

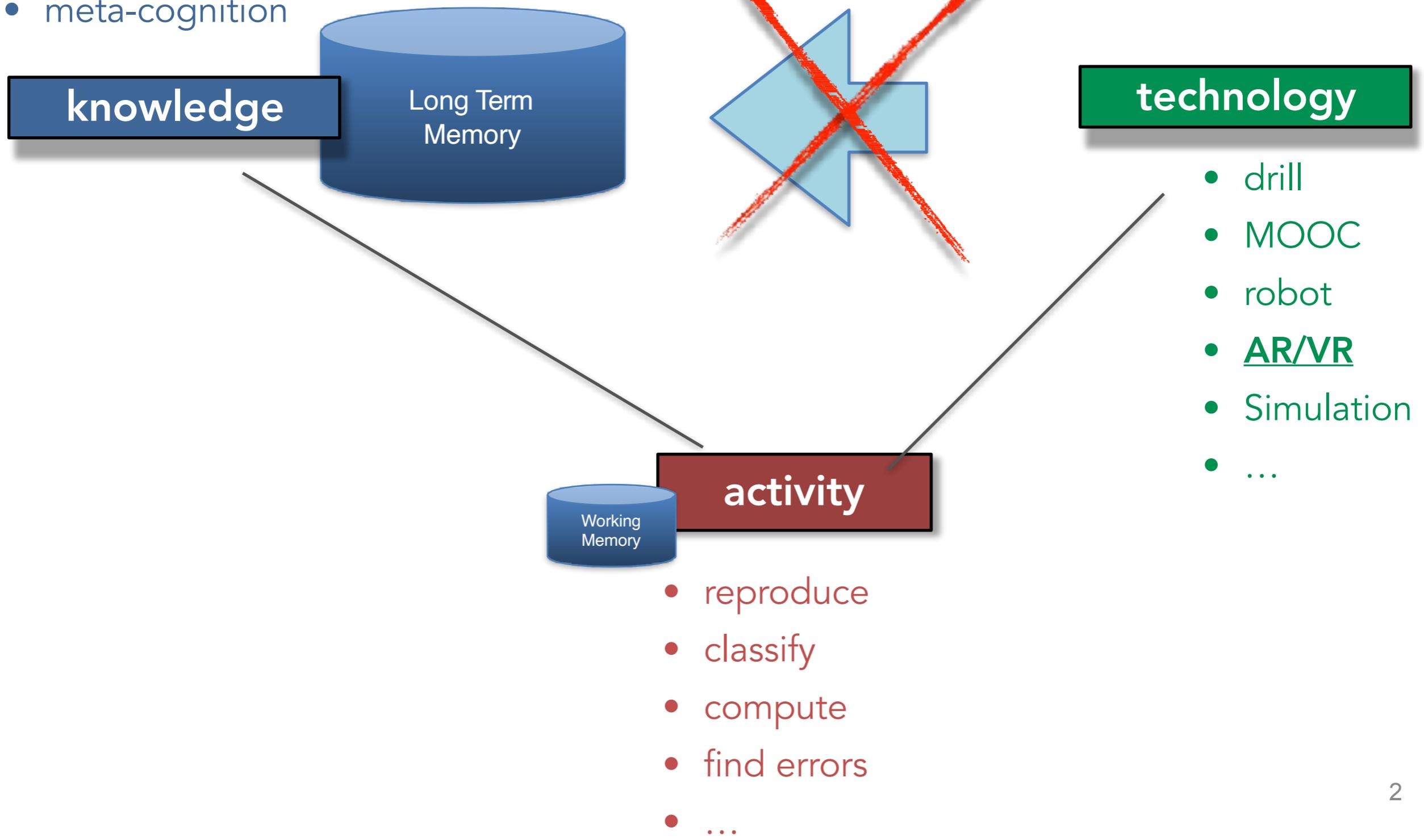
CS-411 : Digital Education

Chapter 9: Extended Reality for Learning



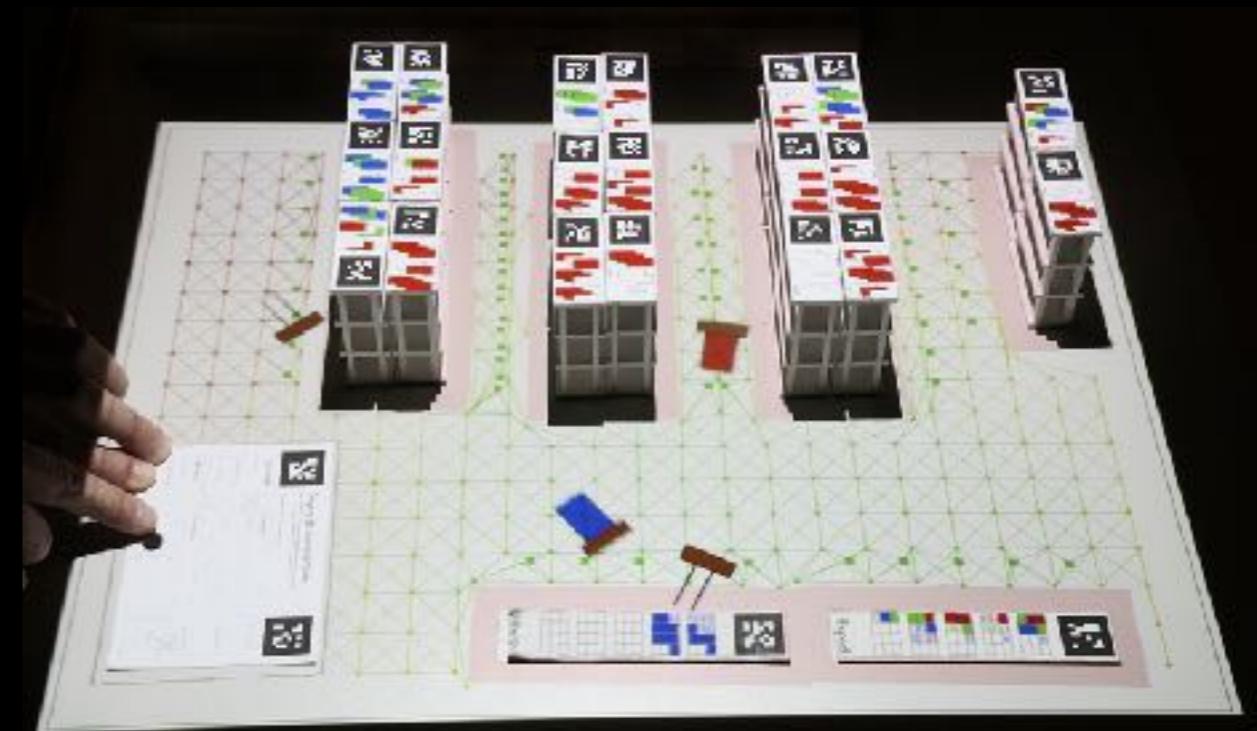
Prof. Pierre Dillenbourg

- fact, concept, rule, theory, ...
- declarative, procedural, heuristic
- meta-cognition



« Extended Reality (XR)»

1. Augmented reality (AR): digital images **superimposed** on real images or real objects
2. Virtual reality (VR)
3. Mixed reality (MR)
4. Metaverse



Adding digital elements to
Real images / objects



Alignment ?

