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Teacher Misconceptions: A Phenomenon of the Lack of Knowledge in Science Subjects

Dyah Aniza Kismiati[1*], Leonard R. Hutasoit[1]

[1] Department of Biology Education, Universitas Terbuka, Tangerang Selatan, Indonesia.

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Corresponding Author:
Dyah Aniza Kismiati
dyah.aniza@ecampus.ut.ac.id

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Abstract: Qualified teachers are a cornerstone of successful learning. This study aims to determine the understanding of teachers in elementary schools on the concept of photosynthesis in science subjects in elementary schools. This type of research is survey research. This survey was conducted on 29 elementary school teachers in South Tangerang. Sampling is done randomly (random). The instrument used is a concept statement instrument of 10 statements. The analysis that will be carried out is descriptive by looking at the percentage of misconception scores in each question item. The results showed that there were 3 question items that showed the highest level of misconceptions, with an error range of 86.2% on the presence of chlorophyll, 79.30% on the photosynthesis time item, also 72.4% on results of photosynthesis. The degree of moderate misconception is that 69.00% in statement items related to the role of light in photosynthesis and 62.10% on the photosynthetic product statement item, and. In addition to filling out questionnaires, interviews were also conducted to explore information on why the phenomenon of misconceptions can occur in teachers. The interview results showed that most of the teachers who were sampled for research and teaching science in elementary schools had different educational backgrounds (other than science) as much as 66.00%, 28.00% had science education backgrounds and 7.00% came from other educational backgrounds.

Keywords: Misconceptions; Photosynthesis; Science; Teacher

Introduction

A lesson will be meaningful if taught by competent and professional teachers. This means, a teacher must have good qualities. In science, the success of science education will influence the daily activities and success at work in the future (Atkinson et al., 2020; Rokhiyah et al., 2023). Simmie et al. (2018) found that the understandings of quality are becoming a scientific, where the good teaching concepts are reconfigured within a new scientific as the clinical practice of standardized knowledge.

Teacher quality has emerged as a prevailing concept that permeates media and policy portrayals as a key factor impacting the core business of schools and student learning outcomes (Barnes & Cross, 2021). The things that causes low teacher quality according to Bradford et al. (2021) is teacher education programs are not attracting high-achieving and thus high quality students into the professional.The achievement of a learning goal is influenced by the ability and quality of teachers (Haji & Yumiati, 2021). This was revealed by Kaskens et al. (2020) and Fauth et al. (2019) stated that teacher ability affects the quality of learning, where teachers who have the ability to manage classes as well as teachers who provide feedback, it will create a conducive academic atmosphere. A conducive learning atmosphere makes students feel comfortable in learning and motivated. Motivation serves as a driver that leads to the targeted goals to be achieved (Sidabutar, 2020). Motivation also functions as a selection of activities, which determines what activities must be done to achieve the goal by setting aside activities that are not beneficial to the goal (in this context it is learning).

Law Number 14 of 2005 concerning Teachers and Lecturers article 10 paragraph (1) explains that teacher

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competence includes pedagogic competence, personality competence, social competence, and professional competence obtained through professional education. Competence is a term used widely by many different people in different context (Nessipbayeva, 2020). Competencies consist of different skills classified under knowledge, attitudes and skills to improve performance. Competency becomes very important for an educator who wants to achieve student success in learning (Wordu & Isiah, 2021). Competence is a major component of a teacher's professional standards. This is in addition to the code of ethics as a regulation of professional behavior that has been determined in a certain system (Nur & Fatonah, 2005). Teacher competence is a qualitative description of how meaningful the nature of teacher actions (Jahidi, 2014). In other words, competence can be defined as a set of behaviors related to investigation, exploration, analysis and attention and thinking that guides a person to find steps to achieve a particular goal efficiently. Teacher competence, as one of the determinants of learning quality, is an output obtained when the teacher receives Education in Higher Education (Kismiati et al., 2023).

