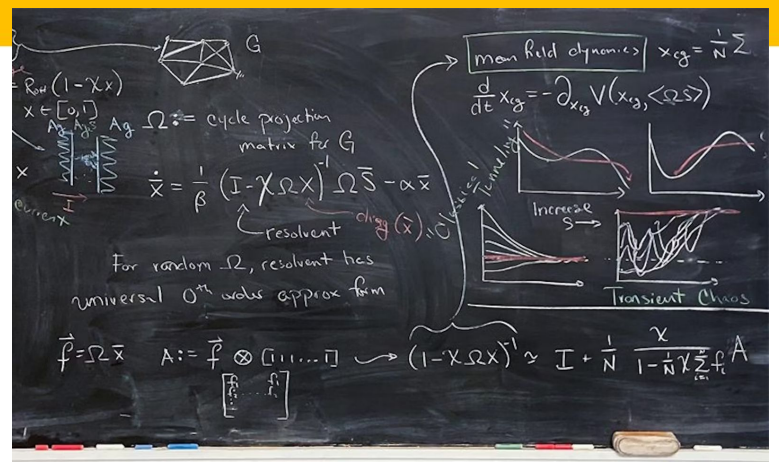
VR in Education

- What is holding you back? –

Martin Skrodzki

Teaching Academy
Meet & Eat

27 February 2024



Virtual Reality in Education – What is holding you back?

Martin Skrodzki, Computer Graphics and Visualization, INSY, EEMCS

Delft University of Technology

Who has … used VR before?

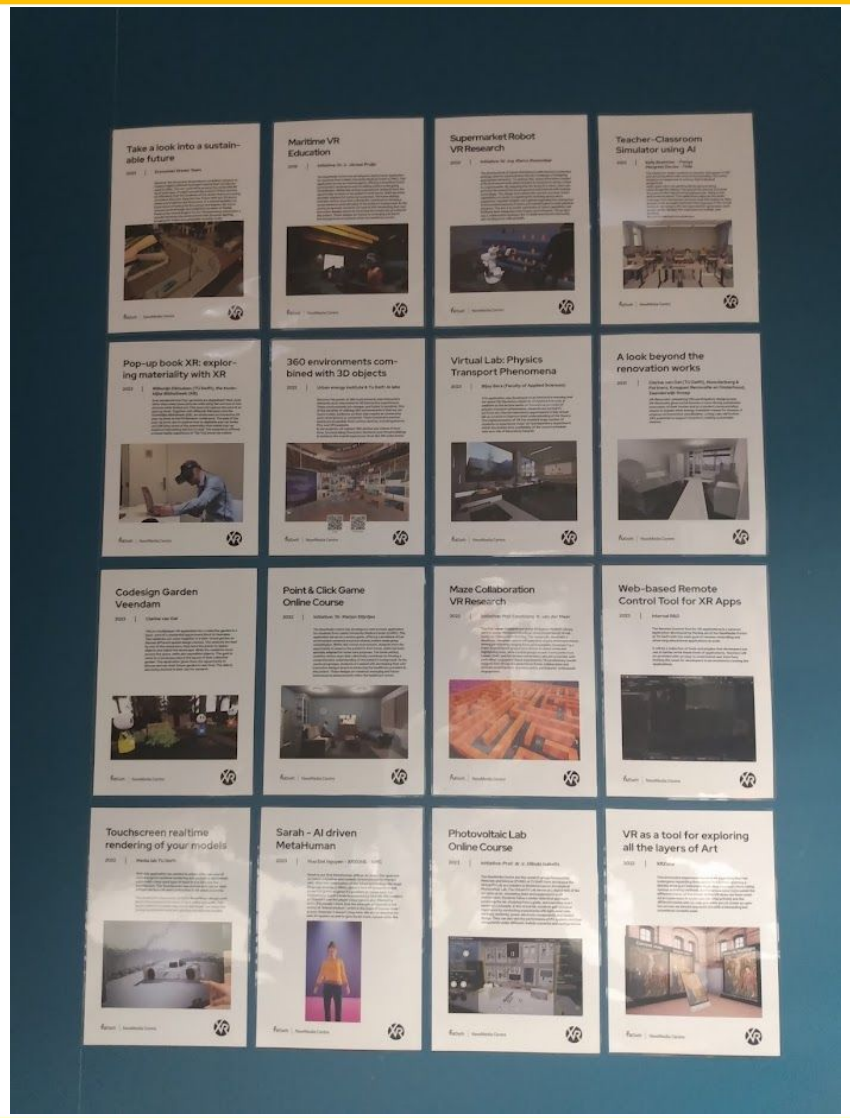
Who has … access to a VR setup?