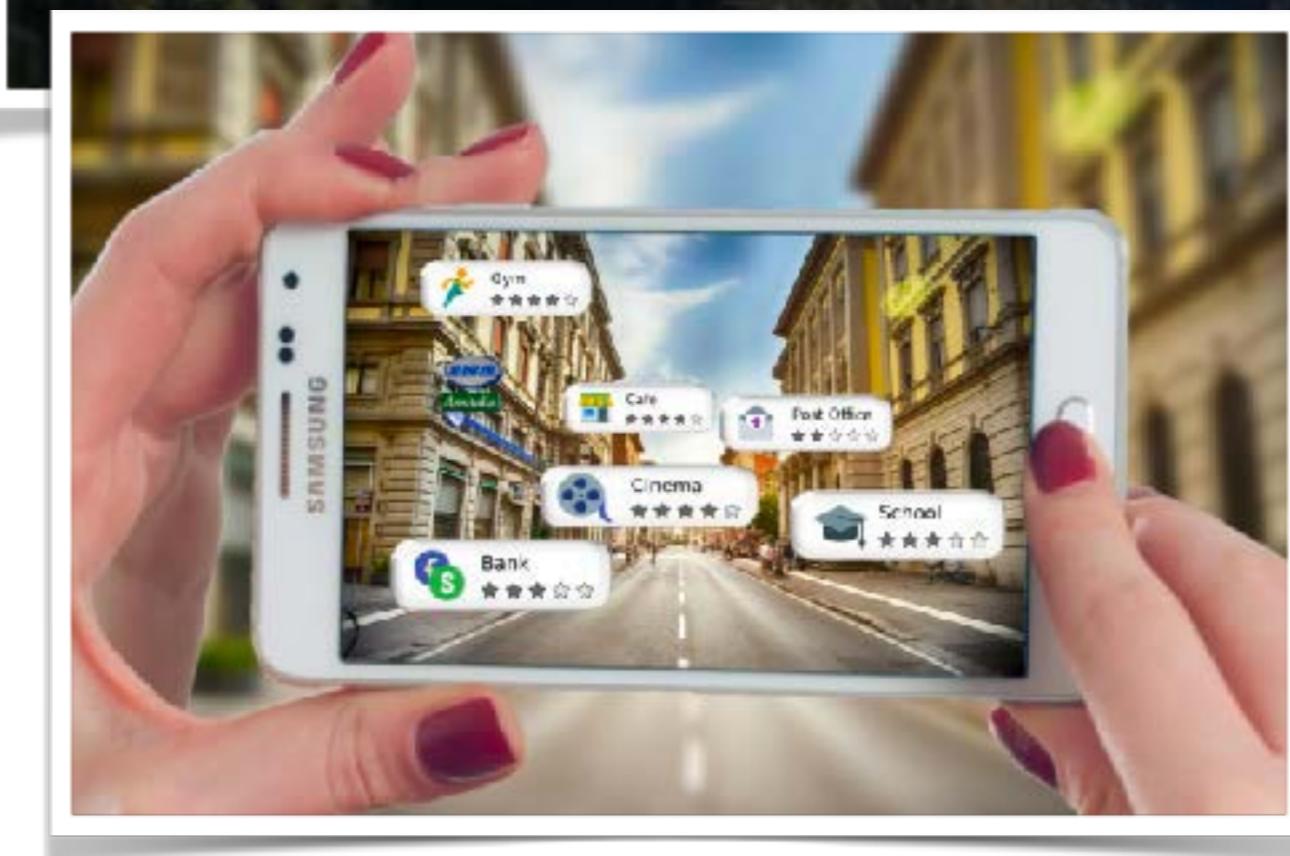
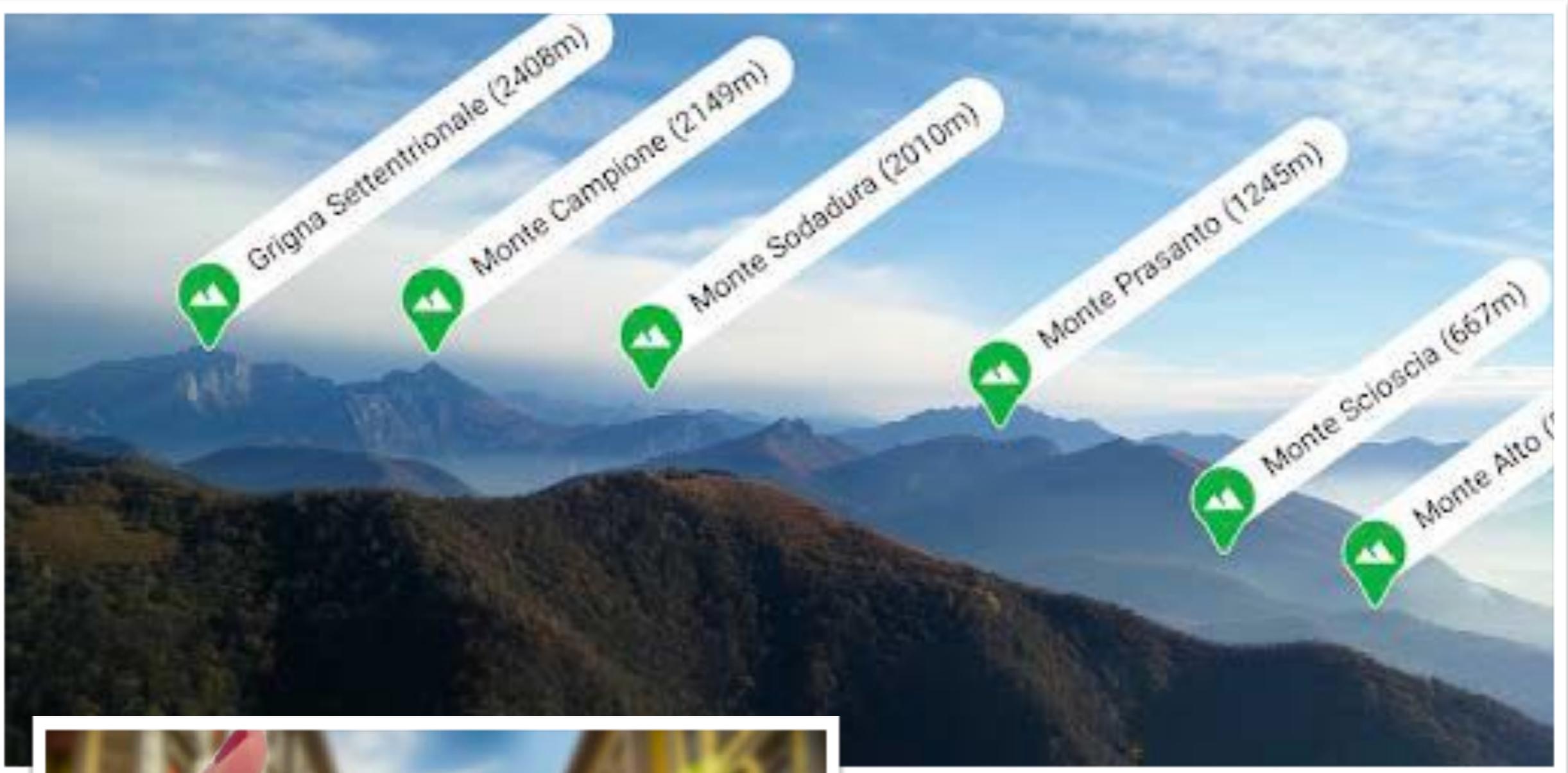


Caméra + Modélisation des trajectoires

Alignment ?

