virus materials are difficult to grasp owning the fact that it is complex and there are unfamiliar words which are hard to identify to make them less appealing to students.
Teachers	Students assume that the interpretation of the teacher is straightforward and in line with the textbook.
Teaching Methods	Teachers taught using the lecturing method due to social distancing during the Covid 19 Pandemic
Textbooks	Students suggested that the text book was inadequate.
Context	There is a lack of awareness among students over certain concepts in the concept of viruses.

Based on interviews with students, it was shown that the sources of misconceptions made up of 5 (five) variables, including students, teachers, teaching methods, textbooks and context (Tridiyanti & Yuliani, 2017).

Misconceptions encountered by students are derived from students themselves, such as the effects of student perceptions of the knowledge they obtain in their environment. These meanings become insights acquired in daily life that are less applicable to biological topics and this misinterpretation may be induced by the challenge of students interpreting biology words (Tekkaya, 2002).

The teacher is the aspect that affects the misconceptions of the students. Teachers have a significant role to play in the development of students' misconceptions about certain material. If the teacher has assumptions about any information, the teacher may

instruct students then causing it to be misconception (Cibik & Dikien, 2008).

Several textbooks provide inaccurate information based on the understanding of scientists. The misconceptions created by the textbook are attributable to the analogy of incorrect material, the usage of vague words, the incorrect choice of vocabulary and the author's concepts (Nusantari, 2015).

Misconceptions are influenced by the use of common words that students first know. Even in common vocabulary there is a word or a name with similar as the concept name in science, but it has a particular usage or a different concept (Ibrahim, 2012).

The implementation of incorrect teaching techniques, improper applications and the use of media that is unable to reflect the concept mentioned can contribute to misconceptions in students' thought. For instance, students who did practices but have not completed it yet feel confident that the data they found are the correct findings, but in reality, their results are incomplete, causing the students to conclude the practicum results incorrectly and apply them to the correct topic concept (Liliawati & Ramalis, 2008).

CONCLUSION

Based on the findings of the research, 5.43% of students encountered positive misconceptions, 6.88% students encountered negative misconceptions, 30.56% students encountered misconception. The highest misconception was found in the concept of bacteriophage reproduction, which had the largest misconception of 49.07%. The lowest misconception was found in the concept of the role of viruses, which had the smallest misconception of 36.8%. Total misconceptions showed that 42.87% of students encountered misconception of virus topic. The highest misconception was found in the indicator of Identifying the way the virus lives in the host cell, which had the largest misconception of 63.89%, while the lowest was 19.44% in the indicator of identifying the role of viruses that are beneficial to human life. The aspects that contributed to the misconception were inadequate books, restricted choice of learning approaches during the Covid-19 pandemic, and context errors faced by students.

SUGGESTION

The teacher is the main factor that can prevent the formation of misconceptions in students to such an extent that the teacher needs to look for correct concepts considered difficult by students during learning.

ACKNOWLEDGEMENT

The researcher would like to thank Mrs. Drs. Yuliani, M.Si and Mr. Guntur Trimulyono, S.Si, M.Sc. as validator and Mr. Drs. Imron Rosidi M.Pd. as the principal of State High School 1 Nglames, Mrs. Yuli Chasanah, S.Si, S.Pd, M.Pd as the biology teacher, students of class X MIPA-5 and X MIPA-6, and other parties involved and helped to finish this research.

REFERENCES

Adriani, W., Selaras, G. H., & Yogica, R. 2019. Identifikasi Tingkat Pemahaman Konsep Menggunakan Three-Tier Multiple Choice Diagnostic Test. *Atrium Pendidikan Biologi*, *1*(1), 1–8.

Ardiyanti, Y., & Utami, R. M. 2018. Identifikasi Miskonsepsi Siswa Pada Materi Sistem Reproduksi. *BIOSFER : Jurnal Biologi Dan Pendidikan Biologi*, *2*(2).

Arikunto, S. 2010. *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.

Ariska, M. 2015. Studi Pemahaman Konsep Siswa Pada Sub Konsep Rangkaian Listrik Arus Searah di Kelas XI SMA Negeri 1 Palembang. *Jurnal Inovasi dan Penbelajaran Fisika*, 2, 147 – 154.

Arslan, H. O., Cigdemoglu, C., & Moseley, C. 2012. A Three-Tier Diagnostic Test to Assess Pre-Service Teachers' Misconceptions about Global Warming, Greenhouse Effect, Ozone Layer Depletion, and Acid Rain. *International Journal of Science Education*.

Auwaliyah, R. & Raharjo. 2017. Profil Miskonsepsi Siswa pada Materi Sistem Pencernaan Kelas XI SMA. *BioEdu,* Vol. 6 (3): 304-310.

Ayu, D., Saputri, F., Widyaningrum, T., & Articles, I. 2016. Misconceptions Analysis on The Virus Chapter in Biology Textbooks for High School Students Grade X. *International Journal of Active Learning*, *1*(1), 30–37.

Beals, A. M., Road, H. N. D., Krall, R. M., & Wymer, C. L. 2012. Energy Flow through an Ecosystem : Conceptions of In-service Elementary and Middle School Teachers, 2(1), 1–18.

