

ANALYZING MISCONCEPTION ABOUT EARTH AND SOLAR SYSTEM HELD BY JUNIOR HIGH SCHOOL STUDENTS IN CENTRAL BANDUNG REGION USING A FOUR-TIER DIAGNOSTIC TEST

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Abstract: The difference between students' conceptions and science concepts is known as misconceptions. One of the topics that has a high percentage of misconceptions is the topic of Earth and Solar System. Misconception in this topic can cause other misconceptions which ultimately reduce students' motivation in learning science. Therefore, further research is needed in evaluating misconceptions on this topic to help teachers identify the most common conceptions and the concept with the highest number of misconception, so they can prepare the most suitable methods, models, and media to explain this topic. The instrument used was the Four-Tier Diagnostic Test. The research method used was quantitative research method, with cross-sectional survey design. The sample in this study consisted of 904 grade 8 junior high school students in the Central Bandung Region. The results showed that there are three types of conceptions with the highest percentage, namely Lack of Knowledge (29%), Scientific Knowledge (26%), and Misconception (24%). From these results, it can be seen that the number of misconceptions among students in this topic is still high, especially in the concept of planets (35%), earth movement in the solar system (23%), and sun characteristics (39%).

Keywords: Misconception; Earth_and_Solar_System; Conception; Diagnostic_Test

INTRODUCTION

In the world of science, students are taught about many scientific concepts, ranging from how the Earth was formed to microscopic phenomena that cannot be seen with the naked eye. All concepts taught in science are directly related to the life of living organisms on Earth. However, it does not mean that all students can understand science at the same type. Samsudin et al. (2025) state that the different type of student's conception can be influenced by many factors, some of which are sourced from classroom learning, interaction at school, and daily experience. Differences in conception not only occur between one student and another but also between students and the scientific concepts themselves. According to Gusmalini et al. (2020), a misconception is said to occur when the conception of students is not suitable with the conception that has been accepted by the experts in the field. Misconception itself has a main characteristic that can be identified, the main characteristic is that misconceptions tend to persist for a long time (Malaterre et al., 2023). Students who experience misconceptions tend to maintain their conceptions even after being given more accurate information.

Misconceptions have become a significant challenge in the realm of science, especially in the subject of physics. According to Resbiantoro et al. (2022), misconceptions in physics remain a challenge that teachers cannot ignore. This indicates that misconceptions can occur even in subjects with well-established formulas and theories. One topic where misconceptions are still prevalent is the Earth and Solar System. According to Azizah et al. (2022), there is a misconception among students on the Solar System topic, with this misconception reaching 64.3% for the rest are 10% of students

that do not understand the concept, 9.7% partially understand the concept, and 40.9% fully understand the concept. From the results of this research, it can be concluded that the rate of misconceptions among students on the topic of Earth and Solar System is still above 50%, which means misconceptions regarding this topic are still common among students.

Misconceptions can occur due to various factors, one of which is the knowledge index in society. Based on the Central Bureau of Statistics of West Java Province (2025), Bandung City is one of the major cities in West Java which has a high knowledge index of 65.89. The high knowledge index in Bandung does not make it one of the cities with a low misconception rate. There are several studies that have high misconception percentage results. Based on Sitepu and Yakob (2019), the highest average student misconception on the topic of Newton's Law reached 89.3%. Further research conducted by Ambarita and Rusyati (2025), resulted in the second highest percentage of misconceptions after Lack of Knowledge. The results of the percentage of misconceptions that became the second highest percentage of Type of Students' Conception also occurred in the research conducted by Saputri and Rusyati (2024), which resulted in the percentage of misconceptions as the second highest percentage after Scientific Knowledge. This result is in line with the research conducted by Amelia et al. (2024) which also states that the second highest percentage of students' conception after Scientific Knowledge is misconception. Some of the research results above reveal that the level of misconceptions in the city of Bandung is still relatively high, because it still ranks first and second. Of the many studies on misconceptions in Bandung City, research on misconceptions in the topic of Earth and Solar System is still very rarely done.