Caméra + GPS + GIS





Alignment

Peak Lens

« Extended Reality (XR)»

1. Augmented reality (AR): digital images **superimposed** on real images or real objects
2. Virtual reality (VR): a 3D computer-**generated** world that **reproduces** a real or fictional world



VR = computer-**generated** (real) 3D environments

<https://www.vrfocus.com/2017/05/everspace-to-launch-this-month-with-full-vr-support/>

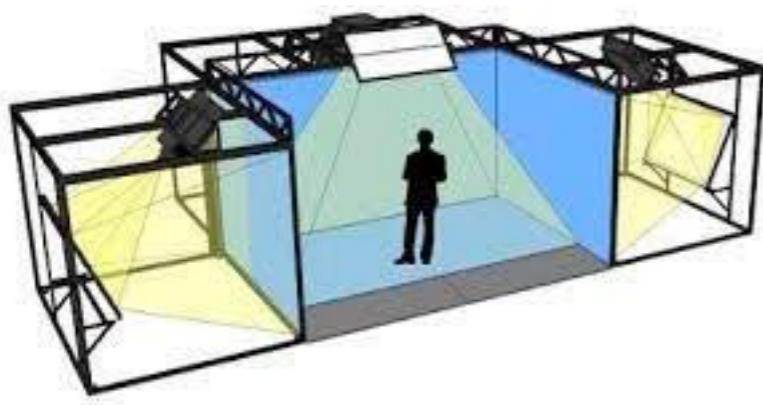


VR = computer-generated (fictitious) 3D environments

CAVE

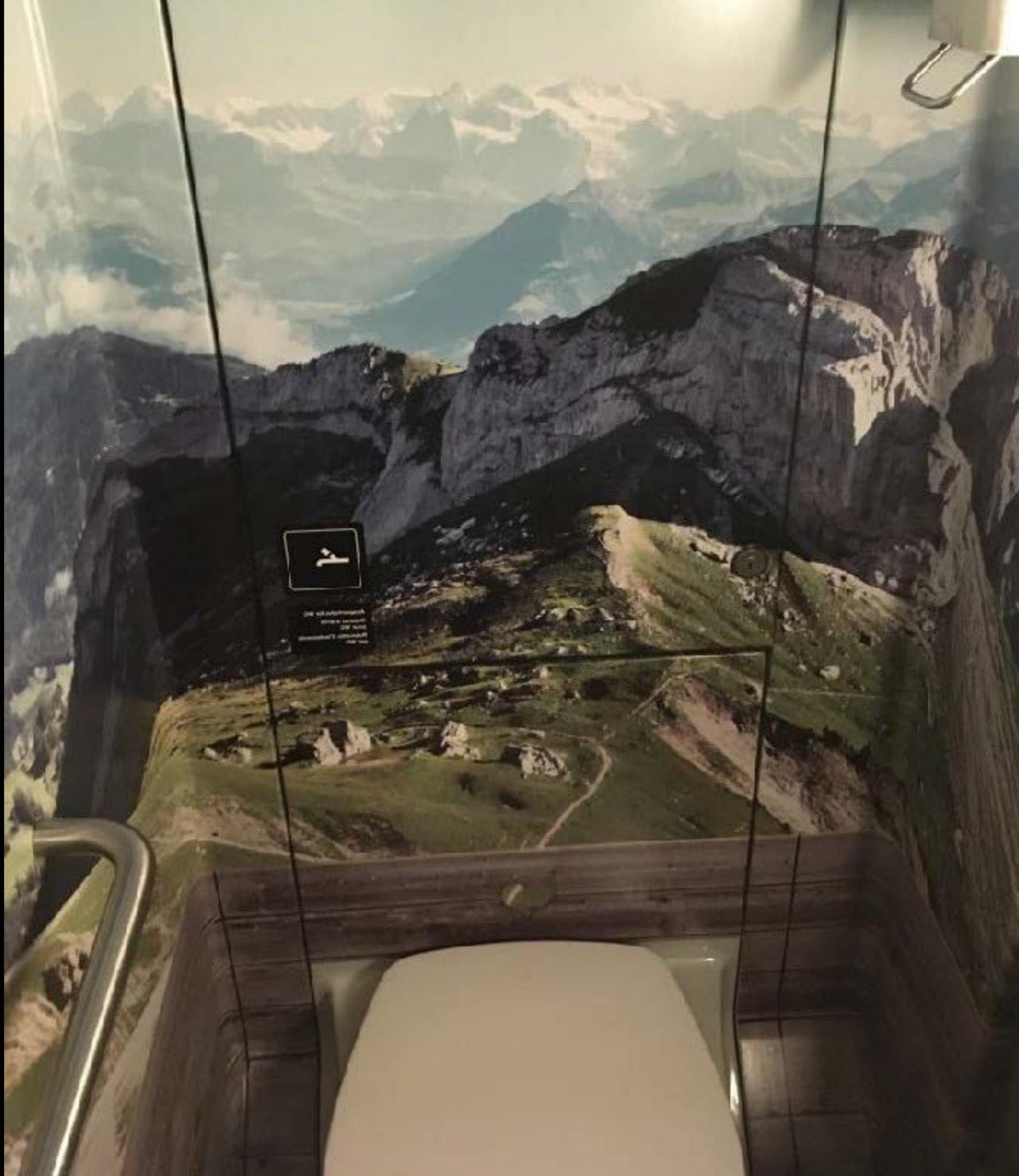


https://sky-real.com/wp-content/uploads/2020/09/image_articlecave8-e1600960536904.jpg





<https://www.barco.com/en/product/transportable-cave#&gid=1&pid=1>



« Extended Reality (XR)»

1. Augmented reality (AR): digital images **superimposed** on real images or real objects
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4. Metaverse



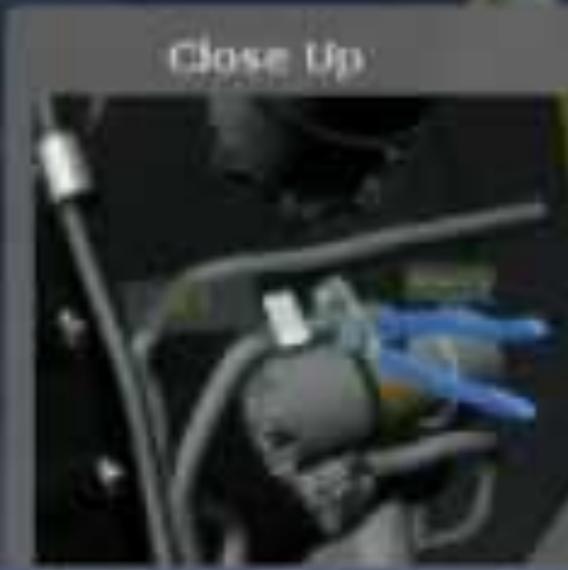
<https://virsabi.com/mixed-reality/>

Mixed reality (MR) : merging of **real** and **virtual worlds**, physical and digital objects co-exist and interact in real time

Remove generator cable J1 using channel locks



Close Up





VR + haptic Feedback

« Extended Reality (XR)»

1. Augmented reality (AR): digital images **superimposed** on real images or real objects
2. Virtual reality (VR): a 3D computer-generated world that **reproduces** a real or fictional world
3. Mixed reality (MR): virtual interface **acting** on real objects
4. Metaverse: network of 3D **immersive** virtual worlds, focused on **social** interaction, made of **persistent** spaces, navigated through VR/AR

Immersive ?



