Enhancing Astronomy Learning through Cognitive-Aligned Experiential Strategies

Luthfiandari and
Yatny Yulianty

BOSSCHA OBSERVATORY
INSTITUT TEKNOLOGI BANDUNG

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Perform:
Education, Research,
Public Service



Bosscha Observatory

Faculty of Maths & Natural Sciences, ITB - Indonesia



Students Education At Bosscha Observatory

- Continuous enhancement of astronomy education since 2024
- Focus on **interactive, contextual** (school curriculum), **hands-on activities**
- **Collaboration** with astronomy undergraduates of ITB
- Tailored to students' **cognitive development** across educational levels



01 Early Childhood (3–6 years)

Piaget's Cognitive Development Theory

- *Sensorimotor stage (0-2 years)*
  Learning through senses and actions; object permanence develops.

- *Preoperational stage (2-7 years)*
  Symbolic thinking emerges; egocentrism and intuitive reasoning dominate.

sensory exploration, play-based learning

Hands-on Activities

1. Constellation from Beads
2. Jupiter in a Jar
3. Galaxy Clay
4. Paper Rocket Craft
5. Moon Painting
6. Crescent Moon Magnet
7. Constellation Projection
8. Moon Crater Model

Constellation from Beads







Moon Painting







02 Elementary School (7–12 years)

Piaget's Cognitive Development Theory

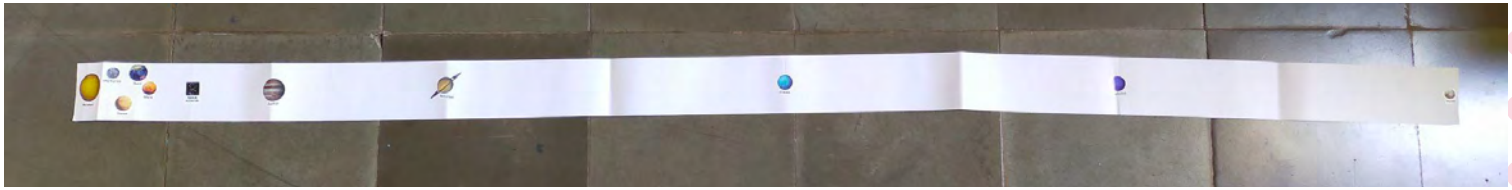
- *Concrete Operational (7–11 years)*
  Logical reasoning about concrete events; mastery of conservation and classification.

simple experiments, interactive demonstrations

Hands-on Activities

1. Lava Layering of Olympus Mons
2. Solar System Distance Ribbon
3. Constellation Distance
4. Earth and Moon Scale
5. Solar Surface Activity Model
6. Milky Way Galaxy Model
7. Constellation Box

Solar System Distance Ribbon







Milky Way Galaxy Model





03 Middle School (13–15 years)

scale modeling, basic astronomical calculations

Piaget's Cognitive Development Theory

Formal Operational (12+ years)
Abstract reasoning, hypothetical thinking, and systematic problem-solving.

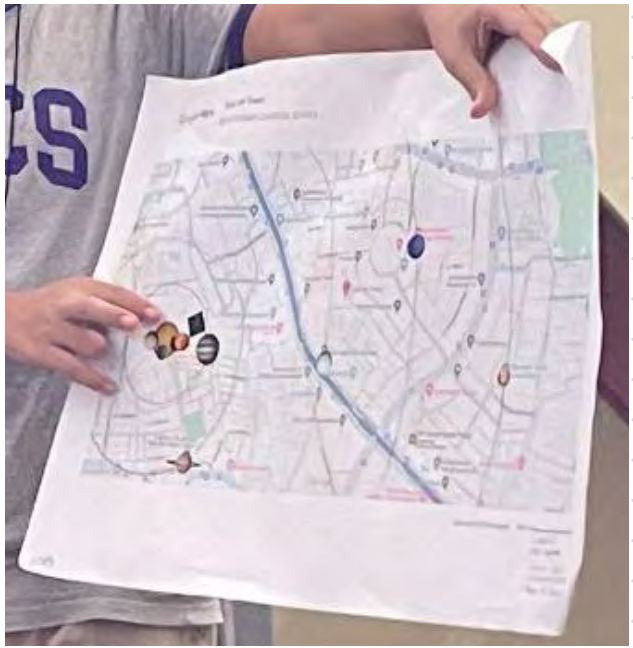
Hands-on Activities

1. Solar Activity Scale
2. Solar System Distance Scale on a City Map
3. Determining Prayer Times (Salat) with a Sundial
4. LED Constellations
5. Constellation Distance Scale
6. Saturn's Ring Scale

04 High School (16–18 years)

scientific analysis, data interpretation

Solar System Distance Scale on a City Map





Solar Activity Scale

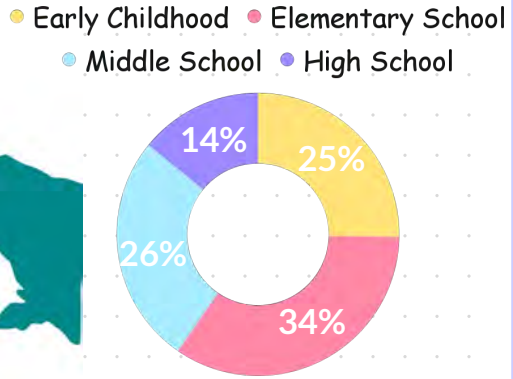




Reach & Implementation

Program reached more than **600 teachers** and **5,000 students** from **96 school/institution**.





Key Takeaways



- Reinforce the value of **experimentation and modeling strategies** in astronomy education
- Reinforce the **relevance and impact** for current and future generations

Future Works

- **Enhance** existing hands-on modules.
- **Design and develop** new hands-on modules.
- **Expand** online presence through digital media (Website, YouTube, Instagram).





Thanks!

Do you have any questions?
luthfiandari23@gmail.com

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