Misconceptions from Earth and Solar System topic as the gateway science may lead to the development of further misconceptions down the line (Salimpour et. al., 2021). If these misconceptions continue to accumulate, it can cause difficulties for students in understanding subsequent concepts. In addition, this topic is a gateway for students to develop an interest in science. If students find it difficult to understand the concepts in this topic, their motivation to learn science will decrease (Zuniari et al., 2022). This will certainly have a significant impact on students' critical thinking skills. According to Makhrus et al (2018), in science learning, we not only learn about concepts, laws, principles, and facts, but also learn the process of obtaining scientific reports, which will improve critical thinking skills, logical reasoning, and creative problem-solving abilities. Therefore, a decrease in students' motivation to learn science can lead to a decline in critical thinking skills, which will result in students' inability to solve problems, which will certainly have fatal consequences for their future lives. Therefore, reducing misconceptions in this topic can lower the likelihood of other misconceptions occurring. Additionally, there is a limited number of studies on identifying misconceptions in the solar system topic using the four-tier diagnostic test. Take a look at Figure 1.

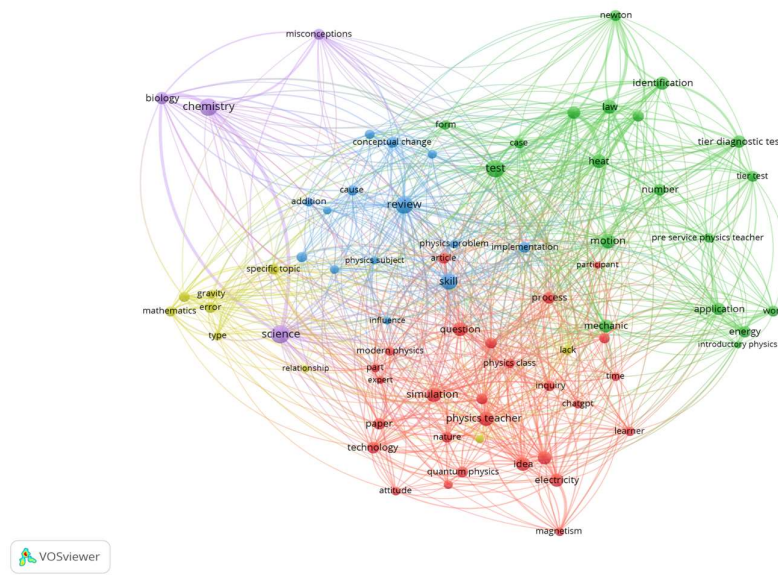


Figure 1: Bibliometric of Students' Misconception in Physics Topic

Based on Figure 1, it can be seen that there are five clusters in the study of misconceptions on topics in physics. If focused on the word misconception, there are several topics that appear, namely Newton, motion, heat, and temperature. In bibliometrics, there are no words that directly mention the topic of earth and solar system. This proves that misconceptions about physics topics, especially Earth and Solar System, in junior high school have not been widely researched before. In addition, there is little research on this topic using the Four-Tier Diagnostic Test instrument at the junior high school level in the Central Bandung Region. Most research on this topic has been conducted on samples of elementary school students and university students. Therefore, the development of a four-tier test instrument on this topic is crucial to identify and address misconceptions, as well as prevent further misconceptions from arising in the future.

There are various methods available to identify misconceptions held by students, mind-mapping or diagnostic test. Each method has its strengths and weaknesses, and not all methods are equally effective in identifying misconceptions. Four-Tier Diagnostic Test is one of diagnostic test that effective to identify the misconception. Based on Fenditasari et al. (2020), the four-tier diagnostic test has many advantages, which are this test can explore the understanding of students' concepts deeper because it includes a confidence type in the answer and reasons, becomes more effective in diagnosing students' misconceptions, becomes a reference that needs emphasis to understand the concept deeper and become a reference for determined learning that can decrease students' misconceptions. Because this research aims to identify the students' conception and common misconception among junior highschool students, The Four-Tier Diagnostic Test used in this research. According to Fakhriyah & Masfuah (2021), the advantage of the four-tier diagnostic test is that it can identify students' confidence in answering questions, allowing misconceptions to be identified more effectively. Although the four-tier diagnostic test provides many advantages in analyzing students' misconceptions, this test also has some drawbacks. One of them is that the four-tier diagnostic test itself cannot delve deeper into the reasons why misconceptions occur on the given topic (Habiddin & Page, 2019). However, to address this limitation, the diagnostic test can be supplemented with interviews conducted after the test with students who are indicated to have misconceptions on the tested topic (Dewi et al., 2020).

