The Sun, the Earth and the Moon: Young Students’ Grappling with an Illustration of the Lunar Phases

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Illustrations Making Meaning? Young Pupils Encountering Explanatory Pictures and Models in Science and Mathematics Education in Primary School and Pre-school (MILL)
RATIONALE

Our research is based upon:

- A cultural-historical and sociocultural perspective within the Vygotskian tradition

- Socio semiotic theories maintaining that visual information is always coded and that its interpretation is related to particular cultures and situations (Kress & van Leeuwen, 1996; Meira, 1998; Pintó, 2002; Roth 2003a, 2004)

- Arguments by Wartofsky such as: “Representing is something we do, [...] nothing is a representation except insofar as we construct or construe it to be one” (Wartofsky, 1979, p. xxi)

Adopting such a theoretical approach implies that students’ understanding of explanatory images and models in education cannot be taken for granted.
New ways of presenting information have affected both contemporary society and education:

- Not only is there a steady increase of graphics in children’s books (Norman, 2010) ....
- but the illustrations have also become more and more important “as they now carry as much, if not more, meaning as the written text” (Norman, 2010, p. 2).
- In addition, multimodal electronic teaching aids steadily gain terrain.

Considering this, there is a surprisingly small body of research on how pre- and primary school children interact with and make sense of illustrations they meet in educational contexts.
THE PRESENT STUDY

Young Students’ Grappling with an Illustration of the Lunar Phases

... or in the words of a young student: “Can there be a full moon at day-time?”

The illustration was chosen because:

a. it is of a kind frequently used to explain the lunar phases and...

b. the phenomenon (i.e. what causes the lunar phases) is known to be difficult to understand for students of all ages.
THE AIM OF THE STUDY

.... has been to contribute to the understanding of children’s interpretation of images used in science education as well as to point out what problems (if any) this particular illustration may cause.

Research questions directing the analysis:

- Which central features of the illustration do the students identify?
- Are the students able to point out the new and full moon phases in the lunar orbit with point of departure in the provided information?
- Are there indications of the students’ adopting necessary perspectives, and if not, what are the consequences?
- What resources do the students use to place phases of the Moon in the lunar orbit? (Will not be further mentioned in this brief presentation)
**THE EMPIRICAL STUDY**

Subjects:

✓ 20 students 9-12 years old (i.e. school years 3-6) attending a village school in the inlands of southern Sweden

Data:

✓ Video recordings, field notes, and the children’s solutions to a given task

Conducting the study:

The students, working in pairs and guided by the first author, were ...

a) asked to read two double pages from a booklet labelled Månboken (the Moon Book),

b) shown a picture of eight moon phases, which they went through with the researcher... (to be continued)
“The Moon Book” and is part of an often used series of reading material with a declared twofold purpose:

- to practice reading and
- to provide knowledge in topics of interest.

It contains 16 pages and is categorised by the publisher as Level 5 (out of 11).

There is often just one set of booklets in a classroom.

Varför lyser månen?

Why does the Moon shine?
The Moon is cold and dark. It cannot shine. It is the Sun that shines on the Moon. That is why the Moon looks bright.

We see the part of the Moon that the Sun shines on. We call it the day side. But the Moon wanders around the earth. Therefore, we see different amounts of the day side of the Moon.

It takes almost a month for the Moon to orbit.
The Moon looks round when we see the whole day side.

The Moon looks half when we see half the day side.

Sometimes the moon looks like a small crescent. That is when we see just a small, small part of the day side.

Some nights we do not see the Moon at all. Then the night side of the Moon is turned towards us.
THE PICTURE OF EIGHT LUNAR PHASES ...
running from a new moon through a waning crescent
Conducting the study (continued):

Working in pairs and guided by the first author, the students were:

a) asked to read two double pages from a booklet labelled Månboken (the Moon Book),

b) shown a picture of eight moon phases, which they went through with the researcher,

c) asked to point out the positions of the new and full moon phases in the lunar orbit in the illustration of the first double page, and

d) given the task to write down the eight phases of the Moon in the lunar orbit on a copy of those pages.
The research questions were taken as the main point of departure for the analysis.

We have used Engebretsen’s (2012) approach to the study of semiotic complexity. Engebretsen argues for the need of an acute balance between cohesion and tension in the interplay between different modes.

In addition, we have considered the children’s ways of handling illustrations and text with respect to four of Carney and Levin’s (2002) five functions of images:
Carney and Levin’s (2002) five functions of images

Four are conventional:

1. **Decorational images** bear little or no relationship to the text content
2. **Representational images** are the most common and mirror the text content and their function is to make the text concrete.
3. **Organizational images** provide a structural framework for text content
4. **Interpretational images** aim to clarify difficult text.