According to Suparlan in Ramaliya (2018) minimum competencies that must be mastered by teachers at least include mastery of the material, teaching methods as well as an assessment system. However, if competence is not based on mastery of teacher personality and other skills, then teachers will not be able to fulfill their obligations professionally. Therefore, this professional ability or competence is described in expertise or expertise in their fields, namely mastery of the material that must be taught and its methods, a sense of responsibility for their duties and a sense of community with other fellow teachers.

The lack of professional competence of teachers will lead to misconceptions. Until now, misunderstandings or misconceptions about scientific concepts still occur (Soeharto et al., 2019; Kurtulu, 2021). Misconceptions refer to a concept that is not the same as the understanding possessed by experts in the field. Misconceptions are also considered as chaos in using and connecting concepts in solving problems caused by misunderstood conditions (Rohmah et al., 2023). Misconceptions that often occur are in abstract science materials whose understanding requires visualization in their explanations (Hera & Oktavia, 2023). Misconceptions about the concept of science occur in many students in various countries, ranging from elementary school (SD) students to tertiary level (Akbas & Gencturk, 2011).

Misconceptions made by teachers will cause a domino effect to students, because students will remember the wrong concept during learning and if there is no correction from the teacher. Misconceptions, can also be called false concepts, alternative conceptions preconceptions, conceptual roadblocks, spontaneous conceptions, alternative notions, conceptual misunderstanding, non-scientific beliefs, factual misconceptions, preconceived notions, and vernacular misconceptions (Chavan & Khandagale, 2023). Suhantoro (2020) classifies misconceptions into five types, namely preconceived notions, nonscientific beliefs, conceptual misunderstandings, vernacular misconceptions, and factual misconceptions. Meanwhile, when viewed from the scope of the area, there are types of misconceptions that only occur in certain areas (specifically), but there are also those that occur as a whole with a wider area coverage (universally). Misconceptions that occur in science subjects are for example in the concept of photosynthesis. This photosynthesis material is material given to students from elementary school, junior high school, high school to college (according to their fields).

Method

The research was a quantitative descriptive research. The research aims to determine the understanding of teachers in elementary schools on the concept of photosynthesis in science subjects in elementary schools. The flow of research carried out is shown in Figure 1 below.

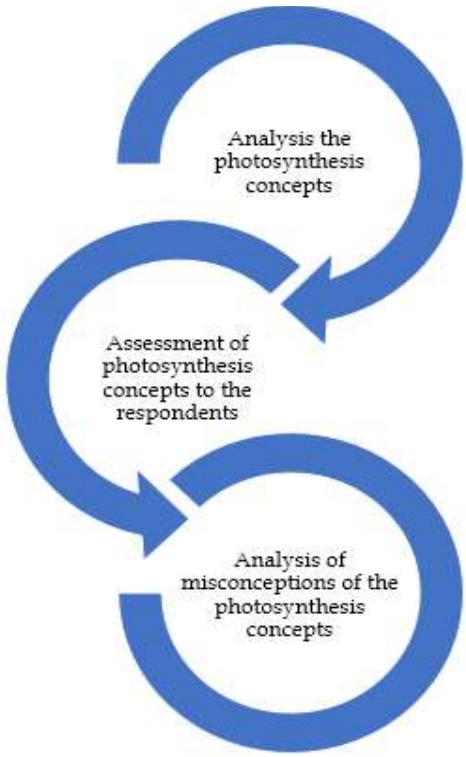

Figure 1. The flow of research

This quantitative descriptive research is a type of survey research conducted on elementary school teachers in South Tangerang City who teach science subjects. A total of 29 teachers were sampled in this study. Samples are obtained randomly without any consideration. Figure 2 below is the distribution of sample data based on teacher education background.