The Objective of this research are to analyze the type of conception and the most common misconception in each subtopic of Earth and Solar System among students. This research expected to help teachers in understanding the students' conception in Earth and Solar System topic and also understanding the most common misconception in this topic among the Junior Highschool Students so they can plan more effective learning to prevent misconception.

METHOD

In this Research, the method used was quantitative research method. While the research design used in this Research is a cross-sectional survey design. In this research, data collection in this design was carried out only once for each school in the research sample (single-data collection). The use of this type of survey has proven to be very useful for evaluating and understanding programs and situations at a certain point in time (Cohen et al., 2007). As explained by Fraenkel & Wallen (2009), data collection in this research design is carried out at one time, with a period that can be one week, one month or longer. The research is conducted at the Public Junior High School in Central Bandung region, West Java, focusing on 8th-grade students taught about Earth and Solar System topics based on *Kurikulum Merdeka*. There are 23 junior high schools in the Central Bandung Region but the research was only conducted in 20 schools that qualified as respondents.

The instrument in this research was distributed via google form and use Indonesian language to comply with school regulations and facilitate effective communication. The test instrument used in this study is a four-tier diagnostic test used to evaluate students' conceptions on the topic of Earth and Solar System and also to identify misconceptions that may exist on this topic. At the beginning of the instrument formation, there were 14 question instruments in the form of essays with two tiers to test students' conceptions, these questions were then formed into multiple choice questions with choices formed based on the answers or information obtained during the preliminary test. After the preliminary test, these questions were brought to experts for evaluation. After being approved by the expert, the preliminary test was conducted again to strengthen the test instrument. In addition to expert judgment and preliminary test, validity and reliability tests were also conducted, resulting in 12 question instruments that used in the research. Based on Inabuy et al. (2021), there are three subtopic of Earth and Solar System topic, namely Solar System, The Earth, and The Sun. In this Research, each subtopic has a different number of questions. The Solar System subtopic has five questions, The Earth topic has four questions, and The Sun topic has three questions. Each of these questions is considered to represent each subtopic because each subtopic is represented by more than one question

The research analysis using a coding system to categorize students' responses to the four-tier diagnostic test. The categories for concept type include Scientific Knowledge (SK), False Positive (FP), False Negative (FN), Misconception (M), and Lack of Knowledge (LK), based on the students' answers and confidence levels (Kiray & Simsek, 2021). The students that have the correct answer for Tier 1 dan Tier 3 and also confidence in answer the question will assumed as a student with Scientific Knowledge. While students with wrong answer in Tier three or one but confidence in answer the question, the students will assumed as the students with False Positive or False Negative conception type. While for the students that answer wrong in Tier 1 and Tier 3, they will assumed as the students with Misconception. The last, if the students have wrong answer in Tier 1 or Tier 3 or both of them and not confidence in Tier 2 or Tier 4 or both of them, they will assumed as students with Lack of Knowledge.

RESULTS AND DISCUSSION

Based on the Data Analysis, there are three students' conception type that have the highest percentage. To know the percentage for each type of conception can be seen in Figure 3.

