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Misconceptions Analysis of Biology Textbooks for First Grade of Senior High School of the 2013 Curriculum on Protist Lesson

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Abstract

This study aims to see the existence of misconceptions, the categories of misconceptions found, and the percentage of misconceptions found in the 2013 curriculum biology textbooks for the tenth grade of high school students on Protist lesson. The data were analyzed by using the content analysis method. The research sample consisted of three biology textbooks from the 2013 curriculum for tenth-grade high school students. The data were selected by using a purposive sampling technique which had previously been used in several schools in Medan. The object of this research is the material concepts of the Protist lesson. The analysis of misconceptions in this study is based on Hershey's five categories of misconceptions, namely oversimplifications, overgeneralizations, obsolete concepts and terms, misidentification, and undergeneralization. The results indicate that there are 2 misconceptions found in Book A, namely Oversimplications and Undergeneralization. Also, there are four misconceptions in Book B, namely oversimplification and Misidentifications. In addition, there are three misconceptions in Book C, namely Oversimplification. The percentage of misconception categories found is as follows Oversimplifications (0.83%), Misidentifications (0.11%), and Undergeneralizations (0.11%). Meanwhile, Overgeneralizations, Obsolete concepts, and terms categories are not found in the three textbooks.

Keywords: *textbooks, misconceptions, protists.*

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INTRODUCTION

Textbooks are guidelines that must be used by educators and students during the learning process (Rahmawati, 2016). Textbooks are media that have an important role in learning and are also part of teaching materials that facilitate teachers and guide students in learning (Afriliska & Zulyusri, 2021). In addition, textbooks function as a medium of communication between educators and students so that subject matter can be understood properly. However, there are some textbooks that if not studied further can convey the

wrong understanding to students. Therefore, if there are inaccurate concepts in textbooks, it is necessary to analyze misconceptions in textbooks so that these inaccurate concepts can be updated with the correct concepts (Handoko & Sipahutar, 2016).

The misconception is a term that refers to a concept that is not quite right with the scientific understanding or understanding of experts (Suparno, 2013). Many concepts must be understood in biology, so mastery of concepts is very important for every student (Irani et al., 2020). Generally, misconceptions come from educators, learning methods, students, and textbooks. Textbooks are one of the things that cause misconceptions (Putri & Isnawati, 2014).

Misconceptions in textbooks can harm student understanding because this can affect students' understanding of biology concepts in the future if these misconceptions are not immediately straightened out (Wijiningsih et al., 2016). Hershey (2005) states that various kinds of misconceptions in textbooks are categorized into five categories, namely Misidentifications, namely errors in the introduction of terms that make the term statement incorrect. Overgeneralizations, namely the generalization of concepts that are expressed too broadly, which causes the concepts presented to be too general. Oversimplifications are concepts that are stated too simply, in this case, the concepts presented in textbooks are incomplete and different from literature concepts. Obsolete concepts and terms are concepts and terms that no longer reflect the current state of research. Undergeneralizations are generalizations of concepts that cannot be used broadly breadth (too narrow) of the concept literature.

Various analyzes of misconceptions in biology textbooks have been carried out by previous researchers. These studies include Sakti et al., (2017) who discussed the structure and function of plant tissues, Dwijayanti et al., (2016) who discussed Archaebacteria and Eubacteria, Astuti (2018) who discussed the circulatory system, and Ramadhan, (2013) who discussed the human nervous system. This opens up opportunities to analyze textbook misconceptions about other topics, one of which is protists. Protist is a topic that still creates many misconceptions among students. One of the causes of students' misconceptions about protists is textbooks. Agustina & Indana (2022) reported the causes of students' misconceptions, one of which comes from textbooks. The concept of protist is abstract, which causes students to only assume and imagine without being able to know the actual protist, and the material is too densely discussed (Sari, 2013). Therefore, it is necessary to analyze textbook misconceptions about protists.