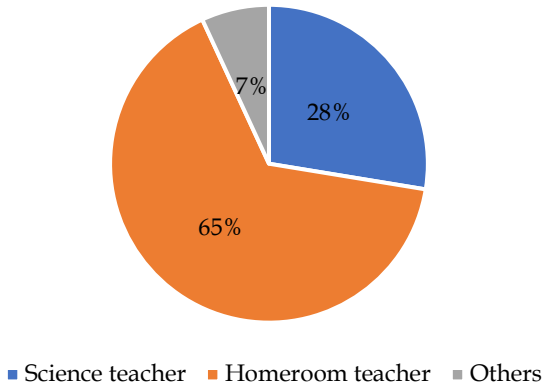

Figure 2. Dissemination of teacher education background

The data collection technique used an instrument test by using 10 items related to the concept of photosynthesis. Respondents were required to select each given photosynthesis concept statement whether the statements were true or false. The 10 concepts related to photosynthetic matter adapted from the misconception instrument are as follows (Yunia et al., 2019).

Table 1. The Misconception Instruments of Photosynthesis Matter

Statement
1. Plants only perform photosynthesis during the day.
2. Chlorophyll lies only in the leaves.
3. The process of photosynthesis produces water and carbon dioxide.
4. The function of chlorophyll in the photosynthesis process is to bind carbon dioxide and convert it into glucose.
5. The gases needed by plants to carry out photosynthesis are oxygen.
6. Proteins are also the result of photosynthesis.
7. Photosynthesis occurs in stomata.
8. Photosynthesis can take place without any light.
9. Photosynthesis produces lactose.
10. Photosynthesis can occur at night.

The data was analyzed quantitative by looking at the percentage (%) of truth from a number of samples that became respondents. Each statement was analyzed by quantitative analysis techniques use the equation:

$$P = \frac{f}{N} \times 100\% \quad (1)$$

Description:
P = Final value
f = Score obtained
N = Maximum Score

The percentage of respondents who answered incorrectly will show the level of misconception in the concept of photosynthesis according to Table 2 (Susanti et al., 2023).

Table 2. Distribution of Effectiveness Analysis Results

Percentage average	Criteria
85-100	Very high
70-84	High
55-69	Moderate
40-54	Low
0-39	Very Low

Result and Discussion

Research related to misconceptions in learning is never saturated to always be researched. Misconception was originally a loophole due to the lack of knowledge. The misunderstanding referred to in misconceptions can occur when connecting a concept with other concepts, between new concepts and concepts that already exist in students' minds, so that wrong concepts are formed and contradict the conceptions of scientists (Yunia et al., 2019). As explained earlier, misconceptions in science often occur in abstract materials or concepts, one of which is related to photosynthetic matter.

Photosynthesis is a biochemical process of formation of carbohydrate food substances carried out by plants, especially plants that contain green leaf matter or chlorophyll (Hasbiah & Wahidah, 2013). Photosynthesis is also defined as a biological process, which uses energy and sunlight that can be utilized by chlorophyll contained in chloroplasts (Maftukhah et al., 2023).

In Figure 3 the following shows a research activity where the teachers who were respondents filled out questionnaires related to the concepts of photosynthesis that they considered correct. Filling out this questionnaire is carried out in real time and limited in time so that it does not allow respondents to search for answers in reference books, the internet or ask questions between teachers.