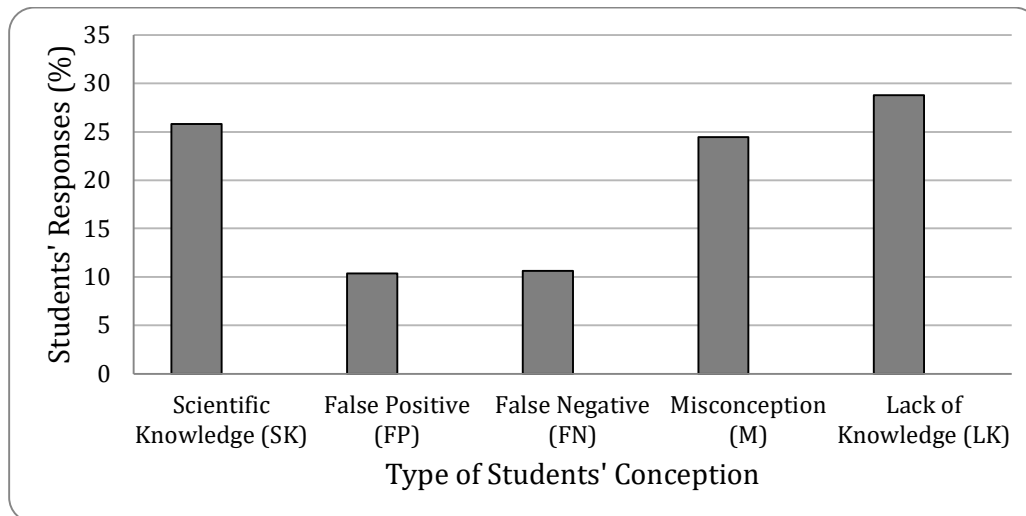


Figure 3. Type of Students' Conception in Earth and Solar System Topic

Based on Figure 3. about Type of Students' Conception in Earth and Solar System Topic, it can be seen that the type of conception that has the highest percentage is Lack of Knowledge with a percentage of 29% of the total student responses. When averaged, there are at least 260 out of 905 students who have this type of conception. This proves that there are still many students who do not have a good enough understanding of Earth and Solar System Topic. A student can be said to have a Lack of Knowledge type of conception when the student has no confidence in his answer, whether the answer is correct or not. This lack of confidence is caused by the lack of knowledge he has, so that the student feels unsure of the answer he has chosen. Based on the type of conception expressed by Kiray & Simsek (2021), when students answer incorrectly in tier one and tier three or answer incorrectly in both, and the student is not confident in the choices he chooses in tier one or tier three or both, whether the answer is correct or incorrect in that tier, then the student can be classified as a student with Lack of Knowledge.

The lack of student knowledge on the topic of the Earth and Solar System can be caused by students who have never received an explanation of some of the concepts in the topic of the Earth and Solar System, or students forget the explanation of the concepts that have been conveyed by the teacher. The ease of students forgetting the concept can be caused by a lack of student concentration while learning which can be caused by a lack of student motivation when studying this topic (Sanjaya et al., 2021). From the results of interviews with several teachers who teach students on the topic of the Earth and Solar System, it can be seen that during learning the main method used is lecture. From the method used not all students are enthusiastic about learning this topic. So it can be concluded that this lack of student enthusiasm can affect student motivation in learning. This lack of student motivation can be caused by the learning methods used which do not make students interested in learning. According to Zuniari et al. (2022), when learning only uses verbalism or lecture methods, where information is only obtained from the teacher, it can result in students only hearing and

memorizing what is conveyed by the teacher. This method will result in reduced student motivation in learning more about the topics taught. In addition to learning methods, learning media also affects student motivation in learning. The right learning media will improve the quality of learning, so that student learning motivation will increase (Sanjaya et al., 2021).

Another thing that can affect learning motivation in students is the concepts in science subjects that are more abstract, or difficult to describe concretely. Based on Mayanti et al (2022), science itself contains many abstract concepts that cannot be observed or observed directly, one of which is the concept of Physics. This abstract concept will make it difficult for students to understand these concepts (Duda & Adpriyadi, 2020). From the results of interviews with several students who became samples in this study, it can also be seen that there are some students who think that science subject is one of the subjects that is difficult to understand. Because Science is a subject that has interconnected concepts, the difficulty of understanding abstract things in one concept will lead to difficulties in understanding other concepts. When there are already too many concepts that are considered difficult to understand, this results in reduced student motivation in learning which results in a lack of student knowledge in science subjects (Syahputra et al., 2022).

There are several studies that have results where Lack of Knowledge is one of the types of conceptions with the highest percentage. The first study, with the subject of 5th semester students in the physics education study program, obtained results where the types of conceptions that have the highest percentage are Misconception (57.34%) and Not Understand the Concept (NUC) or what we know as Lack of Knowledge (34.68%) (Azizah et al., 2022). Another study was conducted using a two-tier diagnostic test among primary students in grade VI, the results showed that misconceptions had the highest percentage followed by lack of knowledge in second place, this result was caused by less effective, adaptive, and interactive teaching approaches and learning media used which affected students' learning experience (Muhabib et al., 2024). These research results state that Lack of Knowledge has a fairly high percentage and is caused by a mismatch of learning methods and learning media which results in student experience and student motivation.

