Concept Domains

(numbers correspond to the questions in table 2 of Lindell 2002 )

**Dynamics of the Moon itself**

* Orbit period/direction
  + - 2, 3, 11, 19
* Rotation period/direction
  + - 8
* Orbit tilt/size/relation to Earth/Sun
  + - 9
  + Leads to Cause of phases
    - 4, 6, 18

**Phase patterns**

* Progression pattern/position
  + - 5, 14, 16, 17
* Earth/Sun relation to phases
  + - 13, 16
  + Leads to predictive capabilities

**Phase Timing/perception**

* Corresponding Earth events (Noon, sunsets, sunrises, midnight)
  + - 1, 10, 12
* Viewing location
  + - 7, 15

Summary of environment

**• Button layout:**

* R/L triggers control forward/reverse in time, tap to advance 1/8th in phase, hold to smoothly advance.
* R/L grip triggers cycle through viewing position (this may not be necessary)
* A,B,X,Y answer multiple choice questions, press twice to confirm

**• Objects and motions of environment**

* 3 spheres : Earth, Moon, Sun sized and separated realistically (may change for better viewing)
* Appropriate textures for Earth/Moon
* Sun lighting effects for recreate shadows
* Object movement/orientation: Earth orbit, Earth tilt, Earth Rotation, Moon orbit, Moon Rotation (Ignore Moon eccentricity/orbital procession for now)
* Student position will place the Earth at the center of the viewing area allowing for their motion to change view angle.
* Student moves with Earth orbit
* Time and date displayed

Experience

**• Intro will show controls and provide the first question.**

* Display button maps and ask to test them to proceed.
* First question to test multiple choice questioning

1. Which direction does the Moon move around the Earth when looking down on the North Pole?
   1. West to East (counter clockwise)
   2. West to East (clockwise)
   3. East to West (counter clockwise)
   4. East to West (clockwise)

**• Once the student is comfortable they will be asked to go through a series of questions based on how the Moon phase concept domains progress.**

1. How long does it take the moon to orbit the Earth once?
   1. About 1 month
   2. About 1 day
   3. About 2 weeks
   4. About 2 months
2. How long does it take the moon to rotate on its axis?
   1. About 1 month
   2. About 1 day
   3. About 2 weeks
   4. About 2 months
3. Cycle through 6 questions about where the moon needs to be for a certain phase and pressing A to confirm choice.
4. How much does the Moon’s phase change over a single day?
   1. Not much
   2. A lot
5. Does the phase of the Moon change if you move around the Earth on a given day?
   1. No
   2. Yes

Pre/post-test Questions

**Basic questions taken from ADT2.0**

1. In general, how confident are you that your answers to this test are correct?
   1. Not at all confident (just guessing)
   2. Not very confident
   3. Not sure
   4. Confident
   5. Very confident
2. What is your college Major or area of interest?
   1. Business
   2. Humanities, Social Sciences, or Art
   3. Science, Engineering, or Architecture
   4. Other
3. What is your age?
   1. 0-16
   2. 17-20
   3. 21-25
   4. 26+
4. What is your gender?
   1. (what are the most PC options to give?)
5. How good are you at science?
   1. Very poor
   2. Poor
   3. Average
   4. Good
   5. Very Good
6. How many astronomy courses have you taken?
   1. I have never taken an astronomy course
   2. I am taking one this semester
   3. I have completed one
   4. I have completed more than one

**Moon Phase questions**

+ Questions 2, 18, and 19 from ADT

+ Questions 1, and 2 from VR questions

Limitations

- can maybe only do 10-15 minutes at a time in VR

- without a grasp of horizons and celestial motions asking questions about the precise timing/positioning of events is challenging

- May have to remove realism to focus the viewer

- In-VR vs Proctor questions

- Camera tracking of objects may disorient viewers