Iowa Science Teachers Journal

Volume 17 | Number 1 Article 8

1980

Moon Phases and Piaget

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Introduction

According to Piaget, a teacher must be aware of the mental development of children in order to present concepts to students in a meaningful way (1). Too often, the mental processes of children are ignored in teaching.

After years of teaching the phases of the moon in the traditional manner of using diagrams in texts, drawings on the board and teacher demonstrations with models, I discovered, several months after instruction, that a majority of my students could not demonstrate the positions of the moon in relation to the sun and earth in explaining moon phases. Previously, these students had been able to pass tests with flying colors during the moon phase instruction. Somehow this concept had not been presented to them in a meaningful way. The explanation for moon phases, if truly learned, should not be forgotten.

While taking a course in Piagetian philosophy, I began to understand why students have difficulty in explaining the phases of the moon. Traditional methods require students to visualize the moon from a different point of view than they actually have in the real world. According to Piaget, the ability to accurately visualize an object from a different point of view is reached late in the stage of concrete operations. Obviously, many of my students had not reached this stage of mental development. They could not visualize what caused moon phases from pictures in a text, drawings on the board, or from demonstrations with models. They needed a more concrete, hands on experience with the models to help them bridge a gap in their mental development.

Bridging the Gap

Keeping Piagetian philosophy in mind, the following changes were made in my teaching methods:

1. When students answered discussion questions they were asked the reasons for their answers. Such questioning gave insight into their level of thinking.
2. Students were administered short answer or essay type tests to see if they understood the phenomenon tested.

3. A greater effort was made to analyze student answers to ascertain the basis of their thinking.
4. Students were given more opportunity to explore subject matter on their own through special projects.
5. More time was spent listening to students.
6. Teacher demonstrations were converted to student manipulation of models.
7. Less attempt was made to cover a certain amount of material, with more emphasis on understanding the material covered.
8. Students were presented with more problem solving situations, giving them greater opportunity in controlling and manipulating variables.

Laboratories

Major changes were made in laboratory instruction. For example, in teaching the phases of the moon, time was spent in discussing the different shapes of the moon as experienced through student observation. Students were asked to draw the various shapes of the moon that they had observed. Each student experimented with and manipulated a model of the sun (a lamp), the moon (a styrofoam ball) and the earth (their head) in a darkened room (Fig. 1) so that they could recreate the shapes of the moon that they had drawn from experience. Students were asked to draw a picture of the model which they found explained all the shapes of the moon that had been observed. The following is a laboratory exercise used in the moon phase instruction.

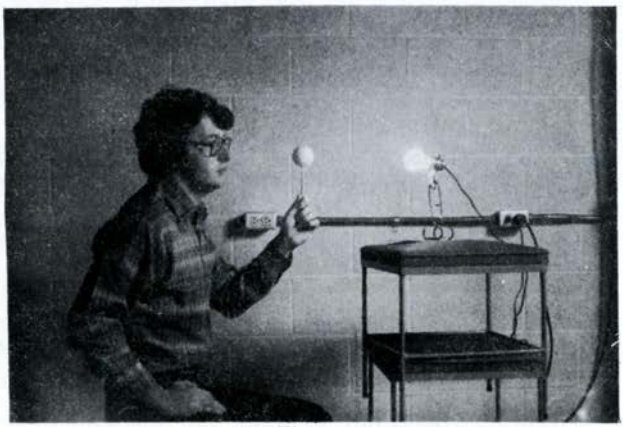

Fig. 1.

Moon Phase Laboratory

1. What is represented by each of the following in your model system?
   a. sun
   b. earth
   c. moon

2. While sitting at a desk, using the equipment provided, have the model moon move in such a way that all shapes appear exactly as illustrated in the pictures provided. Make a drawing of the system that best accounts for each phase of the moon in relation to you and the light bulb.
3. Experiment with various earth-moon distances to find where the different phases appear best. Do the phases appear better when the moon is closer to the earth or closer to the sun?
4. On your drawing show the direction of the moon's motion with arrows. Does this motion indicate rotation or revolution?
5. Indicate on your drawing in what position the sun could be blocked out (solar eclipse).
6. Indicate on your drawing in what position the moon could be blocked out (lunar eclipse).
7. Why doesn't an eclipse occur every month?
8. In addition to ease in study, why was the instruction given for you to sit at a desk while performing this lab?

Conclusion

Awareness of Piagetian philosophy concerning the mental development of children has changed my teaching of astronomy drastically. The teaching process is much slower than in traditional methods where students receive step-by-step instruction. More teacher patience is required since time is allowed for concept development to become an operational rather than a rote experience. Many of these changes bother students because they are more on their own and have to think for themselves, but isn't this one of the ultimate goals of education?

Literature Cited

1. Allen, T. 1977. Implications of Piaget for everyday laboratory experiences for children. *Iowa Science Teachers Journal* 14(2):32-35.

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Borrowing Moon Rocks

Samples of the Moon's surface (rocks brought back by Apollo mission astronauts) may be borrowed for classroom use from NASA at no charge. Before being entrusted with the rocks, however, teachers must attend a three-hour NASA briefing session.

Six lunar rock samples make up part of a kit that also includes slides, literature, audio tape and a film. The rock samples are enclosed in plastic discs, and can be studied using ordinary 10X-20X microscopes.

The kit is designed for grades 5-12. For more information, write: James Poindexter, Mail Code AP-4, Johnson Space Center, Houston, Texas 77058.