



**DIPF**

Educational Research  
and Educational Information

# Interactive Learning Technologies

Dr. Jan Schneider



# Teaching Machines



U. J. S. I. M. I. S. T. R. I. A. L. I. N. F. O. R. M. A. T. I. O. N.

1981?



# Intelligent Tutoring System



Figure 1: The screen configuration after line 1 in listing 1.



Figure 2: The screen configuration before line 4 in listing 2.

# How do we learn?

# How do we learn?





# How do we learn?



# Sensors in Learning

- What are sensors?
  - A device which detects or measures a physical property and records, indicates, or otherwise responds to it. (Oxford Dictionaries, 2018)
- Examples of sensors:



# Sensors in Learning

- What type of sensors?

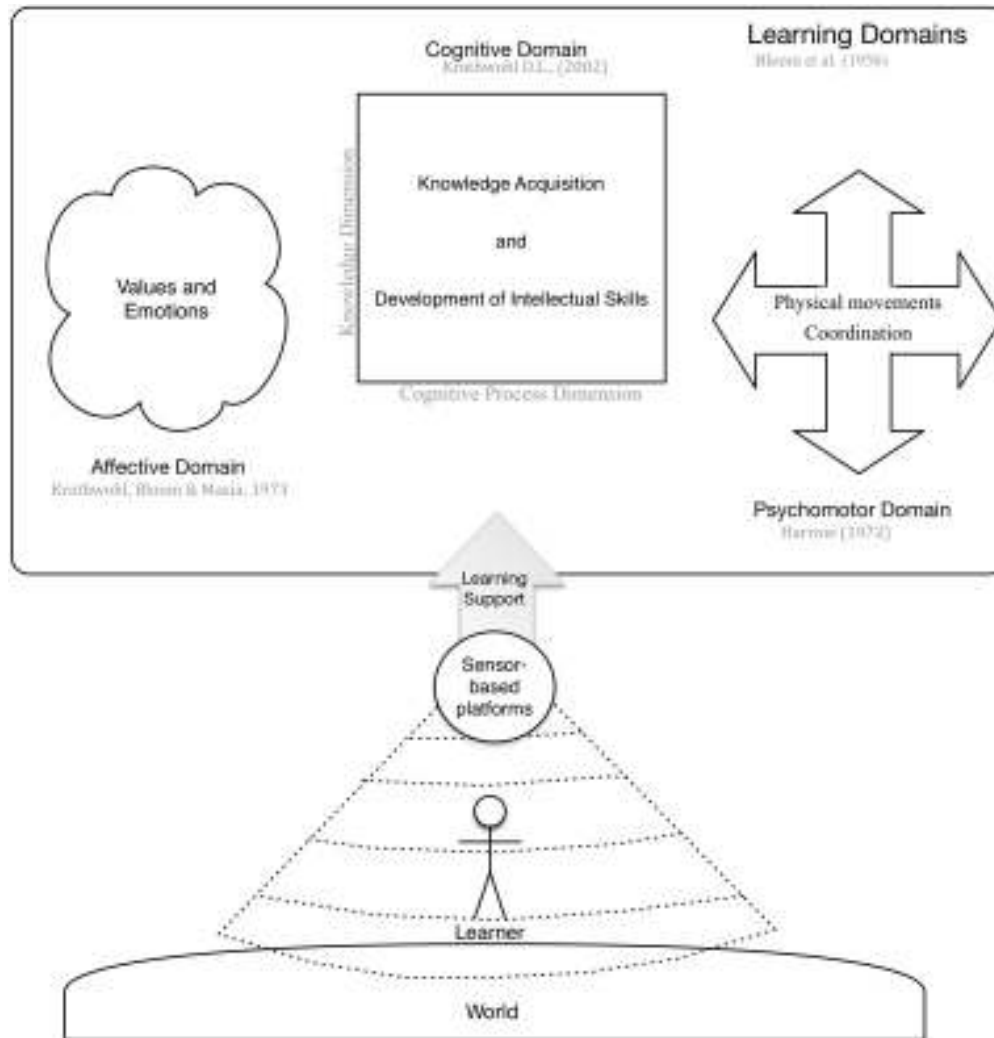


# Sensors in Learning

- Do specific sensors matter?



