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5th-grade Students' Misunderstandings and Misconceptions about Fungi

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Abstract. The fungi kingdom is among the important topics of biology, and students can develop misunderstandings and misconceptions about this subject. This study aims to determine misunderstandings and misconceptions of 5th-grade students about fungi. The participants of the study consisted of 22 (12 girls, 10 boys) fifth graders of an elementary school in Erzurum city center, which was determined by the convenience sampling method. In this qualitative study, a 'semi-structured interview form' was used. The form includes 16 open-ended questions prepared following the learning outcomes of the curriculum. The data collected in the study were subjected to descriptive analysis and the findings were presented by calculating the frequency and % values. The findings indicate that the students have misunderstandings and misconceptions on the structure of mold, yeast, and fungi, their feeding, whether they are alive, their classification, reproduction, living conditions, etc. At the end of the study, some suggestions were made on the teaching of the biology concepts with examples from daily life, usage of visual elements during teaching, more laboratory applications. It is also suggested that similar studies should be implemented with different grade levels and sample groups.

Keywords: Elementary education, student, fungi, misunderstanding, misconception

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INTRODUCTION ~ In recent years, studies on science education focus on how people learn information and its daily implementation (Genç, Genç, & Yüzüak, 2012; Kaya & Gül, 2021; Magwilang, 2016). In this context, the education program in Turkish schools has been renewed from the 2004-2005 academic year in which a constructivist learning approach has been adopted (Kaya & Gül, 2021). It is argued that constructivist learning is a mental formation because it is a result of the active interaction of students with their environment and is not independent of individuals. However, in this process, the concepts are not formed in the mind of the individual through the information provided by the teachers in the learning environment alone (Fernando & Marikar, 2017; Saygın, Atılboz, & Salman, 2006).

Concepts are common names given to these groups when entities, events, people, and thoughts are categorized according to their similarities (Kaptan, 1999). People learn basic concepts from childhood, classifying concepts and finding relationships between them. This learning and reconstruction process in the mind continues throughout life. People have a character concept organization in which they construct these concepts and simultaneously structure them. In other words, they establish a connection between previously learned and newly learned concepts (Ecevit & Özdemir-Şimşek, 2017).

From the literature, it is stated that Piaget started to work on understanding and teaching the concepts in the 1920s (Aydın & Uşak, 2003). Concept teaching is one of the topics that should be emphasized frequently in learning. Knowing the concepts related to a subject area and the relationships between these concepts form the basis for new subjects to be learned or taught. For this reason, students inability to use their prior knowledge in new learning situations, teachers' failure to provide conceptual change, and inability to establish meaning integrity between concepts cause misunderstandings and misconceptions (Gül & Özay-Köse, 2018a; Özay-Köse, 2014). On the other hand, several studies also emphasize that misunderstandings and misconceptions occur due to various reasons such as students, teachers, language used, learning, and teaching environment (Klymkowsky & Doxas, 2008; Özay-Köse & Gül, 2016).

A misconception is defined as an individual's discernment of occurrences happening in the mundane world that is not consistent with the scientific elucidation of the phenomena (Modell, Michael, & Wenderoth 2005, p. 20). On the other hand, misconceptions are information that fundamentally affects individuals' understanding of the natural world and scientific explanations. In addition, they are strongly attached to the cognitive structure, unlike scientific views. Misunderstandings and misconceptions must be overcome or prevented to learn scientific knowledge, as it prevents the appropriate acquisition or structuring of new knowledge and skills without being aware (Bozdağ, 2017; Hasan, Bagayoko, & Kelley, 1999; Treagust & Chandrasegaran, 2007; Tuncay, Akçam, & Dökme, 2011).