The fifth is unconventional and not applicable in this study:

5. **Transformational (mnemonic) images** with memory enhancing components are designed to improve information recall and are relatively rare.
Glimpses from the Results

When having read the four pages, the students were asked if they had also looked at the pictures. Not all had done so. After that they were asked what the illustration showed.

- All students identified the Earth, the Moon, and the lunar orbit, but some of them missed that the Sun was part of the illustration.
- Later in the discussions some students did not take notice of the direction of the arrows.

Varför lyser månen?


Det tar nästan en månad för månen att vandra ett varv.
When the students were requested to point out the new and full moon positions, three main ways to approach the task were identified:

- One builds upon the idea that the phases of the Moon are caused by an eclipse of the Moon by the Earth.
- Another builds on students’ own experiences of seeing the Moon in the sky.
- A third way was to make interpretations more closely related to the illustration.
**EXEMPLARY 1**

Lisbeth: When the moon looks like this [points at the full moon in the picture with the eight phases] ... where is it in the other picture then?

Emma: Maybe here [points at the new moon position].

Lisbeth: Mm. Why do you think so?

Emma: Cos then the sun´s shining right on it.

Approaching the illustration with an eclipse interpretation inevitably results in placing the new and the full moon phases at positions of the lunar orbit opposite to the correct ones.
EXPERIENCES OF SEEING THE MOON AT NIGHT...

EXCERPT 2

Robin: ... there...[points at the full moon position]
Lisbeth: Mmmm. Why do you think so?
Robin: Just that...like it’s dark there [points at the dark side of the Earth directly opposite the full moon position]... ...

David: I think it’s there [points again at the new moon position]. It’s a full moon when it’s daytime.
Robin: What? Can you have a full moon during the day?

This way leads to correct placing of the new and full moon phases in the lunar orbit -- but without need of adequate understanding.
**POINT OF DEPARTURE IN THE ILLUSTRATION ...**

**Excerpt 3**  

**Iconic interpretations**

**Lisbeth:** When do we see the full moon from Earth? …

**Ellen:** ..it´s half here..[points over the lunar orbit in the book]. and after that it´s whole

**Lisbeth:** Mmm. When the Moon is here then [points the pencil toward the full moon position]?  

**Elsa:** Hmmm ... Half.

**Ellen:** Yes..it is half..and then ... Then it´s full four times as well then [points over the arrows with a circling gesture]?

Seeing the four semi-filled circles as half moons leads to suggesting four full moons in a lap. Three pairs made such iconic interpretations.
These two fourth-year students were the only ones that without hesitation talked about the moon phases in an adequate way.
Following Carney and Levin (2002), the images on the second double page have a representational function. They mirror the text content and help making the text concrete.

“The Moon looks round when we see the whole day side.”
“The Moon looks half when we see half the day side.”

However, to make sense of this, it is necessary to get to grips with “the day side on the moon”.

The illustration on the first double page (i.e. the illustration in focus for the present study) has an interpretational function in that it aims to clarify difficult text.

However, our analysis shows that it does not provide much help to the students to understand why the moon in the sky looks different on different occasions.

Why not?
DISCUSSION (continued)

According to Engebretsen (2012) there is a need for an acute balance between cohesion and tension in multimodal texts designed for learning.

Even if Engebretsen argues for a certain amount of tension between different modes to create engagement, he also maintains that informative texts typically have high levels of cohesion in the semantic dimension.

In our understanding, the level of tension between the text introducing the day side of the moon and the illustration might be too high to promote adequate meaning making.

“We see the part of the moon that the sun shines on. We call it the day side.”

However, there is another stumbling block to consider!
THE NECESSITY OF TAKING TWO PERSPECTIVES

➢ An “above-the-ecliptic” perspective ...

... is necessary for understanding the shading of the Moon and the Earth in the illustration.

Making iconic interpretations of the four semi-filled circles is one indication of not having adopted this perspective.

➢ A “standing-on-Earth” perspective ...

... (or rather a perspective from “standing on the northern hemisphere of the Earth”) is needed to correctly point out the positions of the lunar phases.
Some Didactic Reflections

- The image in focus, like many other images illustrating the phases of the Moon, is obviously not self-explanatory for all students in the ages for which the booklet is intended.

- Most groups were able to place the eight phases correctly in the lunar orbit but only with extensive scaffolding.

- It seemed as those students who leaned on experiences of seeing the full moon at night had an advantage compared to those making an eclipse interpretation.

- Whether this topic is to be treated as early as prescribed, in at least the Swedish curriculum, is an open question, and in line with previous arguments (Trundle, Atwood, & Christopher, 2007).
Thank you for your attention!

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