



Article Review

Students' Misconceptions in High School Biology Subjects

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ABSTRACT

Misconceptions understand concepts that are different from scientific concepts that have been approved by experts in their fields and can cause difficulties for students in understanding material. On average, there are still many students who still experience misconceptions in Biology material with different percentages for each material. The purpose of this study was to examine the results of the analysis of students' misconceptions on Biology material from 7 articles selected from 32 relevant sources. The type of research used is a meta-analysis with literature review research methods through literature studies using several data sources such as articles in electronic journals and books. The results showed that students experienced misconceptions in high school biology material studied by researchers in source articles with different percentages. Continuous misconceptions can harm students and prevent students from understanding the material well, which will result in students failing to understand new concepts, and it will continue with other related material.

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INTRODUCTION

A concept is a person's idea or thought. According to (Sagala, 2012), the concept is the result of someone's ideas published in the form of a definition so that a product of knowledge is formed that contains principles, laws, and theories. One of the fields of science that contains many concepts is Biology. Biology learning is not only about memorizing, but students must understand the concept because it is the basis for thinking; with understanding the concept, students can quickly develop and link one concept with interrelated concepts (Auwalayah, 2017).

Students must master many concepts in Biology learning. According to Agustina et al. (2016), the concepts in Biology learning have a relationship between one concept and another. This causes difficulties for students to understand the concept. In line with Imran's (2015) statement, individuals can only understand a concept correctly if the underlying

concept has previously been mastered correctly. Understanding different concepts from scientific concepts is called misconceptions.

Misconceptions refer to a concept that is not following the actual meaning put forward by experts in the field (Irani et al., 2020). According to Fajriana (2017), Misconceptions can be in the form of initial concepts, errors, incorrect relationships between concepts, intuitive ideas, or naive views.

The misconceptions that exist in students can come from several things. According to Agustina (Agustina et al., 2016), misconceptions in Biology, the material can be sourced from textbooks that contain descriptions of the wrong material, teachers who experience misconceptions, language errors that arise due to community culture that is already misguided in defining something scientifically, and wrong intuition. This is the most dominant factor causing misconceptions, and inappropriate teaching methods can also cause misconceptions. Misconceptions are often encountered in the concept of Biology, students have difficulty understanding the concept of Biology, which is abstract and difficult to understand.

In several articles that the researchers used as sources, it was found that there was still a percentage of misconceptions among students in Biology subjects analyzed by the source article researchers. This study indicates that it is important to analyze students in Biology subjects so that they can be used as references about how many students' misconceptions in Biology subjects are.

METHOD

The research was conducted by reviewing some of the data from the analysis of misconceptions uploaded in online journals through literature studies using various data sources such as articles or proceedings in electronic journals and accountable websites. References that have been obtained are processed using three stages, namely: 1) descriptive analysis, namely collecting and analyzing data; 2) Content analysis, which is using certain procedures to conclude; and 3) critical analysis, namely criticizing the facts that have been found during the literature study, and addressing the meaning of a phenomenon scientifically.

Researchers collect research data by browsing articles in online journals that are uploaded on the Google Scholar site. The researcher used the keyword "Analysis of Misconceptions for Class X, XI, and XII Biology for Students" to browse articles related to the title of the research. From a search using the keyword "Analysis of Misconceptions for Class X, XI, and XII Biology for Students," 32 articles were obtained, then from those 32 articles, 10 articles were selected related to students' misconceptions on Biology material. The analysis in this study was carried out by comparing the percentage of students' misconceptions that each researcher in the source article analyzed to provide information to readers about students' misconceptions in Biology subjects. According to Istigfarin (2015), misconceptions are categorized as low if the percentage of misconceptions is 0% - 30%, medium category if the percentage of misconceptions is 31%-60%, and high category if the percentage of misconceptions is 61%-100%.