THEORETICAL FRAMEWORK

One of the most important goals of science education is that students learn scientific concepts in a meaningful and permanent way by relating to the concepts they have already learned. It will allow them to associate the learned knowledge and concepts with daily life and to enable them to be used in solving problems encountered (Bozdağ, 2017). However, since science contains many abstract concepts, it is one of the significant courses in which students have learning difficulties and develop misunderstandings and misconceptions. In fact, many studies on this subject support this idea (Elmesky, 2013; Gül & Özay-Köse, 2018a; Klymkowsky & Doxas, 2008; Newman, Catavero, & Wright, 2012; Strgar, 2013; Thompson & Logue, 2006; Yates & Marek 2014). To overcome their misconceptions, it is necessary to determine which subjects the students have misunderstandings and misconceptions. During the literature observation, it was revealed that many misconceptions related to science topics have been identified by many studies (Modell et al., 2005; Thompson & Logue, 2006; Yağbasan & Gülçiçek, 2003). Similarly, misunderstandings and misconceptions are frequently encountered in biology subjects as in other fields of science (Reiss & Tunnicliffe, 2001; Rogayan & Albino, 2019; Songer & Mintzes, 1994; Utari, Maridi, & Ramli, 2017). In biology, it was discovered that students have troubles in learning photosynthesis (Gül, 2016; Svandova, 2014), osmosis-diffusion (Hasni, Roy, & Dumais, 2016; Reinkea, Kynn, & Parkinson, 2019), cell divisions (Erdoğan-Karaş & Gül, 2020; Ozan, Yildirim, & Ozgur, 2012), ecology (Mambrey, 2020; Rogayan & Albino, 2019), evolution

(Nehm & Reilly, 2007; Yates & Marek, 2014) body systems (Fančovičová & Prokop, 2019; Çuçin, Özgür, & Güngör-Cabbar, 2020), enzymes (Bretz & Linenberger, 2012; Halim, Finkenstaedt-Quinn, S, Olsen, Gere, & Shultz, 2018) and genetics (Gül & Özay-Köse, 2018b; Shaw, Horne, Zhang, & Boughman, 2008). It was also revealed that they have misunderstandings and misconceptions on these issues. The literature also includes numerous studies related to students' ideas and misunderstandings and misconceptions about plants. In these studies, several studies show examples from the fungus kingdom like mushrooms, shelf fungi, or bread mold to elicit beliefs from students (Bulunuz, Jarrett, & Bulunuz, 2008). These studies interpreted the findings that biology is considered hard by students because it contains many abstract concepts. Thus, this situation causes students to have learning difficulties that also result in many misunderstandings and misconceptions (Adıgüzel, & Yılmaz, 2020; Elmesky, 2013; Erdoğan-Karaş & Gül, 2020; Fančovičová, & Prokop, 2019; Halim et al., 2018; Rogayan, & Albino, 2019). Similarly, Kumandaş, Ateskan, and Lane (2019) argue that the content and complexity of biological concepts and the abstract or hidden aspects of natural phenomena are the reason why biology is considered to be a difficult subject to teach and to learn.

Some studies further suggest that students' misunderstandings and misconceptions are not at a certain level of education and can continue lifelong starting from primary education and even pre-school (Ecevit & Özdemir-Şimşek, 2017). Therefore, it is important to examine and determine these misunderstandings and misconceptions starting from the lower levels of education. In addition, this study is up-to-date that can detect students' misunderstandings and misconceptions about fungi by taking into account the learning outcomes of the primary school science curriculum updated in the country. This study aims to determine the misunderstandings and misconceptions of 5th-grade students about fungi, which is an important topic in biology. The question, "what misunderstandings and misconceptions do the students have about fungi?" constitutes the main problem statement.

METHOD

In this study, a qualitative approach was used to collect detailed and in-depth data to directly learn the participants' perceptions, experiences, and perspectives and to understand and to explain current situations (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2014). The data was collected using the semi-structured interview technique. In the interviews, although the questions had been prepared in advance, new questions were developed and asked during the interview. Therefore, the participants were allowed to rearrange and discuss the questions by providing partial flexibility during the interview (Yıldız-Bıçakçı, Er, & Aral, 2017).

Participants

The participants of the study include 22 students (12 females and 10 males) who are attending the 5th-grade of a primary school in the city center of Erzurum. The participants were selected using the convenience sampling method. Convenience sampling is a nonrandom sampling

technique where members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included in the study (Etikan, Musa, & Alkassim, 2016). This sample group was included in the study because there was a familiar teacher at a school in the close vicinity of the researcher and the students voluntarily participated in the study.