# Sensors in Learning



# Cognitive Domain

- Contextual information

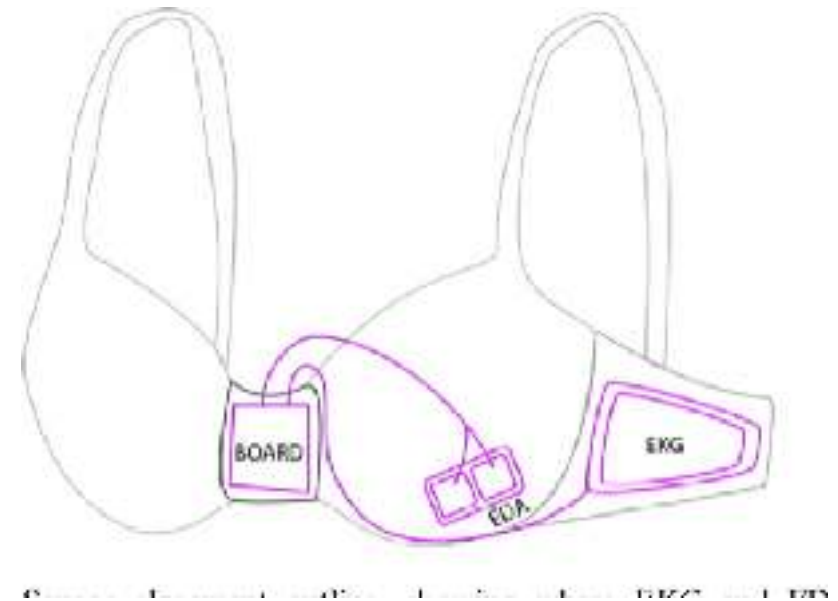


# Cognitive Domain

Sensor Data for analysis

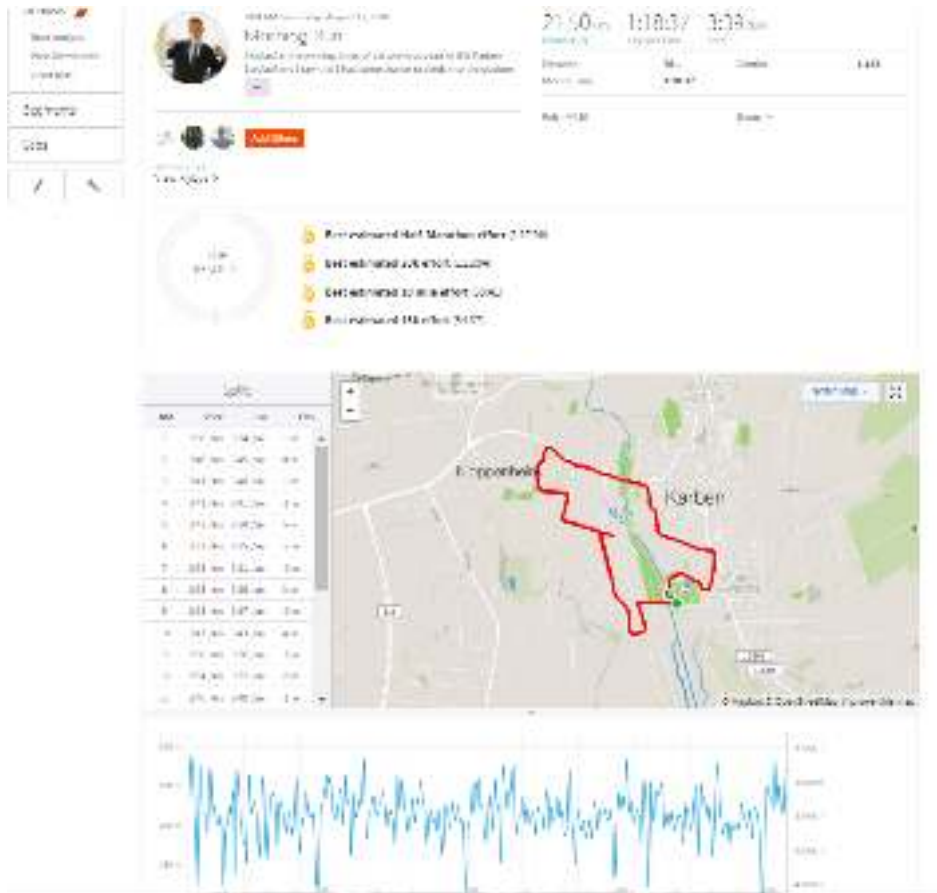


# Affective Domain

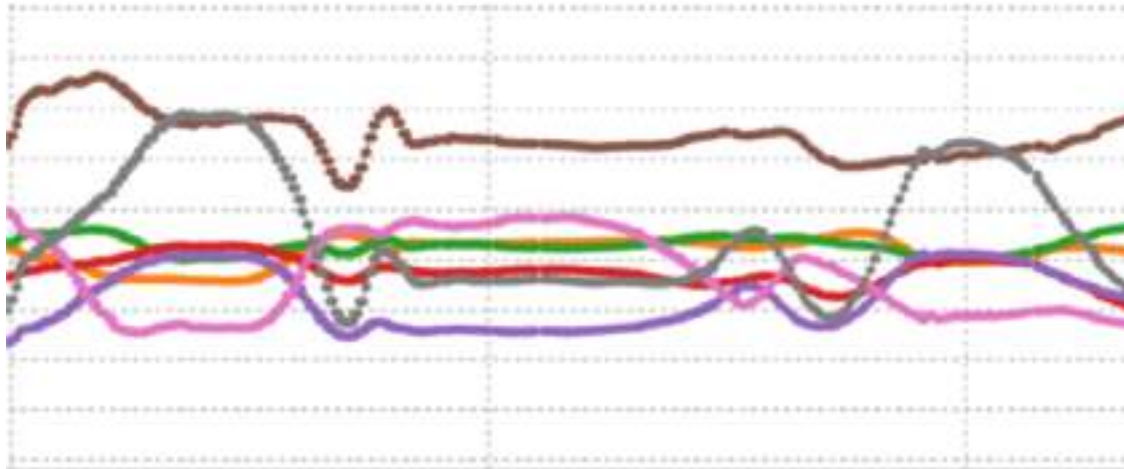
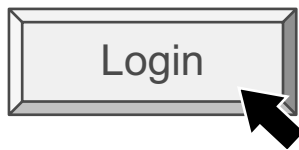




# Psychomotor Domain



# Limitations of Sensors



Sensor data is difficult to interpret  
1 source might not be enough to interpret some task

# Limitations of Sensors

## Multimodality

- What instrument is being played in the picture?



# Limitations of Sensors

## Multimodality

- What is the instrument being played in the sound clip?



# Limitations of Sensors

## Multimodality

- What are the instruments being played in this sound clip?



# Limitations of Sensors Multimodality

- Why do we need multimodality? (Example 1)



- <https://www.youtube.com/watch?v=Kmf674XPC0>

# Multimodality



Original Music  
Triumphant and Victorious

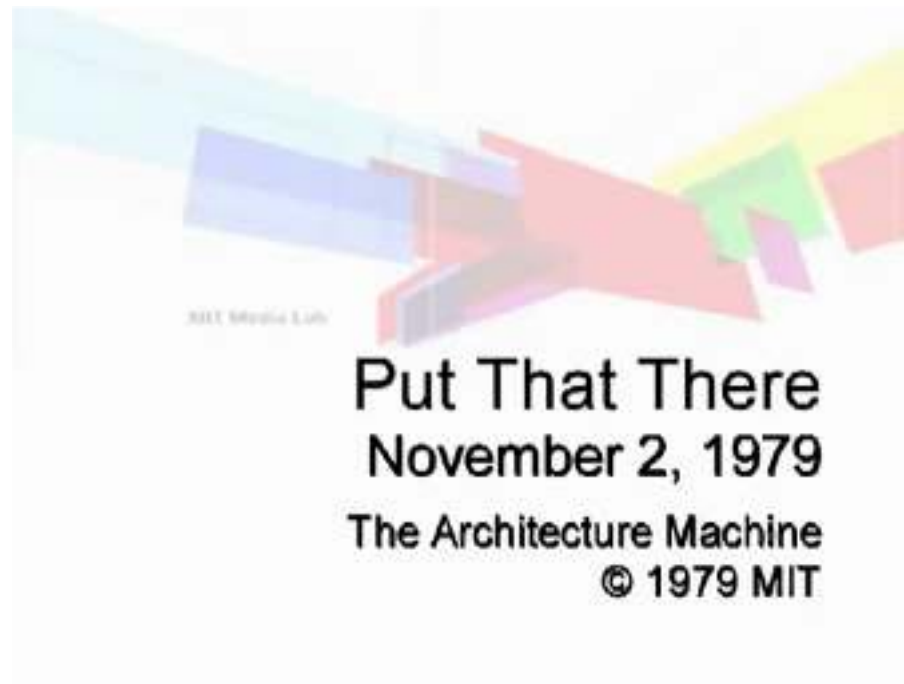
- <https://www.youtube.com/watch?v=rn9V0cN4NWs>



# Multimodality

- Why do we need multimodality? (Example 4)