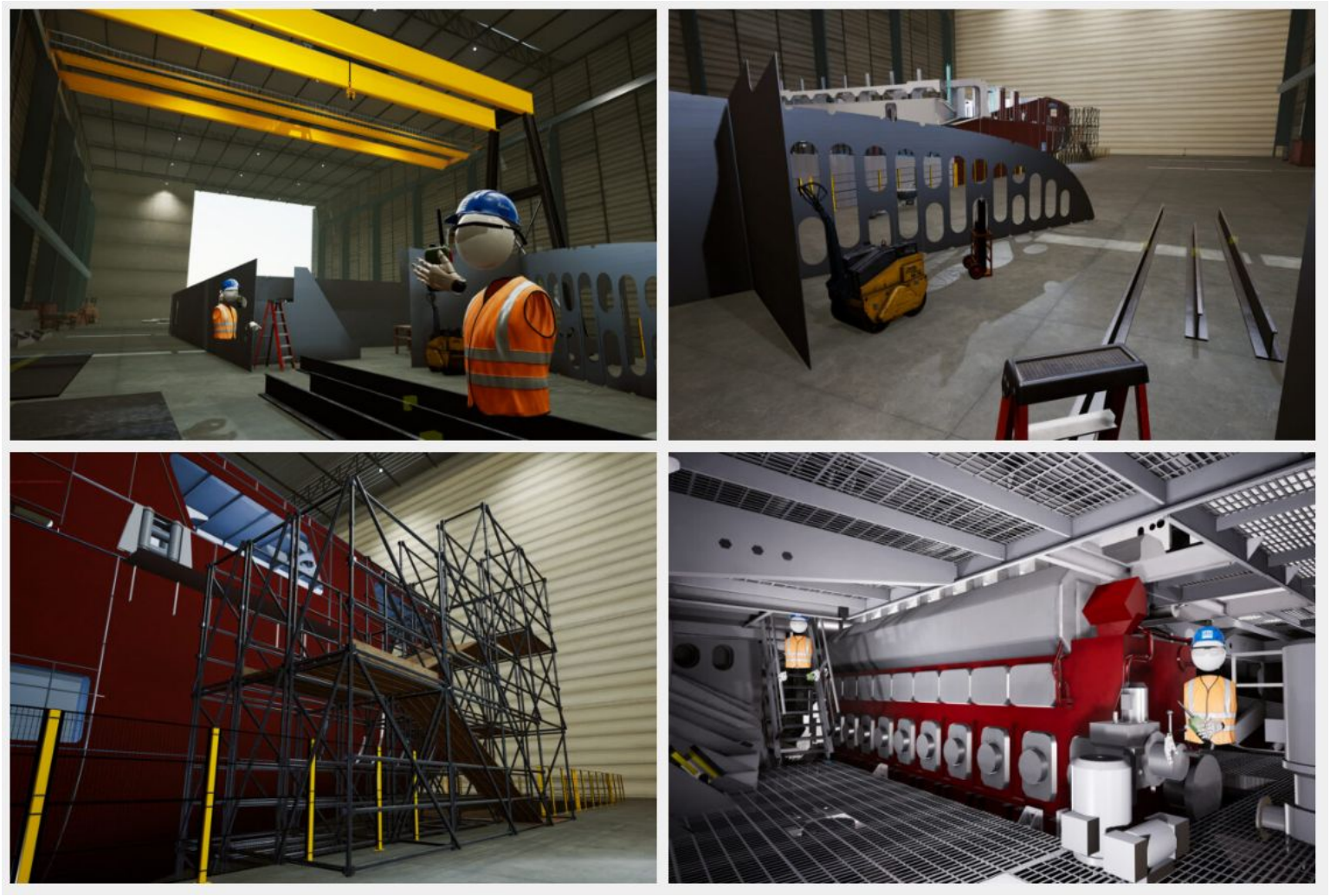
Who has … used/seen VR in education?

Virtual Reality (VR)