Data Collection and Analysis

A 'semi-structured interview' was used to determine students' misunderstandings and misconceptions about fungi. For the interview, 16 open-ended questions used by Bulunuz et al. (2008) were utilized. The validity and reliability of the interview form were provided by Bulunuz et al. (2008). Internal consistency can be assumed because the researcher conducted all the interviews, took notes on students' responses, and coded the responses for misunderstandings and misconceptions. Therefore, no interrater reliability was calculated for the questions. As stated by Bulunuz et al. (2008), the interview questions have a face validity that all of them are about fungi. In addition, the questions are also compatible with the current curriculum. Detailed information about the unit that includes the subject of fungi in the curriculum is provided in Table 1.

Table 1. General Information about "World of Living Organisms" in the 5th Grade Science Textbook

Unit no	2
Unit name	World of Living Organisms
Subject area name	Living organisms and life
The number of learning outcomes	1
Time/ Course Hours	12

As stated in the curriculum of the Ministry of National Education (MoNE, 2018), this unit is aimed to teach the students to classify living organisms according to their similarities and differences and learn the skill to recognize microscopy, microscopic creatures, fungi, plants, and animals. There is one learning outcome in the unit (MoNE, 2018):

F.5.2.1.1. Classifies living organisms according to their similarities and differences by giving examples.

a. Living organisms are classified as plants, animals, fungi, and microscopic organisms.

b. The use of systematic terms (kingdom, genus, species, etc.) is avoided in the classification of living organisms.

c. Examples of microscopic organisms (bacteria, amoeba, euglena, and paramecium) and mushrooms are given, but structural details are not included.

ç. Observes the existence of microscopic organisms with the help of a microscope.

d. Warning about not to eat poisonous mushrooms.

The study was conducted in the 2019-2020 academic year. The semi-structured interview was done face to face and the process took approximately 30-40 minutes. During the interviews, the data were noted and recorded using an audio device. Next, the data were analyzed using descriptive analysis. The purpose of descriptive analysis is to present the obtained findings to the reader in an edited and interpreted manner (Yıldırım & Şimşek, 2011).

RESULTS

In this section, the findings obtained by analyzing the data collected from students are presented below. Accordingly, the descriptive analysis results are shown in Table 2. Firstly, the student answers to the question of what is mold are presented in Table 2.

Table 2. Distribution of Students' Answers to the Question "What Is Mold?"

Answers	f	%
Mold is a type of fungus. It develops on bread, cheese, etc.	9	40.9
Mold is spoiled and inedible substances (such as food spoilage).	2	9.1
Mold is a microscopic organism that lives on food that has been left out.	1	4.6
Mold is a living organism that occurs when food is kept for a few weeks.	4	18.2
Mold is a decay phenomenon.	1	4.6
Mold is a living organism that thrives on something in a humid environment.	3	13.6
Mold is a protective shield that forms on exposed food.	2	9.1

As shown in Table 2, almost half of the students (40%) think that molds are a type of fungus. It can be seen that some students are aware of some of the features of mold, even though they cannot fully describe it. For example, some students stated that mold is alive and can grow on spoiled foods. However, it shows that some students have misunderstandings and misconceptions as mold is a decay phenomenon or a protective shield on food. On the other hand, the findings regarding the question of whether a mold is alive or not are presented in Table 3.

Table 3. Distribution of Students' Answers to the Question "Is Mold Living or Not?"

Answers	f	%
Mold is alive. It is found in dough and makes it moldy.	3	13.6
Mold is a dull thing because it doesn't move.	2	9.1
Mold is fungus because mushrooms feed on it.	2	9.1
Mold is inanimate, a dead thing.	3	13.6
Mold is alive because it consists of fungus.	5	22.7
It is a microscopic creature.	1	4.6
Mold is alive and reproduces by reproducing.	5	22.7
Mold is alive and contains millions of microscopic creatures.	1	4.6

As shown in Table 3, most students think that mold is living. However, some students also have misinformation about mold. For example, some students think mushrooms feed on mold and mold contains millions of microscopic creatures. Similarly, some students stated that mold is not

alive. The findings of the study regarding the question of whether the students can draw a mold picture are shown in Table 4.

Table 4. Distribution of Students' Answers to the Question "Can You Visualize "Mold" and Draw a Picture of It?"

Answers	f	%
Yes	22	100

As shown in Table 4, all of the students stated that they could draw a mold picture. Below are some examples of students' drawings. When the drawings are examined, it is shown that the majority of the students visualize the mold on the bread.