# Multimodality for human computer interaction (1979)

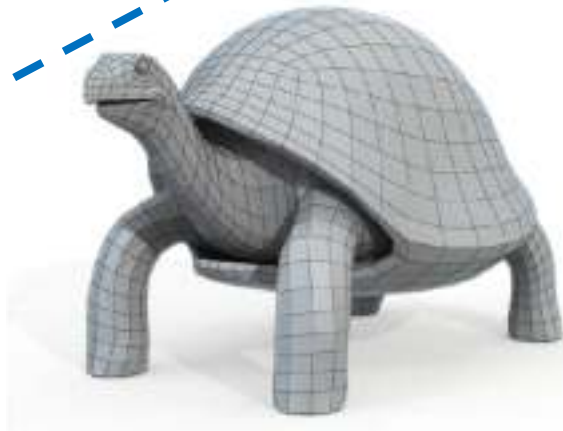
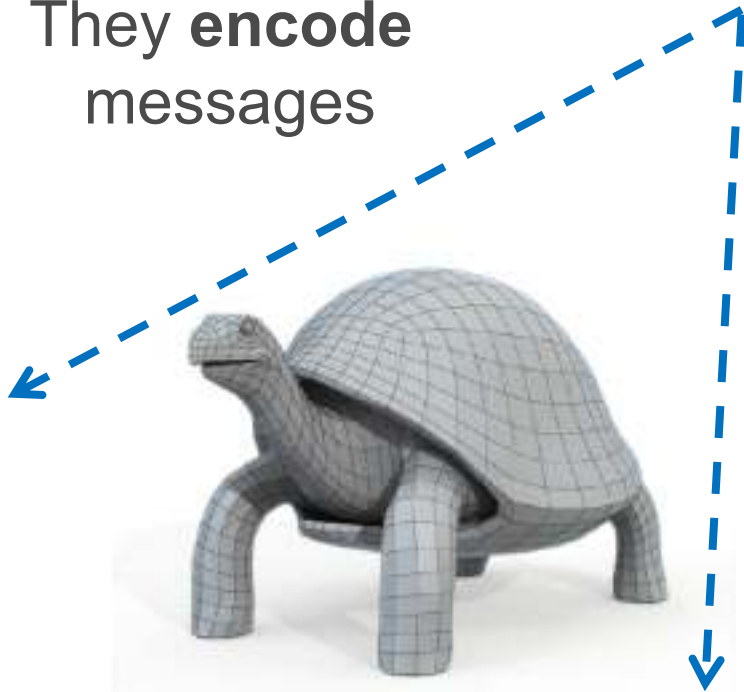


<https://www.youtube.com/watch?v=RyBEUyEtxQo>

# Today's multimodality for computers



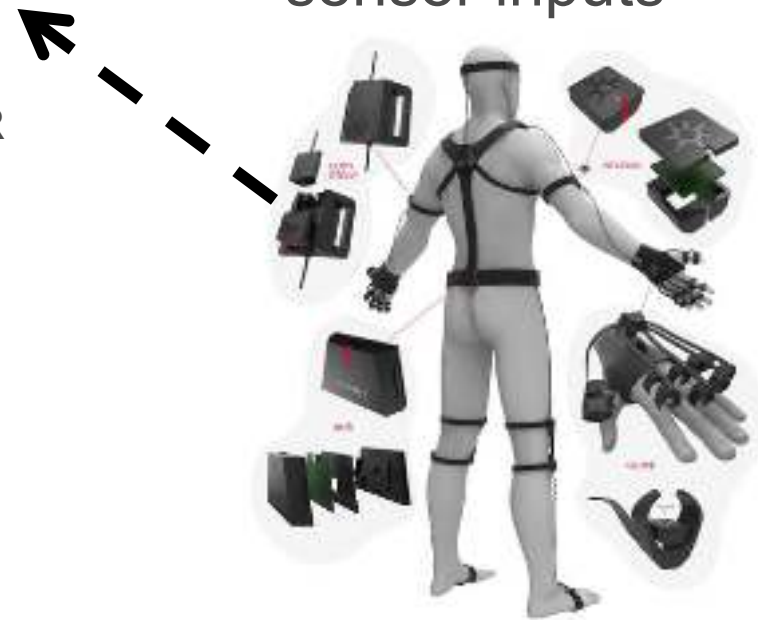
They **encode** messages



e.g. 3D visualisations in AR

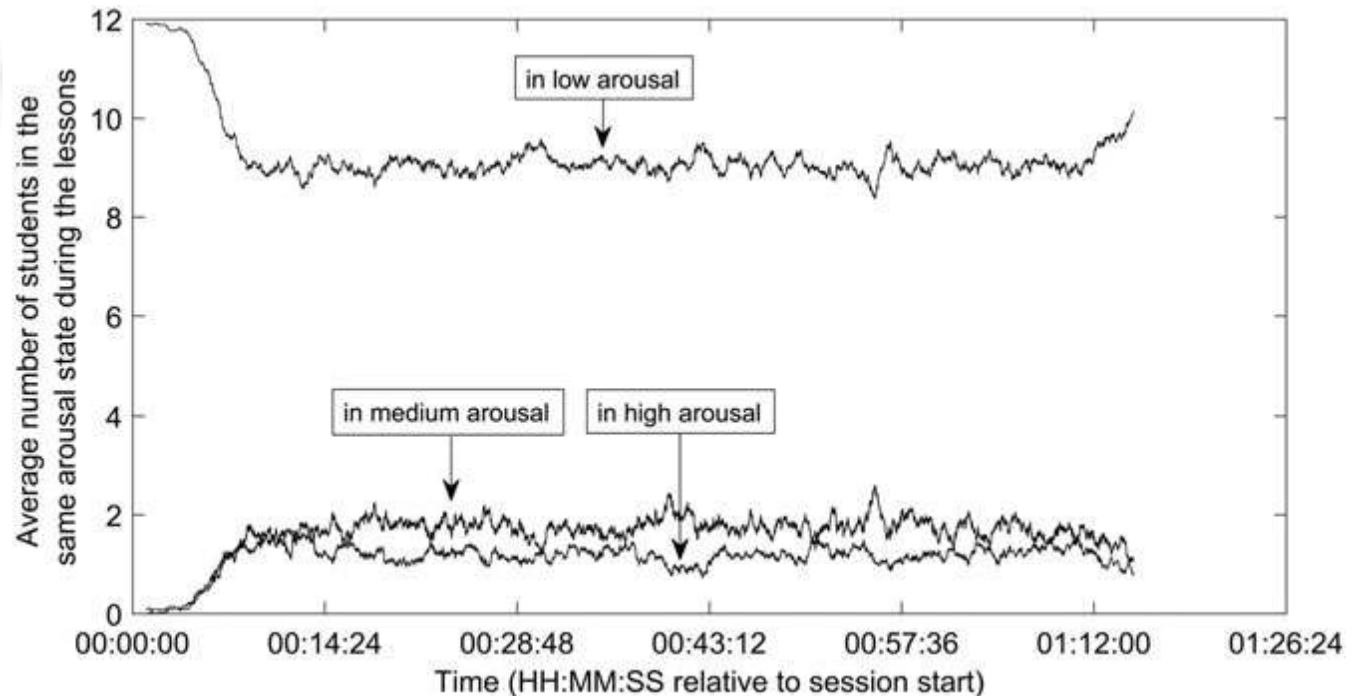
e.g. modern AR headsets like HoloLens

They **decode** sensor inputs



# Examples of Interactive Multimodal Learning technologies

# Making Predictions



„During the course lessons, arousal was positively and highly correlated ( $r = .66$ ) with achievement as measured by the students' grades.“

