



Design, Implementation and Evaluation of a Teaching and Learning Sequence concerning Apparent Movement of the Moon

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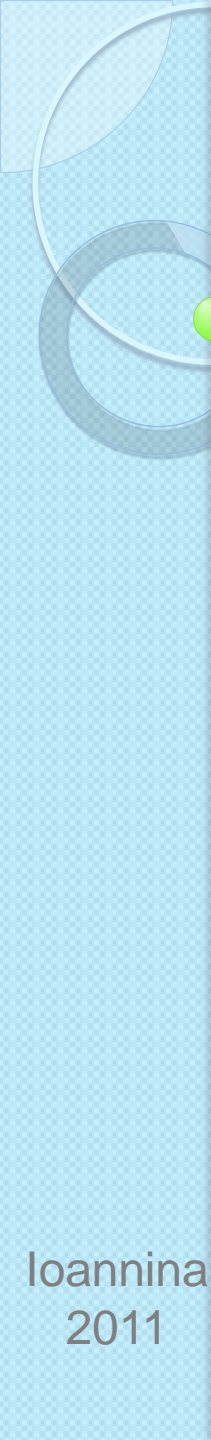
University of Athens (pedagogical department)



◦ Part of a broader research:

Sun - Earth – Moon system's relative movements from an educational point of view.

“Educational Reconstruction” (Duit et. al, 2005)

- 
- Structure Analysis of the scientific content
 - Empirical studies on students' explanations and learning pathways
 - Development of instructional modules



Earth's spinning on its rotational axis

Moon's revolving around Earth

Earth's revolving around Sun



Earth's spinning on its rotational axis
Sun's Apparent Movement



Moon's revolving around Earth
Moon's Apparent Movement



Earth's revolving around Sun
Seasonal Change





Moon's revolving around Earth
Moon's Apparent Movement





Apparent Movement of the Moon (Scientific Model)

The Moon rises every day with an approximate 50 min. delay due to:

- *spinning of the Earth once a day,*
- *revolving of the Moon around the Earth within a synodical Month.*

Moon's Apparent Movement (Students Conceptions)

- Mant & Summers 1993
- Sharp 1996,
- Bekiroglou 2007,
- Plummer 2009,

Moon's Apparent Movement (Students Conceptions)

- The phenomenon is attributed to celestial movements and not to human centered or teleological views
- takes place always at night
- 24hour periodicity of the phenomenon
- Geocentric views of the **S – E – M** system
- Development of a instructional module based on the fact that the phenomenon's periodicity isn't 24hour

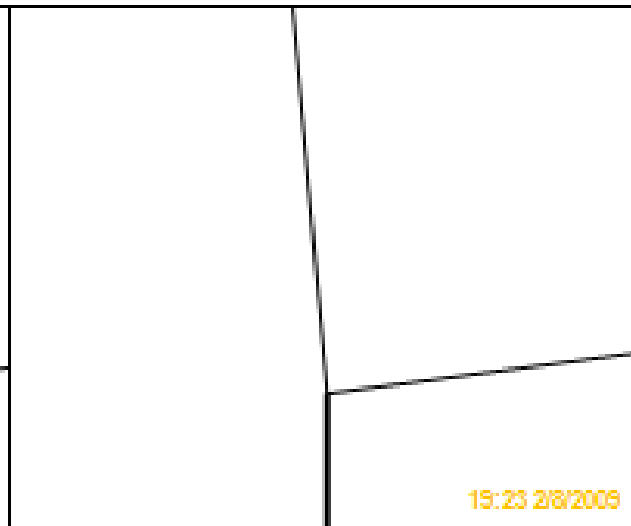
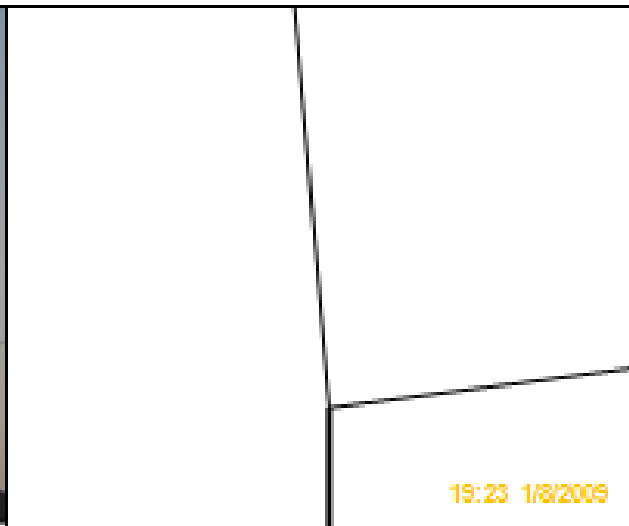
(Starakis & Halkia 2010)