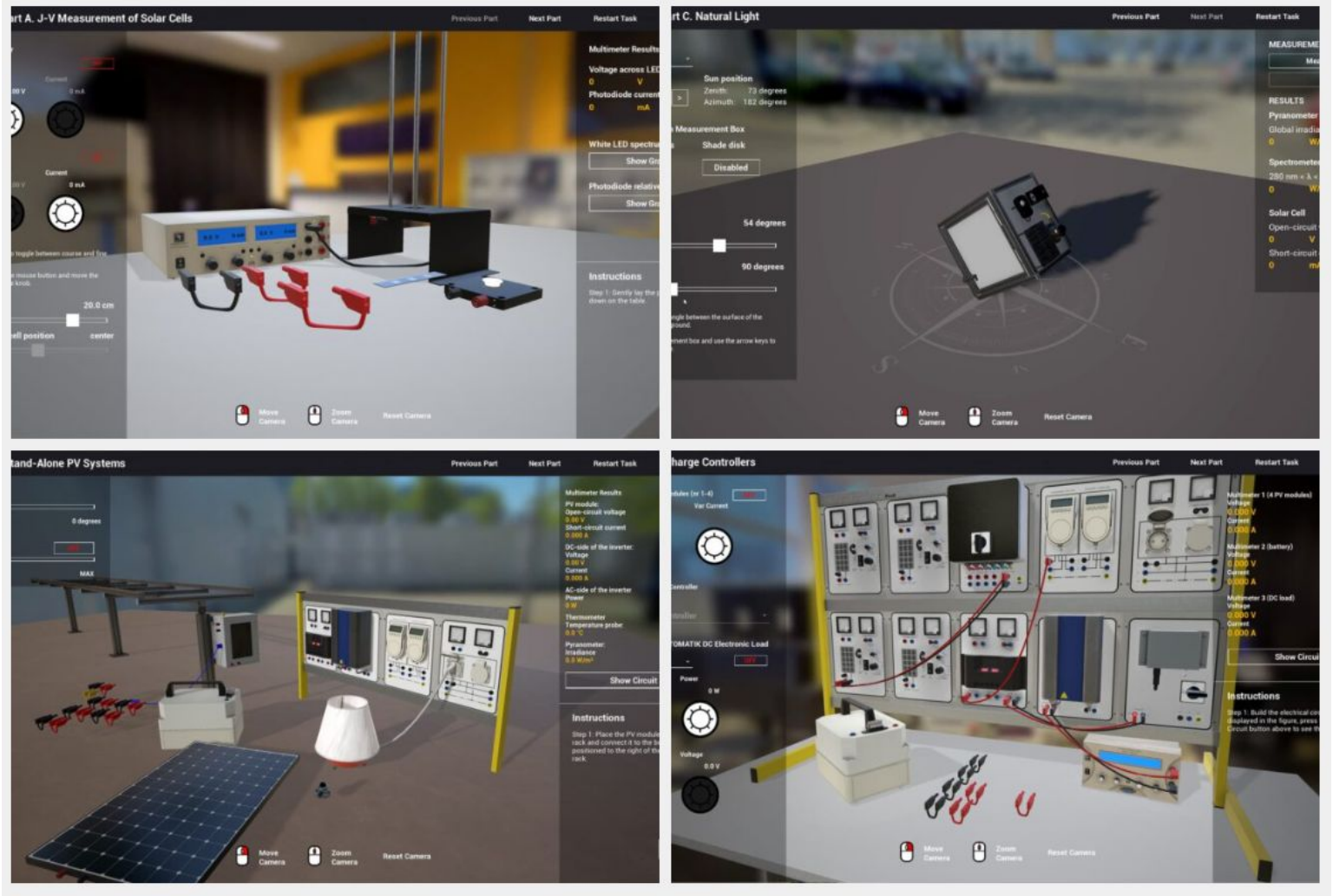
augmented reality

mixed/extended reality


Take a look into a sustainable future
Maritime VR Education
Supermarket Robot VR Research
Teacher-Classroom Simulator using AI
Pop-up book XR: exploring materiality with XR
360 environments combined with 3D objects
Virtual Lab: Physics Transport Phenomena
A look beyond the renovation works
Codesign Garden Veendam
Point & Click Game Online Course
Maze Collaboration VR Research
Web-based Remote Control Tool for XR Apps
Touchscreen realtime rendering of your models
Sarah - AI driven MetaHuman
Photovoltaic Lab Online Course
VR as a tool for exploring all the layers of Art



https://newmediacentre.tudelft.nl/vr-maritime/



https://newmediacentre.tudelft.nl/pv-lab/

TU Delft | NewMedia Centre

What we Do

XR Workstations

The XR Zone is equipped with more than ten state of the art workstations with all the required software installed. There are HTC Vive headsets and other VR tools for you to experiment with and a friendly dedicated staff to help you get started.

XR Workshops

The XR Zone organizes workshops and classes for various XR topics: students, teachers and researchers from the TU Delft are welcome to learn modeling, animation and XR applications development.

