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Misconception of biology education student of teacher training and education of Sriwijaya University to the concept of photosynthesis and respiration

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Abstract. This study aimed to gain an overview of misconceptions on the concept of photosynthesis and respiration. The study involved 58 students from Biology Education of Sriwijaya University. Collecting data used written test of 16 questions, which are 10 questions of multiple choice and 6 of choice with reason. The results showed that: photosynthesis occurs continuously (37.9%), energy used for photosynthesis are light and heat energy (34.5%), plants take CO_2 to respiration (47%), plants carry on respiration in the absence of light for photosynthesis (22.4%), respiration in plants occurs only in leaf cells (76.4%), and only animals that take O_2 of photosynthesis to respiration (68.9%). The conclusion: 1) on the concept of photosynthesis is still prevailing misconceptions about the concept of the place and time of the occurrence of photosynthesis in plants, the role of the sun in photosynthesis, energy is required in the form of photosynthesis, and the role of photosynthesis for the plant. 2) on the concept of respiration is still prevailing misconceptions about the place of the respiration in plants, gas necessary for respiration of plants, and the plants perform respiration time, as well as the cycle of CO_2 and O_2 that occurs in nature.

1. Introduction

Study on misconceptions in science has often been studied by many experts. Misconceptions can be interpreted as a mismatch someone description of a concept. This discrepancy refers to the scientific understanding or definition accepted by experts. Some research indicates that there are a lot of misconceptions that happen to students, ranging from primary school level to the college level in the various fields of study. Some research suggests a common misconception among students, among others misconceptions on the concept of photosynthesis, respiration, diffusion, osmosis, ecology, genetics, classification, and human circulation system [1]; [2]; [3]; [4]; [5]; [6]; [7]. Most learners experiencing misconceptions on the concept of diffusion and osmosis [8]. Results of a study involving 200 high school students and college students, showed that more than 60% of high school students and college students have misconceptions on the concept of diffusion [9]. In addition to the concept of diffusion and osmosis which are prevalent misconceptions, another concept also undergone many misconceptions is the concept of photosynthesis.



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Photosynthesis is a process that is very important in life. Photosynthesis provided food for almost the entire life of the world, either directly or indirectly [10]. Food gained by living things, will be used as a source of energy to do all the activities of life. This energy can be produced by living things by way of oxidizing the food with the use of oxygen through the process of respiration. Photosynthesis not only provide food, but also provide the oxygen for respiration or breathing all living creatures on earth. Thus the process of photosynthesis and respiration are two processes that are essential for life. Once the importance of these two processes for life, so that it can be said that there is no life if there is no process of photosynthesis and respiration [11].

Research on the misconception that specifically examine in depth the concept of photosynthesis and respiration have been done [12]; [13]; [14]; [15]. Things to cause difficulties in understanding the concept of photosynthesis, and occurs misconceptions because this concept is abstract and complex, and involves many chemical reactions [16]; [17]. The results showed that 99% of students do not understand the role of chlorophyll in photosynthesis and 46% of students do not understand the changes of light energy into chemical energy [18].

The process of photosynthesis is closely related to respiration. CO₂ gas that results respiration of living organisms (plants and animals) will be used by plants for photosynthesis. O₂ gas that results of photosynthesis in plants used by living things (plants and animals) for respiration. Given the importance of the concept of photosynthesis and respiration, as well as common misconceptions on both the concept, then in this paper will be presented the results of a descriptive study of misconceptions on photosynthesis and respiration in biology education student.

2. Research Method

This study is a descriptive study that revealed the understanding of concepts and misconceptions biology student teachers about the basic concept of photosynthesis and respiration. Subjects were first-year students of Biology Education of the Faculty Teacher Training and Education University of Sriwijaya consisting of 58 people. Collecting data using diagnostic tests that refers to Haslam and Treagust [15]. The test consists of 16 questions, which are divided into two groups, 10 questions multiple choice test on photosynthesis, and 6 a matter of choice on the grounds of photosynthesis and respiration. Research data in the form of qualitative and quantitative data were processed and presented descriptively.

3. Results and Discussion

Questions posed to gain knowledge about the concept of photosynthesis, consisting of 10 questions in the form of multiple choice, namely questions related to: 1) the site of photosynthesis, 2) the role of solar energy in photosynthesis, and 3) the compound is necessary and produced of photosynthesis. Two questions of 6 questions with answers reason is related to the concept of respiration which occurs in plants. The results of the analysis of student answers to questions about the site of photosynthesis is presented in Table 1.