<https://www.berlitz.lu/fr/total-immersion>

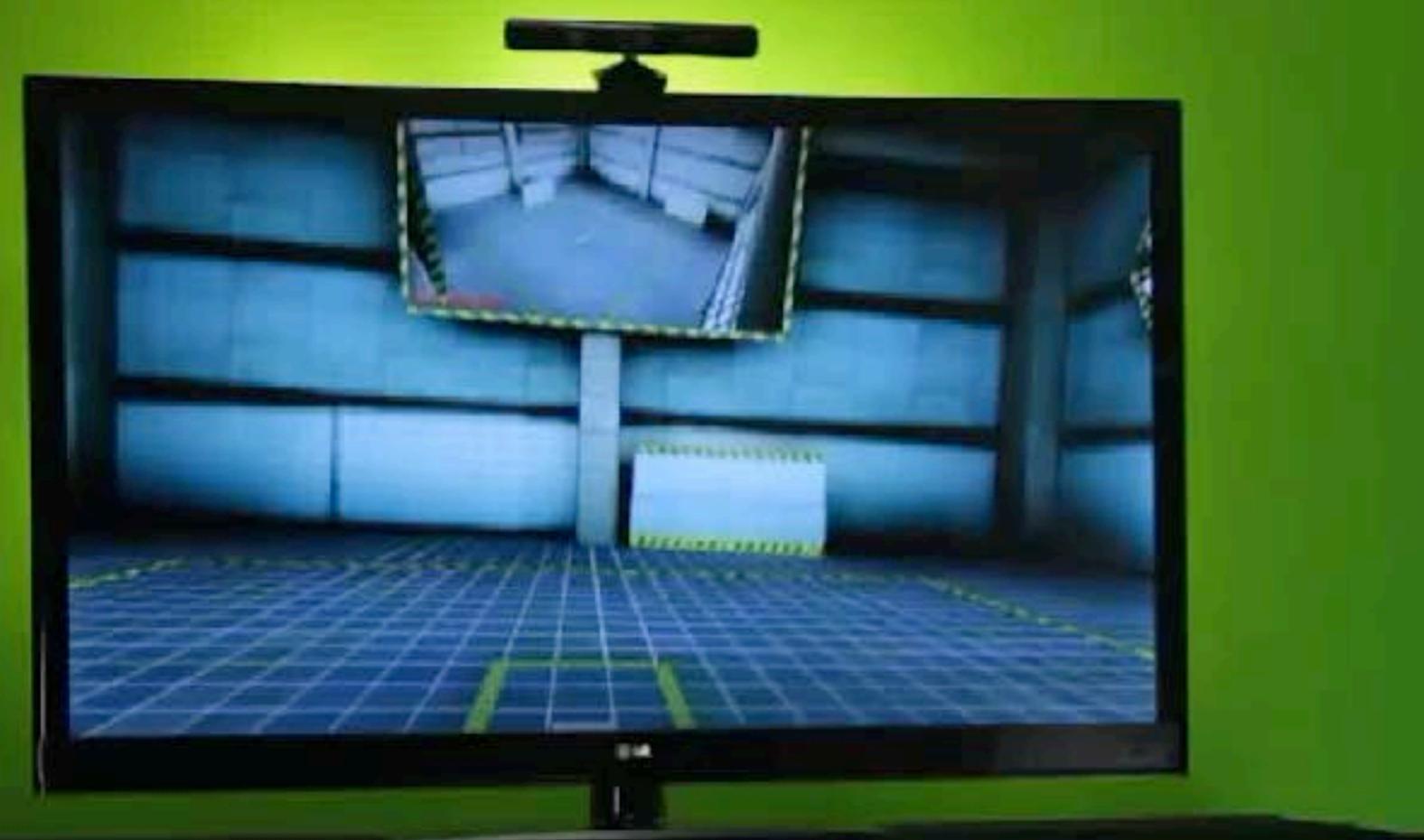
A virtual reality environment is **IMMERSIVE** if it generates **stimuli** for the user similar to those she would perceive in a real environment similar to the one being simulated (Sight, Touch, Hearing, ...)



The Pitt Experiment

Stanford VR Lab

A virtual reality environment is **IMMERSIVE**
if it generates for the human user **stimuli** similar
to those he would perceive in a real environment



