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Astronomy Teaching in Primary Schools: Underrated Pupils

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4TH SHAW-IAU WORKSHOP ON ASTRONOMY FOR EDUCATION

THE 4TH SHAW-IAU WORKSHOP ON ASTRONOMY FOR EDUCATION WILL BE HELD FROM THE 15TH OF NOVEMBER 2022 TO THE 17TH OF NOVEMBER

Primary school students learn astronomy in a superficial way

- The scientific education standards of most countries and regions have very low requirements on astronomy. They mainly study factual knowledge and seldom discuss causal explanations or mechanisms. For example, as for the study of lunar phase, the Korean science curriculum clearly puts forward that the focus is to observe and confirm the periodic changes of the shape and position of the moon, regardless of the causes of the lunar phase.
- Some countries and regions have not even included astronomy in the primary school science curriculum standards. Such as Finland and Singapore.
- The astronomy content in the science curriculum standard for primary schools in China has gone through the process from the requirements for factual knowledge in the 2001 version of the curriculum standard to the exploration of laws in the version after 2017. However, the 2022 version of the curriculum standard has reduced the learning requirements for astronomy.
- Take the lunar phase content as an example: Know that the moon is a satellite of the earth, and know the daily and monthly motion mode of the moon (2001 edition curriculum standard); The moon moves around the earth, and its phase changes regularly every month (2017); The moon is the earth‘s satellite (2022). The learning period of specific content moves postponed.

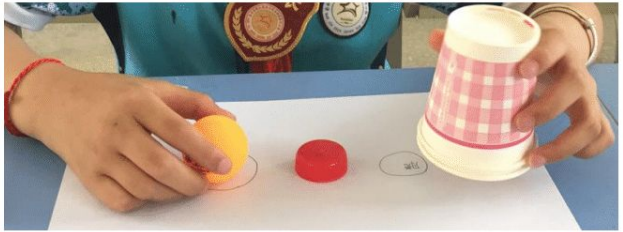
Grade	Primary School Science Curriculum Standard issued in 2017 in China	Science Curriculum Standards for Compulsory Education in 2022 in China
Grade 1-2	Describe the changes of the moon phase.	Know that the shape of the moon observed every day changes.
Grade 3-4	Know that the moon is the earth's satellite. Describe the law of moon phase change. Know the general situation of the moon surface.	Know that the moon is the earth's natural satellite; Understand the general situation of the moon's surface through telescope observation or image data.
Grade 5-6	Describe the relative size and relative motion of the Sun-Earth-Moon（S-E-M）.	Know the four phases of the new moon, the first quarter moon, the full moon and the last quarter moon, and explain the changes of the phases. Compare the relative sizes of the S-E-M.
Grade 7-9		Learn to use the three ball instrument to simulate the relative motion of the S-E-M, know the causes of solar eclipse and lunar eclipse, and understand that solar eclipse and lunar eclipse can be predicted.

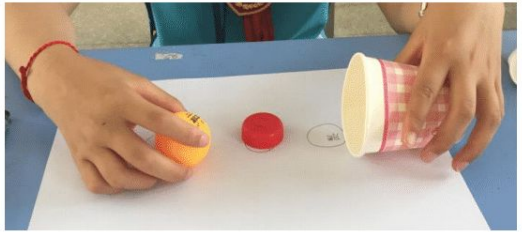
Does the curriculum standard underestimate pupils:
How do pupils understand the changes of moon phases?

Participants:
9 pupils from grade 1 to grade 6, a total of 54 were interviewed. 28 boys and 26 girls; 24 from urban schools and 30 from township schools.

Method: problem solving interview
1.What do you know about the moon?
2.What is the law of moon phase change?
3.How did the moon phase come into being?
4.How do you justify your claim?
5.How do you refute other claim?

Give the pictures of moon phases in different periods to the students. The students will sort the pictures according to their understanding of the law of moon phase changes and explain the reasons for sorting. This is to investigate the students' understanding of the prototype of the moon phase. And ask why the moon phase changes.





According to their own guesses about the causes of the moon phase, students use the items they can think of and find to simulate and verify, constantly adjust the model in the simulation process, and revise their understanding of the causes of the moon phase.

- **Results**:

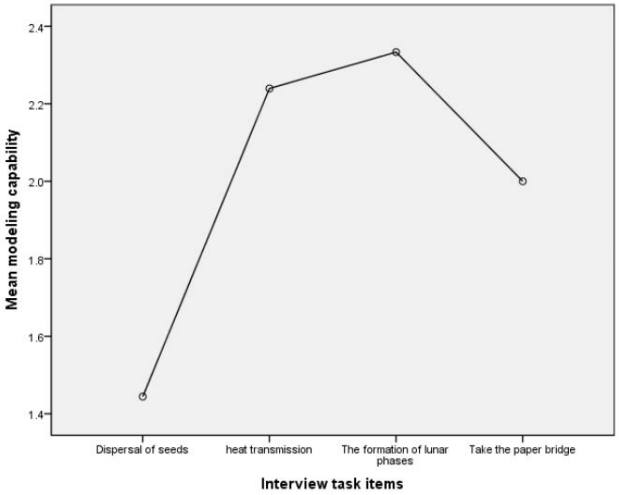
1. Pupils basically know that the shape of the moon will change;

2. Pupils' understanding of the law and cycle of the moon phase changes increased with the grade;

3. Grade 1-2 students are prone to work from naive mental models, such as the moon becomes smaller when thirsty, and when undressed; The most common explanation for the phase change is that it is covered by tall buildings, clouds, and the earth. Some pupils also think that part of the moon cannot be seen because the earth blocks the sunlight that shines on the moon. Through physical modeling, pupils can basically rule out the guess of being blocked by objects. The senior primary school students were able to successfully construct an explanation model to explain that the reason for the formation of the moon phase was related to the size and the rotation of the.

4. Compared with the contents in other fields of science curriculum, astronomy education can better cultivate students' modeling ability.

When using the model to explain the reason for the change of the moon phase, the students of grade 5 (11 years old) found that the moon phase could not be seen when it should be full. After several minutes of deliberation, He found that the model was also related to the distance and size between the S-E-M, and the parallel light of the sun. He revised the model and successfully explained the reason for the formation of the moon phase.



As for the modeling ability, the score of moon phase problem solving interview is higher than that of other projects, which shows that astronomy education has obvious advantages in cultivating students' modeling ability.

Collective learning in the classroom: pupils in grader 3 can build a part of the model of S-E-M

The high-definition camera is used to simulate the observer on the earth, the parallel light source to simulate the sun, and the big white ball to simulate the moon. One student holds the moon and revolves around the camera. One student restores the moon phase diagram observed by the camera to this location, and the next student restores the moon phase diagram observed at the next location. Through entity modeling, the third grade students can clearly see the process of moon phase change, understand that the size, location and mutual rotation of the are the reasons for the formation of the moon phase, so they build a more detailed S-E-M model.

When understanding the distance between the S-E-M, guide the students to think about "how is the distance relationship between the S-E-M so that the sun and the moon seen on the earth are about the same size?" By simulating the proportional relationship between large and small spheres and using the visual relationship of near large and far small, they can find the mathematical relationship that makes objects of different sizes look the same, understand the distance between S-E-M, and feel the vastness of the universe. The third grade students can improve the S-E-M model by participating in entity modeling through embodied cognition.

As long as the method is appropriate, pupils can also carry out simple model reasoning.