RESULT AND DISCUSSION

The analysis of students' misconceptions in high school biology subjects has been done before. The following are the results of the research on student misconceptions in high school biology subjects using the meta-analysis method:

Table 3.1. Percentage of Students' Misconceptions in Biology Subject Class X Ecology at SMAN 17 and Al-Falah Private High School Surabaya

No	Subject Matter	Misconception (%)	Category
1.	Energy Flow	36,21	Medium
2.	Niche	31,89	Medium
3.	Food Chain	30,6	Medium

(Source: Margalita, 2014)

In **Table 3.1**, it is known that students experience misconceptions in Ecology material, namely on the topic of energy flow, niches, and food chains with different percentages. Of the three materials studied, the energy flow material has the highest percentage in the medium category. This means that students have difficulty in energy flow material, this is because the energy flow material is presented in the form of a scheme or chart that is difficult for students to understand. If the teacher does not explain the scheme completely, it will lead to misconceptions in students. Not all students quickly understand the concepts in the scheme/chart. According to Nurhidayah (2020), in her research on the identification of high school students' misconceptions on the topic of ecosystems, it was found that the energy flow material in the context of energy transfer and the order of energy transfer has the highest percentage of misconceptions. This is because students do not understand the principle concepts on the topic of energy transfer and their sequence. According to Margalita (Margalita, 2014) the cause of the misconception of the topic of energy flow components is known to be caused by factors from the students themselves who have not mastered the concept and limited information. Students who have not mastered the concept can occur because when students learn a concept they do not fully understand or understand the concept, they do not fully understand the prerequisite concepts that they must understand so that they are not understood clearly, and students who experience limited information because the concepts they have understood is an old concept. Then the lowest misconception is on the food chain material, which is classified as moderate. Food chain material tends to be easier to understand because it is simpler than complex energy flow charts. One of the causes of misconceptions about the food chain topic is from books, namely the existence of an inaccurate understanding of the food chain from the student book of SMA Negeri 17 Surabaya.

Table 3.2 Percentage of Students' Misconceptions in Class X Biology Subject Kingdom Plantae and Animalia at SMAN 1 Pringgabaya, East Lombok

No	Subject Matter	Misconceptions (%)	Category
1.	Kingdom Plantae	46,82	Medium
2.	Kingdom Animalia	48,56	Medium

(Sumber: Nining et al., 2019)

Based on **Table 3.2**, it is known that students experience misconceptions on the subject of kingdom Plantae and kingdom Animalia, which are classified as moderate. The percentage of misconceptions on the two subjects is not much different. This means that students have difficulty understanding the subject of kingdom Animalia and kingdom Plantae; this is because, in these subjects, students are required to understand the classification, which is divided into many types. On the subject of kingdom Animalia, there are groups of invertebrates and vertebrates which are divided into 16 phyla then in the kingdom Plantae, and there are phylum *bryophyta*, *pteridophyta* and *spermatophyta* there is a division for each. In these two subjects, students must also memorize the Latin language of each classification, understand the characteristics, types, and life cycles. The number of divisions on the subject and the addition of using Latin make it difficult for students to understand the material so that there are misconceptions. According to Nining (Nining et al., 2019), The high percentage of misconceptions on the subject of Kingdom Plantae and Kingdom Animalia is due to the inappropriate method used by the teacher, and the Biology teacher should guide students to have group discussions by predicting the plants around the school environment. It would be better if the teacher guides the students to conduct experiments in the form of mini-research in the school environment or do a practicum in the Biology garden already available at school. Thus, it can help students understand the material well.

Table 3.3 Percentage of Students' Misconceptions in Biology Subject Class XI Reproductive System Materials at MAN 1 West Lombok

No	Indicator	Descripton	Misconception (%)	Category
1.	1.	Students can explain the structure and function of reproductive organs or organs in men and women.	68,33	High
2.	2.	Students can explain disorders or abnormalities in the structure and function of the reproductive organs	75	High
3.	3.	Students can determine the process of formation of spermatocytes and oocytes in humans.	70,41	High
4.	4.	Students can determine the events that occur in the menstrual cycle	83,33	High
5.	5.	Students can determine the hormones that play a role in the process of pregnancy until birth	78,33	High
6.	6.	Students can conclude the process of sperm and ovum formation	77,78	High
7.	7.	Students can identify the menstrual cycle in women	75	High
8.	8.	Students can study the process of fertilization and embryo development	79,44	High

(Source: Surya Pratama, 2020)

Based on **Table 3.3**, it is known that students have misconceptions on all indicators of the reproductive system material tested in the high category. The highest misconception is found in indicator 4, namely the menstrual cycle. This means that students have difficulty with material related to the process. In the menstrual cycle material, students are required to understand the process of the menstrual cycle, which is divided into several phases, namely the menstrual phase, the preovulatory phase, the ovulation phase, and the luteal phase. The teacher usually explains the menstrual cycle with pictures containing hormone charts, pictures of follicle development, and pictures of the endometrial cycle that

are difficult for students to understand. Then the lowest misconceptions are found in indicators of organ structure and function, which are rote in nature, but misconceptions on this indicator are still relatively high. According to Pratama et al. (2020), the high level of misconceptions in the reproductive system material occurs because students have difficulty in remembering and understanding abstract concepts because the reproductive system material processes occur in the body.

