ThinkSpace: Spatial Thinking in Middle School Astronomy Labs

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ThinkSpace labs teach astronomy while supporting spatial thinking skills, like imagining a scene from multiple viewpoints.
Project OVERVIEW

ThinkSpace labs teach astronomy while supporting spatial thinking skills, like imagining a scene from multiple viewpoints.
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The Three Labs

1) Moon phases and eclipses
2) Planetary systems around stars other than the Sun
3) Celestial motions within the broader universe
Spatial Thinking and STEM

- Spatial skills correlate with performance in science domains, and likelihood to enter a career in STEM (e.g. Hegarty, 2014, Wai et al. 2009, 2010)
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Perspective Taking

16-item task
Liben, Downs, & Bower, 2015
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WWT ThinkSpace Moon Lab

• 3-day lab experience tested with middle school students
• Focus on WHY we experience Moon Phases and Eclipses
• Students use physical and virtual models (WorldWide Telescope) to understand the Moon phenomena and practice perspective taking skills
Modeling Moon Phases

Physical model
lamp/styrofoam balls
Modeling Moon Phases

**Physical model**
- lamp/styrofoam balls

**Virtual model**
- WorldWide Telescope

![Image of Earth, Moon, and Sun models](image.png)
Modeling Moon Phases

Physical model  Virtual model

• Students use models to practice switching mentally between 2D “sky” view and 3D “space” view of Moon - *perspective taking*
Research Questions

RQ 1: Are spatial skills levels predictive of students’ content learning gains from these spatially rich labs?
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**RQ 1:** Are spatial skills levels predictive of students’ content learning gains from these spatially rich labs?

**RQ 2:** Do students’ spatial skills (e.g. perspective taking) improve after completing a ThinkSpace Lab?
Pilot Testing, Dec 2015

- Distractor-driven multiple choice (MC) questions from the Astronomy and Space Science Concept Inventory (Sadler et al, 2010): 11 questions about Moon Phases and Eclipses on pre/post assessments.
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- Cohen’s d ~ 0.5 → medium effect
- Cohen’s d >0.7 → large effect
Pilot Testing, Dec 2015

- N=83 sixth grade students, 3-day intervention

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- Moon Phases assessment: Cohen’s d = 2.07±0.12

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- Moon Phases assessment: Cohen’s d = 2.07±0.12

DOUBLE the effect size of a prior version of the Moon Lab that did NOT emphasize perspective taking skills

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Pilot Test Results

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RQ 2: Do students’ spatial skills (e.g. perspective taking) improve after completing a ThinkSpace Lab?

Cohen’s $d = 0.34 \pm 0.07$
Takeaways

- ThinkSpace Moon Lab is effective (Cohen’s d = 2.07±0.12, N=83)
- Perspective taking skills increased (Cohen’s d = 0.34±0.07) - but need to do a test/re-test with control group
- 240 additional students will pilot test Moon Lab in winter/spring 2016
- Goal: learn how to best support students of all spatial thinking abilities in astronomy classes.
- The ThinkSpace Moon Lab is free to download and use.

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