

Idea

Talk about MMLA and why MMLA is gaining popularity given that EDM and LA already exists. Then introduce the variety of sensors that are being used in current research. Talk about how the sensors help in better understanding the student data.

****Talk about Microsoft Kinect and/or multi-touch tables with respect to MMLA.**

This is interesting because it provides insights on how students are learning and what can be done to improve student learning when considering both the physical and digital worlds.

The benefit would be to show how sensors help researchers gain knowledge of the different patterns that students show when learning in different environments. How researchers can use this knowledge and data to bring an improvement in the learning process and how the research community and the readers benefit from this paper.

MMLA in non-classical learning environments

Literary Review Outline draft:

① Introduction from the Harvard LIT page

Over the past decade, high frequency sensors (such as eye-trackers, motion sensors, wearables) have become affordable and reliable, which is opening new doors for capturing students' behavior. Educational researchers can now collect significantly larger datasets using these variety of sensors. The [Microsoft Kinect sensor](#), for example, collects information about a person's body joints (x,y,z coordinates), their facial expressions, and their speech at 30 Hz (i.e., 30 times per second). One can easily define ~100 variables that can be captured from the Kinect sensor. This opens the possibility of combining these sensors with data mining techniques for analytics!

From <<https://lit.gse.harvard.edu/multimodal-learning-analytics>>

② A little intro on MMLA from different research papers:

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X. Ochoa and M. Worsley, "Augmenting Learning Analytics with Multimodal Sensory Data," *JLA*, vol. 3, no. 2, pp. 213–219, Sep. 2016, doi: [10.18608/jla.2016.32.10](https://doi.org/10.18608/jla.2016.32.10).^[1]

the main objective of MMLA is to study collaborative, real world, non computer mediated environments.

featured articles in the paper:

featured articles:

①

Multimodal Learning Analytics and Education Data Mining: Using Computational Technologies to Measure Complex Learning Tasks

the paper discusses:



text, speech, handwriting, sketch, actions/gestures, affect, neurophysiology, and eye gaze

②

Sleepers' Lag: Study on Motion and Attention

the paper discusses:



focus their study on the relative differences between learner reaction times, measured automatically by their body movements

③

Using Multimodal Learning Analytics to Model Student Behaviour: A Systematic Analysis of Epistemological Framing

the paper discusses



They use information from posture, gesture, gaze, language, and speech to predict the different epistemological frames that students adopt during interviews and, based on the clustering of these frames, establish the level of mechanistic reasoning done by the students

②

[1]
M. Worsley, "Multimodal learning analytics: enabling the future of learning through multimodal data analysis and interfaces," in *Proceedings of the 14th ACM international conference on Multimodal interaction*, Santa Monica, California, USA, Oct. 2012, pp. 353–356, doi: [10.1145/2388676.2388755](https://doi.org/10.1145/2388676.2388755).

MMLA as open ended learning environment
↳ discusses SPB 2 → student designed project based learning
↳ inquiry based learning and construction.

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[1]
P. Blikstein and M. Worsley, "Multimodal Learning Analytics and Education Data Mining: using computational technologies to measure complex learning tasks," *Journal of Learning Analytics*, vol. 3, no. 2, pp. 220–238, Sep. 2016, doi: [10.18608/jla.2016.32.11](https://doi.org/10.18608/jla.2016.32.11).

MMLA definition: students act with both the physical and the digital world.

③

Talk about the current projects on MMLA.

MMLA and the Microsoft Kinect

MMLA and multi touch tables

relevant papers :

- ① "A Wide Lens: Combining Embodied, Enactive, Extended, and Embedded Learning in Collaborative Settings."
- ② Schneider, Romano, and Drachsler, "Beyond Reality—Extending a Presentation Trainer with an Immersive VR Module," *Sensors*, vol. 19, no. 16, p. 3457, Aug. 2019, doi: [10.3390/s19163457](https://doi.org/10.3390/s19163457).
- ③ F. Roque *et al.*, "Using Depth Cameras to Detect Patterns in Oral Presentations: A Case Study Comparing Two Generations of Computer Engineering Students," *Sensors*, vol. 19, no. 16, p. 3493, Aug. 2019, doi: [10.3390/s19163493](https://doi.org/10.3390/s19163493).
- ④ K. Sharma, I. Leftheriotis, and M. Giannakos, "Utilizing Interactive Surfaces to Enhance Learning, Collaboration and Engagement: Insights from Learners' Gaze and Speech," *Sensors*, vol. 20, no. 7, p. 1964, Mar. 2020, doi: [10.3390/s20071964](https://doi.org/10.3390/s20071964).
- ⑤ I. Brishtel, A. A. Khan, T. Schmidt, T. Dingler, S. Ishimaru, and A. Dengel, "Mind Wandering in a Multimodal Reading Setting: Behavior Analysis & Automatic Detection Using Eye-Tracking and an EDA Sensor," *Sensors*, vol. 20, no. 9, p. 2546, Jan. 2020, doi: [10.3390/s20092546](https://doi.org/10.3390/s20092546).
- ⑥ X. Li, R. Younes, D. Bairaktarova, and Q. Guo, "Predicting Spatial Visualization Problems' Difficulty Level from Eye-Tracking Data," *Sensors*, vol. 20, no. 7, p. 1949, Jan. 2020, doi: [10.3390/s20071949](https://doi.org/10.3390/s20071949).

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Presentation Trainer (PT), a multimodal sensor-based application designed to support the development of public speaking skills

The study aims to see if combining VR with the PT module results in a better experience.

This papers describes the use of Kinect in oral presentation scenarios and how it can be used to give automatic feedback to students about their postures throughout the speech.