Table 3.4 Average Percentage of Students' Misconceptions in Biology Subject Class XI Digestive System Materials at SMA Negeri 1 Menganti

No	Concept	Misconception (%)	Category
1	Organ structure and function of digestion	43,75	Medium
2	The chemistry of the digestive system	58,75	Medium
3	Digestive process	65,50	High
4	Digestive Diseases/Disorders	62,22	High
5	Food Nutrition	57,22	High
6	Test the content of food substances	58,33	High

(Source: Mu'arikha & Qomariyah, 2020)

From **Table 3.4**, it is known that the material on the digestive system of students was identified as having misconceptions. The highest misconception is found in the digestive process material with a high category. This means that students have difficulty understanding the process of the digestive system. The concept of the digestive process is an abstract concept that we cannot see directly. The process of digestion of food begins with ingestion, i.e., food enters the mouth and is then chewed, swallowed, broken down into simpler ones with the help of enzymes, then absorbed, and the rest of the process is expelled. Many students have difficulty in the chemical digestion process because it involves many enzymes. The result of (Istikomayanti & Mitasari, 2017) research explained that students have not been able to explain chemical digestion, which involves digestive enzymes. Students tend to have difficulty understanding the process of the digestive system because many students only memorize the digestive process but do not understand the process. The number of scientific terms in the Digestive System material is also a factor causing students to have difficulty understanding the material. Then the lowest misconception is found in the material of the structure and function of the digestive organs, which is classified as moderate. The structure and function material which includes rote learning, is easier for students to understand than the process.

Table 3.5 Average Percentage of Students' Misconceptions in Biology Subject Class XI Materials on the Movement System at SMA Negeri 21 Surabaya

No	Concept	Misconception		Category	
		Class A1 (%)	Class A2 (%)	Class A1	Class A2
1	Muscle structure	29	38	Low	Medium
2	Mechanism of muscle contraction	36	23	Medium	Low
3	Mechanism of muscle relaxation	36	31	Medium	Medium
4	Bone type	21	28	Low	Low
5	Ossification mechanism	33	38	Medium	Medium
6	Abnormalities/disorders in the movement system	33	31	Medium	Medium

(Source: Dini, 2019)

Based on **Table 3.5**, it can be seen that from the two classes studied, and there were misconceptions about the motion system material in the low to medium category. This means that students still have difficulty understanding the motion system material. The highest misconception in Class A1 is on the mechanics of muscle contraction and muscle relaxation. This is because, in the mechanics material, students are required to understand the processes that occur in the mechanism of muscle contraction and relaxation. If students only memorize the theory but do not understand the process that occurs, they will quickly forget the concept; eventually, the concept that is understood becomes imperfect. Concept imperfections experienced by students are a major factor in the occurrence of misconceptions. This also happened to Class A2, which also experienced misconceptions in the mechanics material, namely the ossification mechanism material. Class A2 also experienced moderate misconceptions in the matter of muscle structure. Although this material is rote in nature, if students lack information in learning, it will also cause misconceptions. According to Dini & Raharjo (2019), misconceptions that occur in students can occur due to limited information owned by students.

Table 3.6 Average Percentage of Students' Misconceptions in Biology Subject Class XII Genetic material at SMA Negeri 13 Medan

No	Indicator	Misconception (%)	Category
1	Describe the structure of chromosomes	27.69	Medium
2	Describe the relationship of cells, chromosomes, genes, and DNA.	37.55	Medium
3	Describe the structure of DNA.	34.07	Medium
4	Describe the process of DNA Replication.	25	Low
5	Describe the structure of RNA	37.94	Medium
6	Describe the relationship of DNA and RNA	25.48	Low
7	Describe the genetic code (Codon).	22.25	Low
8	Describe the process of protein synthesis.	38.46	Medium

(Source: Sarhim & Harahap, 2015)