Teaching and Learning Sequence (1)



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Teaching and Learning Sequence (2)

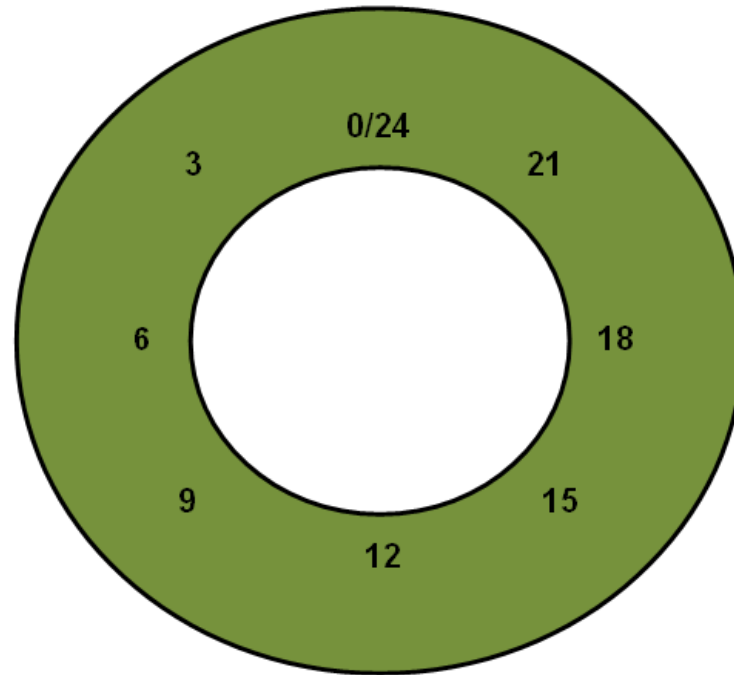


Teaching and Learning Sequence (3)

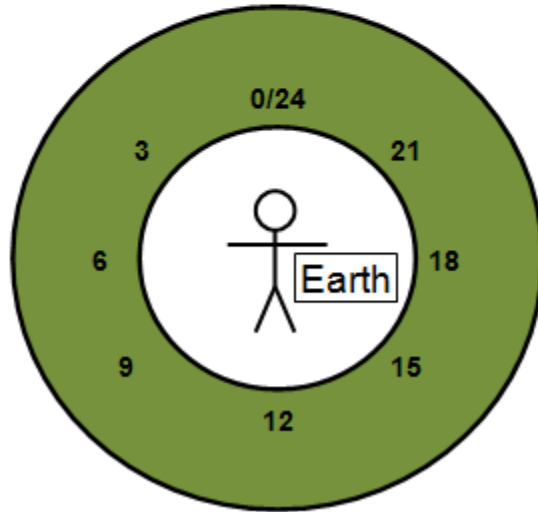
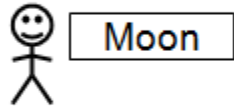


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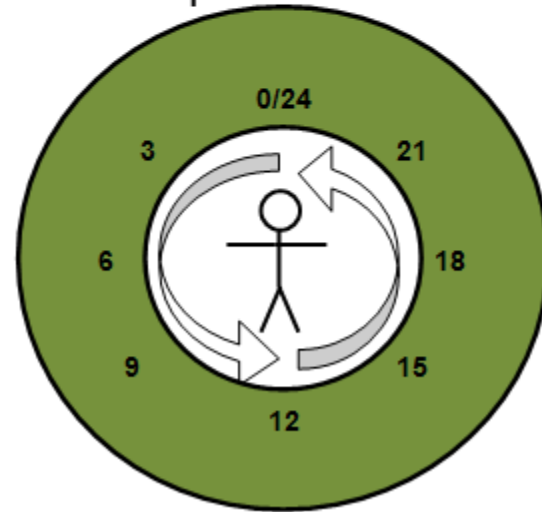
Teaching and Learning Sequence (4)