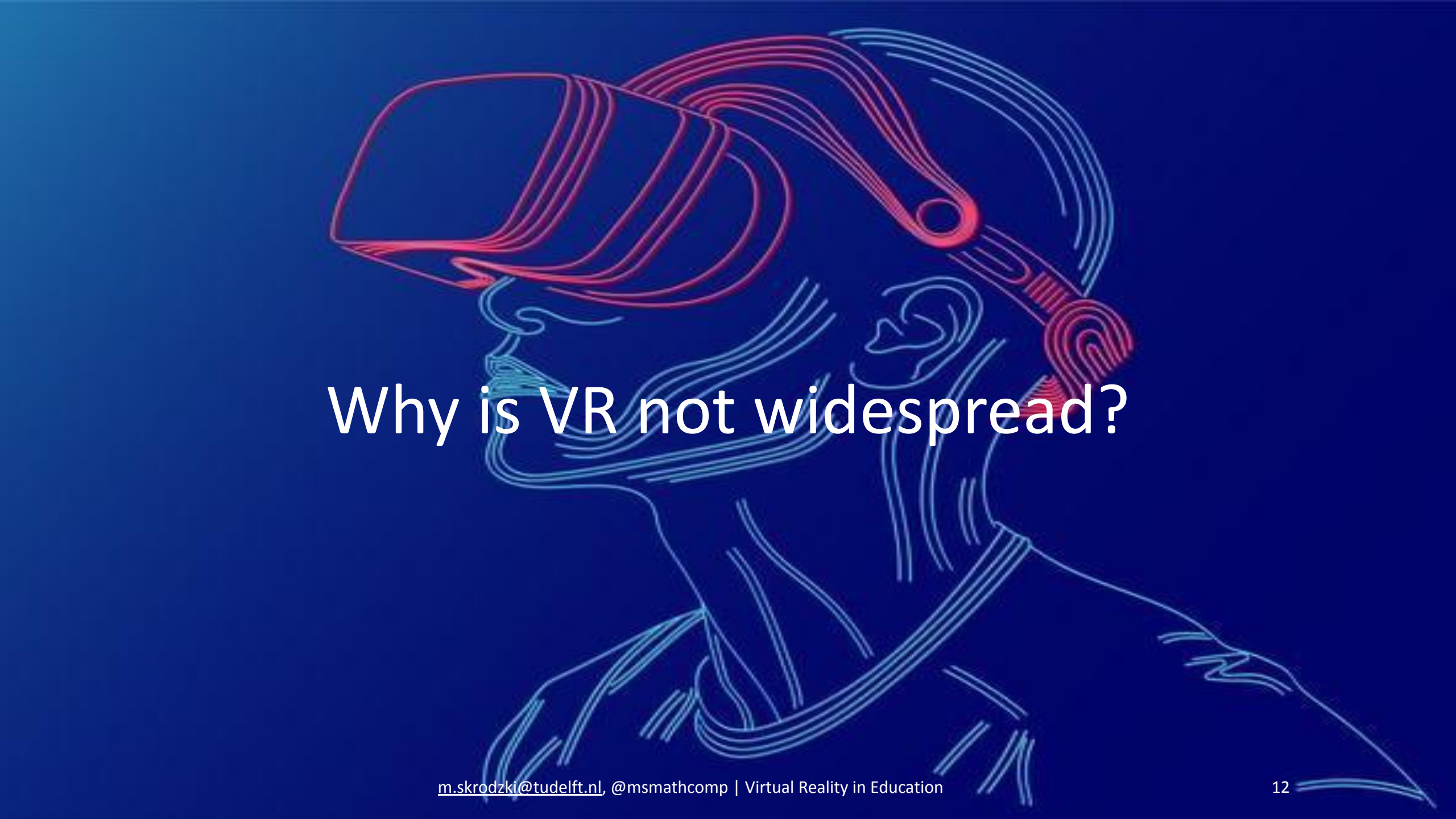
XR development

The XR Zone team is always happy to assist and advise you in exploring the use of XR in education or research. We can develop complete solutions or just assist and advise in existing or start-up projects.

https://newmediacentre.tudelft.nl/xr/

XR IN EDUCATION

SURF



Why is VR not widespread?

REVIEW article

Front. Virtual Real., 19 May 2023
Sec. Virtual Reality and Human Behaviour
Volume 4 - 2023 | https://doi.org/10.3389/frvir.2023.1159905

Virtual reality and collaborative learning: a systematic literature review

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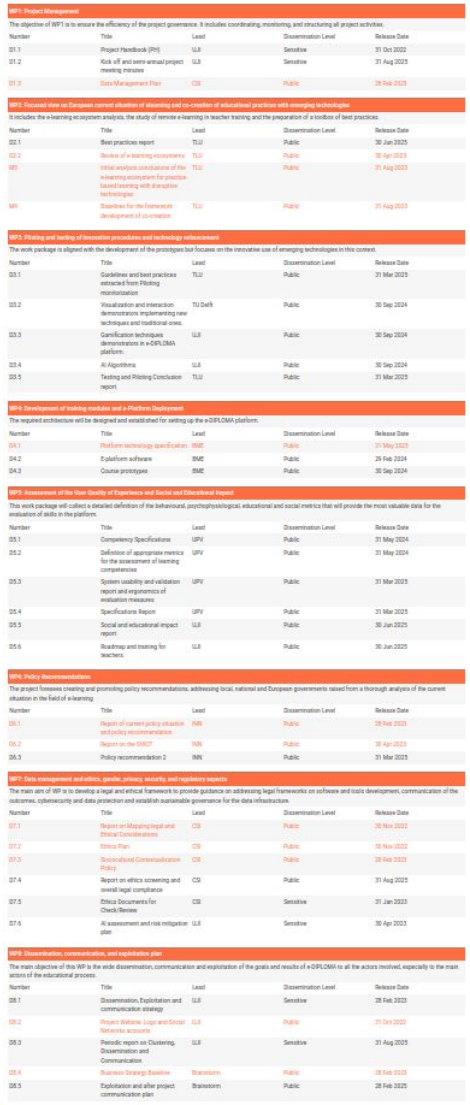
[2] Leiden Institute of Advanced Computer Science, Leiden University, Leiden, Netherlands
[3] Interactive Intelligence, Delft University of Technology, Delft, Netherlands

