LA in VR: Perspectives on LA and VR: from tracking guitar chords to discussing airplane design.

Prof. Marcus Specht
Delft University of Technology, EEMCS
Erasmus University Rotterdam, ESSB
Leiden University, LIACS
Virtual Reality ... XR

- **Gaze tracking** is fundamental
- **Contextual** (environmental) **awareness** is optional
- The user is “cut off” from reality; vision and hearing are simulated
Augmented Reality

- **Gaze tracking** is optional
- **Contextual** (environmental) **awareness** is fundamental
- The user (and the device) should to some extent be able to hear and see reality
Mixed Reality
A spectrum

Blended reality in relation to the physical-virtual environment continuum (adapted from Milgram & Kishino, 1994, as presented in Bower et al, 2010) (known as the reality-virtuality continuum)
Virtual Reality (VR) in Education
Virtual Reality - Types

Then and now

1: (3D) Virtual Environment
2: CAVE
3: Head-Mounted Display (HMD)
Affordances of Virtual Reality in Education
Virtual Reality - Affordances (1):

*Enhances experiential learning*

“Immersive VR allows a user to learn how they would feel and respond (physiologically, tactfully, and procedurally) when interacting with virtual situations that the brain treats as real”
(Concannon, Esmail et al., 2019)

“Allowing players to navigate freely through the [VR] game has positive effects on presence and cognitive interest”
(Ferguson, van den Broek et al., 2020)

Interaction & Imagination ➔ Learn by doing

Virtual Reality - Affordances (2):
*Facilitates immersive learning and engagement*

“Immersion has been outlined as a strong factor to enhance the concentration when learning in a digital environment”
(Pirker, Holly et al., 2019)

“The sensory immersion [VR] facilitates is emerging as a potentially revolutionary mode of content delivery - one which both heavily engages the “viewer”, and democratises students’ access to a range of historical experiences”
(Froese, 2019)

**Immersion → Engagement**

Virtual Reality - Affordances (3):

*Effective method of training deliberate Practice*

- **Limited / no danger** compared to real-life scenarios
- **High level of interaction** possible (e.g. controller or even haptic input)
- **Immersion creates convincing simulations**
- **Low cost** compared to real-life enactments / actors
- **Allows for easy repetition**

*SurviVR (2016)*

*NYPD Counterterrorism VR Training (V-Armed, 2019)*
Virtual Reality - Affordances (3):

**Effective method of training**

“[Virtual Reality] provides a comprehensive and immersive training environment, which would bring new opportunities on safety teaching and learning processes”
(Le, Pedro et al., 2014)

“We can use VR for the training of specialists such as preparing teams for security against nuclear facility attacks and real-time radiation monitoring in nuclear installations”
(Hagita, Kodama et al., 2020)

---

Virtual Reality - Affordances (4):

Enhances collaborative learning

“Many researchers argue that the virtual reality technology has great potential which may change the collaborative learning experience”
(Zheng, Xie et al., 2018)

Three affordances:

1. Social interaction
2. Resource sharing
3. Knowledge construction

Virtual Reality - Affordances (4):

*Enhances collaborative learning*

---

Training & Simulation: Collaborative VR Procedural Trainer

(ST Engineering, 2018)
Affordances in summary

- **Experiental** learning is effective, freedom of exploration
- **Immersive** learning and focus and engagement
- Deliberate **practice**
- **Collaboration** in and across platforms

- Capturing expert and novice practice in similar environment also XR
- Observation, Demonstration, Based on Models
#1 Observing learner behaviour in VR
TU Delft Campus

Objects explored

NPC Interaction
Creative World

Objects created

Materials, Structures used
Survival World

Challenges achieved

Cooperation
Minecraft Escape Room
Course Computer Organisation

- Learning about Logic Gates observing problem solving behaviour
Minecraft Geology Museum

- Information about different parts of a bigger process, tracking of exploration

Figure 5: Different platforms are scattered throughout the area, each providing different pieces of information.

Figure 1: The rock cycle [12].
#2 Capturing expert performance in VR
Calligraphy Trainer: Handwriting Feedback

GuitarJam (Student Project 2022)

- Objective: Learn how to play the Guitar
- Practice on Specific Chord changes
- Senseglove for creating expert recordings
- For giving instruction and feedback
#3 Structuring Collaboration in VR
Collaboration in AR

- Interaction with AR Model and physical devices
- Loading of different pathologies for diagnostics training
- Collaborative exploration and diagnostics
- Foot, Lung and other models used in education
Collaboration in VR

2: Focus of Project

Framework

Virtual reality

Visualizing actions

Shared situational awareness

Social modes of co-construction

Virtual embodiment

Social presence

Participation

Collaborative learning

Virtual environment control

Joint attention

On-task discourse

independent

mediator

dependent
3: Experiment

Visualization of actions

1: Vision cones
- Visualization of a user’s view
- Others can see what is (and isn’t) inside a user’s vision
- Does knowing what your group members are (and aren’t) looking at create a higher level of shared situational awareness and transactivity?

2: Highlighting / pinging
- Ability to highlight anything considered a point of interest
- Used (at will) to attract the attention of other users
- Does the ability to point out any elements of interest at will, both from far away and up close, create a higher level of shared situational awareness and transactivity?
Thanks
Conclusion and Discussion

- Pregiven sensors built into the system
  - Eyetracking, movement, pointing, deictic references,
  - Object interaction,
  - NPC scaffolding,
  - Collaboration sensors

- Task manipulation (4CID)
  - Support, Procedural, Part Task
  Simplication
  - Scaffolding
  - Highlighting, Prompting
Conclusion and Discussion

- Single user learning objectives and selection of indicators can be nicely linked to performance objectives considering
  - Capturing, expert performance
  - Observation, model practice
  - Exploration, object and task level
  - Practice and Training
  - Problem Solving

- Collaboration
  - Monitoring of practice (real-time feedback)
  - Demonstration of practice
  - Information distribution for collaborative tasks