Teaching and Learning Sequence (5)



t = 0



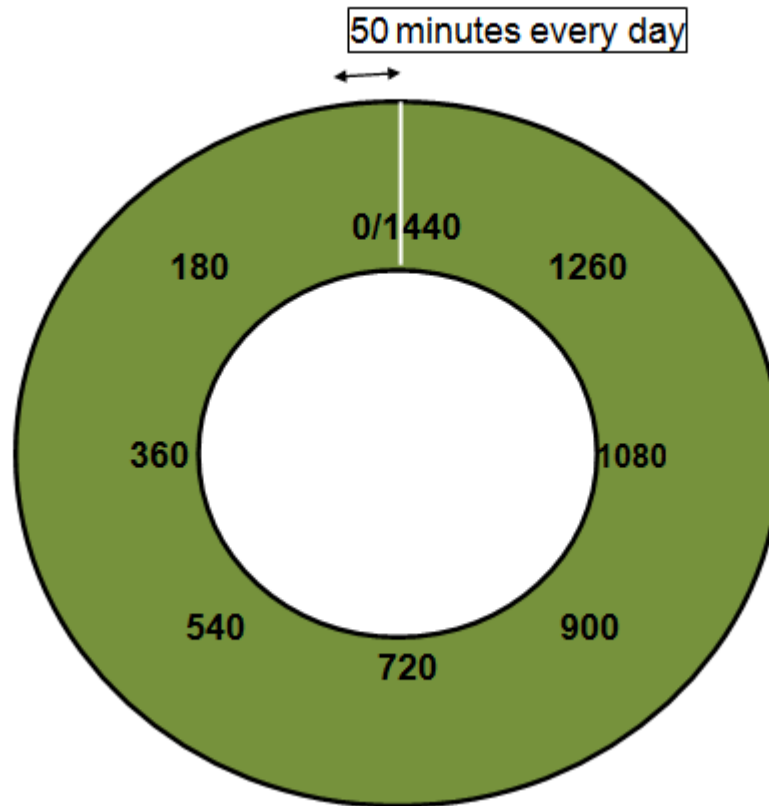
t = 24 hours

Teaching and Learning Sequence (6)



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Teaching and Learning Sequence (7)



Sample

- 5 Primary Schools of Athens
- 40 students chosen by random sampling
- 8 5th grade students from each school (*2 groups of 4 students in each school*)
- “Teaching Experiment” (Komorek & Duit, 2004)

Collection of the Data

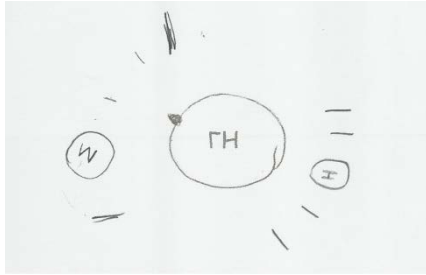
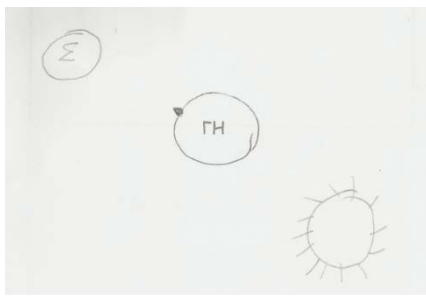
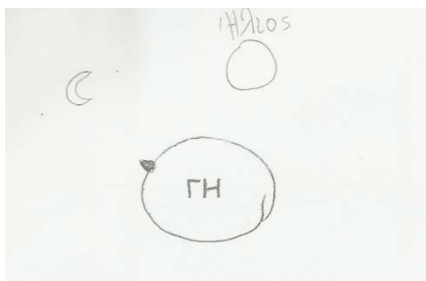
- Quantitative Methods
- Qualitative Methods

Results (1)

PERIODICITY OF THE APPARENT MOVEMENT OF THE MOON	PRE TEST (N)	POST TEST (N)
More than 24 hour (scientific explanation)	0	22
More than 24hour (earth spins within 24 hours- moon revolves earth)	0	8
More than 24hour (moon revolves earth within a synodical month)	0	1
24hour	24	6
No apparent movement of the Moon	12	0
Incoherent	2	2
“I don’t know”	2	0

Results (2) pre test

“Imagine that on the spot representing the place you live it is midnight.
Add on the picture the Sun and the Moon relative to the place you live in.”