https://www.frontiersin.org/articles/10.3389/frvir.2023.1159905/full



e-DIPLOMA

https://e-diplomaproject.eu/

Holonomy

Master Students: Scott Jochems, Joris Rijsdijk, Ravi Snellenberg
Professors: Martin Skrodzki, Rafael Bidarra
Contact: m.skrodzki@tudelft.nl

What is Holonomy?

- Holonomy is a Virtual Reality (VR) game in which a player attempts to navigate through **a hyperbolic space while staying within a 3x3** meter Euclidean space [2].
- Figure 2 shows the game from the player's perspective. Around the left of the pillar, a river can be seen but around the right, the objective can be found. This difference is caused by the hyperbolic space.
- Players navigate this space with help from a minimap, shown in Figure 3.

What is Hyberbolic Space?

- This **hyperbolic space** consists of **square rooms.**
- On the corners of each room, five square rooms come together.
- In this game, **a circle consists of 450 degrees**. To walk a circle, you must take five 90-degree turns around a pillar.
- The difference between the real world and the virtual space can be seen in Figure 1. Keep in mind that in both rows each turn is a 90-degree turn and each space is a square.
- You can see that from step 1 to step 3 (in Figure 1) the player walks a full circle in the virtual world while appearing to be one step further in the normal world. While walking a full circle in the virtual space you can also see that the player's orientation between the real and virtual space has changed by 90 degrees.

Why a Virtual Reality Game?

- The holonomy team has been developing a game that allows players to navigate through rooms connected by hyperbolic geometry, see Figure 1.
- While **navigating an unknown** space can already be difficult, this difficulty only increases when the player finds themselves in a non-Euclidean space.
- Virtual reality (VR) is widely used to teach complex topics [1]. VR allows players to explore and understand the space. An additional benefit is that, because of the hyperbolic space in VR, a player can walk infinite distances in the virtual world while only staying within a 3mx3m room.

References

[1] Gan, W., Mok, T.-N., Chen, J., She, G., Zha, Z., Wang, H., Li, H., Li, J., and Zheng, X. (2023). *Researching the application of virtual reality in medical education: one-year follow-up of a randomized trial*. BMC Medical Education, 23(1).
[2] Baran Yarar, Bo Bakker, Ravi Snellenberg, Riley Slotboom, Wenkai Li (2022). *"Holonomy": a non-Euclidean labyrinth game in virtual reality*: http://resolver.tudelft.nl/uuid:60d473f0-f327-411e-a402-95d44e27f088
[3] Joris Rijsdijk (2023). *Exploring the Impact of a Procedurally Generated Environment on Immersion in Virtual Hyperbolic Space*: http://resolver.tudelft.nl/uuid:b2bcf835-240d-420e-b2f3-79aa433dbc21
[4] Scott Jochems (2023). *Mini-map positioning for Virtual Reality environments in hyperbolic space*: http://resolver.tudelft.nl/uuid:9b3a815e-7366-4b08-9544-cb1ae6b78070
[5] Ravi Snellenberg (2023). *Shortest Path algorithms for the traversal of an Order-5 square tiling from within a confined space*: http://resolver.tudelft.nl/uuid:b27fd9bd-8f8a-49b4-b1f8-5e6774a0f304

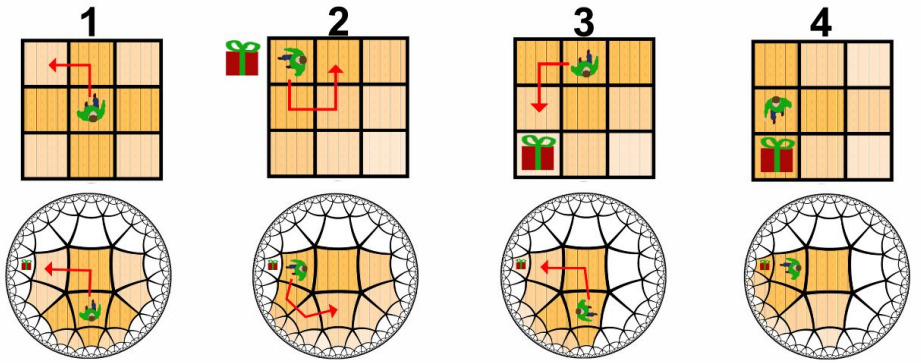


Figure 1: Real world (Top) vs hyperbolic movement in VR (Bottom)