Based on the information above, this study aims to find out the existence of misconceptions, the categories of misconceptions found, and the percentage of misconceptions found in the 2013 curriculum biology textbooks for tenth-grade high school students on protists topic. The results of the research can be a reference for teachers in teaching to find out which books have fewer misconceptions so that there are no deviations in student understanding due to these misconceptions.

METHOD

This is content analysis research with research procedures in the form of determining the problem to be analyzed, selecting research objects, determining the

formula to be used, taking samples, and analyzing data (Ary et al., 2010). The research samples to be analyzed were three Biology textbooks from the 2013 curriculum for tenth-grade high school students, selected using a purposive sampling technique that had previously been observed in several schools in Medan. The topic analyzed in this study is protist. The books analyzed are explained in the following table 1.

Table 1. Book Identity

No	Title	Authors	Publisher
1.	Concept and Application of of Biology for the tenth-grade high school students (Konsep dan Penerapan Biologi SMA/MA Kelas X)	Slamet Prawirohartono & Sri Hidayati	Bailmu
2.	Biology for the tenth-grade high school students specializing in Mathematics and Natural Sciences (Biologi untuk SMA/MA Kelas X Kelompok Peminatan Matematika dan Ilmu-Ilmu Alam)	Tim Masmedia Buana Pustaka	PT Masmedia Buana Pustaka
3.	Biology for the tenth-grade high school students specializing in Mathematics and Natural Sciences (Biologi untuk SMA Kelas X Peminatan Matematika dan Ilmu Alam)	Tati Suryati Syamsudin Subahar & Lilis Setiasih	Quadra

The misconception analysis in this study was based on Hershey's five categories of misconceptions namely oversimplifications, overgeneralizations, obsolete concepts, and terms, misidentification, and undergeneralization. The instrument used in this research is in the form of a misconception analysis sheet in a textbook on protist which contains numbers, pages, concepts in the book, concepts according to literature, misconception categories, and description.

The research procedure for analyzing the data in this study is as follows.

a. Conducting observations of several high schools in Medan regarding the biology textbooks used in each school.
b. Determining three textbooks that will be analyzed according to the results of observations.
c. Coding the books to be analyzed, Book A (Bailmu), Book B (Masmedia Buana Pustaka), and Book C (Quadra).
d. Identifying concepts that experience misconceptions.
e. Comparing the concepts in the textbook with the concepts in the reference book.
f. Fill out the analysis sheet based on the data obtained.

g. Determining reliability, to avoid observer subjectivity in descriptive research, so that observation reliability must be carried out (Budiastuti, 2018). Observer reliability must be carried out by observers other than researchers. The goal is that the research is conducted by an observer and the results are more objective (Retnawati, 2016). The research instrument was taken from predetermined analysis sheets and filled out by the researcher (as an observer I) and through the re-analysis stage by observer II (expert lecturer) and observer III (biology teacher). The agreement on Book A (Bailmu) is 100%, The agreement on Book B (MasmediaBuana Pustaka) is 100%, and The agreement on Book C (Quadra) is 100%.

$$K = \frac{Nks}{Nk} x\ 100\%$$

Description:
K: misconception percentage
Nks: misconceptions about concepts
nKs: number of concepts

h. Making conclusions based on the results of the analysis obtained in the form of narrative text.

RESULTS AND DISCUSSION

Results

Based on the research conducted, the percentage of the total number of misconceptions found in the three textbooks is shown in table 2 as follows.

Table 2. Percentage of Total Misconceptions in the Three Books

Textbooks	Percentage of Misconceptions
Book A	0.53%
Book B	1,65%
Book C	1,32%

According to Zulfani., et al (2014), the percentage of misconceptions ranges from 0% - 30% is the percentage level of the low category of misconceptions. Therefore, the three textbooks have a low percentage of misconceptions. In Book A, two misconceptions were found, namely oversimplifications and Undergeneralization. In Book B, there are four misconceptions, namely Oversimplification, and Misidentifications. In Book C, there are three misconceptions, namely in the Oversimplications category.

