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2

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Pre-service physics teachers' understanding on total lunar eclipse: A response of supermoon on January 31st 2018

N Suprpto*, U A Deta, N A Lestari, A Kholiq, A S Adam, H Mubarak, and M N R Jauhariyah

Department of Physics, Universitas Negeri Surabaya, Indonesia.

*Corresponding Author's E-mail: nadisuprpto@unesa.ac.id

Abstract. At the end of January 2018, the spectacular phenomena of astronomy that some people call super-blue-blood moon happened on the night of January 31st or the early morning of February 1st. These phenomena are consequences of a total lunar eclipse. In Indonesia, these three terms of moon become a controversy. Therefore it needs to be more investigated. Furthermore, this study has two research questions: (1) to what extent do the Indonesian PSTs' existing knowledge and reasoning of the lunar eclipse phenomena? and (2) to what extent do the Indonesian PSTs' existing knowledge and reasoning of the supermoon, blue moon, and blood moon?. A qualitative research method was considered in helping the researcher to construct some meanings. There were eight teen participants involved in an interview and a written questionnaire process. The PSTs' reasoning was categorised into four levels: dissatisfied (naïve), intelligible, plausible, and fruitful. The findings indicated that PSTs have some reasoning about the lunar eclipse, however, they unfamiliar with the super-blue-blood moon. It means their reasoning reached the level of plausible and fruitful according to the first research question and at the level of 'dissatisfied' and 'intelligible' for the second research question.

1. Introduction

At the end of January 2018, the spectacular phenomena of astronomy that some people call supermoon, blue moon, and blood moon happened on the night of January 31st or the early morning of February 1st. These phenomena are consequences of a total lunar eclipse. It occurs when the moon is in its closest position to the earth (perigee). In Indonesia, these three terms of moon become a controversy [1]. A supermoon happens where the moon is in 'perigee' position to the earth, blue moon indicating it is the second full moon in a month, and the blood moon is signifying the moon radiates blood red. The first full moon of January happened on the night of January 1st or the early morning of January 2nd, according to our location [2]. It was noted that the study about the moon had been considered by some authors, i.e. [3-9].

To response this phenomenon, as physics researchers we captured the perception of public or citizen about the phenomena. Pre-service physics teachers (PSTs) as a group are appropriate to explain these phenomena. They have already learnt about concepts of astronomy, including eclipse since primary school, indeed, through earth science course in the university. Specifically for PSTs, they will teach students scientific phenomena like a solar eclipse and lunar eclipse to their students.



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Furthermore, [this study](#) has two research questions: (1) To what extent do the Indonesian PSTs' existing knowledge and reasoning of the lunar eclipse phenomena? (2) To what extent do the Indonesian PSTs' existing knowledge and reasoning of the supermoon, blue moon, and blood moon?

2. Method

A qualitative research method was considered in helping the researcher to comprehend better the process of constructing meaning. The study used an interview and a written questionnaire. There eight teen participants in this study which forms the focus of this report. The participants were referred to by pseudonyms with popular Indonesian nickname, i.e. Rani (Rn), Hesy (Hs), Harun (Hr), Handal (Hn), Nabil (Nb), etc. The qualitative data from the results of semi-structured interviews were transcribed and analysed by reading the responses to each interview question [10-11]. The PSTs' reasoning was categorised into four levels: dissatisfied (naïve), intelligible, plausible, and fruitful.

3. Result and Discussion

RQ 1: To what extent do the Indonesian PSTs' existing knowledge and reasoning of the lunar eclipse phenomena?

Based on the RQ 1 data findings, There is the different opinion about lunar eclipse among PSTs'. Many of them have the lowest level or in the dissative (naïve) level. These opinions are shown as the statements and figure below:

"Sun, moon and earth are taken place in one straight line". [Hs]

"Blue moon, super moon and blood moon happens where sun, moon and earth are taken place in one straight line". [Kn]

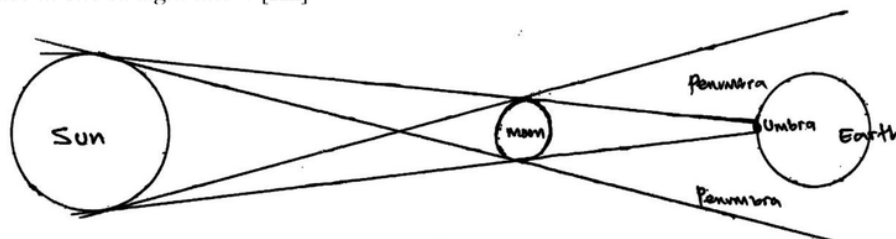


Figure 1. Kn's opinion about lunar eclipse illustration.