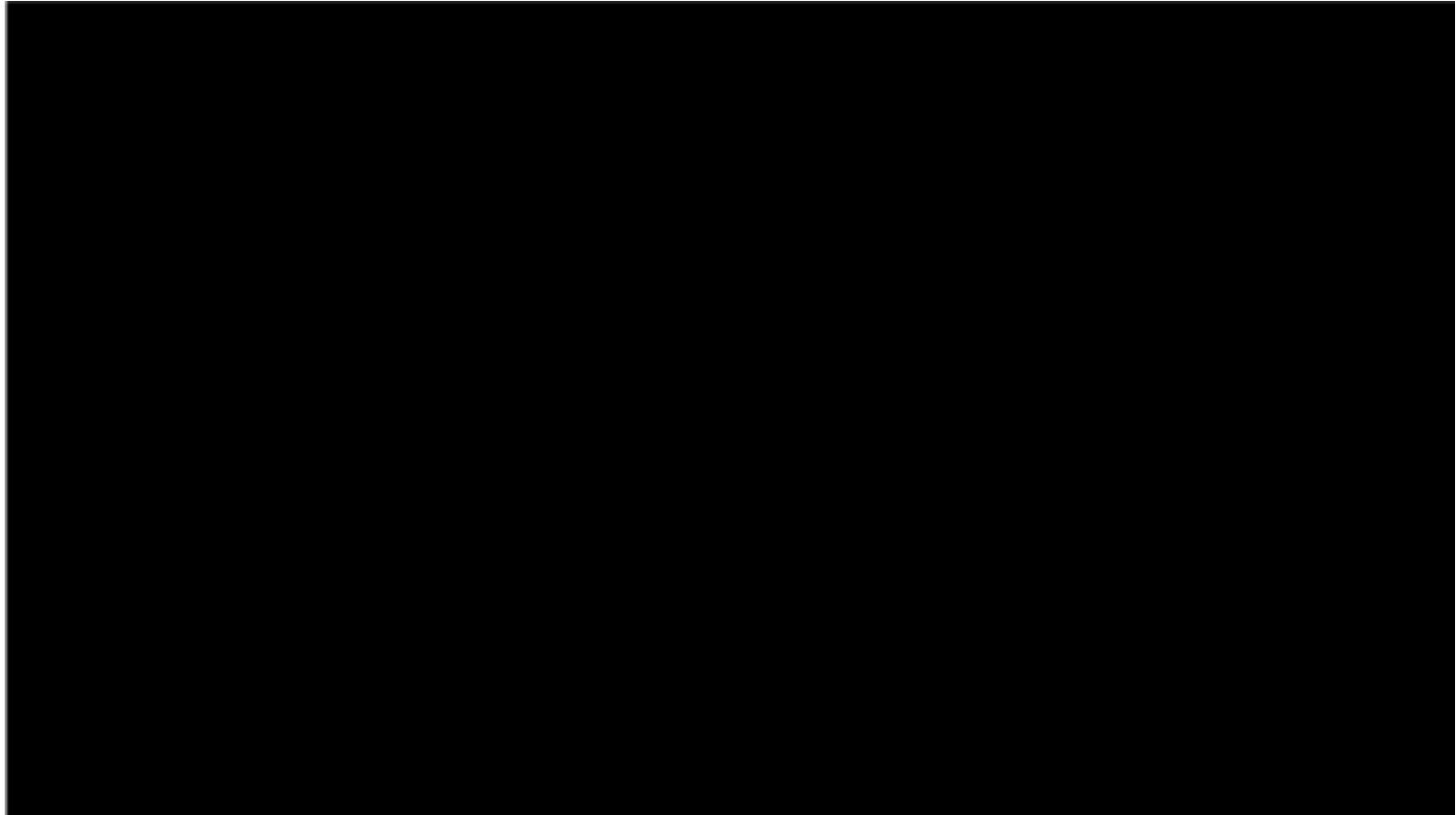
# Understanding Learning Process



The distance between learners' hands and faces is a strong predictor of students' artefact quality which can indicate the value of student collaboration.

Spikol, D., Ruffaldi, E., Dabisias, G., & Cukurova, M. (2018). Supervised machine learning in multimodal learning analytics for estimating success in project-based learning. *Journal of Computer Assisted Learning*, 34(4), 366-377.

# Mimicking Expert Performance



<http://wekit.eu/>

[https://www.youtube.com/watch?v=RkGXdpSB\\_AM](https://www.youtube.com/watch?v=RkGXdpSB_AM)

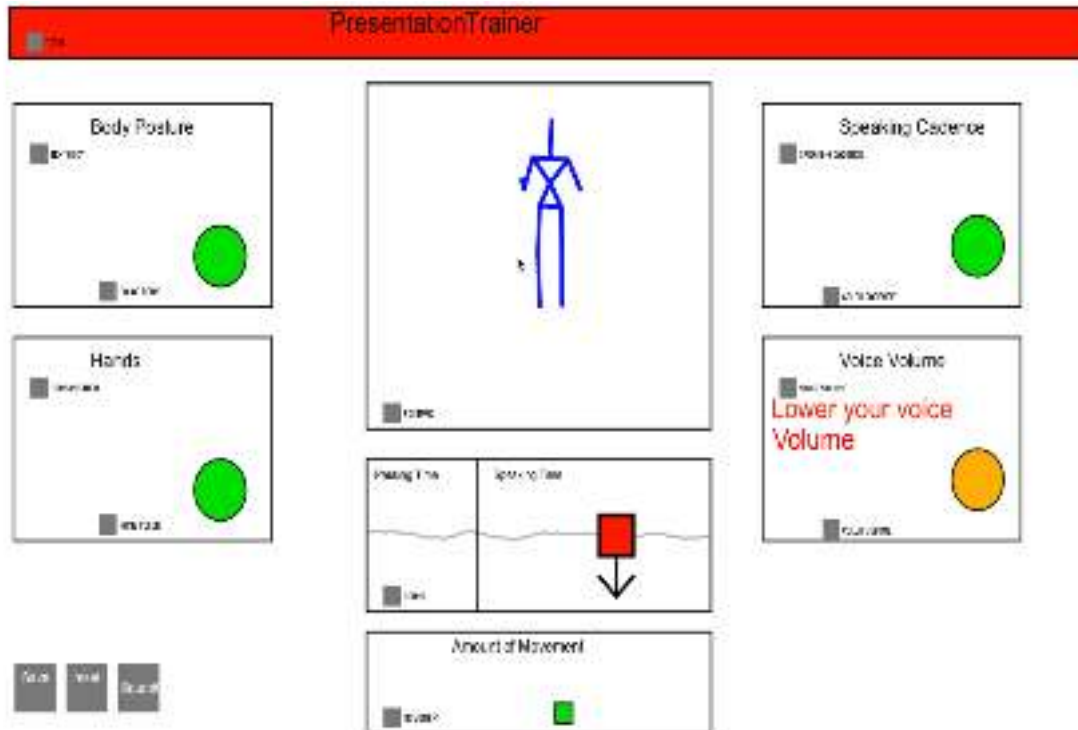
# Presentation trainer

Schneider, J., Börner, D., Van Rosmalen, P., & Specht, M. (2016). Can you help me with my pitch? Studying a tool for real-time automated feedback. *IEEE Transactions on Learning Technologies*, 9(4), 318-327.



