Interdisciplinarity of Applied Machine Learning in STEM Education

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Assistant professor of Learning
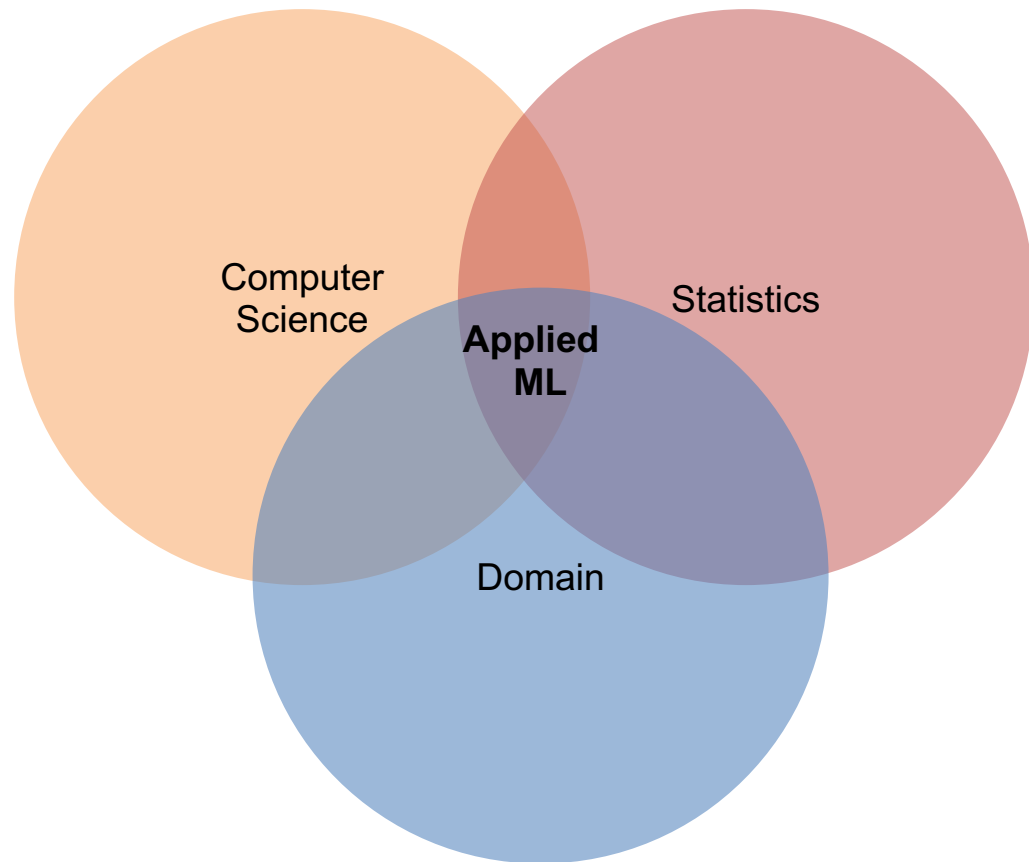Design and Technology

What is Machine Learning?

- Large dataset
- **Informative feature**
- Pattern
- Prediction

Chihuahua or Muffin?

Machine Learning is about automatically finding meaningful patterns in data

Interdisciplinarity

Interdisciplinarity

Measuring Students' Self-Regulatory Phases in LMS with Behavior and Real-Time Self Report

Authors   Fatemeh Salehian Kia, Marek Hatala, Ryan S Baker, Stephanie D Teasley

Computer scientist   Educational researcher

Outline

- Literature Review

- Case Study - Augmented Reality in Science Laboratories

- Affordances

- Limitations

Literature Review

- Journal of Science Education and Technology [Special Issue](#) (2021) Applying ML in Science Assessment

- Alonso-Fernández et al. (2019) reviewed the literature for applications to game learning analytics (GLA) data

- Luan & Tsai (2021) reviewed the literature for applications of ML for precision education

Case Study: Augmented Reality in Science Laboratories
Jiang et al. (in press)

Research gap: How students interacted with AR technologies and how these interactions may affect their learning performance in science laboratories.

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Research question

- RQ1:
  - What kinds of interaction patterns exist when students conducted hands-on science experiments with the mobile AR technology?