Besides lack of knowledge, the type of conception that has the highest percentage for the whole topic is Scientific Knowledge with a percentage of 26%. With this result, it can be seen that although there are many students who still have a lack of knowledge on this topic, there are still quite a number of students who understand this topic according to the scientific concepts agreed upon by scientists. If averaged, there are about 233 out of 905 students who have conceptions that are in accordance with the concept of science. After Scientific Knowledge, in third place there is a type of misconception that has the highest percentage with a percentage of 24%, with an average of 221 students out of 905 students experiencing misconceptions in each question. The two types of conception that have the lowest percentage are False Positive and False Negative, with a percentage of 10% and 11%, and if averaged there are less than 100 students who have this type of conception. This means that there are only a few students who have knowledge of the concept but have a wrong understanding and there are only a few students who have the correct understanding but choose the wrong concept. False positive and false negative conditions can be caused by students who choose answers by guessing, or students are too hasty to answer questions (Bessas et al., 2024). With the small percentage of these two types of conceptions, it means that the possibility of students answering questions by guessing or in a haste is small.

The percentage of misconceptions in the results of this study is not the highest percentage, but misconceptions rank third after Lack of Knowledge and Scientific Knowledge. From Figure 3, it can be seen that the percentages between these three types of conceptions are not too far apart, all three being the three types of conceptions with percentages that are far above False Positive and False Negative. Therefore, we can conclude that misconceptions in this topic are still quite common. From the results of the analysis conducted, it is known that there is one concept each from each subtopic that has the highest percentage of misconceptions. Take a look at Figure 4.

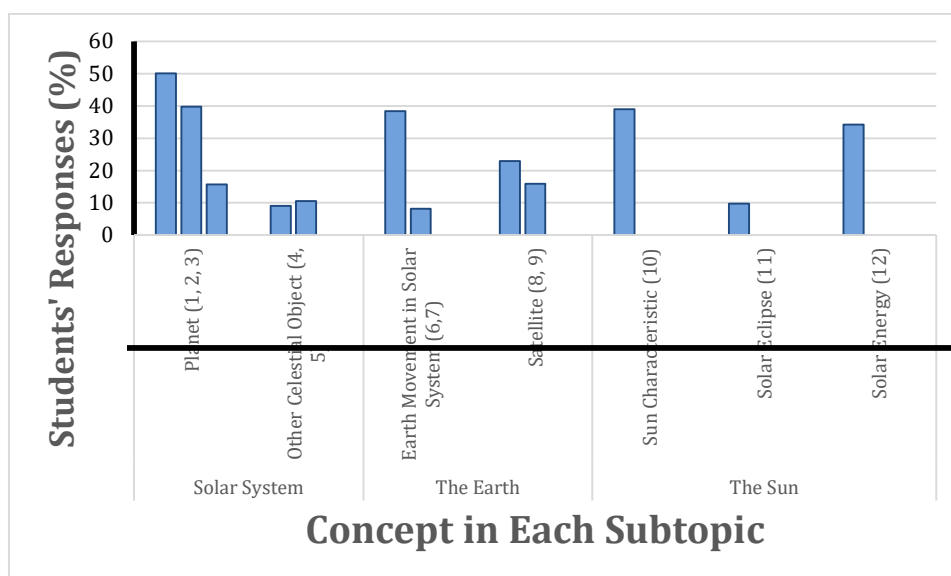


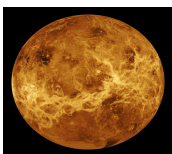
Figure 4. Students' Misconception in each Concept

In Figure 4., we can see the percentage of misconceptions for each concept on each subtopic in the Earth and Solar System topic. Each subtopic in this topic consists of 2 - 3 different concepts. In general, we can see from each subtopic there is one concept that has the highest percentage of misconceptions. For the first subtopic, Solar System, when averaged there is a planet concept with the highest percentage of misconceptions at 35%. For the second subtopic, The Earth, when averaged there is the concept of Earth Movement in Solar System which has the highest percentage of misconceptions at 23%. Then for the third subtopic, The Sun, when averaged there is the concept of Sun Characteristics which has the highest percentage of misconceptions at 39%. The high misconceptions in these three concepts can be caused by various factors. One of the factors is the initial concept owned by students that comes from the experiences they have. According to Duda & Adpriyadi (2020), one of the main factors of misconception is the initial conception derived from experience. In addition to the main factors that cause misconceptions in the three concepts, there are also supporting factors that can also cause misconceptions in the three concepts.