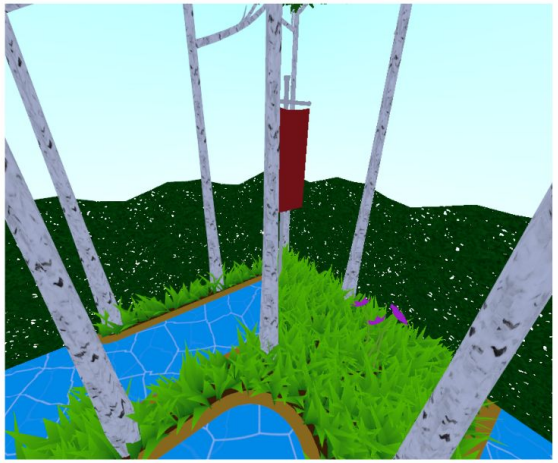


Figure 2: An example of the visible 3x3 grid in the VR world

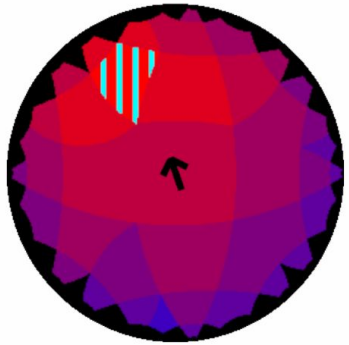
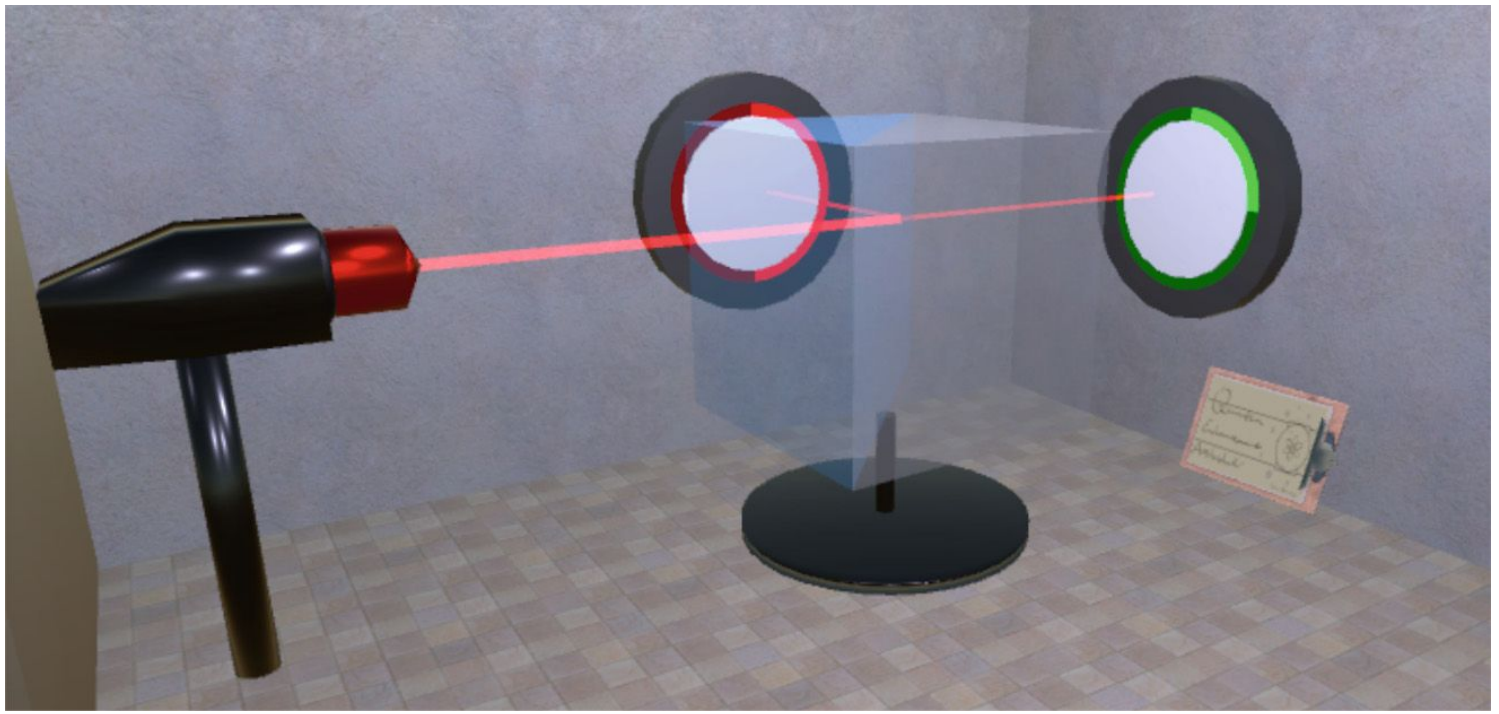


Figure 3: The minimap of holonomy. It uses a Hot-Cold colouring to help the player navigate toward the objectives. And the objectives are represented by striped squares.