# Presentation trainer

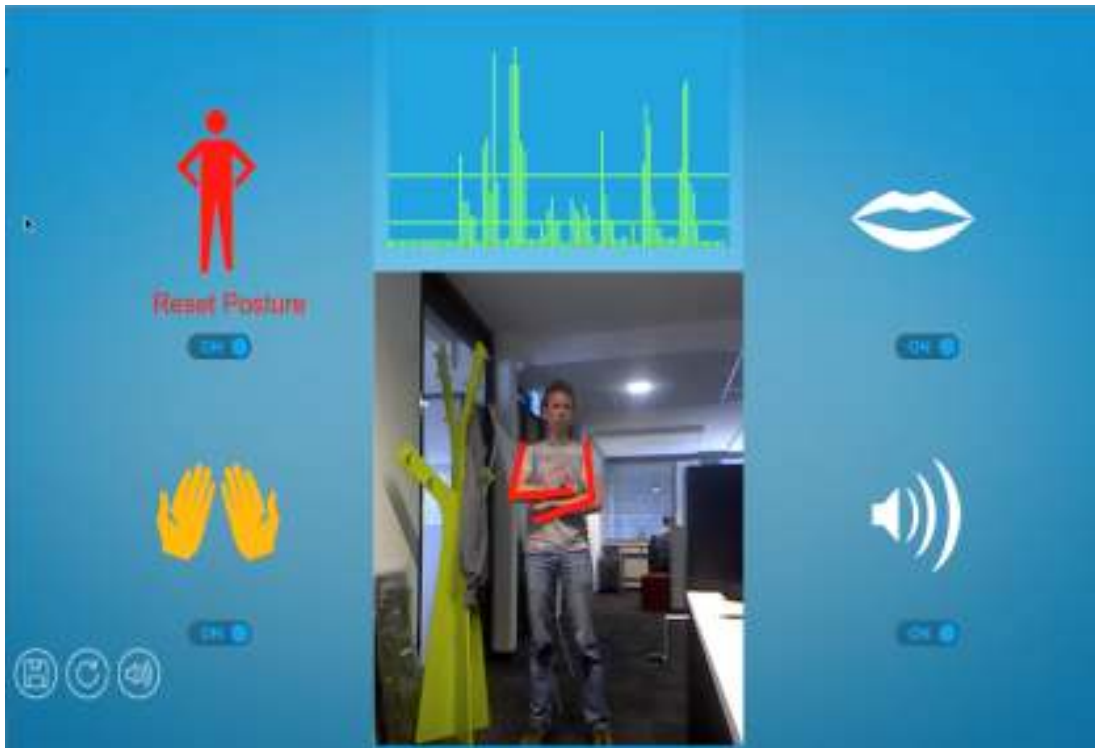
(Real-time Feedback)



Schneider, J., Börner, D., Van Rosmalen, P., & Specht, M. (2015). Stand tall and raise your voice! a study on the presentation trainer. In *Design for teaching and learning in a networked world* (pp. 311-324). Springer, Cham.

# Presentation trainer

(Real-time Feedback)



Dashboard interface  
Is not useful!

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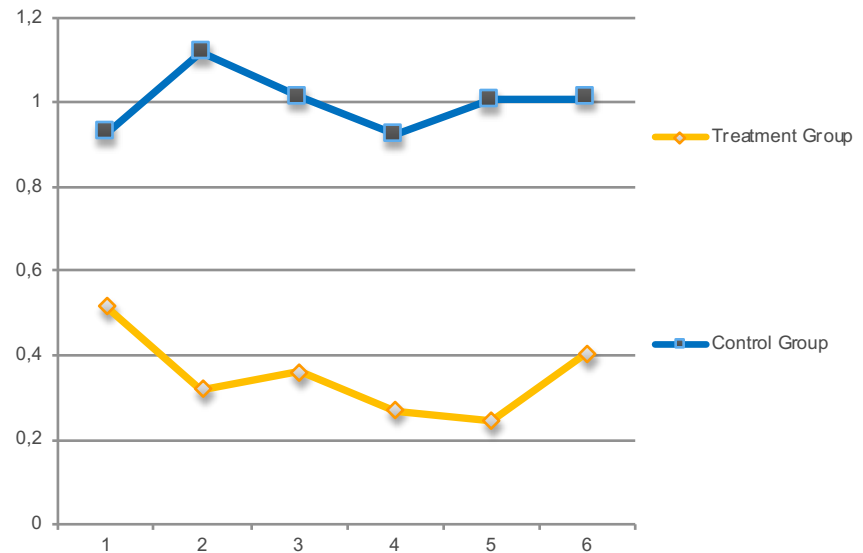
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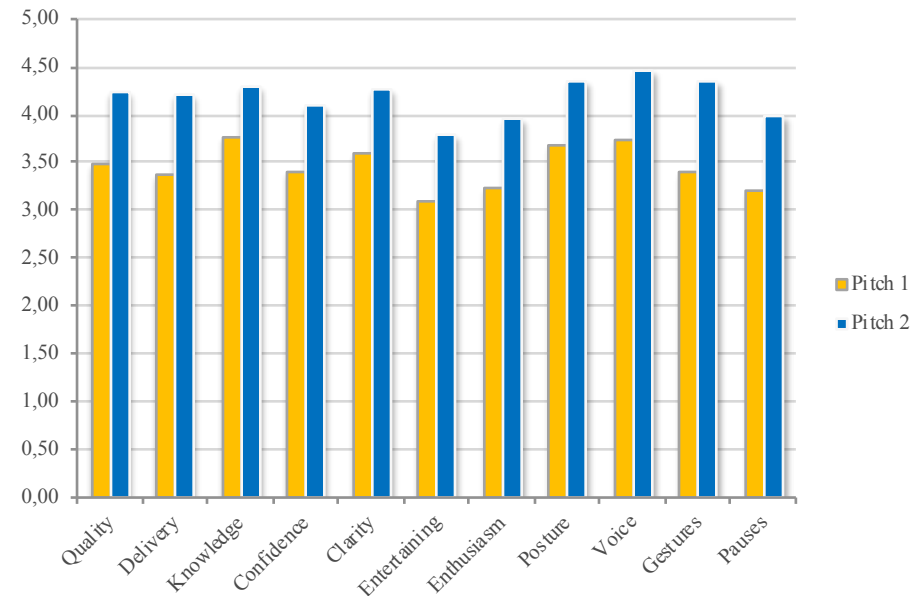
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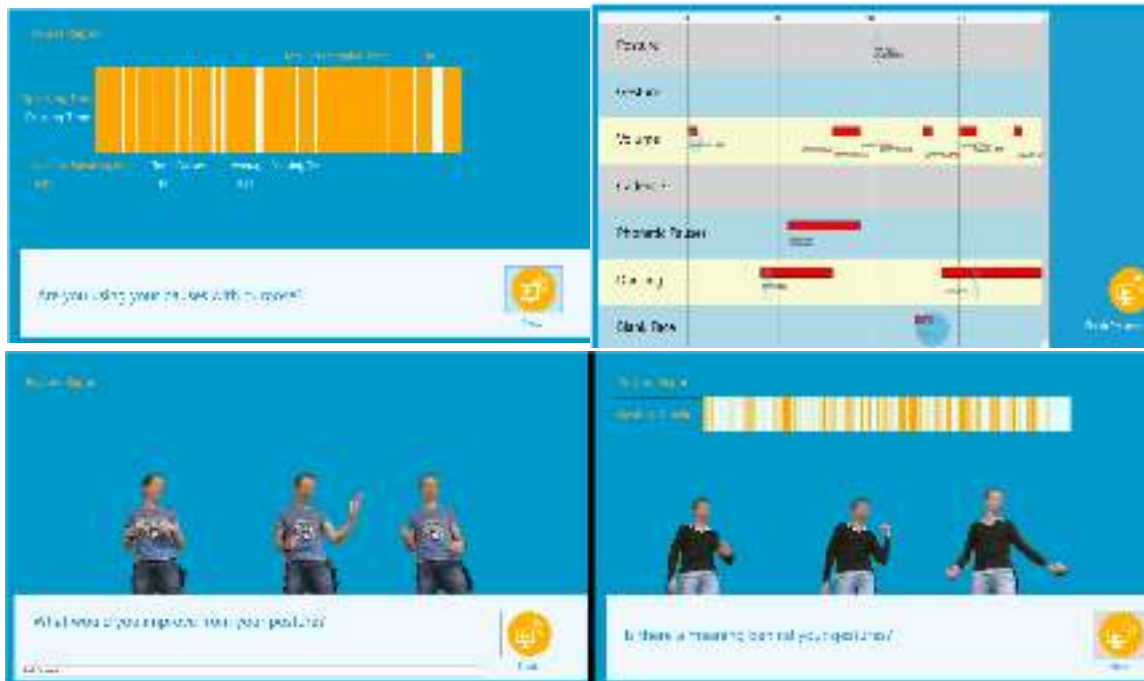
Schneider, J., Börner, D., Van Rosmalen, P., & Specht, M. (2016, September). Enhancing public speaking skills-an evaluation of the Presentation Trainer in the wild. In *European Conference on Technology Enhanced Learning* (pp. 263-276). Springer, Cham.