Based on the identification results of the categories of misconceptions in the three textbooks, the percentage of each category of misconceptions in the three textbooks can be calculated as shown in table 3.

Table 3. Percentage of Each Category of Textbook Misconceptions

Misconception Category	Percentage of Misconceptions
Oversimplifications	0,83%

Overgeneralizations	-
Obsolete concepts and terms	-
Misidentification	0,11%
Undergeneralization	0,11%

Table 3 above shows the percentage of misconception categories in the form of Oversimplifications of 0.83%, Misidentifications of 0.11%, and Undergeneralizations of 0.11%. Meanwhile, the Overgeneralizations and Obsolete concepts and terms categories were not found in the three textbooks. In the research conducted by Putri & Isnawati (2014), Oversimplification was also the highest percentage found, while Overgeneralizations and Obsolete concepts and terms categories were also not found in the books he studied.

The following are misconception sentences found in each textbook:

Oversimplification

In Book A page 106, "Red algae that live in deep sea generally have a purple-black color, at medium depths the color is bright red, and those that live in shallow seas have a greenish color." While the concept in the literature explains, phycobilin absorbs green and blue-green light and reflects red. Blue green and light green can penetrate deeper into the water than any other light, so the ability to absorb this light allows red algae to grow in deeper places. Shallow-water red algae tend to have little phycobilin and appear green, while deeper algae appear black (Starr et al., 2013). Based on this comparison, the sentences in the book are classified as Oversimplications because the sentences in the book do not explain that the cause of different colors at each depth in red algae is due to the presence of phycobilin.

In Book B page 136, "Protists also have membrane organelles, such as mitochondria, chloroplasts (algae), endoplasmic reticulum, Golgi bodies, and vacuoles". While the concept in the literature describes the organelles used by protists, namely the nucleus, endoplasmic reticulum, Golgi apparatus, and lysosomes. Certain protists also rely on organelles not found in most eukaryotic cells, such as contractile vacuoles which pump excess water out of the protist cell (Campbell et al, 2010). Based on this comparison, the sentences in the book are classified as Oversimplications because the sentences in the book do not mention that the nucleus and lysosomes are cell membrane organelles found in protists.

In Book B page 148, "Asexual reproduction (Rhizopoda) through binary fission and cyst formation". While the concept in the literature explains, the way of reproduction (Rhizopoda) is by dividing (Wulandari, 2019). Based on this comparison, the sentences in the book are classified as Oversimplications because generally, rhizopods reproduce through binary fission, while rhizopods only use cyst formation when conditions are not supportive.

In Book B page 151, "Ciliate bodies are also covered by cilia, which wrap the entire main body is called somatic cilia". While the concept in the literature explains, the entire surface of the cells in the ciliate body can be covered by cilia, besides that, they can also be grouped in several rows or pinches(Campbell et al., 2010). Based on this comparison, the sentences in the book are classified as Oversimplications because the

sentences in the book do not explain that there are also cilia that are grouped in several lines or pinches.

In Book C page 88, "The siliceous skeleton of Radiolaria". While concepts in the literature explain, some genera have an exoskeleton of siliceous spines or scales, while some have no skeleton at all (Madigan et al., 2012). Based on this comparison, the sentences in the book are classified as oversimplifications because the sentences in the book do not explain that there are some Radiolarians that do not have a framework at all.

In Book C page 90, "The main characteristic of the ciliate phylum (Chiliophora) is the presence of vibrating hairs or cilia on the entire surface of the body". While the concept in the literature explains, the entire surface of the cells in the ciliate body can be covered by cilia, besides they can also be grouped in several rows or pinches (Campbell et al., 2010). Based on this comparison, the sentences in the book are classified as oversimplification because they sentence in that book explain that cilia are found on the entire surface of the ciliate body, while not all ciliates have cilia all over their body, some are grouped in several rows or pinches.