Table 3.6 shows that students have misconceptions about genetic material. The highest misconception is found in the indicator of the protein synthesis process which is categorized as moderate. This means that students still have difficulty understanding these indicators. This is because the indicators of the protein synthesis process contain complex material. The protein synthesis material is divided into two processes, namely transcription and translation, each of which also has stages. If students only memorize the theory and do not fully understand the protein synthesis process, students will find it difficult to understand the material. Moreover, genetic material is abstract and uses many other languages, making it difficult for students to understand the material. Genetic material becomes difficult for students because it is abstract, the development of molecular genetics is rapid, and it is full of foreign languages, so that student's interest in studying genetics is low (Sarhim & Harahap, 2015). In their research, Sarhim & Harahap (2015) also stated that books also play a big role in students' misconceptions, books which sometimes lag behind the rapid development of genetics, causing fragmentary information and causing students to be unable to coordinate genetic concepts.

Table 3.7 Average Percentage of Students' Misconceptions in Biology Subject Class XII Protein Synthesis Material at MAN 1 Sidoarjo

No	Concepts that have been misconceived	Misconception (%)	Category
1	Structure and function of DNA (<i>Deoxyribonucleic Acid</i>)	55	Medium
2	Difference between DNA and RNA	87	High
3	Replication of DNA (<i>Deoxyribonucleic Acid</i>)	79	High
4	RNA types and functions	32	Medium
5	Transcription process	84	High
6	Translation process	66	High
7	Genetic code	37	Medium
Average		62	High

(Source: Permata et al., 2017)

Based on **Table 3.7**, it can be seen that students have misconceptions about protein synthesis material. The highest misconception is found in the concept of the difference between DNA and RNA, which is classified as high. This means that students still have difficulty understanding the concept. In this concept, students say that the location of RNA is only in the cell nucleus (Permata et al., 2017). This contradicts the actual concept that RNA is not only found in the nucleus of the cell but also in the cytoplasm. This proves that the material differences between DNA and RNA, although theoretical and can be memorized, still occur in students who are classified as high. Then in the material of the translation process, students also experience a high level of misconception. This is in line with the study results in table 6, which also contains a high level of misconception on the material of the protein synthesis process, in which the transcription process is one of the stages of protein synthesis. In the process material, students must understand the concept thoroughly so that there are no misconceptions. According to Dini & Raharjo (2019), teacher explanations that are not coherent and teaching methods that are not contextual can lead to an incomplete understanding of students and encourage the possibility of misconceptions.

From the seven tables that have been described, it can be seen that many concepts in biology learning taught at the high school level are still not well understood by students, so that students experience misconceptions. The percentage of misconceptions obtained varies. The difference in the percentage of misconceptions is suspected by researchers depending on the methods and techniques used by one author and another. The causes of misconceptions in students that researchers can summarize vary, namely the teacher, the students themselves, the way teachers teach, and the textbooks used. Misconception refers to a concept that is not relevant to the scientific understanding accepted by experts in the fields concerned (Suparno, 2013). A misconception is a concept that is not under the concept recognized by experts. Misconceptions can occur when students are trying to form knowledge by translating new experiences in the form of initial conceptions. The formation of this initial concept can be started when students get learning experiences at school and in their own environment (Istigfarin, 2015). Misconceptions in students need to be identified by teachers from an early age so that teachers can determine remediation learning that is following the needs of students so that students understand more about the material being studied following the indicators of achievement of material competencies that must be achieved.

The occurrence of misconceptions in students can be said to be malpractice in the world of education because the misconceptions experienced by students will apply until the end of their learning period. The higher the percentage of misconceptions, the more likely it is that students will find it difficult to understand the following materials because one Biology material is related to another (Irani et al., 2020). Misconceptions will prevent students from understanding the material well, which will result in students failing to understand new concepts, and it will continue with other related material. Misconceptions in students must be corrected immediately so as not to affect other concepts in the next Biology material.

CONCLUSION

Students experience misconceptions on the material of ecology, kingdom Animalia, kingdom plantae, reproductive system, digestive system, locomotion system, genetics, and protein synthesis with different percentages for each material. Miskonsepsi yang dialami peserta didik berasal dari guru, peserta didik itu sendiri, cara mengajar guru, dan buku ajar yang digunakan.

SUGGESTION

Misconceptions in students must be handled properly, and teachers must be able to detect students who experience misconceptions so that they are good and are given appropriate remedial so that misconceptions in students can be replaced with correct concepts and do not hinder students in understanding the next.

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