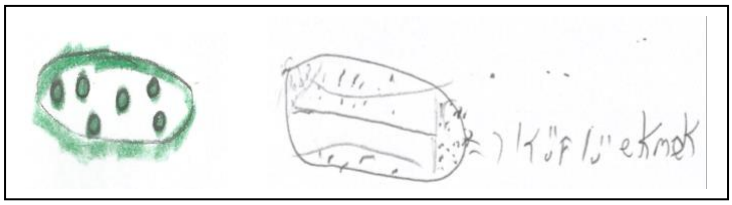

Figure 1. Students Drawing of Mold

In this study, the students were asked what is yeast. Analysis of student responses is shown in Table 5.

Table 5. Distribution of Students' Answers to the Question "What Is Yeast?"

Answers	f	%
Yeast is a mold.	1	4.6
Yeast is a type of fungus.	5	22.7
Yeast is a type of plant.	2	9.1
Yeast is used to making things like yogurt and bread.	11	50.0
Yeast is a type of mushroom that puffs bread.	3	13.6

As shown in Table 5, half of the students are aware of several mold characteristics, even though they cannot fully describe them. However, most students have misinformation about yeast. On the other hand, the findings regarding the question of whether the yeast is alive or not are presented in Table 6.

Table 6. Distribution of Students' Answers to the Question "Is Yeast Living or Not?"

Answers	f	%
Yeast is alive because mushrooms are alive.	3	13.6
Yeast is alive because it releases carbon dioxide.	1	4.6
Yeast is alive because of respiration.	6	27.3
Yeast is alive because it puffs our bread.	3	13.6
Yeast is alive because we make yogurt with yeast.	1	4.6
Yeast is not alive because it has a dry structure.	1	4.6
Yeast is alive because it is bubbling.	6	27.3
Yeast is lifeless because it doesn't move.	1	4.6

As shown in Table 3, most students think that yeast is living. However, many students also have some misinformation about yeast. For example, some students think yogurt is made using yeast. In addition, some students stated that yeast is not alive because of its dry structure and because it is not moving. On the other hand, the findings of the study regarding the reason that bread is like a sponge are shown in Table 7.

Table 7. Distribution of Students' Answers to the Question "Why Do You Think Bread is Like a Sponge?"

Answers	f	%
Yeast softens the bread.	8	36.4
Fungi turn the bread into a sponge.	4	18.2
Yeast rises and softens the dough.	6	27.3
Molds	1	4.6
I don't know.	3	13.6

Table 7 shows the different opinions of the students. The majority of them explained that the reason for the rising of bread is due to yeast. In this study, the students were also asked what is fungi. Analysis of student responses is shown in Table 8.

Table 8. Distribution of Students' Answers to the Question "What is a Fungus?"

Answers	f	%
Fungus is a type of plant.	2	9.1
Fungi are different from other creatures such as plants and animals.	5	22.7
Fungi are living things that are both capped and too small to be seen with the eye.	1	4.6
Fungus is a creature with poisonous and non-poisonous species.	6	27.3
Fungi are creatures that live in nature and can reproduce.	1	4.6
Fungus is a white-colored creature with a long body and a hat.	5	22.7
People die from fungi, fungi take up the nutrients of an old tree and reproduce by seeds.	1	4.6
Fungi are microscopic creatures that are not plants and can cause disease	1	4.6

In Table 8, most of the students know that fungi are a different living group than plants and animals and that they have poisonous/non-toxic species. However, the findings show that most of them think of the structural features of fungi as hat mushrooms. This study also asks whether they could see fungi using naked eyes. The findings are shown in Table 9.

Table 9. Distribution of Students' Answers to the Question "Can You See All Fungi with a Naked Eye?"

Answers	f	%
No, there are also microscopic fungi.	12	54.6
No, can not be seen.	5	22.7
Mushrooms are visible to the naked eye.	1	4.6
Yes	4	18.2

Table 9 shows that more than half of students are aware of microscopic fungi. The study also asked the student on how the structure of the fungus, which is shown in Table 10.

Table 10. Distribution of Students' Answers to the Question "What is the Structure of a Fungus?"