Quantum Physics vs. Classical Physics: Introducing the Basics with a Virtual Reality Game

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Abstract. Unlike classical physics, quantum physics is harder to explain, as it involves very small scales and phenomena that are not visible to the naked eye. Understanding the differences between classical and quantum physics is difficult, especially for children, who cannot grasp the subtleties conveyed in complicated formulae.

We propose to achieve this in a playful and immersive manner, which is a more familiar and convenient way to introduce children to new concepts. For this we developed *Save Schrödinger's Cat*, a puzzle game in virtual reality featuring a classical physics mode and a quantum physics mode. As virtual objects and phenomena behave differently in each mode, this mechanic encourages players to toggle between modes, in order to explore the differences between quantum and classical physics in an immersive, entertaining and challenging way. A preliminary evaluation showed that players could better identify various distinguishing features of either mode.

Keywords: Classical physics · Quantum physics · Virtual reality · Educational games

1 Introduction

Differences between quantum physics and classical physics can be hard to convey without referring explicitly to in-depth formalisms like formulas [6]. Quantum physics is important for understanding concepts of the universe that are not explicable with classical physics. However, quantum physics is generally considered to be difficult to understand, since this requires knowledge of the underlying theories and classical physics.

How can one convey the differences between quantum physics and classical physics visually, without referring explicitly to in-depth formalisms like formulas? Apart from some videos, there are currently no known accessible mediums that have accomplished this goal successfully for a large audience. Understanding

A. Liapis et al. (Eds.): GALA 2019, LNCS 11899, pp. 383–393, 2019.
https://doi.org/10.1007/978-3-030-34350-7_37

https://repository.tudelft.nl/islandora/object/uuid%3A793c3cf1-5506-43d1-90c3-feb12b0a41b0?collection=research

Are you interested to see how …

- … the obstacles that we identified can be overcome?
- … VR can work in your educational setup?
- … success metrics for VR in education can be defined?

Join me in starting a work group for VR in TU Delft education.

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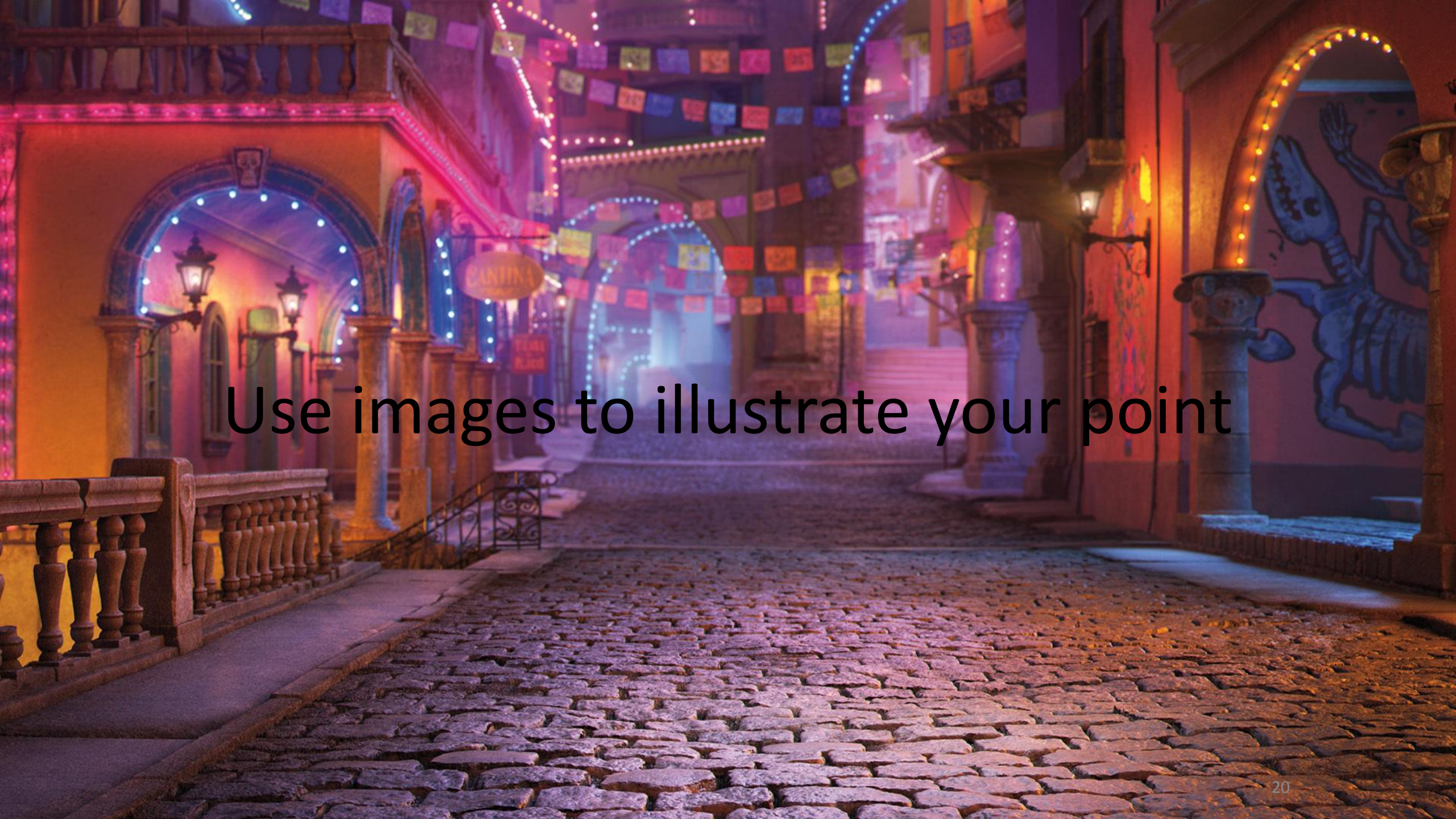
Virtual Reality (VR)