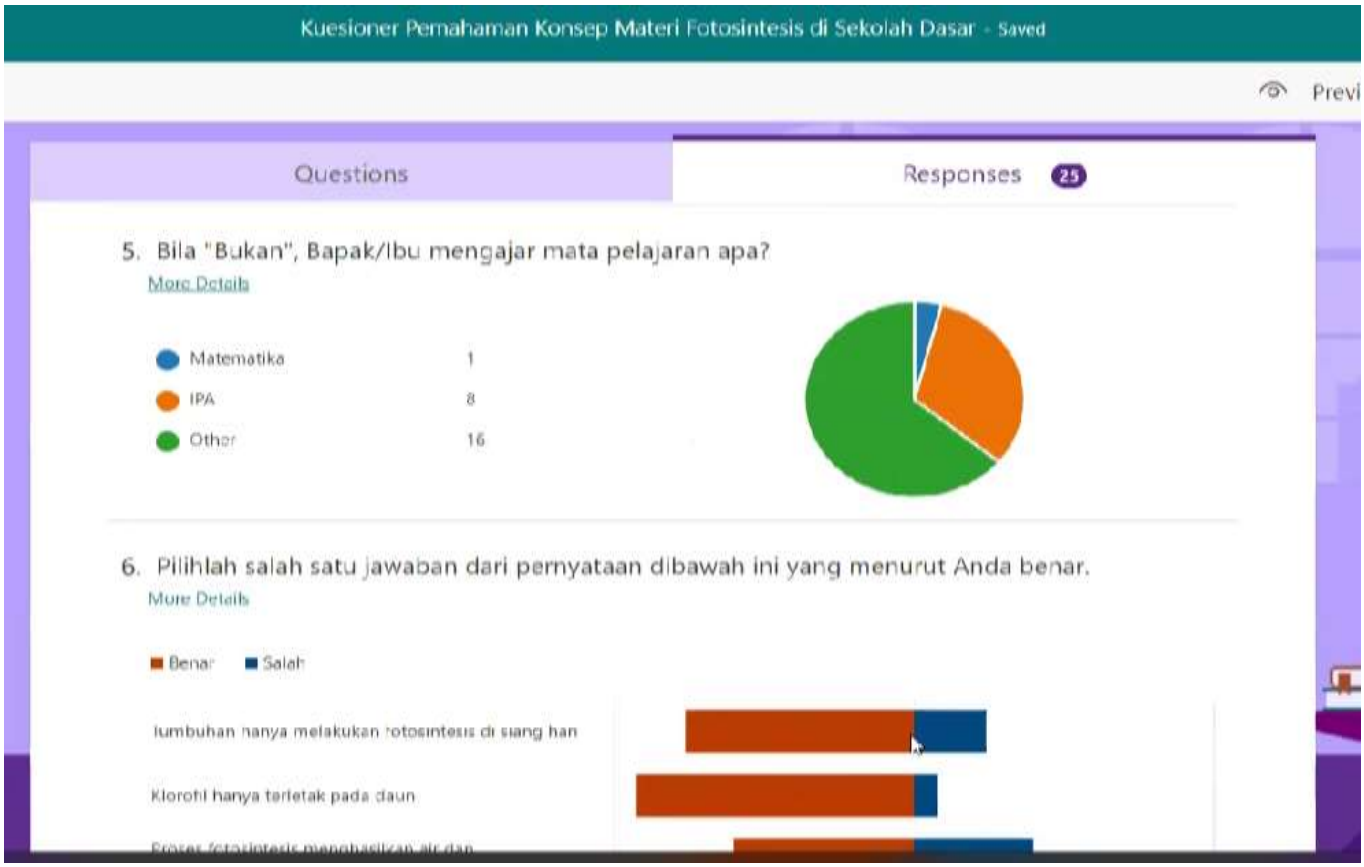

Figure 3. Questionnaire filling out of photosynthesis concepts by respondents

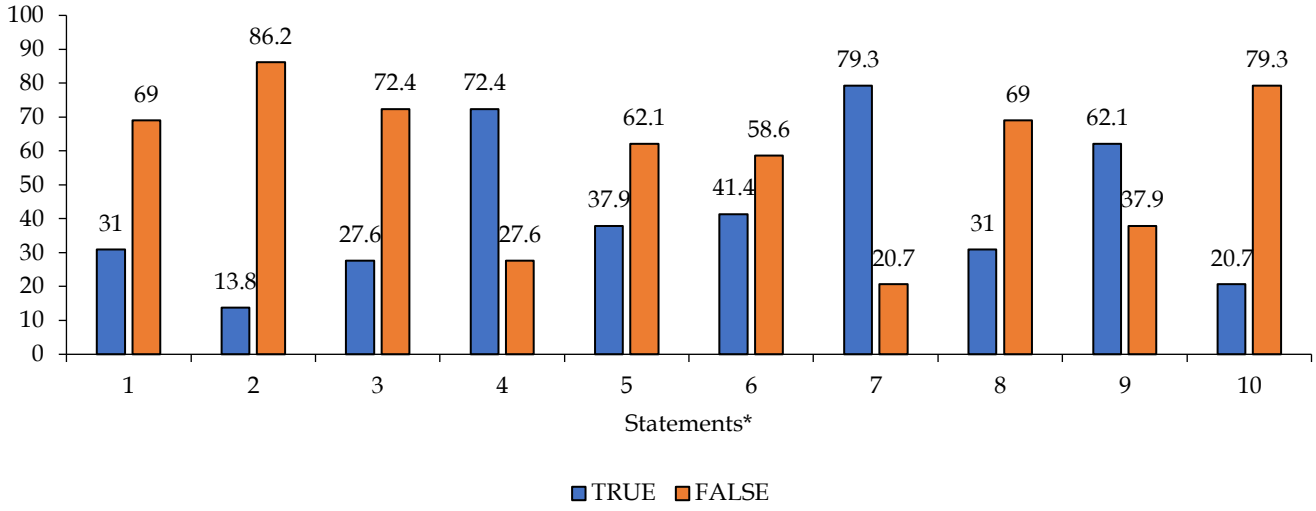

Figure 4. Misconceptions of elementary school teachers on photosynthetic material. Statements* = According to the statements in Table 1

The results of filling out questionnaires related to the concepts of photosynthesis that were considered correct by the respondents were then analyzed descriptively. The results of the analysis of misconceptions in photosynthesis material in elementary school teachers are shown in Figure 4.

From the results of data analysis in Figure 4, it is known that most of the concept items asked were answered incorrectly by the elementary school teachers who were sampled, namely as many as 7 out of 10 concept items asked. The seven items are related to the time of photosynthesis, the location of chlorophyll, the products of the photosynthesis process, and the components needed in photosynthesis. As many as 69% of teachers answered incorrectly that plants that carry out the process of photosynthesis only during the day,

as well as the concept items asked related to photosynthesis can occur at night which were answered incorrectly by 79.3% of respondents (sample).

The process of photosynthesis, not only can be done during the day, but the process of photosynthesis can also occur at night. Of course, not by using sunlight as used by plants during the day. The role of sunlight at night can be replaced by fluorescent light (Muna, 2012). 86.2% of teachers stated that chlorophyll is only found in leaves. This is a misconception. The correct concept is that chlorophyll is not only found in leaves, but chlorophyll is also found in green tree trunks, even though the green on the tree trunk is small (Yunia et al., 2019).

Concept item 5 related to the gas component required in photosynthesis was responded incorrectly by as many as 62.1% of teachers who assumed that the gas needed to carry out photosynthesis was oxygen gas (O_2). This is wrong because the gas needed in the process of photosynthesis is carbon dioxide gas (CO_2). Sutoyo (2011) revealed that carbon dioxide gas plays an important role in plant growth and production because the availability of CO_2 gas is sufficient to increase photosynthesis yield. In other words, the process of photosynthesis will not be able to take place if there is no carbon dioxide gas.

In concept item number 6, as many as 58% of teachers answered incorrectly related to proteins are the result of the process of photosynthesis. This is because in the process of photosynthesis by utilizing carbon dioxide gas, water, chlorophyll and sunlight, oxygen and glucose will be produced. Then the last is the misconception in concept item number 8 related to photosynthesis can take place in the absence of light where 69% of teachers answered incorrectly. The correct concept is that photosynthesis occurs there must be light, even though the light is not from sunlight (Yunia et al., 2019).