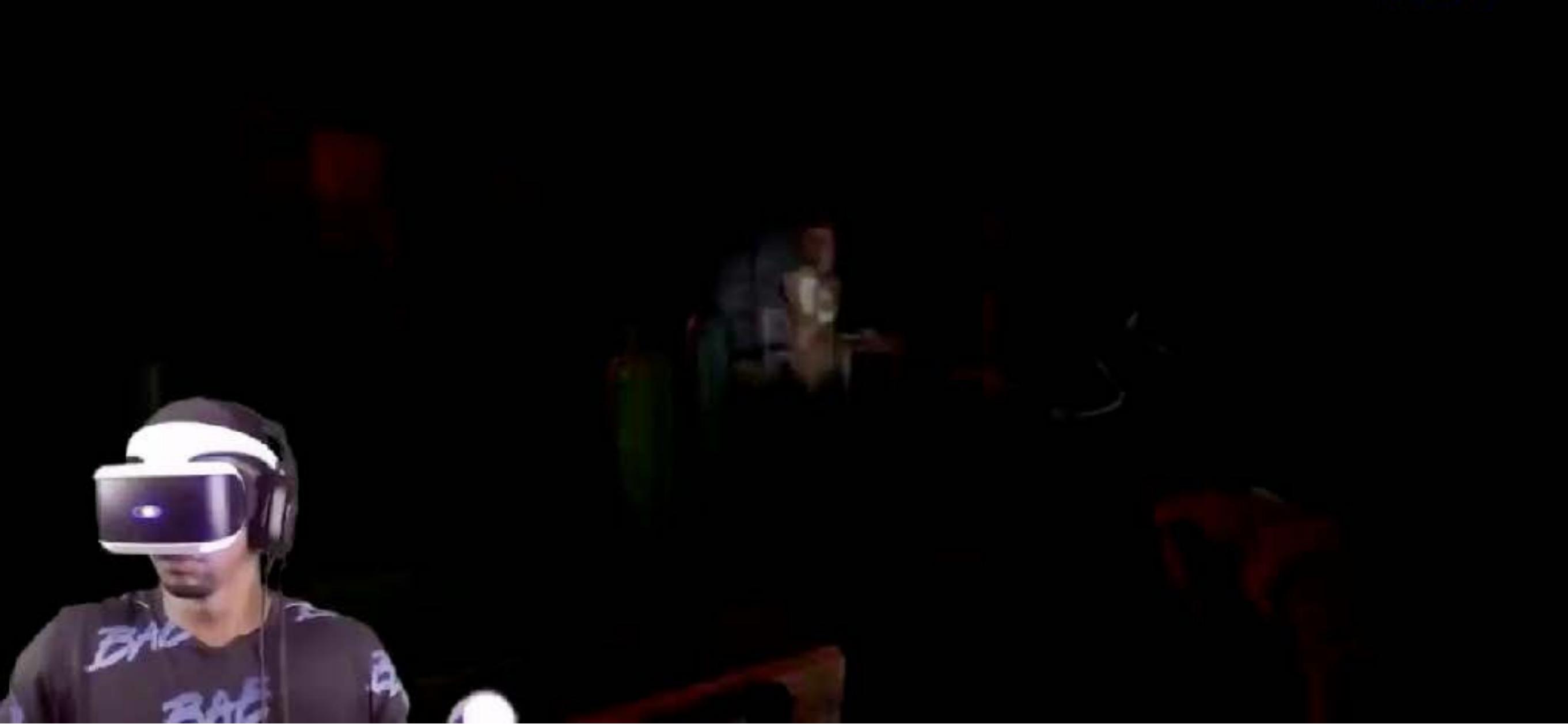
WORLD VIZ



Immersive ?

<https://www.youtube.com/watch?v=9cma-1DNIZU>

sandbox
TEN

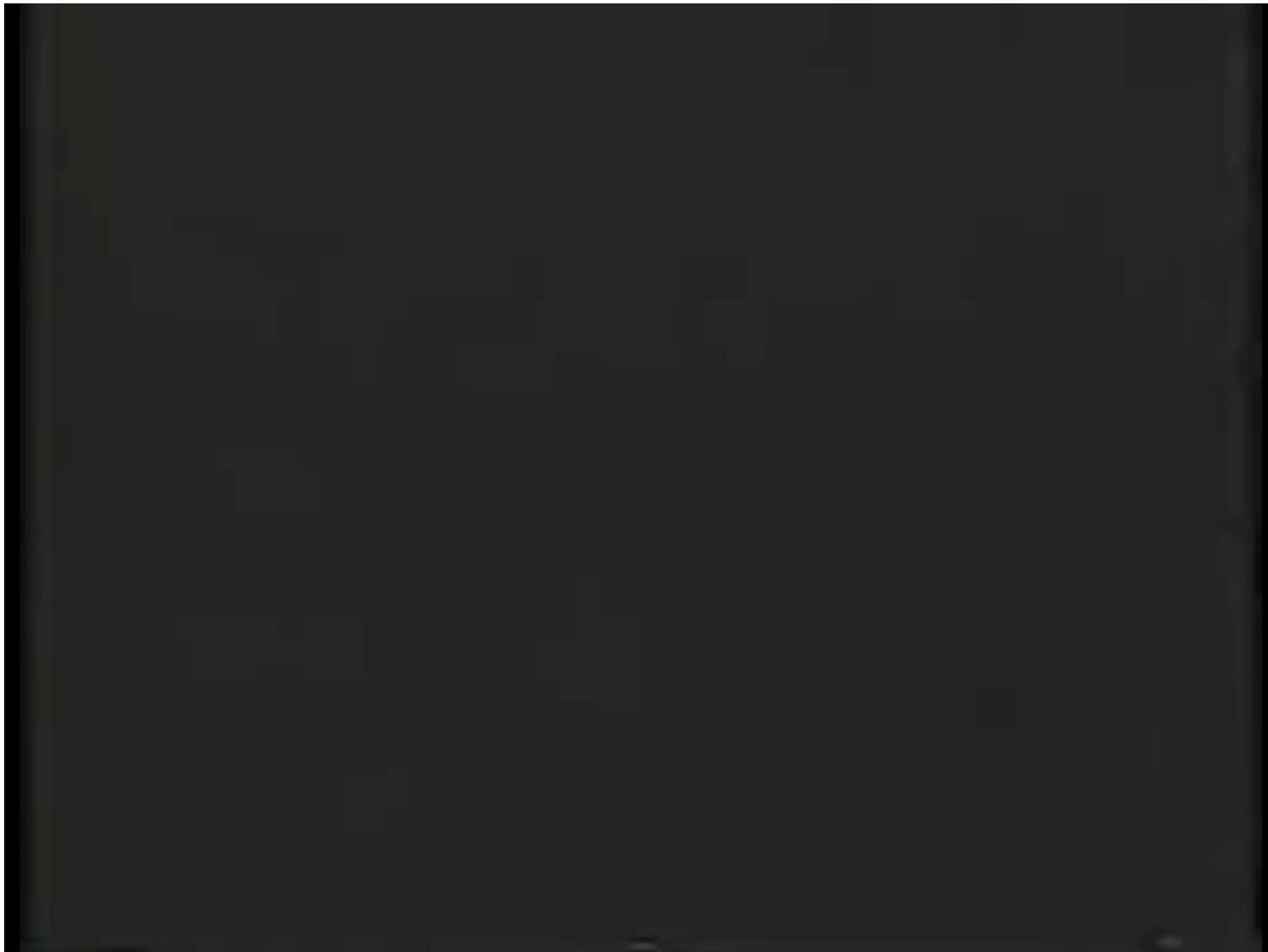




Dario Floreano, EPFL

Birdly

Immersion ?



<https://www.youtube.com/watch?v=VTNmLt7QX8E>

Heider & Simmel, 1944 ?