Answers	f	%
Fungi have a cap, roots, and stem.	16	72.7
Fungi are soft and there are lines under them.	2	9.1
Fungi is hard and mottled.	1	4.6
The inside of the fungus is filled with microscopic creatures.	1	4.6
Fungi have a cap. Some have structures containing poison.	1	4.6
Fungi feed on humid environments when grown, it is collected and eaten	1	4.6

In Table 10, most of them show the structure of the mushroom. However, some misunderstandings and misconceptions can be found. The findings of the study regarding the question of whether the students can draw a fungus picture are shown in Table 11.

Table 11. Distribution of Students' Answers to the Question "Can You Visualize "Can You Visualize a "Fungus" and Draw a Picture of It?"

Answers	f	%
Yes	21	95.4
No	1	4.6

As shown in Table 11, almost all students stated that they could draw fungus pictures. Below are some examples of students' drawings. When the drawings are examined, it is striking that all students showed mushrooms.

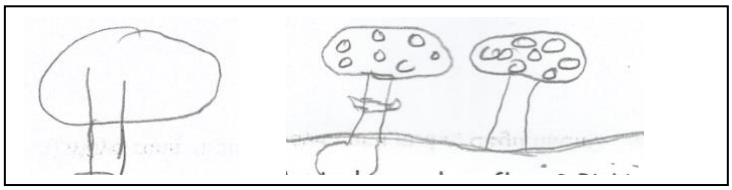

Figure 2. Drawings of Students about Fungi

In the study, the findings regarding the question of how fungi are classified are shown in Table 12.

Table 12. Distribution of Students' Answers to the Question "How Can You Classify Fungi? Plants? Animals? or What Else?"

Answers	f	%
Fungi kingdom	11	50.0
Plant	6	27.3
Photosynthetic organisms	2	9.1
Microscopic organisms	1	4.6
Poisonous and non-poisonous	2	9.1

As shown in Table 12, half of the students gave the correct answer. However, misunderstandings and misconceptions were found in some students. On the other hand, Table 13 shows the findings on the question of how fungi reproduce.

Table 13. Distribution of Students' Answers to the Question "How Do They Reproduce?"

Answers	f	%
Fungi reproduce in hot and humid environments	7	31.8
Fungi reproduce similarly to plants.	1	4.6
Fungi reproduce by clinging to soil or trees.	5	22.7
Fungi reproduce with their roots.	1	4.6
Fungi reproduce by spore.	2	9.1
I don't know	6	27.3

Table 13 shows the differences in students' knowledge about the reproduction of fungi. Most students interpreted fungus reproduction as the environment in which it lived. However, the answers to the question of which kind of environment is suitable for them to reproduce (Table 14) show that the students have the correct information.

Table 14. Distribution of Students' Answers to the Question "What Kind of Environments is Suitable for Them to Reproduce?"

Answers	f	%
Hot and humid environments	9	40.9
Warm forest areas	8	36.4
On the dead trees	4	18.2
Autumn season	1	4.6

Table 15 shows that students have misunderstandings and misconceptions.

Table 15. Distribution of Students' Answers to the Question "How Do They Feed?"

Answers	f	%
Using the nutrients of old trees	7	31.8
Taking nutrients from the soil	3	13.6
Taking oxygen from the soil	1	4.6
Taking nutrients from dead plants	2	9.1
By drinking water and breathing	4	18.2
By photosynthesizing with leaves	2	9.1
It feeds on its roots	1	4.6
I don't know	2	9.1

In Table 16, all of the students state that they could not eat any mushrooms. Therefore, students were asked about the difference between poisonous and non-poisonous mushrooms (Table 17).

Table 16. Distribution of Students' Answers to the Question "Can You Eat Each Mushroom?"

Answers	f	%
No	22	100

As seen in Table 17, many of the students have conceptual understandings misconceptions. Also, many students could not answer this question.

Table 17. Distribution of Students' Answers to the Question "Do You Know the Differences Between Poisonous and Non-poisonous Fungi?"