# Presentation trainer (Real-time Feedback)



- 1 feedback instruction that does not go away until the learner corrects the mistake works.
- For good and for bad, there is no emotion between PT's feedback and the learner.

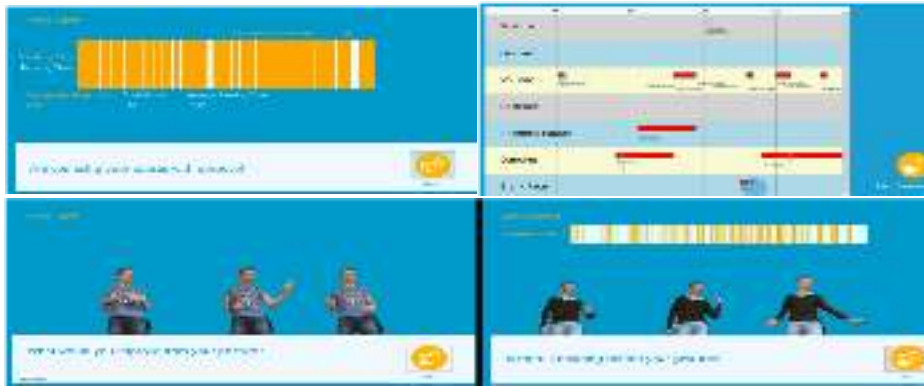
# Presentation trainer (Self-reflection)



Schneider, J., Börner, D., Van Rosmalen, P., & Specht, M. (2017, June). Do You Know What Your Nonverbal Behavior Communicates?—Studying a Self-reflection Module for the Presentation Trainer. In *International Conference on Immersive Learning* (pp. 93-106). Springer, Cham.

# Presentation trainer

## (Self-reflection)



Does it work?

- Inconclusive evidence
  - Learners identify problems but do not know what to do about them.
  - It seems that learners change behavior for a few seconds and then go back to old habits.

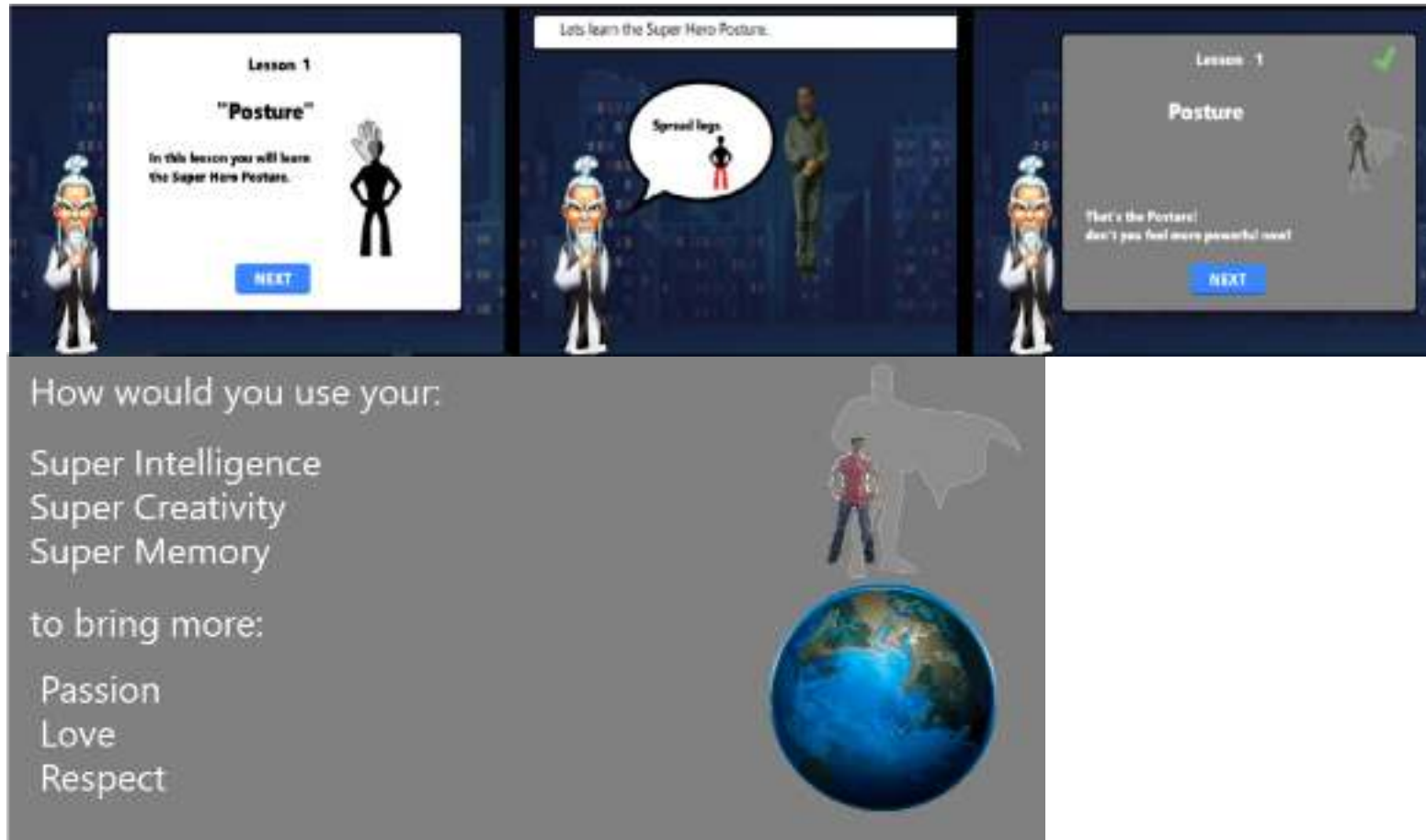
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# The Booth