Focus on one thing at a time



Use images to illustrate your point

Section headers

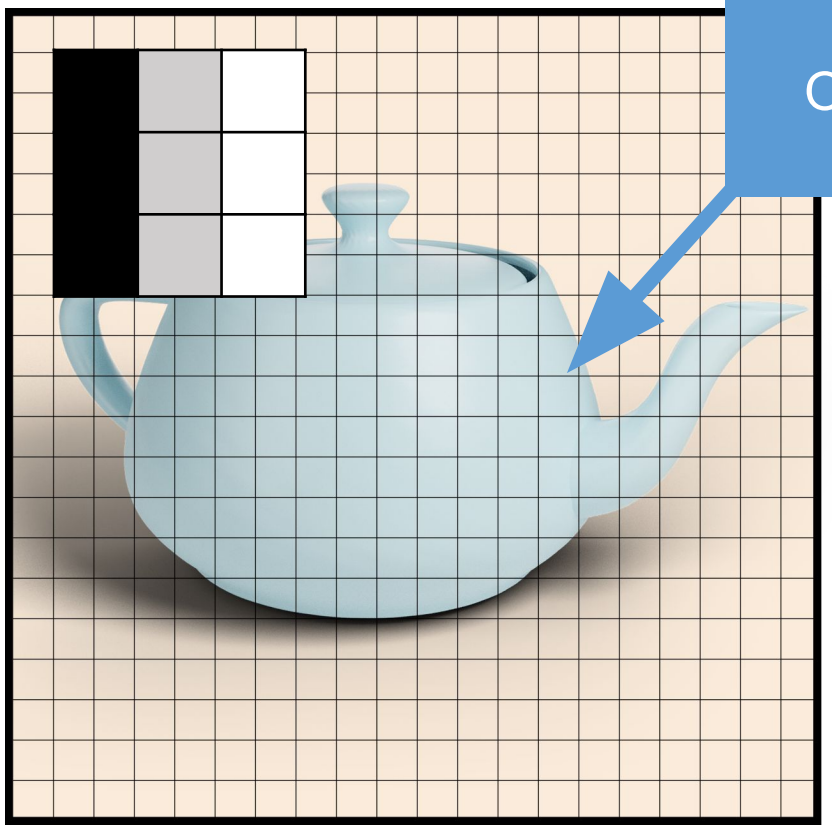
Subtitles with section headers

Section headers

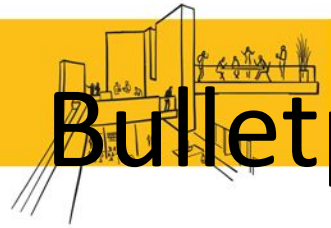
Subtitles with section headers

Use colors from the TU Delft template

Animations can guide focus



Optimize kernel weights



Bulletpoints

- Don’t default to bulletpoints
- People read them while you talk [1]
- Slides should support, not replace
  - Keep the bulletpoints in your notes
- If you **need** bulletpoints
  - Stick to the 7x7 rule: 7 points with 7 words max
  - Animate, so people don’t read ahead

[1] This needs a citation, which you could leave in the notes if you like

This was the CGV Template

Author Firstname, First Lastname, Third Contributor

Delft University of Technology