- RQ2:
  - And How did the different interaction patterns, measured on the basis of log data, relate to students' learning performance?
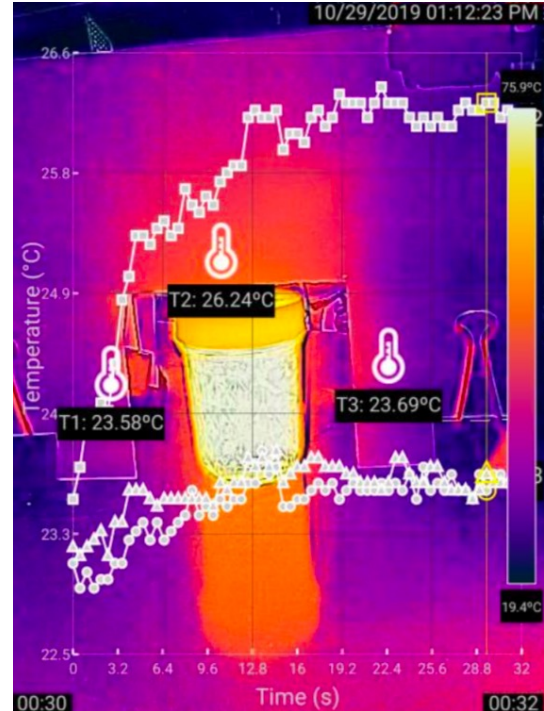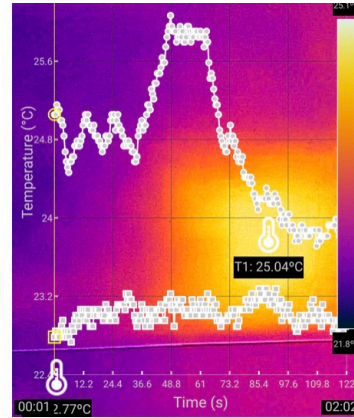
Learning context

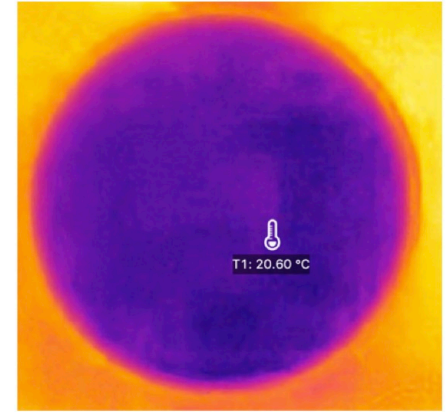
Inquiry Process

Predict → Observe → Explain
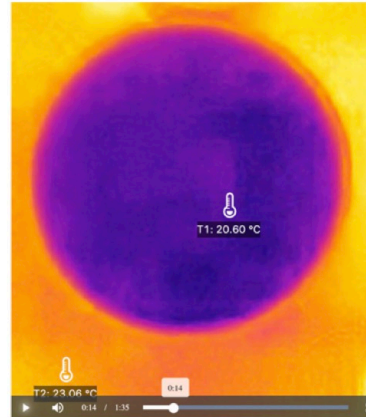
AR technology

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AR technology

(a)

(b)

(c)

(d)

Methodology

Data source:

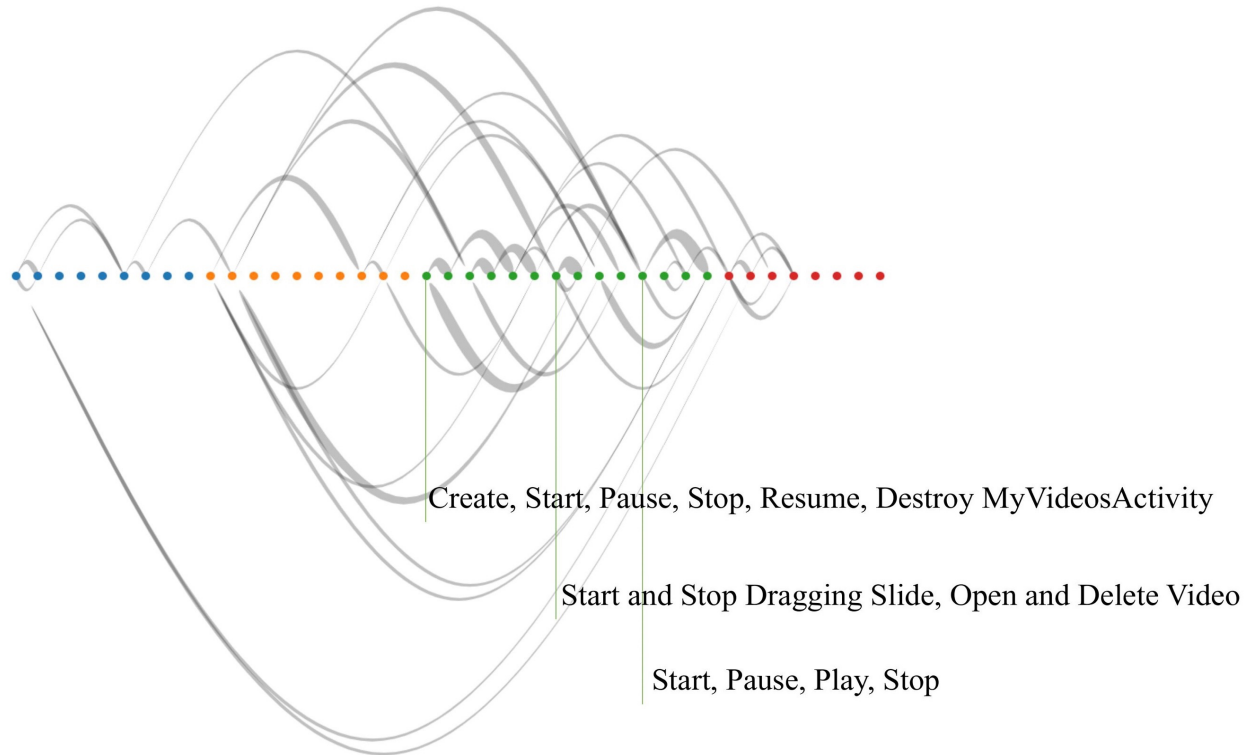- Semi-structured interview
- Log data

Data analysis:

- Coding
- Hierarchical clustering analysis

Findings

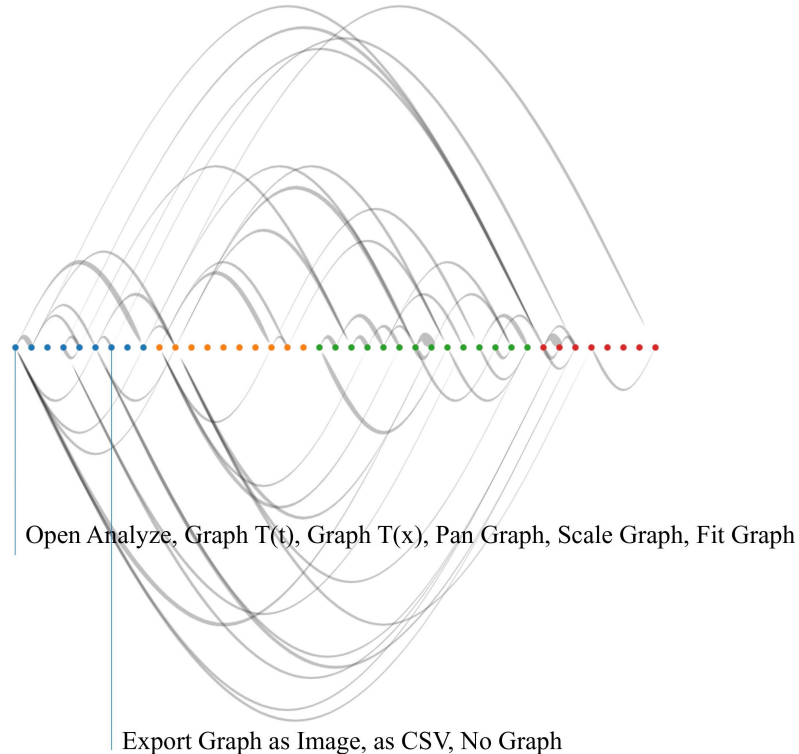The cluster analysis classified student pairs into two distinct groups:

– Group 1: Focus on particular representation

– Group 2: Frequent movement between representations

Group 1: Focus on particular representation

Create, Start, Pause, Stop, Resume, Destroy MyVideosActivity

Start and Stop Dragging Slide, Open and Delete Video

Start, Pause, Play, Stop

"*The thermal view is more of a way to experience different things from a new angle or point-of-view.*"

Group 2: Frequent movement between representations

Open Analyze, Graph T(t), Graph T(x), Pan Graph, Scale Graph, Fit Graph

Export Graph as Image, as CSV, No Graph

"*Because every single time that I moved the video and I see the thermometer (referring to the graph) go up and down. That was so, in my opinion it was like it was controlling how much it went up every single minute and second. Some changed and some stayed the same, and then it comes to me why some stayed the same, you know, with hot jar close to it.*"

The patterns could help us to understand different ways that students used representations in science experiments and guide us to design scaffolds based on these patterns.

Literature Review – ML for K-12
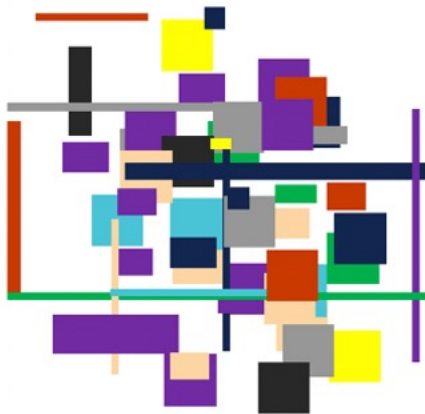
Unstructured data
Data is messy and
disconnected

Structured data

Affordances of Machine Learning

- **Students:** e.g., customizable experiences for learners

- **Teachers:** e.g., automated scoring

- **Researchers:** e.g., analyze patterns in data

Limitations of Machine Learning

- Ethical considerations

- Deterministic problems

- Lack of (good) data

- Interpretability

Machine Learning is a current hot topic and continues to grow in popularity based on its applications

Thank you!