Table 1. Percentage of Student Answers to Questions About The Site of Photosynthesis

No	Question	Answer	%
1	In which part of the plant photosynthesis to occur?	Photosynthesis occurs in all green plant parts	67.2
		occurs in leaf photosynthesis	32.8
2	Which part of plants containing chlorophyll?	Chlorophyll contained in the green part of the plant	68.9
		contained chlorophyll the leaves	31.1
3	In which part of the plant photosynthesis to occur, and where there is chlorophyll?	Photosynthesis occurs in the green part of the plant and chlorophyll contained in the green section	60.4
		Photosynthesis occurs in the leaves and leaf chlorophyll contained	39.6

Based on analysis of student answers to questions about the site of photosynthesis and the presence of chlorophyll in plants can be explained that most students (>60%) have understood that photosynthesis occurs in the green part of the plant. Their green color is caused by the presence of chlorophyll. Nevertheless, it is still large enough that 39.6% occurred on student misconceptions, which occurs in leaf photosynthesis and chlorophyll contained in leaves. The concept of photosynthesis occurs in leaves already owned by students from an elementary school level. Results of previous studies show that 69% of elementary school students stated that photosynthesis occurs in the leaves, the rest in stomata, root and leaf stalk. Further results showed there were 22% of primary school students expressed photosynthesis occurs in the spines of cactus plants, because they assume cactus spines are leaves [19]. This occurs because the green leaves caused by the presence of chlorophyll, whereas chlorophyll plays an important role in photosynthesis. Thus the students chose the answer.

The concept of the right of where photosynthesis and the presence of chlorophyll in plants are all green parts of the plant contain chloroplasts in their cells. However, most plant organs contain chloroplasts of leaves. Chlorophyll contained in the chloroplasts of green that plays an important role in the process of photosynthesis. Therefore, it is often stated that a key site of photosynthesis in plants is the leaves [10]. However, in some plants whose leaves are modified, for example, be a thorn (cactus) or the stem is green, the process of photosynthesis does not occur in the leaves, but it occurs in the trunk. The results of the analysis of student answers to questions about the role of solar energy in plants is presented in Table 2.

Table 2. Percentage of Students Answers to Questions About The Role Of Solar Energy in Photosynthesis

No	Question	Answer	%
1	What is the role of the sun in photosynthesis	Sun provides energy for the plant.	100
2	When did this to occur	Photosynthesis occurs at noon.	32.8
		Photosynthesis occurs when there is light.	34.4
		Photosynthesis occurs continuously (day and night).	32.8
3	Time photosynthesis and the role of the sun in photosynthesis	sun provides energy for plants perform photosynthesis and photosynthesis take place during the daytime.	25.9
		The sun provides the energy for photosynthesis and plants perform photosynthesis occurs when there is light.	36.2
		The sun provides energy for plants perform photosynthesis and photosynthesis take place continuously (day and night).	37.9
4	Forms of energy needed for photosynthesis	Energy sunlight	65.5
		Energy sunlight and heat energy	34.5

Based on the analysis presented in Table 2 can be explained that 100% of the students answered questions about the role of the sun is to provide energy for photosynthesis. However, when combined with questions about the timing of photosynthesis, the energy spread evenly student answers to three different answers that photosynthesis occurs during the day (25.9%), photosynthesis occurs when there is no light (36.2%), and photosynthesis occurs continuously constantly day and night (37.9%). The shape of the energy needed for photosynthesis is the solar light energy and heat energy is answered by the students as much as 34.5%. Misconception that happens is photosynthesis occurs continuously day and night. The right thing is photosynthesis occurs only when there are sufficient light. The

misconception is also the case that plants require heat energy for photosynthesis. The energy used by plants for photosynthesis is light energy instead of heat energy.

The results of the analysis to the question of the necessary compounds produced by photosynthesis and are presented in Table 3.

Table 3. Percentage of Student Answers to The Question of The Necessary Compounds and Generated Photosynthesis

No	Question	Answer	%
1	Pair of compounds which is needed for photosynthesis?	CO ₂ and water	92.8
		O ₂ and Water	3.2
		CO ₂ and oxygen	4.0
2	Pairs where the resulting compound of the photosynthetic	Compounds produced from photosynthesis is glucose and O ₂	94.5
		Compound is produced from photosynthesis is glucose and CO ₂	2.9
		The compound resulting from photosynthesis are CO ₂ and water	2.6
3	Pairs of compounds needed in photosynthesis, and the pair compound resulting from photosynthesis	The process of photosynthesis plants require CO ₂ and water, and produce glucose and O ₂	93.8
		in the process of photosynthesis in plants need glucose and O ₂ , produces glucose and CO ₂	6.2

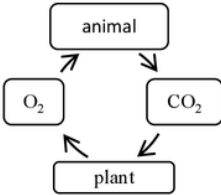
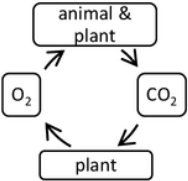
Based on the analysis presented in Table 3 can be expressed energy 100% of the students already understand the concept of compound needed and the compounds produced in photosynthesis. The process of photosynthesis in plants require gas CO₂ and water, and produce glucose and O₂ gas. The results of the analysis of student answers to questions about the role, factors affecting, and the equation of photosynthesis is presented in Table 4.