Answers	f	%
Body shape and colors are different	2	9.1
Their fragrances and colors are different.	6	27.3
Non-poisonous fungi have a structure called the annulus.	4	18.2
Poisonous fungi are red, non-poisonous fungi are brown.	1	4.6
Poisonous fungi are bagged, non-poisonous ones are hat and body.	1	4.6
Poisonous fungi have a hat	2	9.1
I don't know	6	27.3

DISCUSSION

Misconception is one of the problems that make it difficult or even prevent students from learning biology. Students' misunderstandings and misconceptions of science concepts should be addressed immediately so it would not be getting worse (Rogayan & Albino, 2019). Identifying prior knowledge and misconceptions is important during the instructional process to empower educators to structure viable learning situations that help reshape students' prior understanding into scientifically accepted understanding (Eshach, 2014). True misconceptions are learned at an early age and persist into adulthood (Yağbasan & Gülçiçek, 2003). Therefore, primary education is crucial in establishing misunderstandings and misconceptions. Taking this issue into account, this study aims to determine the misunderstandings and misconceptions of 5th-grade students about fungi.

The findings obtained from the questions about mold were examined in the study. The findings indicate that the majority of students have the proper knowledge about mold. For example, about half of the students knew that mold is a fungus. However, two students identified the mold as a protective shield that forms on exposed food. In Table 3, it is shown that the students have several misunderstandings and misconceptions. For example, some students think mushrooms feed on mold and mold contains millions of microscopic creatures. Similarly, some students stated that mold is not alive. Similar to the findings, Barman et al. (2006) found that one student's response to bread mold was "it can't grow, it is not alive." Most of the students knew that bread mold is not a plant. Similar findings have been found in other studies such as Bulunuz et al. (2008). This study reveals that some students still have misunderstandings and misconceptions that were also found in previous studies. Similar misunderstandings and misconceptions were also revealed in their drawings. As stated by Anderson, Ellis, and Jones (2014), drawing and revisiting their ideas allow children to clarify conceptual understandings, resulting in metacognitive growth in developing ideas around complex scientific concepts. Additionally, while the interviews show that, in some cases, the knowledge was present, children demonstrated a lack of advanced conceptual knowledge of fungi in their drawings. However, one of the most striking findings is that students draw the mold on bread. This finding reveals the importance of the relationship between science concepts and daily life. One student even drew the mold in green. Similarly, Bulunuz et al. (2008) found that some students stated that molds are green. Related to this finding, Gül (2020) stated that associating the events that students encounter in their daily lives with science lessons during the teaching

process can provide meaningful and permanent learning. In this case, those drawings indicate that most of the students did not have information about the real structure of the mold. Moreover, some of them believed that mold is a microscopic organism. This finding has highlighted the importance of materials such as microscopes in biology courses. In a similar case, Haşiloğlu and Eminoğlu (2017) asked fifth-grade students to draw a bread mold cell and instructed them to explain it. Before observing bread mold using a microscope, 38% of student explanations about bread mold were irrelevant, 51.7% were partially irrelevant, 10.3% were partially correct, and 0% were correct. After using the microscope, the ratio of correct explanations concerning the bread mold increased to 74.7% and the ratio of partially correct explanations increased to 12.6, whereas the ratio of partially irrelevant explanations decreased to 10.3%, and the ratio of irrelevant explanations decreased to 2.3%. Biology is interesting because it aims to study living things, both in a laboratory and in a real environment. Despite this, students could not the subject's integrity at the level of biological organization. In addition, they have difficulties understanding some of the concepts due to invisible abstract subjects and grasping the relationships at the macro-micro level. These issues cause them to have difficulties in forming conceptual structures in the teaching of biology subjects (Ekici, 2016; Jones & Rua, 2006; Lukin, 2013). "Microscope" is one of the most important tools that make it easier for students to learn biology. Different misconceptions about bread mold are also found in different studies. For example, Anderson et al. (2014) examined children's drawings to explain their conceptual understanding of plant structure and function. When students were asked about a picture of bread mold, the most common response was that a mold is a bush and it means, a mold is a plant. When asked to explain further, the bread was often described as the ground where the "bush" grew.