For the planet concept, there are three questions on this concept. These three questions address different sub-concepts. The first question dealt with the characteristics of the planet venus, where venus is said to be the hottest planet because its rotation time is longer than its revolution time. The second question discusses the characteristics of the earth, especially the characteristics of its atmosphere, where the dominant gas that makes up the earth's atmosphere is Nitrogen due to the difficult nature of Nitrogen to react. The third question discussed the definition of gravity. Based on Figure 4.5, it is

known that the question on the planet concept that has the highest percentage of misconceptions is question number 1 which discusses the characteristics of the planet Venus as shown in Table 1.

Table 1. The Highest Percentage of Misconception about Planet

Tier	Actual Question	Misconception Result
1	Observe the following image!  (source: https://www.detik.com/edu/detikpedia/d-6845415/venus-jadi-planet-yang-selalu-awet-muda-pakar-ungkap-rahasiannya) Venus is the hottest planet in the solar system. Why is Venus considered the hottest planet? A. Venus is close to the sun. B. Venus has a longer rotation time than its revolution time. C. Venus has no water, oxygen and gravity. D. Venus has a more extreme temperature and its temperature	Right Answer (SK): BADA AAAA (17%) AABA (50%) AACA (9%) CAAA (4%) CABA (1%) CACA (3%) DAAA (7%) DABA (4%) DACA (5%)
2	Are you sure with the answer? A. Yes B. No	
3	Why did you choose the answers in tier 1? A. The surface of Venus, with its thick atmosphere rich in carbon dioxide, is exposed to excessive solar heat, causing evaporation. B. The surface of Venus, with its thick atmosphere rich in carbon dioxide, is exposed to more solar heat due to its proximity to the sun. C. The surface of Venus, with its thick atmosphere rich in carbon dioxide, is exposed to solar heat, and this solar energy passes through the surface of Venus. D. The surface of Venus, with its thick atmosphere rich in carbon dioxide, is exposed to the sun's heat for longer and traps it in the Venusian atmosphere.	
4	Are you sure with your answer? A. Yes B. No	

Based on table 1., it is known that of the nine variations of answers that are a combination of answers that indicate misconceptions, there is a combination of answers that has a percentage with a very significant difference, namely 50%. In this question, there are 50% of students who think that Venus is called the hottest planet because of its proximity to the sun. Students assume that with Venus' close proximity to the sun, the surface of Venus, which has a thick atmosphere rich in carbon dioxide, will be exposed to more solar heat. This answer indicates that students have misconceptions because

Venus actually number second if all planets in our solar system are sorted from the closest to the sun. Although Mercury is the closest to the sun and gets more solar heat, Mercury is not the hottest planet because the atmosphere on Mercury is very thin so that the sun's heat will not be trapped in it (Hester et al., 2010). This is in contrast to Venus, which has a thick atmosphere and is rich in carbon dioxide (Westall et al., 2023). This is in accordance with the results of research conducted by Azizah et al. (2022), where there are still many students who have a conception where the naming of the hottest planet is based on the distance of the planet to the sun.

While the actual concept is that Venus is the hottest planet in the solar system because Venus' rotation time is longer than its revolution time. Venus' rotation time is 243 Earth days and its revolution time is 225 Earth days (Westall et al., 2023). With this longer rotation time, some of Venus' surface is exposed to the sun's heat for longer. With Venus' atmosphere being thick and composed of a lot of carbon dioxide, the sun's heat that enters Venus' atmosphere becomes trapped in it. This concept is related to the concepts of greenhouse effect, rotation and revolution. So in understanding this concept, it is necessary to first understand the concepts of greenhouse effect, planet arrangements, rotation, and revolution. Students' misconceptions on this concept can be caused by the incompatibility of students' initial conceptions of the greenhouse effect, planetary arrangement, rotation, and revolution with the new concepts they get about the reasons why Venus is the hottest planet. The mismatch in these four concepts will affect how students understand the new concepts they receive. It is from this inappropriate initial conception that misconceptions can arise (Duda & Adprijadi, 2020). This is in accordance with the results of interviews with students who became samples in this study. Based on the interview results, it was found that some students had insufficient knowledge about rotation and revolution, as well as about the arrangement of planets.

