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## In-Service Science Teachers' Ideas about the Phases of the Moon and Brightest Star

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### Abstract

In this study, 32 science teachers' ideas were studied to determine the phases of the moon and brightest star. Teachers' ideas were grouped under 'right answer', 'misconceptions' and 'no response' categories. About the phases of the moon, correct answer rate was very low and majority of teachers' responses were misconceptions. None of the teachers could give correct answer about the brightest star at night in the summer. For these two concepts, a variety of misconceptions were encountered, more detailed conclusions were reached in the end of semi-structured interviews that were conducted with teachers who hold misconceptions.

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### 1. Introduction

In recent years in constructivist learning theory that widely accepted in education system, students' ideas before education are quite important. These ideas generally defined as misconceptions in the literature often contradict with scientific ideas. Since misconceptions appear as a learning disability in learning process (Helm & Novak, 1983), it is important to determine misconceptions that students have and ensure the exchange of these misconceptions with scientific facts. In the process of conceptual change, teachers have the most important tasks because they are those who plan and apply teaching intended for conceptual change. For this reason the teachers should be aware of the most common misconceptions about the subject and question possible causes about origins of these misconceptions (Kikas, 2004). However it has been determined that besides teachers' lack of enough information to find out and correct misconceptions of students, they have a variety of misconceptions as well. (Gooday & Wilson, 1996; Taylor & Coll; Trumper, 1996; cited in Kikas, 2004).

#### 1.1 Purpose and importance of research

Purpose of this research is to find out ideas of science teachers about the causes of the phases of the moon and the brightest star notions. Teachers must have appropriate cognitive structures related to these notions in order to teach them. The number of studies which aim to uncover the teachers' ideas on the concepts of astronomy is very

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few. Parker and Heywood (1998) have a study intended to uncover teachers' ideas on the concept of phases of the moon. To the best of our knowledge there is not a study carried out to discover teachers' ideas about the brightest star visible in the sky at night. Whereas it is quite important to reveal teachers' ideas because if teachers have some misconceptions, besides they can not correct their misconceptions, they also cause new misconceptions (Küçüközer & Bostan, 2010). So the studies made to reveal teachers' ideas about various notions are important.

## 2. Method

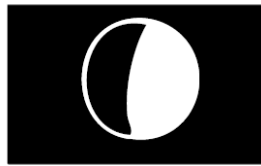
Method of this study has been determined as screening research which is one of descriptive research designs. 32 science and technology teachers (ST) serving in randomly determined 13 primary schools in Balıkesir city center form the sample of study. The teachers took part in this sample were asked the questions: "Image of moon shapes are seen within an interval of couple of nights. What is the reason of the change of moon's image? Explain your answer briefly" and "Which is the brightest star when we look at the sky with naked eye in the cloudless air at night? Explain your answer briefly. "Semi-structured interviews were conducted with a sample of 10 randomly chosen teachers as well. The purpose of a semi-structured interview is to find out the teachers' ideas about the question with more details. Teachers' answers have been collected under 3 categories which consist of "Right answer", "Misconception" and "No answer". Frequency counts of teachers' answers have been made and this frequency counts have been converted into table.

## 3. Findings

### 3.1. Phases of Moon



Any night



A few nights later that night

Findings obtained from the question: "The images of moon shapes are seen in the sky with an interval of a couple of nights. Explain your answer briefly" are summarized below.

Table 3.1.1. Table of ST response grades and frequencies about the cause of phases of the moon

Response Grades	n (%)
Scientific correct response	11 (34.4)
Misconception	17 (53.1)
No answer	4 (12.5)

%34.4 of science and technology teachers gave the correct answer about the question of moon phases that moon rotates around the earth and consequently moon phases occur. For this question, answers given by %53.1 of teachers are kinds of misconception and they show varieties inside. %12.5 of answers given by science and technology teachers has been put into the “No Answer” category. In the table 3.2.2 misconceptions that science and technology teachers have about the phases of moon and encounter frequency are given.

Table 3.1.2. Table of ST misconceptions about cause of phases of the moon

Misconceptions	n (%)
1- Rotating of the moon around the earth while the revolving of the earth in its orbit	6 (35.3)
2-Rotating of the moon around the earth while revolving in its orbit	5 (29.4)
3-Shadow of the earth	3 (17.6)
4- Clouds cover the moon	2 (11.8)
5- Rotating of the moon with the earth around the sun	1 (5.9)

For this question science and technology teachers often had the misconception that while moon rotates around the earth meanwhile the earth revolves in its orbit and as a result moon phases occur. While correct answer is that rotate of moon around the earth form moon phases, the answer that the earth revolves in its orbit is a misconception. A section of interview made with a science and technology teacher who has this misconception is as shown below:

G: What are the causes of the phases of the moon?