Table 4. Percentage of Answers to Students About The Role Of Photosynthesis, and The Factors Affecting The Photosynthesis Reaction

No	Question	Answer	%
1	What is the most important role for plants green to do photosynthesis?	Convert light energy into chemical energy, because during photosynthesis solar light energy is converted and stored in a glucose molecule	29.3
		Moving the CO ₂ from the air, because the CO ₂ taken up by the leaves through the stomata during photosynthesis	25.7
		Generating energy for photosynthesis to provide energy for plant growth	45
2	Factors what is not important in the process of photosynthesis?	Factors that are not important in photosynthesis is the amount of O ₂ because O ₂ is not required for photosynthesis, O ₂ is the result of photosynthesis.	100
3	photosynthesis equation right?	Photosynthesis correct equation is:	82.7
		$\text{CO}_2 + \text{H}_2\text{O} \xrightarrow[\text{Energy of sunlight}]{\text{chlorophyll}} \text{glucose} + \text{O}_2$ Reason: 5 sunlight The energy of sunlight is used plants containing chlorophyll to combine CO ₂ and H ₂ O to form glucose and O ₂	17.3
		$\text{CO}_2 + \text{H}_2\text{O} \xrightarrow[\text{Energy of sunlight}]{\text{chlorophyll}} \text{glucose} + \text{O}_2$ Chlorophyll joining the CO ₂ in the presence of light and produce glucose and water.	

Based on the results presented in Table 4 can be explained that as much as 45% of the students still have the misconception that an important role for plant photosynthesis is to produce energy. Another misconception is happening is the absence of light, chlorophyll joined with CO₂ to form glucose and O₂ (17.3%). The process of photosynthesis in plants do not produce energy, but photosynthesis is the process of converting light energy into chemical energy stored in chemical bonds form sugars that are made from carbon dioxide and water [10]. Analysis of the results of student answers on respiration in plants and its relation to photosynthesis are presented in Table 5.

Table 5. Percentage of Student Answers on Respiration in Plants and Its Relation to Photosynthesis

No	Question	Answer	%
1	Gas what more taken by greenery when the sun's light energy is less ? (CO ₂ or O ₂), provide a reason?	CO ₂ gas, because gas is used by green plants for photosynthesis happens all the time.	13.8
		Gas CO ₂ because this gas is used by green plants for respiration which occurs when light is less	46.6
		Gas O ₂ because this gas is used in respiration which only occurs in green plants, when there is no light for photosynthesis	22.4
		Gas O ₂ because the gas is used for respiration occurs continuously in green plants.	17.2
2	Where is the place of the respiration in plants? (only in the root cells, every cell of the plant, or only in leaf cells), provide a reason.	Respiration occurs in every cell of the plant, because of all the living cells need energy to live	23.6
		respiration occurs only in cells of the leaf, because only the leaves that have a special pores (stomata) for gas exchange.	76.4
3	Figure out which is right for the show cycle CO ₂ and O ₂ in the wild? Give a reason		68.9
		<p>O₂ results from photosynthesis of plants used by animals to breathe, and CO₂ results from animal breathing taken by plants for photosynthesis.</p>	
			31.1
			
		<p>O₂ results from photosynthesis of plants used by animals and plants to breathe, and CO₂ results from respiration of animals and plants taken plants for photosynthesis.</p>	

Based on the analysis presented in Table 5 can be explained that 46.6% of the students stated gas is needed in plant respiration is gas CO₂. Misconception that occurs is respiration in plants require CO₂. Misconceptions also happens to students that respiration in plants occurs only when there is no light (22.4%). This shows that when there is no light, and plants that are doing photosynthesis does not perform respiration. 76.4% of students answered that respiration only occurs in leaf cells, since only the leaves that have a special pores (stomata) for gas exchange. 68.9% of students answered

that O₂ gas resulting photosynthesis of plants used by the animal to breathe, and CO₂ resulting respiration of animals taken by plants for photosynthesis. Misconception that happens is that the only animals that require O₂ gas for respiration.

The concept that is specifically related to the results of the analysis in Table 5 is the O₂ gas produced from the photosynthesis of plants used for respiration not only by animals but also used by plants. Green plants are living things. Therefore, plants must perform respiration to produce energy (in the form of ATP) needed in the metabolic processes that occur in all living cells. Respiration in plants occurs in all living cells, and occurs continuously day and night.

4. Conclusions

Based on our research and discussions described above can be summarized as follows. On the concept of photosynthesis is still prevailing misconceptions about the concept of the place and time of the occurrence of photosynthesis in plants, the role of the sun in photosynthesis, energy is required in the form of photosynthesis, and the role of photosynthesis for the plant. On the concept of respiration is still prevailing misconceptions about the place of the respiration in plants, gas necessary for respiration of plants, and the plants perform respiration time, as well as the cycle of CO₂ and O₂ that occurs in nature.

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