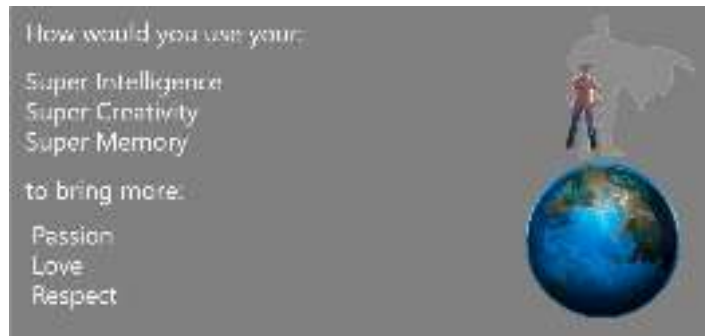
Schneider, J., Börner, D., van Rosmalen, P., & Specht, M. (2018). Do you Want to be a Superhero? Boosting Emotional States with the Booth. *Journal of Universal Computer Science*, 24(2), 85-107.

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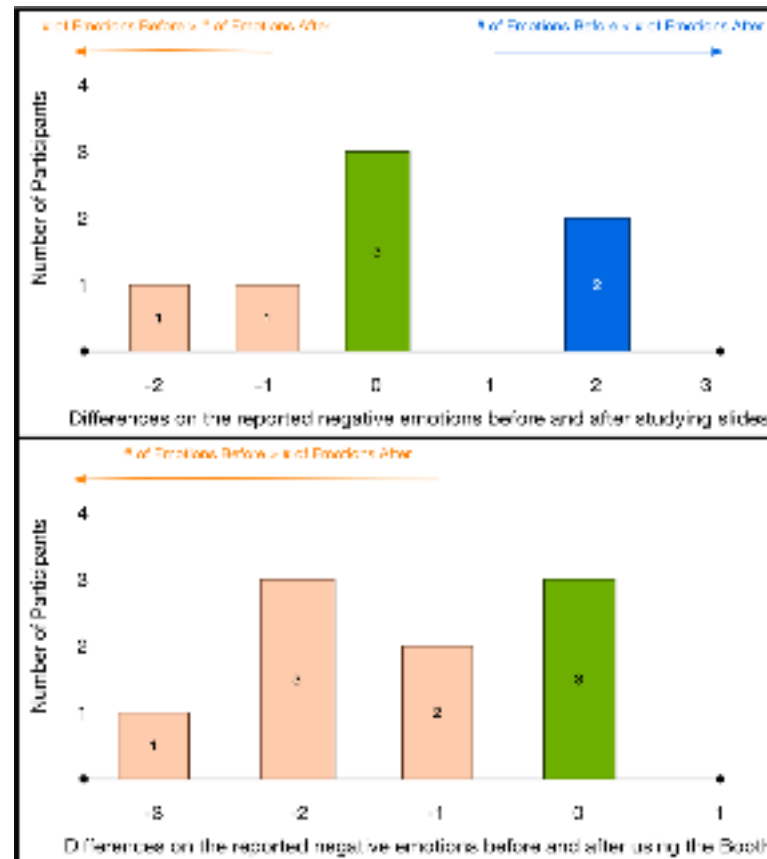


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# The Booth



Does it work?

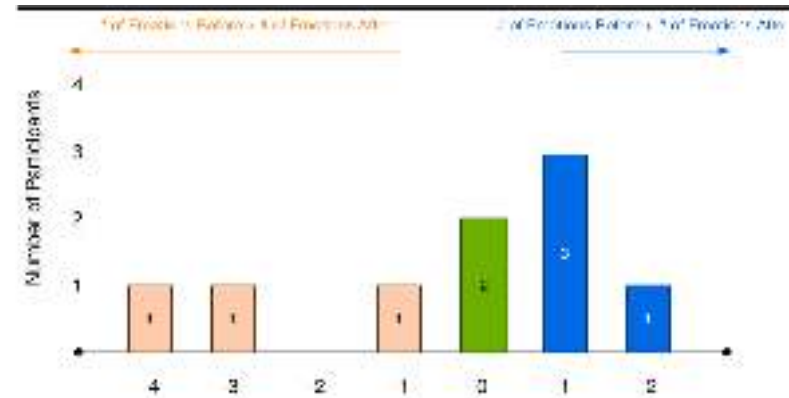


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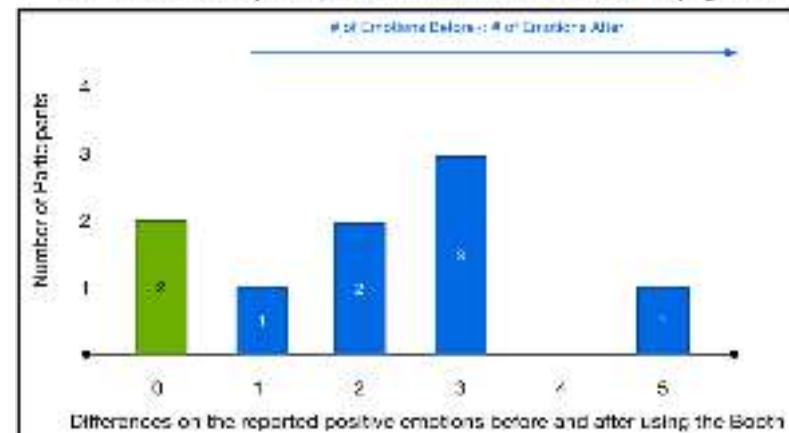
# The Booth



Does it work?



Differences on the reported positive emotions before and after studying slides

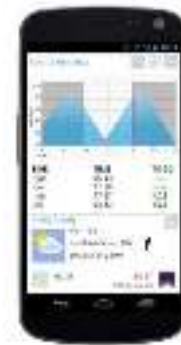
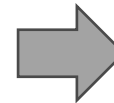


Differences on the reported positive emotions before and after using the Booth

Schneider, J., Börner, D., van Rosmalen, P., & Specht, M. (2018). Do you Want to be a Superhero? Boosting Emotional States with the Booth. *Journal of Universal Computer Science*, 24(2), 85-107.