Ö14: Moon rotates around meanwhile the earth revolves in its orbit. As a consequence of these two motions moon’s visible shape changes.

G: Can you explain your answer a bit?

Ö14: For the formation of phases of the moon rays of light from sun should come to the moon. While moon rotates around the earth and earth revolves in its orbit, sun rays come to different parts of the moon and enables formation of phases of moon.

%17.6 of science and technology teachers has the misconception that as a result of the earth’s changeover between sun and moon, moon phases occur. Ideas of the science and technology teachers who have this misconception are as shown below:

G: What do you think about the causes of the phases of the moon?

Ö22: The earth positions between sun and moon change and moves continuously .The earth rotates both in its orbit and around the sun. During its motions, the earth passes in front of moon or withdraws and the moon appears in different shapes. When the earth withdraws from the sun and moon, full moon phase appears. Earth’s shadow causes that.

Science and technology teachers also have misconceptions that are less common compared to misconception mentioned above about the moon phases. %11.8 of science and technology teachers have the misconception that clouds cover the moon as a result moon phases occur and %5.9 of science and technology teachers have the misconception that the moon rotates around the sun with the earth and as a result moon phases occur.

### 3.2. The Brightest Star

Findings obtained from the question: “Which is the brightest star when we look at cloudless sky with naked eye at a summer night? Explain your answers briefly are explained.

Table 3.2.1.ST response grade and frequency table about the brightest star in the sky at night

Response Grades	n (%)
Correct Answer	0 (0)
Misconception	26 (81.2)
No Answer	6 (18.8)

In this question Sirius, the brightest star, this is mostly visible from southern hemisphere but seen from northern hemisphere only in winters. Arcturus and Vega, the brightest stars, which are visible from northern hemisphere, have been accepted as right answers. As seen in table 3.2.1 none of answers that science and technology teachers gave about the brightest star is not included in correct answer grade. The most common response is in grade of misconception and %81.2 of science and technology teachers had this type of response. %18.8 of science and technology teachers’ responses are in the grade of “No Answer”. Misconceptions of science and technology teachers about the brightest star in the sky at night are shown in the table 3.2.2.

Table 3.2.2.ST misconceptions about the brightest star in the sky at night

Misconceptions	n (%)
1- Polestar	12 (46.2)
2- Venus	8 (30.8)
3- Comet	3 (11.5)
4- Big dipper	2 (7.7)
5- Shooting Star	1 (3.8)

A lot of misconceptions have been encountered about the brightest star visible in the sky at night with naked eye. The most common misconception is “Polestar” response and %46.2 of science and technology teachers had this

kind of response. A section of interview made with science and technology teacher who gave the answer “Polestar” is shown below.

G: Which is the brightest star when we look at cloudless sky at night?

Ö12: Polestar.

G: Why is polestar the brightest star? Can you explain your answer?

Ö12: Polestar positions in the North Pole and it is the brightest star. We can find our direction by looking at the polestar.

%30.8 of teachers gave the answer “Venus” which is another misconception. The other misconceptions, about the brightest star that science and technology teachers have, are “Comet”, “Big dipper” and “Shooting Star”.

## Result and Discussion

According to the findings obtained from this study, most of the ideas of the science and technology teachers about the moon phases and brightest star are misconceptions. About the notion of cause of the phases of moon, Bisard (1994) and the other high school and university students, (Trumper, 2000; Trumper, 2001), Trundle, Atwood and Christopher (2002), Küçüközer (2007), Küçüközer (2008) have encountered the misconception that as a result of the earth’s changing position between sun and moon, moon phases occur in the study which was made with university students. The misconception that clouds cover the moon as a result moon phases occur had been encountered in the studies, at the level of primary (Baxter, 1989; Sharp, 1996 and Dunlop, 2000) and university (Küçüközer, 2008 ) education. Küçüközer (2007) had frequently encountered the most common misconception that polestar is the brightest star in the sky at night in his study made with university students in the period of pre and post education. Küçüközer (2007) encountered the other common misconception that Venus and Comet are the brightest stars in the sky at night in his study. According to the result of this study, the teachers may have misconceptions similar to misconceptions that their students have. In this situation teachers may not be successful in teaching to determine students’ misconceptions and change them with scientific facts. The teachers may even be the sources of misconceptions that students have in some cases. When it has been determined in the studies that misconceptions may have a variety of resources, Helm (1980) and Ivowi (1984) have noted that one of them is inaccuracy in the descriptions of teachers.

## Suggestions

Studies just investigating teachers’ misconceptions are not enough and studies on how to remove those misconceptions as well. Many conceptual change studies conducted for the students have been carried out but it is an unstudied area how to remove teachers’ misconceptions. In-service training activities may be organized to remove teachers’ misconceptions. How to organize in-service training activities, how to run these activities, by whom the courses should be given are the topics to be investigated.

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