Category	Figure	n	%
1. At opposite sides of the Earth (1)	 A hand-drawn diagram on a light background. In the center is a circle labeled 'ΓΗ' (Earth) with a small crescent on its left side. To the left of Earth is a smaller circle labeled 'Σ' (Sun). To the right of Earth is another smaller circle labeled 'Φ' (Moon). There are several short, parallel lines radiating from the Sun and Moon, representing light rays.	23	57,5
2. At opposite sides of the Earth (2)	 A hand-drawn diagram on a light background. In the center is a circle labeled 'ΓΗ' (Earth) with a small crescent on its left side. To the top left is a smaller circle labeled 'Σ' (Sun). To the bottom right is a larger circle with many short lines radiating from it, representing the Sun. The Moon is not explicitly labeled but is represented by the radiating circle.	10	25
3. The Moon is in front of the spot and the Sun is far away	 A hand-drawn diagram on a light background. In the center is a circle labeled 'ΓΗ' (Earth) with a small crescent on its left side. To the top right is a small circle labeled 'Φ' (Moon) with the word 'Ηλιος' (Sun) written above it. To the left of Earth is a small crescent representing the Moon. The Sun is not explicitly drawn but is labeled.	2	5

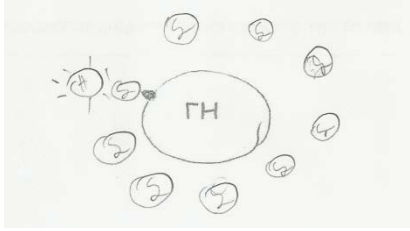
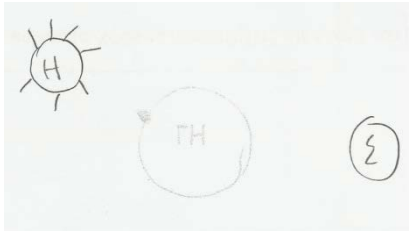
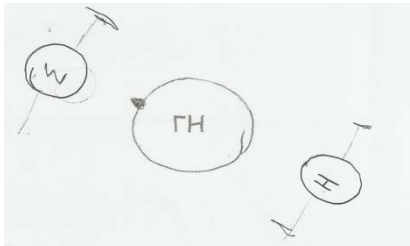
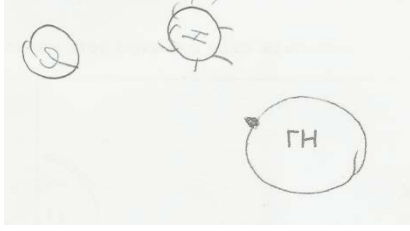
Results (2) pre test

“Imagine that on the spot, representing the place you live, it is midnight. Add on the picture the Sun and the Moon relative to the place you live in.”

Category	Figure	n	%
4. <i>The Sun is “behind” the spot and the Moon could be everywhere</i>		3	7,5
5. <i>Both are in front of the spot and the Moon hides the Sun</i>		1	2,5
6. Incoherent		1	2,5

Results (2) post test

“Imagine that on the spot representing the place you live it is noon. Add on the picture the Sun and the Moon relative to the place you live in.”

Category	Figure	n	%
1. The Sun in front of the spot and the Moon could be everywhere		31	79,5
2. At opposite sides of the Earth (1)		5	12,8
3. At opposite sides of the Earth (2)		1	2,55
4. The Moon is in front of the spot and the Sun is far away		2	5,15

Conclusions



- existence of the phenomenon
- periodicity of the phenomenon and the concerned explanation
- “interfering” concepts/conceptions



- direction of the Moon’s revolving around the Earth



Thank you for your attention...