For the findings of yeast, most of the students are aware that yeast is a fungus. In addition, they also stated that yeast is alive and makes bread rise. However, some misunderstandings and misconceptions frequently encountered in previous studies have also been identified. For example, some students think yogurt is made with yeast. This finding may suggest that students cannot distinguish between bacteria and yeast. In Bulunuz et al. (2008), some students think that bread is similar to a sponge because of bacteria. On the other hand, some students are not sure whether yeast is a living organism or not. According to one student, yeast is alive because it releases carbon dioxide. This finding indicates that the students have incomplete information. Similarly, Çakır, Geban, and Yürük (2002) found that students had some misconceptions about cellular respiration. According to their study, the students believed that only yeast makes anaerobic respiration reactions and it photosynthesizes under the light. Songer and Mintzes (1994) found that students failed to recognize yeast as a living organism and they believed yeast releases O_2 during the fermentation process. On the other hand, this study reveals some students believed yeast is not alive because of its dry structure and because it is not moving. Similarly, Bulunuz et al. (2008) also believe that children who consider

movement as a requirement for life may also have this idea. In this case, animals may be considered to be the only things that are alive.

For the last question about fungi, most of the students were aware that fungi are living things, even a different group from plants and animals. In addition, some of them also understand that all fungi can be seen with the naked eye and some of them are microscopic. Students' classification of fungi as plants is one of the most well-known misconceptions in literature (Anderson et al., 2014; Barman, Stein, Barman, & Mcnair, 2002; Barman et al., 2006; Goldberg & Thompson-Schill, 2009; Hampton, 1988; Keleş & Aydın, 2012; Maskour, Alami, Zaki & Agorram, 2019; Yangin, 2014). Therefore, it can be said that, contrary to those studies, the plant-fungus distinction is generally understood by students in this study (Table 8, Table 12). However, the findings show that the majority of them think that the structural features of fungi are hat mushrooms. This finding indicates that the structural properties of the fungus are to be defined in a similar way to the plant because they discussed structures such as root, stem, and seed while explaining the structure and reproduction of the fungus. Supporting this idea, Türkmen, Dikmenli, and Çardak (2003), Bulunuz et al. (2008), Keleş and Aydın (2012), and Maskour et al. (2019) also found that students classified a mushroom as a plant because its stem resembles plant's stem. Similarly, Yangin et al. (2014) found that prospective teachers are more likely to consider a fungus as a plant if it possesses specific characteristics or parts. As for mistaking the members of the fungus kingdom, especially mushrooms for plants, the misconception is common in their study. On the other hand, this study found that the students believed that fungi are photosynthetic organisms and they don't move and reproduce by seeds. Some studies also found similar findings (Keleş & Aydın, 2012; Türkmen et al., 2003). For example, Barman et al. (2006) investigated the students' concepts about plants and their growth. It was found that seeds and mushrooms are the most difficult concepts for students to characterize. This is not surprising because seeds have the potential of becoming a plant and mushrooms have many plant-like characteristics.

This study revealed students' misunderstandings and misconceptions about fungi using semi-structured interviews and drawing. Similar to Bulunuz et al. (2008), the students had difficulty linking anatomical features they observed to where fungi live and the adaptations they show. This may show the effects of emphasis in many biology teaching on naming and categorizing organisms in isolation from their habitats and their species.

CONCLUSION

Students' misunderstandings and misconceptions are still a major focus of educational research in recent years. Information on students' misunderstandings and misconceptions is necessary so that teachers can detect them (Utari et al., 2017). In this study, some students' misunderstandings and misconceptions were found. In the light of the findings, the following suggestions may be a guide for future studies:

1. In teaching biology, concepts should be presented with examples from daily life.
2. It is necessary to include visual elements in teaching biology. Concretizing each abstract concept using visual elements may also be effective in the realization of permanent learning.
3. It is important to avoid methods and applications that present the subjects theoretically or lead the student to memorization. For this reason, it is necessary to allocate more time, especially for laboratory practices. Particular attention should be paid to the use of microscopes in teaching subjects related to microscopic organisms.
4. Since biology contains many abstract and interrelated subjects and concepts, a similar application can be made for different biology subjects and the cognitive structures of students in these subjects can be revealed.
5. In this study, students' conceptual learning was investigated through semi-structured interviews and drawings. Misunderstandings and misconceptions may also be detected using different types of tools (diagnostic tests, concept cartoons, concept maps, etc.) in the future.
6. This study was conducted on fifth-grade students. Similar applications can be applied to higher grade students as the level of knowledge of the different grade students can be investigated.
7. Conducting similar studies with larger samples may increase the generalizability of the findings.

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