For the concept of earth movement in solar system, there are two questions with different sub-concept discussions. The first question discussed the effect of recollection on the earth, while the second question discussed the effect of the earth's rotation on the condition of the earth itself. Based on Figure 4.5, it is known that on the concept of Earth Movement in Solar System, the sub-concept that has the highest misconception is the sub-concept that discusses the effect of earth revolution on life on earth. It can be seen in Table 2.

Table 2. The Highest Percentage of Misconception about Earth Movement in Solar System

Tier	Actual Question	Misconception Result
1	What is the rotational and revolutionary motion of the Earth? A. The occurrence of day and night B. Determines seasonal changes throughout the year C. Occurrence of tidal cycles D. Regulates the direction of local winds	Right Answer (SK): BABA AAAA (92%) AACA (4%) AADA (0%) CAAA (0%) CACA (2%) CADA (1%) DAAA (0%) DACA (0%)
2	Are you sure with the answer? A. Yes B. No	
3	Why did you choose the answers in tier 1? A. This process causes changes in the duration of day and night	

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| every day.
B. It causes differences in the intensity of sunlight received in different parts of the Earth.
C. This process is mainly influenced by the gravitational attraction of the moon and the sun.
D. It is affected by differences in atmospheric temperature. | DADA(1%) |
|--|----------|
- 4 Are you sure with your answer?
- C. Yes
 D. No
-

Based on table 2., it is known that almost all students (92%) who experience misconceptions on this concept believe that the earth's revolution causes changes in day and night. They assume that the revolution can affect the duration of day and night, therefore the revolution can cause day and night. This indicates that they have misconceptions on this concept because the occurrence of day and night is the effect of the movement of the earth on its axis or commonly known as the rotation of the earth. The rotation of the earth can cause day and night because the rotation of the earth causes parts of the earth's surface to be alternately exposed to sunlight, parts of the earth that are not exposed to sunlight will experience nighttime and parts exposed to sunlight will experience daytime. The earth's rotation time is 24 hours, therefore one day on earth is equal to 24 hours.

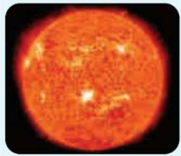
In contrast to students' understanding of the effect of the earth's revolution, the concept related to the effect of the earth's revolution on the actual situation on earth is that the earth's revolution affects the change of seasons on earth because the earth has an inclination of about 23.5 degrees to its revolutionary orbit, so that parts of the earth receive different solar intensities. It is this difference in solar intensity that affects the changing seasons on earth throughout the year (Hester et al., 2010). In summer for example, the sun is higher in the sky with stronger intensity. In winter, the sun is lower in the sky with a weaker light intensity. Furthermore, in spring and fall, the intensity of sunlight is moderate because it is in the transition period between summer and winter. The intensity of sunlight also affects the temperature on the earth's surface (Hester et al., 2010). Because with stronger light intensity and longer daylight duration, this causes the earth's surface temperature to feel warmer. Whereas in winter the temperature will feel colder due to the low intensity of sunlight and the shorter duration of the day.

Research on students' conceptions of revolution and rotation has previously been conducted, from several studies conducted previously, the majority discussed that one of the misconceptions held by students on the topic of the Earth and Solar System is the misconception that revolution causes alternation of day and night. Based on (Leoniza et al., 2025), the percentage of misconceptions in questions that discuss the concept of the occurrence of night reaches 62.5%. This means that more than half of the respondents experienced conceptions that were not in accordance with scientific concepts. Students' misconceptions on this concept can be caused by the initial conceptions that students have that are not in accordance with the new information they get. In this concept, for example, students have an understanding that the occurrence of day and night is an effect of the earth's revolution. In addition to factors from students' initial conceptions that are not appropriate, another factor that causes this misconception to occur is the lack of students' ability to distinguish rotation and revolution.

According to Desfandi et al. (2020), students are less able to distinguish the rotational movement of the earth and the earth's revolution so that they are wrong in understanding the impact of the earth's rotation and revolution on life.

In the Sun Characteristic Concept, there is only one question that discusses sunspots. This question discusses what sunspots are and how they are created. Consider Table 3.