This high level of misconception in understanding the concepts of photosynthesis is a concern. A high level of misconception indicates that teachers' scientific literacy is low and efforts are needed to improve science literacy. Scientific literacy is an important thing to improve the mastery of learning material (Putri & Mufit, 2023). Scientific literacy is the knowledge and understanding of science concepts and scientific processes (She, 2019; Jamaluddin, 2019) it refer to the ability to think scientifically and understand of the concepts (Husna et al., 2022, Elhai, 2023). Scientific literacy helps students to form knowledge, attitudes and competencies towards technological and scientific phenomena in life (Cansiz & Cansiz, 2019). Science literacy also influence to understand the environment and problems that exist in modern citizen (Sharon & Tsabari, 2021; Lestari et al., 2020).

Even, good scientific literacy encourages mastery of problem solving. Therefore, teachers have a very important role. Teachers play a role in connecting learning. The teacher also plays a role in explaining the material, and providing questions related to previous knowledge with the material presented to be studied (Ismail et al., 2023). In the study of science, teachers need to have a comprehensive understanding of the characteristics of science and be able to communicate this understanding effectively to students through various learning strategies or approaches (Fatmawati & Khotimah, 2023). Thus, understanding of science concepts for teachers is absolutely to master. Because, science concepts comprehension is a foundation to create thinking constructions to another related concept and theories in science (Luh et al., 2023). A good concept comprehension will make students' comprehension of the subject matter will increase. That's because of concepts comprehension can help students remember the material they have learned (Nurwulandari, 2018; Saputra & Mustika, 2022).

Related to the misconceptions that occur in elementary school teachers, this can be caused because most of them are actually not teachers who come from a science or science or biology education background. Only 28% of respondents are native to science education, while 65% are homeroom teachers who teach thematic subjects where there are science subjects, while the other 7% come from other educational backgrounds. This the different educational backgrounds and teacher limitations in increasing literature review also mastery of the concepts have an impact on reducing students' scientific (Sulaiman & Azizah, 2020).

In terms of urgency towards this phenomenon of misunderstanding it is of great importance to promote accurate knowledge and understanding of the concept of photosynthesis among students. Educators must have a correct understanding of the material they teach to students. They must understand the correct concepts since college. The misconceptions held by the teacher candidates need to be remedied in order to prevent them from sharing these misconceptions with their students in the future. Therefore, remediation of misconceptions is very important (Mufit & Fauzan, 2023). Teachers should also attend seminars and training in accordance with their field of knowledge, so that their knowledge remains and grows. Thus, it is hoped that students will not experience misunderstandings of the concepts taught by the teacher.

Conclusion

The tendency of misconceptions in photosynthesis material that occurs in elementary school teachers in South Tangerang City is mainly related to the concept of

photosynthesis products, namely 62.1% of teachers consider that lactose is a direct product of photosynthesis; 69% of teachers consider that plants only perform photosynthesis during the day; 86% of teachers consider chlorophyll to be located in leaves only, 58% of teachers consider that the process of photosynthesis produces carbon dioxide; 62.1% of teachers think that oxygen is the gas needed to carry out photosynthesis; and 58.6% of teachers considered that proteins were the result of photosynthesis. This misconception phenomenon occurs because of several things including most teachers who teach in elementary schools have different backgrounds (other than S1-Science Education or Biology backgrounds) even though they teach science which is part of thematic subjects. Therefore, it is actually still necessary to deepen the material and even workshops for elementary school teachers who do not come from a science education background before being given the task of teaching science subject.

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Author Contributions
Conceptualization, methodology, validation, formal analysis, visualization, writing—original: D. A. K.; investigation, data curation, writing—review and editing: L. R. H. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The author declares that there is no conflict of interest regarding the publication of this article.

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