Campbell, N.A., & Jane B. Reece. 2016. *Biologi Jilid 2* Edisi 8. Jakarta : Erlangga.

Cetin-Dindar, A., & Geban, O. 2011. Development of a three-tier test to assess high school students' understanding of acids and bases. *Procedia - Social and Behavioral Sciences*, *15*, 600–604.

Cibik, A. S., & Diken, E. H. 2008. The Effect of Group

Works and Demonstrative Experiments Based on Conceptual Change Approach: Photosynthesis and Respiration. Asia Pasific Forum on Science Learning and Teaching. Vol 9 (2): 2.

Dikmenli, M. 2010. Biology students' conceptual structures regarding global warming. *Energy Education Science and Technology Part B: Social and Educational Studies*, *2*(1).

Güne, M. H., Güne, O., & Hoplan, M. 2011. The using of computer for elimination of misconceptions about photosynthesis. P*rocedia - Social and Behavioral Sciences*, 15, 1130–1134.

Hasibuan, H., & Djulia, E. 2017. Analisis Kesulitan Belajar Siswa pada Materi Virus di Kelas X Aliyah Al-Fajri Tanjungbalai Tahun Pembelajaran 2016 / 2017. *Jurnal Pelita Pendidikan*, 4(4), 16–24.

Hermayani Z. A. & Sri, D. M. 2004. Peningkatan Motivasi Belajar dan Kemampuan Berpikir Kritis Siswa pada Materi Ekosistem Melalui Penerapan Model Inkuiri Terbimbing. *Bioedukasi*, 79–85.

Ibrahim, M. 2012. *Konsep, Miskonsepsi dan Cara Pembelajarannya*. Surabaya: Unesa University Press.

Jihad, A.,& Abdul, H. 20013. *Evaluasi Pembelajaran*. Yogyakarta: Multi Pressindo.

Kamilah, D. S., & Suwarna, I. P. 2019. Pengembangan Three-Tier Test Digital Untuk Mengidentifikasi Miskonsepsi Pada Konsep Fluida Statis. *Edusains*, *8*(2).

Kementerian Pendidikan dan Kebudayaan. 2019. Pusat Penelitian Pendidikan. Available at: https://hasilun. puspendik.kemdikbud.go.id/(Accessed 27 Januari 2021.

Khairaty, N. I., Taiyeb, A. M., & Hartati. 2018. Peredaran Darah Dengan Menggunakan Three-Tier Identification of Students Misconception on Circulatory System Using Three-Tier Test in Class Xi Ipa 1 Sma Negeri 1 Bontonompo. *Jurnal Nalar Pendidikan*, *6*(1), 7–13.

Liliawati, W. & Ramalis, T. 2008. Identifikasi Miskonsepsi Materi IPBA di SMA dengan menggunakan CRI (Certainly of Respons Index) dalam Upaya Perbaikan dan Pengembangan Materi IPBA pada KTSP. *Laporan Penelitian*. Universitas Pendidikan Indonesia.

Madigan, M. T. D. P. 2012. *Brock Microbiology of microorganisms.* San Fransisco: Benjamin Cummings publishing.

Mustika, A. A., Hala, Y., & Arsal, A. F. 2014. Identifikasi Miskonsepsi Mahasiswa Biologi Universitas Negeri Makassar pada Konsep Genetika dengan Metode CRI. *Jurnal Sainsmat*, 3, 122 – 129.

Nusantari, E. 2015. Kajian Faktor Yang Mempengaruhi Retensi Siswa SMA (Analisis Hasil Penelitian Eksperimen dan PTK). Artikel Penelitian Prodi Pendidikan Biologi Universitas Negeri Gorontalo.

Puspitasari, Y., Reza, S. P. K., Bachtiar, Y. & Prayitno, B. A. 2019. Identifikasi Miskonsepsi Materi Jaringan tumbuhan pada Mahasiswa Pendidikan Biologi di Salah Satu Universitas di Surakarta. *Bioedukasi,* Vol. 10 (2): 171-178.

Setyaningrum, P., Ramli, M. & Rinanto, Y. 2018. Profil Pemahaman Konsep Siswa Tentang Materi Virus.. *Prosiding Seminar Nasional KMP UNY*, Yogyakarta: 3 November. Hal 93-104.

Suparno, P. 2013. *Miskonsepsi & Perubahan Konsep dalam Pendidikan Fisika*. Jakarta: PT Grasindo.

Suprobowati, O. D., & Kurniati, I. 2018. Virologi. Pusat Pendidikan Sumber Daya Manusia Kesehatan: Kementerian Kesehatan RI.

Tekkaya, C. 2002. Misconceptions As Barrier to Understanding Biology. *Journal of Faculty of Education*, *23*, 259–266.

Tridiyanti, E. P. & Yuliani, 2017. Profil Miskonsepsi dengan Menggunakan Three Tier Test pada Submateri Katabolisme Karbohidrat. *BioEdu,* Vol. 6 (3): 297-303.

Wening, C. J. I. 2014. Intellectual Process Skillls (within Leves of Inkuri). *Artikel Workshop Inkuiri*.