**RESEARCH CONTEXT**

Body-based interactions can play a critical role in the development of both concrete and abstract understandings in STEM. With the refinement of body detection and tracking technologies arising out of the entertainment and virtual reality industries, software designed to utilize dynamic and continuous body tracking and gesture recognition can now be leveraged to facilitate embodied learning with platforms such as whole-body interactive science learning simulations.

However, there is still a need to explore specific features that can inform the way that these environments support student learning, and in particular how to analyze and integrate the real-time multimodal data that is collected as students interact with the environment.

More clarity and innovation is needed to discover and articulate effective multimodal metrics within immersive and interactive learning environments. More effective metrics will allow for an increasingly sophisticated understanding of how multimodal learning environments facilitate student learning and provide valuable feedback on the design of specific features in these environments.

In this study, we examined what multimodal interaction metrics are available to capture student behavior as they engage with cutting science concepts within an embodied learning simulation.

**METRICS**

1. **Number of gestures**
2. **Time spent on gesture development**
3. **Submitted quantity**

**Videos (Logs)**

- Time spent on gesturing
- Submitted quantity
- Number of gestures

**Simulation of Earthquake Mechanisms and Tasks (Actual vs. Estimated)**

- Students are presented with a task that requires them to reach a certain numerical quantity using gestural inputs of four mathematical functions (e.g., +1, −1, ×10, and ÷10), while being given as much time as they need to perform the quantitative operations required to reach the goal.

**Simulation of Earthquake Mechanisms and Tasks**

- Training phase: where students are creating cubes, students are initially given straightforward objectives to gain familiarity with the system (i.e., create 234 and 431 cubes (2C34, 4C31)).

**Preliminary Results**

- Significant relationships were found between gesture development time of a task and gesturing time of the subsequent task.
- Students who took longer on gesturing during the final task tended to spend more time on gesturing in the following task.

**Future Work**

- Investigate causal relationship between interaction metrics and affective engagement.
- Visualize Kinect data to understand the role of gestures in learning.
- Design powerful forms of feedback and automated prompts based on their tracked progress to further enhance student learning and engagement and reach more populations of learners in diverse environments.