Table 3. The Highest Percentage of Misconception about Sun Characteristic

Tier	Actual Question	Misconception Result
1	Take a look at the picture below!  (sumber : Pearson Heinemann/Wendy Gorton, 2009) The sun has several characteristics that can be observed with specialized solar telescopes from Earth, one of which is sunspots. What are sunspots? A. A more radiant region on the surface of the sun. B. Small components or particles inside the Sun. C. Dark regions on the Sun's surface that are cold. D. Pores on the Sun's surface that give off light.	Right Answer (SK): CADA AAAA (18%) AABA (11%) AACA (4%) BAAA (7%) BABA (15%) BACA (16%)
2	Are you sure with the answer? C. Yes D. No	DAAA (6%) DABA (10%)
3	Why did you choose the answers in tier 1? A. The presence of stronger light around the sun. B. There is a greater concentration of hot gas around the sun. C. There are many small surfaces around the sun. D. A magnetic field from inside the Sun.	DACA (13%)
4	Are you sure with your answer? A. Yes B. No	

Based on Table 3., it is known that the percentage for each misconception answer is not too different. However, there is a misconception with the highest percentage of 18%, this misconception is a misconception with the answer combination AAAA. This means that as many as 18% of students have the conception that sunspots are the brighter part on the surface of the sun, they believe this brighter part can be formed because of the strong light around the sun. According to the National Aeronautics and Space Administration (NASA), solar faculae are bright areas that are usually seen near the limb or edge of the solar disk. These sun faculae are inversely proportional to sunspots. According to NASA, sunspots are the darkest parts of the sun's surface that have cold temperatures. This dark part of the sun can be formed due to the magnetic field originating from inside the sun, when

this magnetic field is more intense this activity will inhibit the transportation of energy by convection causing the section to have a lower temperature (Mourato et al., 2024).

Misconceptions on this concept can be caused by students' initial conceptions and students' lack of understanding of sunspots. In this concept, for example, students have the conception that the sun is a star that emits light and heat but students are not familiar with the term sunspots, so that when given a problem containing a picture of the sun, students will assume that the brighter parts of the sun that they see in the picture are the shape of sunspots. This is in accordance with the results of an interview with one of the students.

Researcher : Please indicate which sunspots are in the picture.

Student 3 : (Points the brightest part of the sun in the picture)

Researcher : Now, before looking at the picture, what do you think sunspots are?

Student 3 : Just the small ones.

Researcher : Have you ever been taught or heard about sunspots?

Student 3 : Never.

From the results of this interview we know that learning about sunspots has never been delivered before. Therefore, students only rely on their initial concepts to answer this question.

From the results of this analysis we can know that students' conceptions of a concept and students' prior knowledge really need to be evaluated before adding new information with new concepts. The mismatch between the initial conceptions that students have and the new concepts they receive can cause misconceptions (Duda & Adpriyadi, 2020). Therefore, it is necessary to evaluate before starting the lesson to prevent misconceptions.

CONCLUSION

This study aims to identify the types of students' conceptions in the topic of Earth and Solar System and also identify the concepts in this topic that have the highest percentage in each subtopic. Based on the results of the study, it is known that from all subtopics in the Earth and Solar System topic, the dominant type of student conception on this topic is Lack of Knowledge, followed by Scientific Knowledge, then Misconception, then the last two orders are occupied by False Negative and False Positive. The high type of Lack of Knowledge conception in students can be caused by the lack of motivation possessed by students in learning the topic of Earth and Solar System. The low motivation of students in learning this topic is caused by the use of the lecture method during learning, inadequate learning media, and the topic of the earth and solar system includes topics that have abstract concepts or are difficult to describe in concrete form.

The results of the analysis for concepts with the highest percentage of misconceptions in each subtopic there is one concept with the highest misconception. For the first subtopic, the concept with the highest misconception is Planet, especially the subconcept of the characteristics of the planet Venus. The second subtopic, the concept with the highest misconception is Earth Movement in Solar System, especially on the concept of the effect of Earth's revolution on life on earth. For the last subtopic, the concept with the highest percentage is Sun Characteristic. The high number of misconceptions in these three concepts can be caused by the mismatch of students' initial conceptions and their lack of knowledge about the prerequisite conceptions of these three concepts.

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