In Book C page 94, "Compared to other algae, red algae are common in deeper water". Meanwhile, the concept in the literature explains that this adaptability is supported by the presence of myofibrils, which are pigments that function to collect green and blue light that enters deep water so that in deep waters there are red algae. Phycobilins absorb green and blue-green light and reflect red. Blue-green and green light can penetrate deeper into the water than any other light, so the ability to absorb this light allows red algae to grow in deeper places. Shallow-water red algae tend to have little phycobilin and appear green. Deeper algae appear black (Starr et al., 2013). Based on this comparison, the sentences in the book are classified as Oversimplications because the sentences in the book do not explain in detail about phycobilin which can make red algae found in deeper water. Thus, the reason why red algae can exist in deeper water is not known.

Undergeneralizations

In Book A page 107, "In each cell, Euglena has chlorophyll a and b pigments, so it is autotrophic." While the concept in the literature explains, Euglena turns into a nutritional heterotroph if light decreases or conditions for photosynthesis are not possible (Starr et al., 2013). Based on this comparison, the sentences in the book are classified as undergeneralizations because the sentences in the book only explain that Euglena has chlorophyll A and B pigments, so it is autotrophic. Whereas in the dark Euglena will turn into a heterotroph because it cannot photosynthesize, but that is not explained in the book.

Misidentifications

In Book B page 141, "Algae do not have true roots, stems, and leaves (no thallus)". While the concept in the literature explains, the term thallus refers to the body of algae that is similar to that of a plant. However, unlike other plants, the thallus does not have true roots, stems, and leaves (Campbell et al., 2010).Based on this comparison, the sentences in the book are classified as misidentifications because in the book the algae are called not thallus, whereas in essence algae are called thallus because they do not have true roots, stems, and leaves.

Based on the data previously described, it is known that the most common category of misconceptions found in the three textbooks is the Oversimplications category with a percentage of 77.8%. Oversimplications are too simplistic concepts, so the concepts presented in textbooks are incomplete (Hershey, 2005). According to Suranti, Tri & Henuhili (2017), Oversimplifications are found in many books due to restrictions on the number of book pages by the publisher, therefore not all concepts can be explained in the book by the author which results in incomplete written concepts. If you pay attention, the textbooks that are usually used for students and teachers do not have as many pages as the literature books used by students, this is because the concepts contained in literature books have a deeper and broader scope.(Suranti, Tri & Henuhili, 2017).

In this case, the teacher should be more careful in reading textbooks, so that misconceptions about textbooks can be reduced. It would be better if the teacher did not only refer to one textbook when teaching but could use other literature books that had a more complete discussion (Dwijayanti et al., 2016)

The use of the language described by the author in textbooks can also be one of the causes of misconceptions, which can lead to different misunderstandings between teachers and students (Syahyani, 2018). Therefore, at the end of learning it is necessary to confirm with the teacher to students about the material being explained. This is also explained by Khairaty et al., (2018), not confirming the teacher's students about the material being explained can also cause misconceptions about students because students are not explained if the concept they understand is wrong.

CONCLUSION

Based on research on the analysis of misconceptions about protists, it can be concluded that in Book A there were two misconceptions found, namely in the Oversimplications category of misconceptions. and Undergeneralization. In Book B, there are four misconceptions, namely in the Oversimplification and Misidentifications categories. In Book C there are three misconceptions, namely the Oversimplification. Therefore, the category found in each book is Oversimplification. Undergeneralizations and misidentifications with the most frequently found are Oversimplifications. The percentage of misconception categories in the form of Oversimplifications is 0.83%, Misidentifications are 0.11%, and Undergeneralizations are 0.11%. Meanwhile, the Overgeneralizations and Obsolete concepts and terms categories were not found in the three textbooks. Meanwhile, the Overgeneralizations and Obsolete concepts and terms categories were not found in the three textbooks. Suggestions for further research are that other researchers can carry out analyses on other materials, or can also use textbooks that are different from those in this study.

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