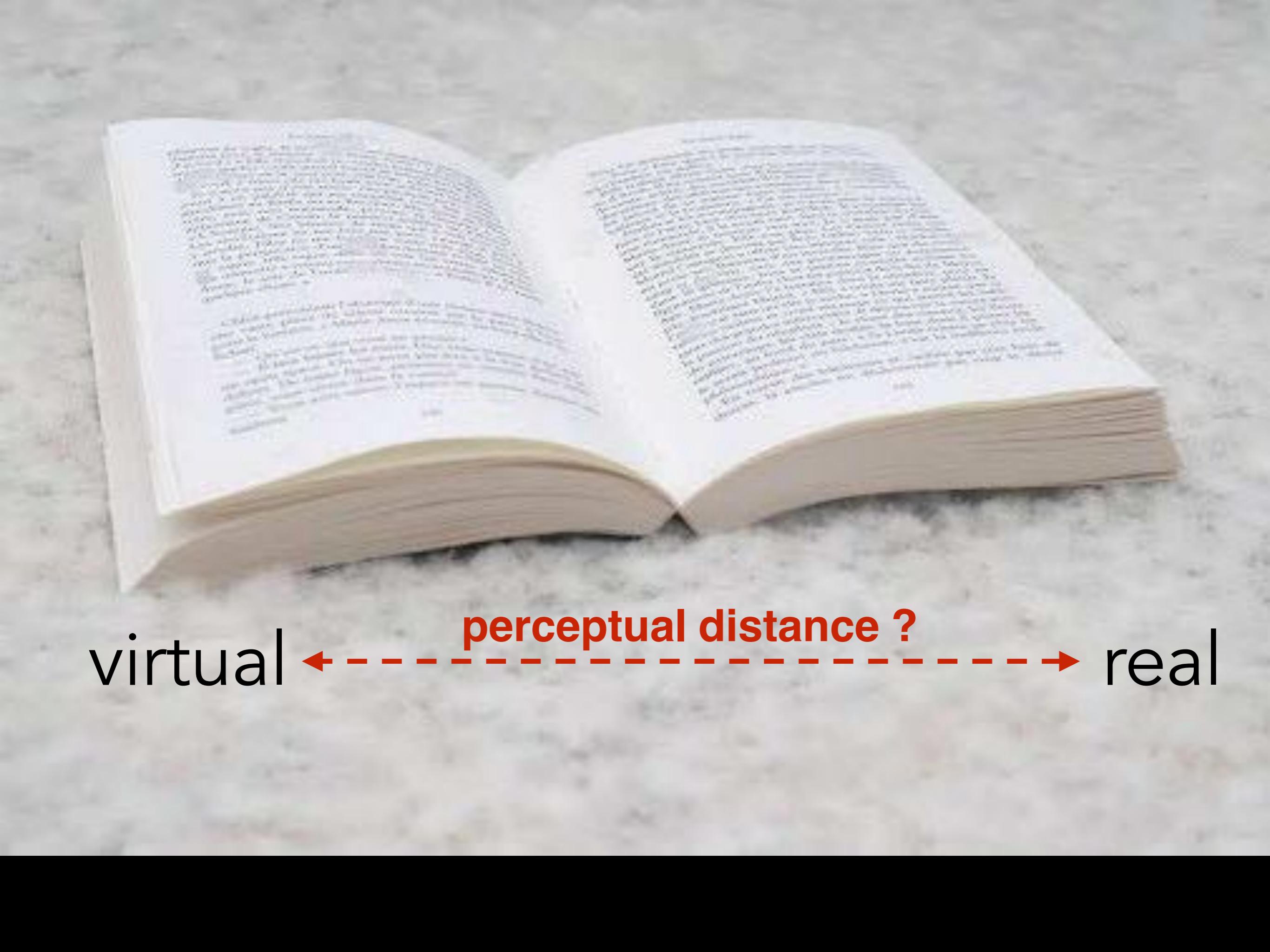
FlyJacket.epfl.ch

Immersion ?



Who is the bad one ?

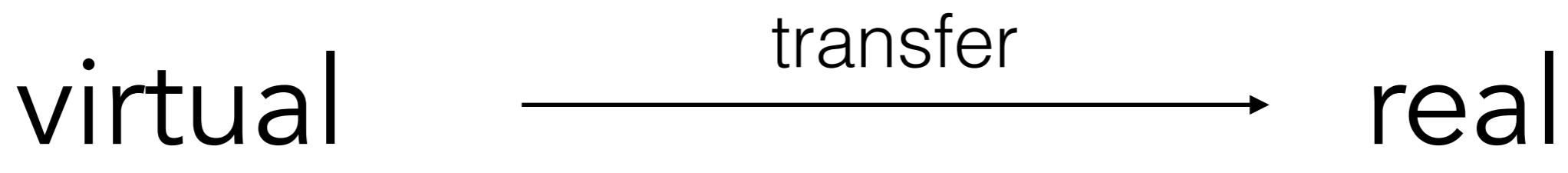
Each step becomes more difficult. My feet are bleeding and the blood is mixing with the dust. This rocky maze is never-ending... What a pain! My sweat fogs up my glasses, already cracked by my falls. In what state of mind are they waiting for me? Have they forgotten the hatred they had towards me?



virtual ← ----- **perceptual distance ?** ----- → real

The similarity hypothesis: transfer

$$\text{transfer}(V \rightarrow R) = f(\text{distance}(V, R))$$





what's in it for learning ?



for

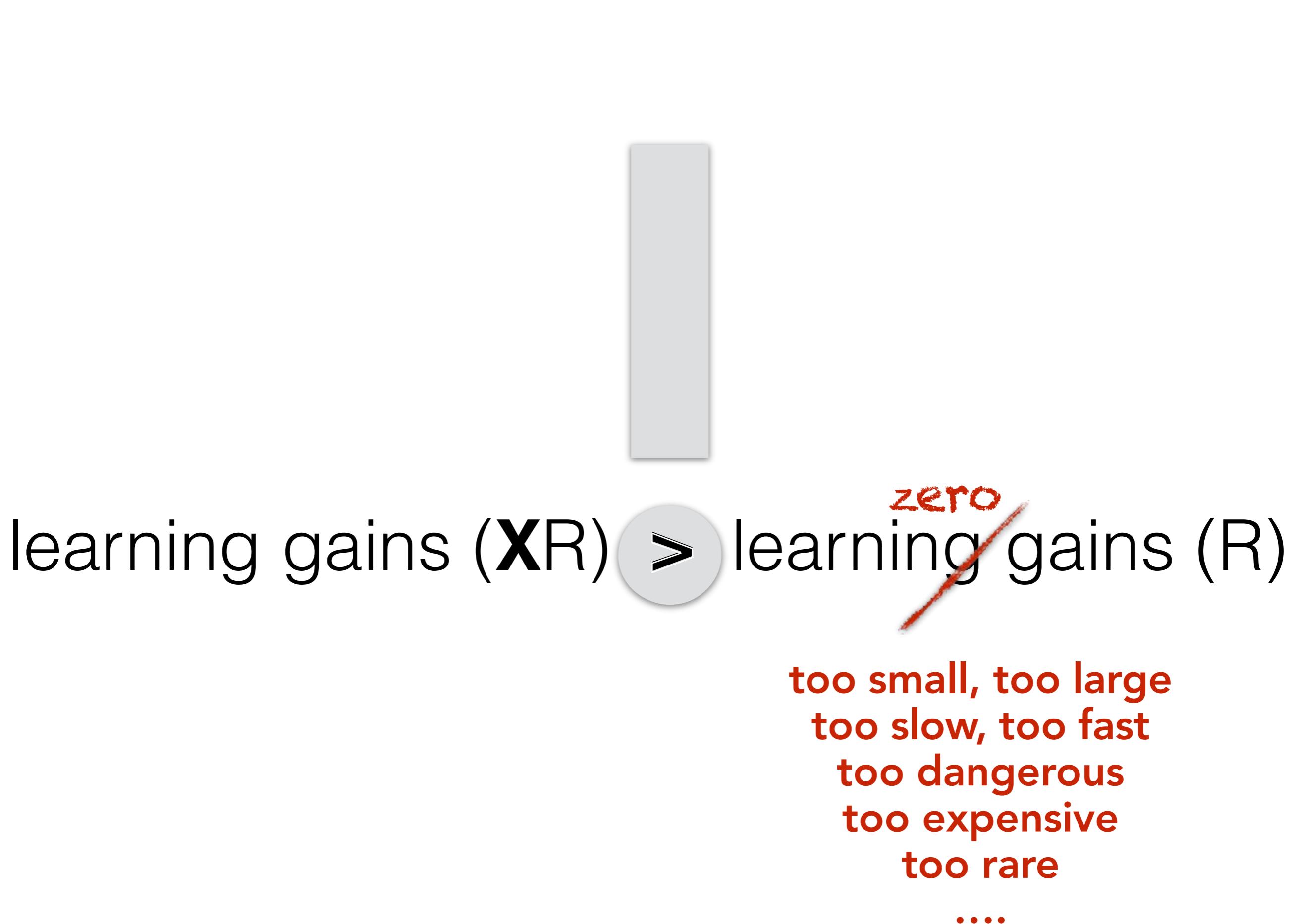


learning

gains

(XR)

> learning gains (R)



Too Dangerous ?