# Limitations

## Hardware costs

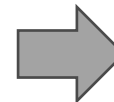


## Software costs

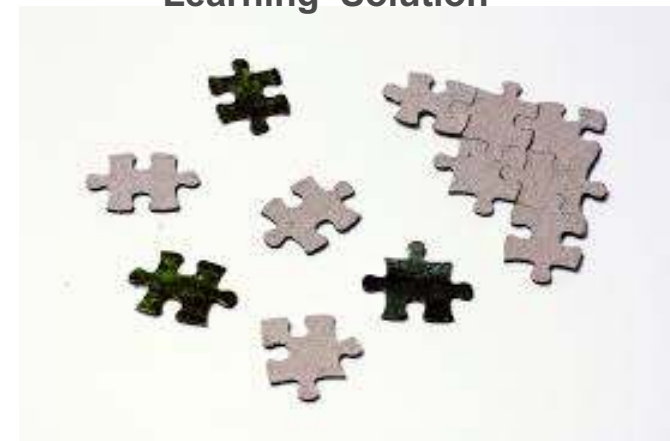
The legacy of knowledge loss...



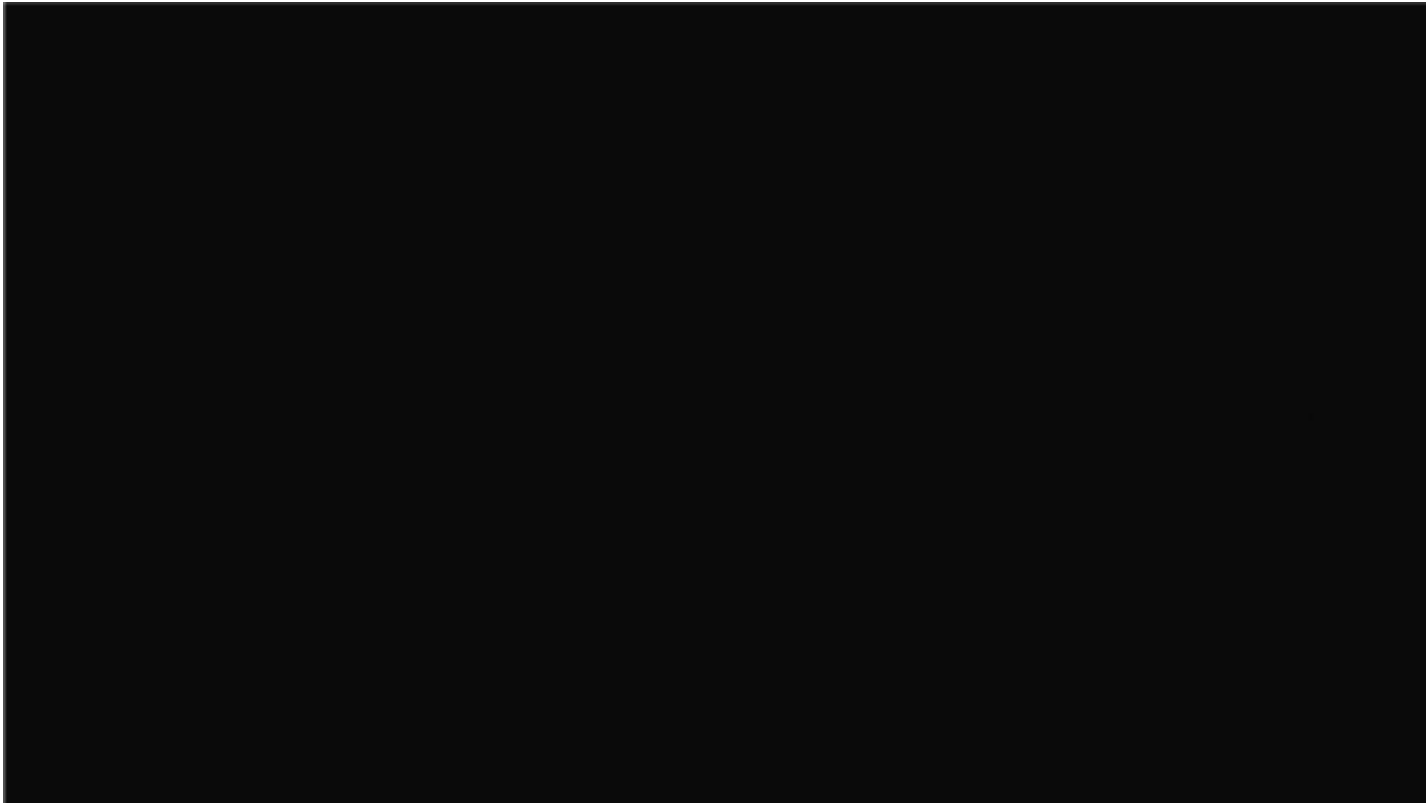
- Reinvented wheels
- Unlearned lessons
- Patterns of repeated mistakes
- Productivity shortfalls
- Lack of continuous performance improvement



## Customizable Multimodal Learning Solution



# MMLA Examples



Schneider, J., Di Mitri, D., Limbu, B., & Drachsler, H. (2018, September). Multimodal learning hub: A tool for capturing customizable multimodal learning experiences. In *European Conference on Technology Enhanced Learning* (pp. 45-58). Springer, Cham.

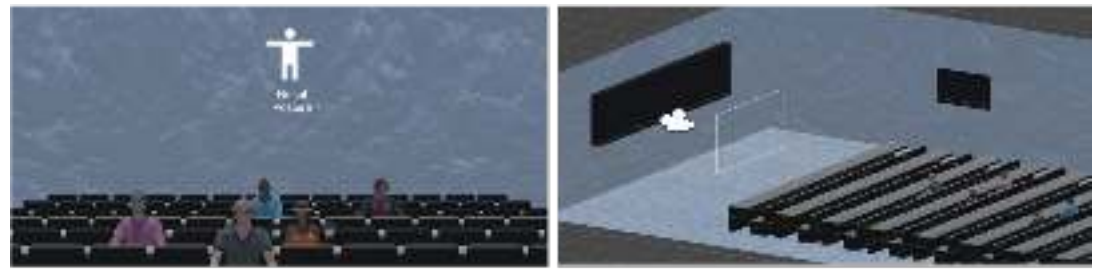
Di Mitri, D., Schneider, J., Klemke, R., Specht, M., & Drachsler, H. (2019, March). Read Between the Lines: An Annotation Tool for Multimodal Data for Learning. In *Proceedings of the 9th International Conference on Learning Analytics & Knowledge*(pp. 51-60). ACM.

# MMLA Examples



Calligraphy tutor

Virtual Reality Presentation Trainer



Smile



Good



Reset Posture  
Stand Still  
Move Hands



Start Speaking



Stop Speaking  
Stop Hummm



Speak Louder



Speak Softer

# Conclusions