"The Blue moon happens where the earth, moon and sun are taken place in one straight line". [Zk]

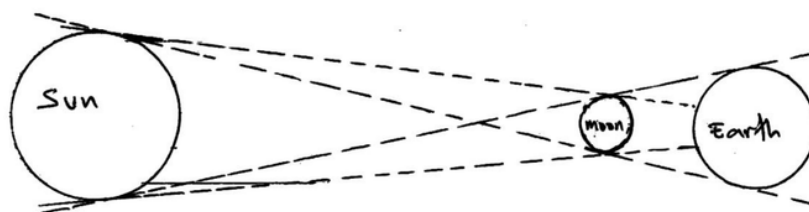


Figure 2. Zk's opinion about lunar eclipse illustration.

In the next level (intelligible level), some reasoning shows inappropriate statement and illustration but better than the previous level. These opinions show in the statements and illustrations below:

"The distance of earth and moon is closer". [LI]



Figure 3. Ll's opinion about lunar eclipse illustration.

"As far as I know, lunar eclipse happened when the earth is blowing light from the sun to the moon. It means the earth position between the sun and the moon". [Al]

"The position of earth and moon is closer". [Fd]

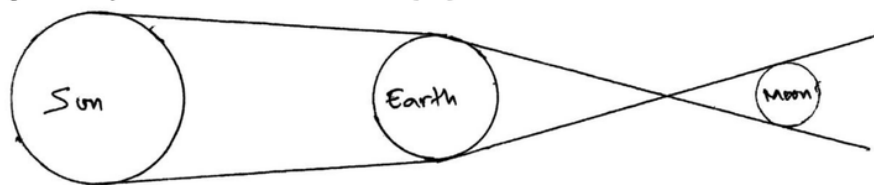


Figure 4. Fd's opinion about lunar eclipse illustration.

"The lunar eclipse happened when moon, earth and sun in a straight line". [Vr]

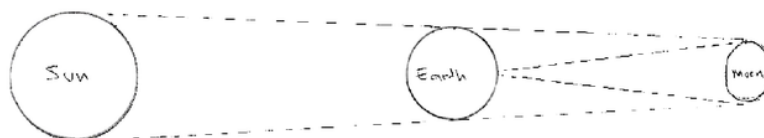


Figure 5. Vr's opinion about lunar eclipse illustration.

In the plausible level, the PSTs' opinion about lunar eclipse getting better, but not in a perfect description. These opinions' show at the statements and illustrations below:

"All type of lunar eclipse (Full moon, blue moon and blood moon) happened in rare time and the position of earth between sun and earth". [El]

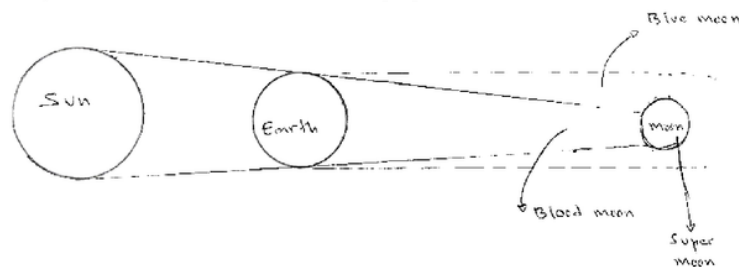


Figure 6. El's opinion about lunar eclipse illustration.

"lunar eclipse is a phenomenon when the sunlight that should be reflected by the moon can't reach the moon surface or can't be reflected". [Hr]



Figure 7. Hr's opinion about lunar eclipse illustration.

"The lunar eclipse occurs when the sun of the earth and the moon are in one straight line".
[Cd]

Regarding RQ 1, the findings also indicated that PSTs have some reasoning about the lunar eclipse. It means their reasoning reached the level of plausible and fruitful according to the first research question. The following are the example of scientific quotations (fruitful level) which performed by them:

"The lunar eclipse occurs when part or all of the moon's cross-section is covered by the shadow of the earth. It happens when the earth is between the sun and the moon in the same straight". [Jl]

"I know about lunar eclipse phenomenon that states if the solar, the earth, and the lunar are taken place at one straight line. Because it happens, it can cause the lunar doesn't have light sometimes". [Rn]

"Supermoon, blue moon and blood moon happen where sun, earth and moon that taken place at one straight line. The difference between of super moon and the common eclipse of the moon is the moon closest to earth, so the moon looks bigger than usual. And why scientific given name 'blood moon' because the colour of the moon is red". [Hn]

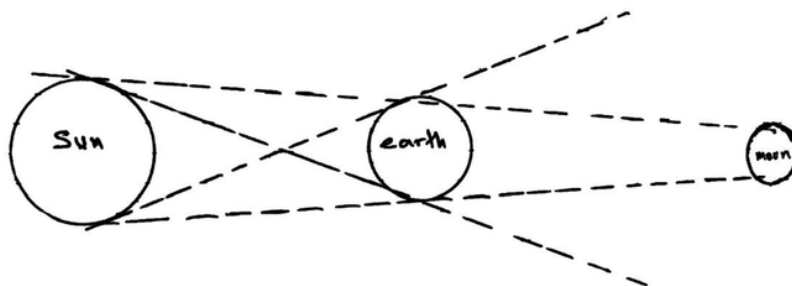


Figure 8. Hn's opinion about lunar eclipse illustration.

RQ 2: To what extent do the Indonesian PSTs' existing knowledge and reasoning of the supermoon, blue moon, and blood moon?

Based on the RQ 2, there are several reasoning of the Indonesian PSTs, which include four level categories. The first level is dissatisfied (naïve),

"A supermoon becomes the size of moon clearly, when the lunar eclipse happened, the general people said that "the moon was eaten Buto (Buto is a giant in the java legend)". [Zk]

"Actually, I don't know the reason, because the super moon happens it just because of the position of the moon and sun. And we can see the supermoon several positions in the earth".
[Dn]

"I think the black moon does not exist because cloud covers the moon. But the blue moon and supermoon exist, this phenomena caused the rotation of the earth." [Sk]

"I really believe that super moon, blue moon and blood moon is one of the marvellous phenomena". [Rn]

"Supermoon, blue moon and blood moon exists. There is a myth of those phenomena; if there is a pregnant woman in a solar eclipse, then the family must give food to their neighbor and people's pure, to protect the fetus". [Hs]

In this level, PSTs' reasoning about super-blue-blood moon is direct to myth, there is a correlation about super-blue-blood moon with the social condition, especially Javanese people. For the second level is an intelligible category, there are several sample reasoning of PSTs' about the super-blue-blood moon.

"Supermoon happens when moon seems bigger than usual; I believe that supermoon exists because I ever see the real condition of the moon is in the biggest condition". [St]

"Supermoon happened because moon look bigger than usual, and blood moon happened because the colour of the moon is red". [Lk]

"Supermoon happens when the coordinate of the moon is near to the earth". [Gb]

Most of PSTs' reasoning on this level is understand about the supermoon and the colour of the blood moon.

For the third level is a plausible category, this is the several sample reasoning of PSTs' about the super-blue-blood moon.

"Supermoon happens when moon seems bigger than usual, the colour of blood moon is red, and the colour of the blue moon is bluish". [NI]

"supermoon is the condition of the moon that has bigger size than usual, and blood moon is the colour of the moon is reddish. Same like blue moon, the colour of the moon is bluish". [Mt]

"supermoon is an anomaly, which the size of the moon is biggest. A blood moon is a condition, where the colour of the moon is reddish. And the blue moon, the colour of the moon is bluish". [Nb]

Most of PSTs' reasoning assumes that the blue moon is the colour of the moon that can see from the earth.

And for the fourth level is a fruitful category, this is the several sample reasoning of PSTs' about the super-blue-blood moon.

"supermoon is real because the moon's orbit isn't perfectly round, it's eclipse, so sometimes it's in the closest point to the earth. Blue moon isn't bluish; it is just terminology of 2 full moons in a month. A blood moon is real because it's light is filtered by molecules in the atmosphere". [Al]

"Supermoon happened when the position of the moon is very near with the earth. Blue moon is when two full moons happen in the same calendar month. The blood moon is the colour of the moon is red". [Ls]

"super moon happened when the position of the moon is closest with the earth. A blood moon happens when the lunar eclipse happens totally, and the colour is red. Blue moon is not the colour of the moon, but the period of lunar eclipse happen twice in one month". [St]

Almost PSTs' reasoning on this level is perfect, about the supermoon and a blue moon, but for blood moon, there are several PSTs' have reasoned that the colour of the moon is red

To sum up, the following section demonstrated they unfamiliar with the supermoon, blue moon, and blood moon. It means their reasoning reached the level of plausible and fruitful according to the first research question and at the level of 'dissatisfied' and 'intelligible' for the second research question. Meanwhile, regarding the second research question, the following are the example of a quotation by PSTs,

"Super blue blood moon is one of the phenomena that happen to the lunar phase. I believe it and really believe it will happen..." [Rn]

"Supermoon happens when moon seems bigger than usual; I believe that supermoon exists because I ever see the real condition of the moon is in the biggest condition". [St]

On the other hands, the following are the scientific conception created by scientists: "(1) Super moon happened when the moon's perigee - its closest approach to Earth in a single orbit - coincides with a full moon. In this case, the supermoon also happens to be the day of the lunar eclipse", "(2) A blue moon is when two full moons happen in the same calendar month; lunar eclipses occur when the moon passes into Earth's shadow", "(3) the term blood moon, there is a light coming into the penumbra area. If a glimpse of the moon is there, it will not make the colour of the moon become reddish or the so-called blood moon. Only if the moon passes entirely to the earth's umbra, the moon's colour becomes red, and the reason is that the light is so dimly lit" [4-9].

4. Conclusion

Finally, the conclusion can be derived from this study include: pre-service physics teachers performed enough understanding of the lunar eclipse phenomena with some levels of reasoning from naïve to fruitful. In contrast, their prevailing knowledge and reasoning of the supermoon, blue moon, and blood moon in the area of dissatisfied (naïve) to intelligible.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7