<https://vrworldtech.com/2020/07/27/fire-fighting-vr-training-can-save-lives/>

Training Firemen

Did you ever
put your life in the hands of a professional
of trained with immersive VR ?



8-11 millions

Trop dangereux !
Trop cher !
Trop rare !
Trop petit !
Trop lent !





Real, recorded real, simulated?

Prof. Jean-Philippe Ansermet



learning gains (XR)  learning gains (R)

virtual experiment

real experiment

Perceptual fidelity → Immersion → Engagement? → Learning



learning gains (XR) > learning gains (R)

AR warehouse

real warehouse

Preceptual fidelity → Immersion → Engagement? → Learning

Cognitive fidelity

Reflect
Predict
Explain
Disagree

Compare
Reformulate
Teach
Summarize
Translate

experience

learning

Engagement

→

Learning

Visual fidelity → Immersion → Engagement → Learning

+ reflection

+ reification

Cognitive fidelity



Make the **in**visible visible



In the real world, we do not see forces !



In the real world,
we do **not** move shelves with 2 fingers !



Make the **impossible** possible

~~Visual fidelity~~ → Immersion → Engagement → Learning
Cognitive fidelity



+ **reflection**
+ **reification**

*Make the **invisible** visible*

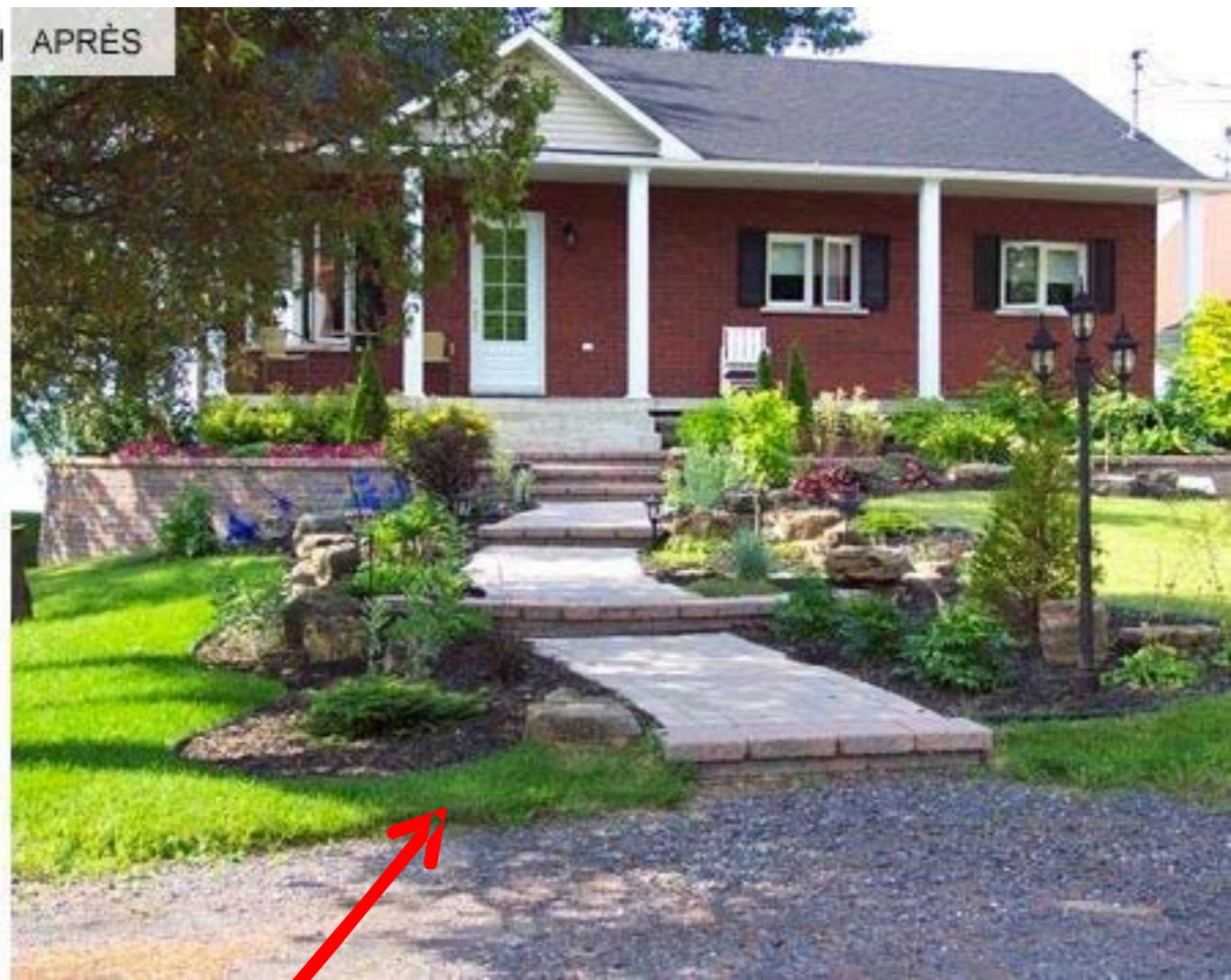


61

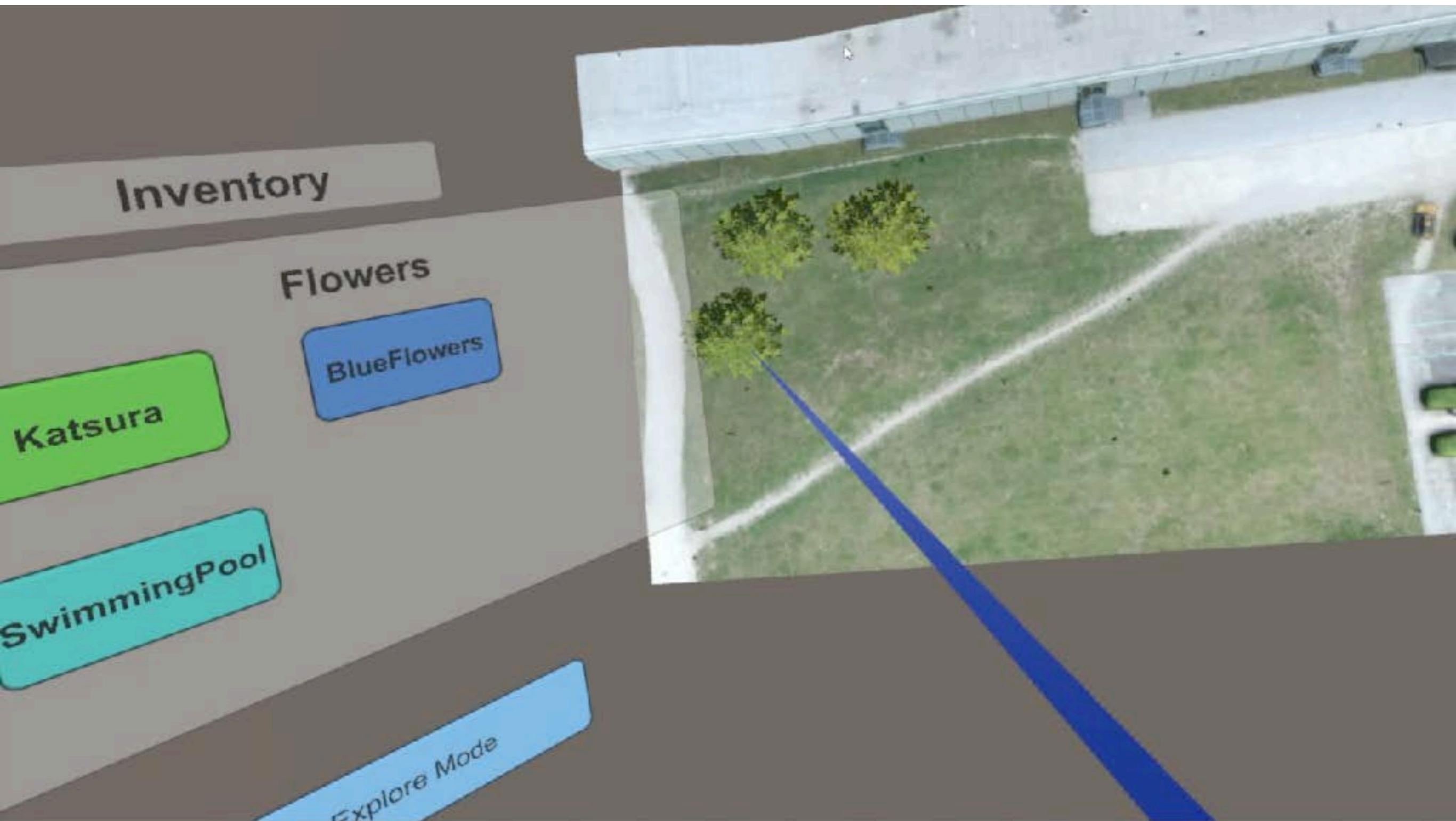
bloomy
pro



AVANT | APRÈS

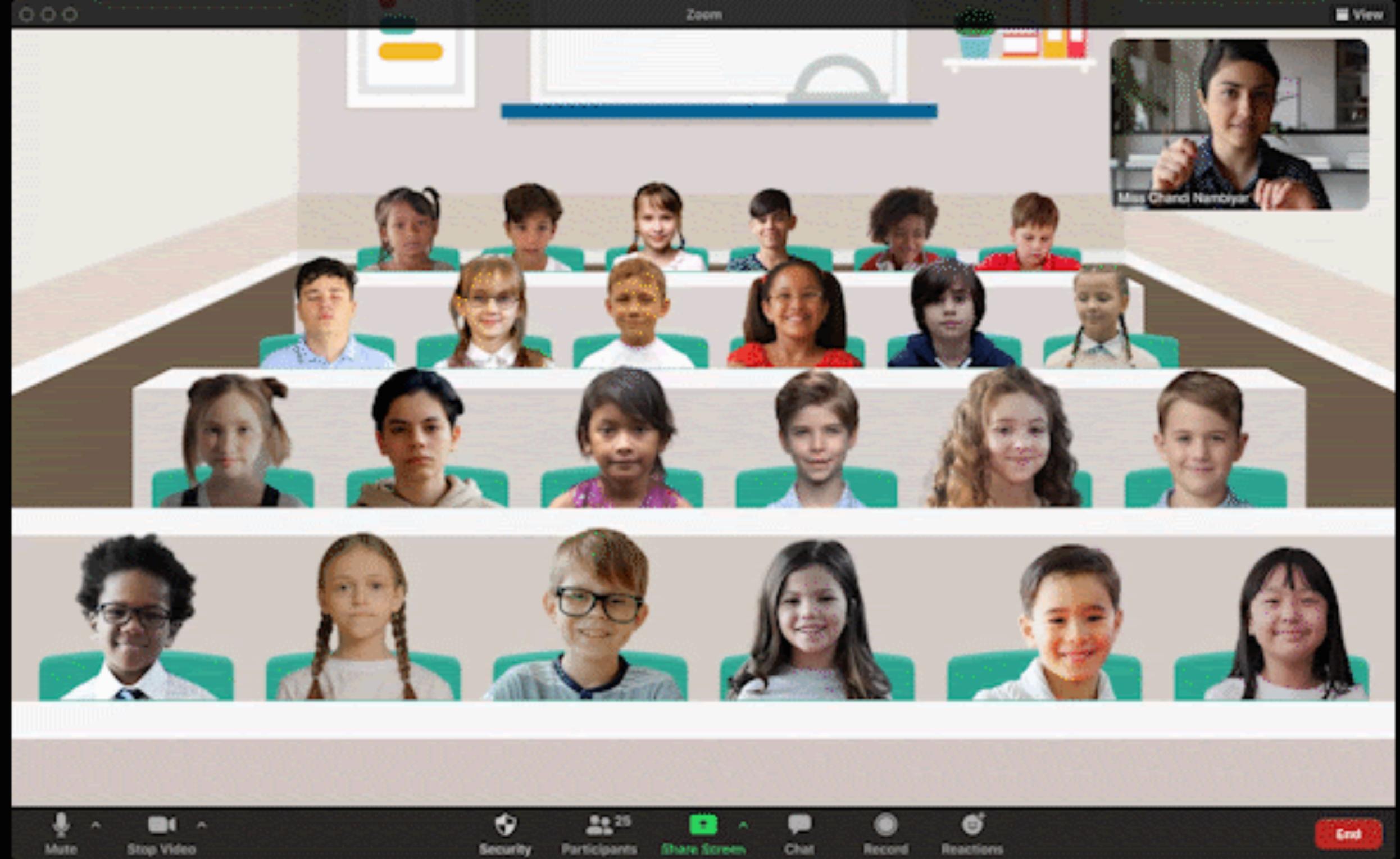


In the real world,
we do **not** change seasons !



Two tracks for AR/VR in education :

- **Imitate**: create **perceptively**-realistic immersive training environments for behavioral training
- **Escape** from reality: create non-realistic features that enable **cognitive** process for knowledge acquisition



3. Expand the classroom

serious 'wow'

1. There is **NO** INTRINSIC learning effects of XR: it is not because it's 'wow' that users learn, its about their cognitive activity
2. It is not R **OR** XR but R **AND** XR: when both are possible, they are complementary

Green rooftop of the Rolex

EPFL

Time: Now

Season: Summer

Saison:

Printemps

Été

Automne

Hiver

Été

<<

>>

maintenant

Croissance
des arbres:

