



CHARM-EU (CHALLENGE-DRIVEN, ACCESSIBLE, RESEARCH-BASED AND MOBILE EUROPEAN UNIVERSITY)

DELIVERABLE D4.5– CHARM-EU: EMERGING TECHNOLOGY PROTOTYPING

Project Acronym	CHARM-EU
Grant Agreement	101017229
Project Title	CHARM-EU (Challenge-driven, Accessible, Research-Based and Mobile European University)
Coordinator	University of Barcelona
Consortium	University of Barcelona Trinity College Dublin Utrecht University Eötvös Loránd University Budapest University of Montpellier
Website	https://www.charm-eu.eu

Deliverable	D4.5
Title of Deliverable	Emerging Technology Prototyping
Work Package	WP4
Leading institution	UU
Work Package Leader	Jan Haarhuis and Sanne Van Vugt (Utrecht University)
Dissemination Level	Public (PU)
License	CC BY
Document Version	V.2 (FINAL)
Due Date	September 2022
Submission Date	01/09/2022
Authors (Main Beneficiary)	Jan Haarhuis and Sanne Van Vugt (Utrecht University)
Other Contributors	Alex Lodder (Utrecht University), Jan Haarhuis (Utrecht University), Antonie van Harteveld (Utrecht University), Carmen Svastics (Eötvös Loránd University), Daniel Griffin (Trinity College Dublin), David Cassagne (University of Montpellier), Jake Byrne (Trinity College Dublin), Márta Turcsanyi-Szabo (Eötvös Loránd University), Vanessa Vigano (University of Montpellier), Oriol



Pujol (University of Barcelona), Jasper Van Winden (Utrecht University)

**DOCUMENT HISTORY**

Date	Revision No	Prepared By	Description
17/02/2020	V.1	Antonie van Harteveld	First draft
01/09/2022	V.2	Vanessa Vigano, Daniel Griffin	Final version

CHARM-EU



CHallenge-driven
Accessible
Research-based
Mobile
European
University

Emerging technologies

A selection of technologies ready to use or still growing.
Useful to design and realize CHARM EU modules.



Table of contents

Emerging technologies in CHARM EU About emerging technology selection

Technology Enhanced Learning

- Sustainability game
- Mixed reality
 - Augmented reality
 - Virtual reality
- Showcase

Assessment

- Skilltrack
- Assessment and mixed reality

Inclusion

- Image recognition
- Speech Recognition and Synthesis

Future vision

- Future vision - Technology Enhanced Learning*
- Future vision - Assessment*
- Future vision - Inclusion*



Already available



Taste of the future

Emerging technologies in CHARM EU

This document **presents a list of technologies**, selected from WP4.5, that can be used in CHARM-EU courses to accomplish the Technology Enhanced Learning educational principle.

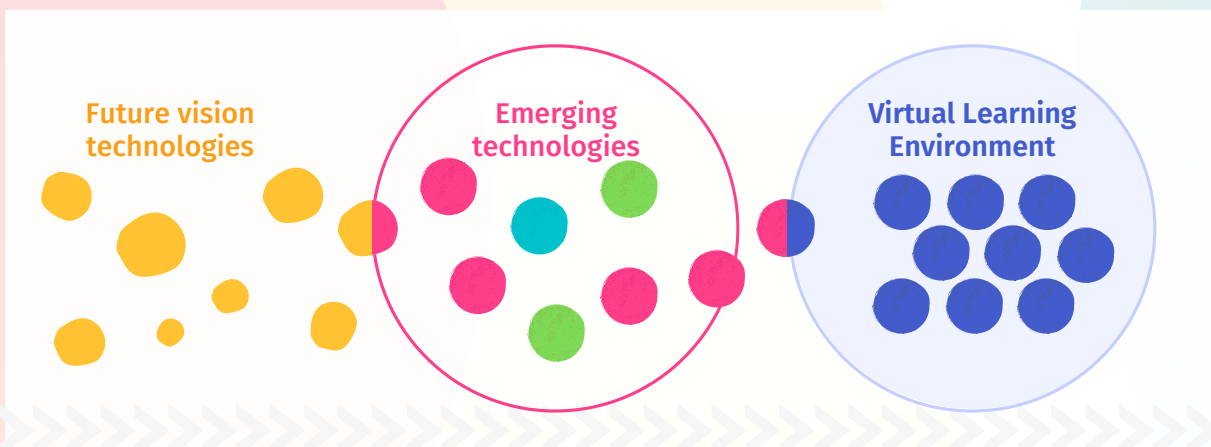
May I ask for those technologies for my CHARM EU module?

Sure!

The aim of this document is to make you hungry and ask for a tech

Are emerging technologies already included in the Virtual Learning Environment?

Emerging technologies presented in this document are not yet included in the VLE. Those technologies will be integrated depending on the number of requests and effective use during the prototyping phase of CHARM-EU project.



About emerging technology selection

How WP 4.5 made the selection?

WP4.5 analyzed a large set of emerging technologies using the technology indicators shown below. The selections were made by considering developments in technology, educational practice and especially the CHARM-EU core values. We leverage the expert knowledge of our colleagues in CHARM-EU universities as much as possible.

May I suggest a technology not yet listed in this document?

We encourage you to do so!

If a tech that you already use or you'll like to explore in CHARM EU courses is not listed please get in touch with us.

Technologies indicators

WP4.5 evaluation index for each technology

Physical accessibility

An indication of how well the technology can be used by persons with visual, auditory or physical disabilities.

Cognitive

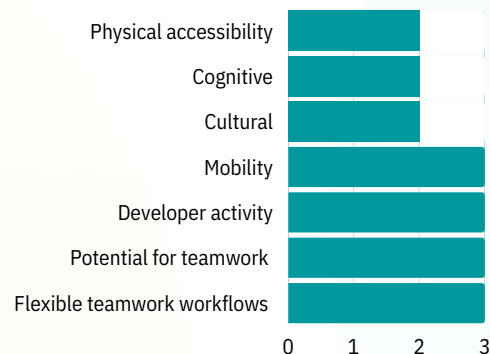
How well does the technology support persons with cognitive difficulties, e.g. delivering content in more than one way, providing easily-understood content, etc.

Cultural

How flexible the technology is with respect to cross cultural challenges, e.g. does it support right to left text.

Mobility

Indicates how well the technology can be used by individuals of reduced mobility. Do we need additional supports to use the tool? Can it be easily moved to a new location? etc.



Developer activity

Indicates how active the development team or community is for the specified technology, and how easy is it to find support.

Potential for teamwork

Indication of the potential for multi-user experiences.

Flexible Teamwork Workflows

If the technology doesn't explicitly support teamwork, can it compensate by providing a mosaic of learning experience?



WP4.5 Emerging Technology presents:

Technology Enhanced Learning

*A unique set of technologies to tickle your curiosity and imagination
At your request we will try to make them available for your course*

University of Utrecht

Sustainability Game

An app that empowers you to create a personal **SDG** (Sustainable Development Goals) profile and go into the city to solve team based sustainability challenges.



Affordances

1. **Promote reflection** relating to the UN SDGs.
2. **Enable on-demand access** to SDG related learning materials.
3. **Ice-breaker**: students learn to know each other through an interactive group activity



Use cases

Initial pilot with 800 students from the University of Utrecht who were sent out in groups into the city to work with entrepreneurs, residents and each other on sustainability challenges.

[Game's website](#)

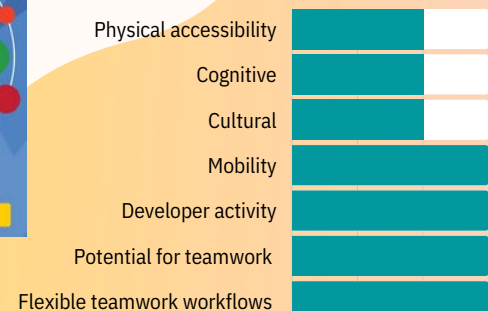
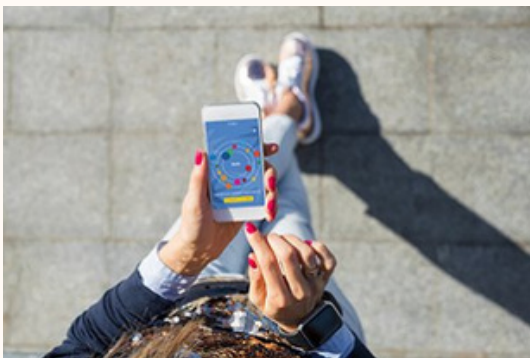
[Video presentation](#)

Benefits

Aligns with our strategic goals to promote the SDGs and a nice interactive activity.

Costs & efforts

Completed for the UU and Utrecht. Needs to be customized for use in other cities and for Corona measures.



Mixed Realities - XR

Mixed reality is **the merging of real and virtual worlds** to produce new environments and visualizations, where physical and digital objects co-exist and interact in real time.

Mixed reality does not exclusively take place in either the physical or virtual world, but is a **hybrid of actual reality and virtual reality**.

When used for Technology Enhanced Learning, XR offers huge potential for situated and social learning and can be a useful too for online socializing.

Based on the amount of immersion on the virtual world we can distinguish at least 2 groups of XR:

Augmented reality - AR

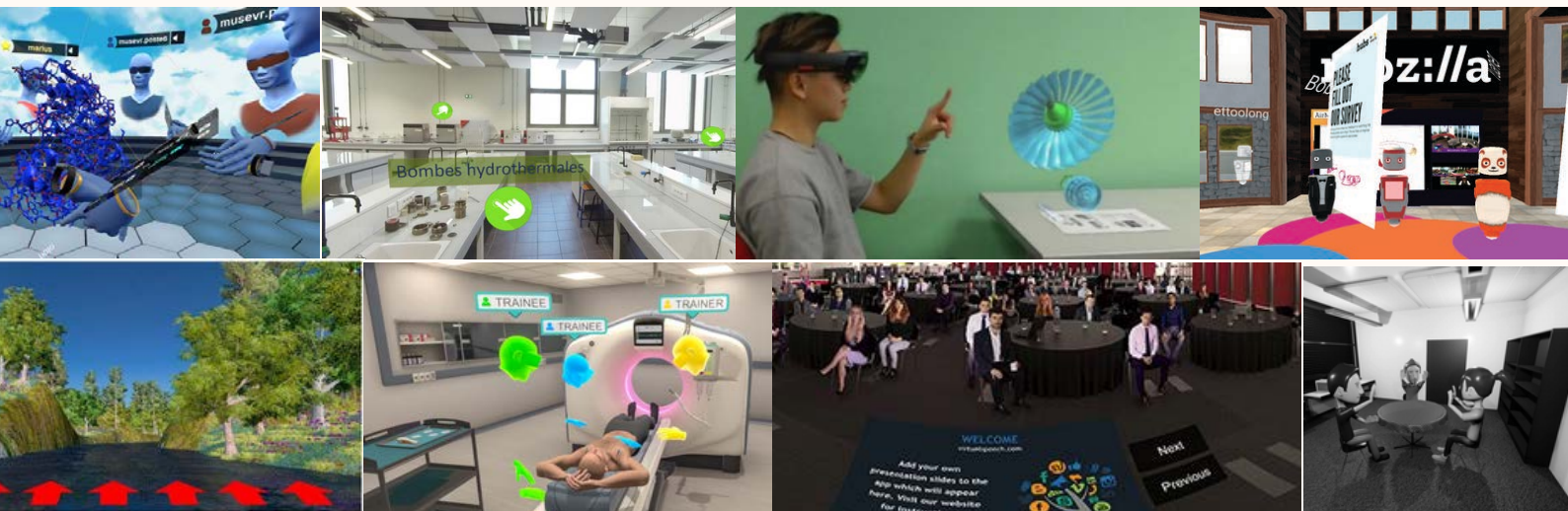
Digital elements are added to a real environment.

Distinguished from VR by the fact that an AR user experience is composed of both real and virtual elements.

Virtual reality - VR

Immerge the user in a fully virtual experience.

Distinguished from AR by the fact that the virtual environment is distinct from the real world



Mixed Realities - XR

Augmented Reality - AR

A subset of mixed reality technologies which overlays computer-generated perceptual information onto a **live video feed of the real world**.

AR ranges from low end experiences on a phone or tablet, to high end experiences using head mounted displays and hand tracking, such as the Microsoft HoloLens.



Affordances

- Useful to **extend the real, physical world** with some additional digital elements such as 3D objects or textual overlay on a real object.
- Support **inter-cultural collaborations**.
- Offer contextual information to a user for any object in view.



Use cases

AR is currently delivering significant value in areas such as **training and simulation, job aids, remote assistance, inspection and repairs, and knowledge capture**.

Benefits

Improved engagement and enhanced learning

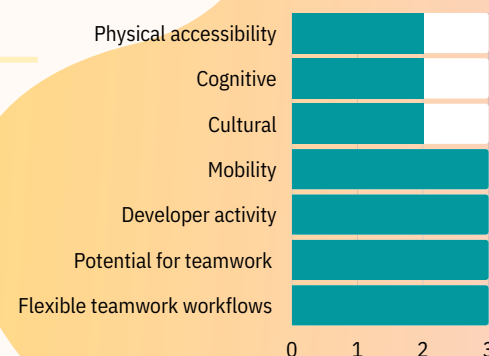
Costs & efforts

Low end experiences only require a phone, tablet or desktop with any number of free apps. High end costs can be affordable or considerable depending on the quality needed. Contact WP 4.5 for more details.

Literature

L. B. Kiat, M. B. Ali, N. D. Abd Halim and H. B. Ibrahim, "Augmented Reality, Virtual Learning Environment and Mobile Learning in education: A comparison," 2016 IEEE Conference on e-Learning, e-Management and e-Services (IC3e), Langkawi, 2016, pp. 23-28, doi: 10.1109/IC3e.2016.8009034.1222.2019.1628877.

Steffen, Jacob & Gaskin, James & Meservy, Thomas & Jenkins, Jeffrey & Wolman, Iopa. (2019). Framework of Affordances for Virtual Reality and Augmented Reality. Journal of Management Information Systems. 36. 683-729. 10.1080/0742



Mixed Realities - XR

Virtual Reality - VR

A subset of mixed reality technologies which aims to **immerse the user in a fully virtual experience**. Distinguished from AR by the fact that the virtual environment is distinct from the real world.



Affordances

- **Virtual field trips** and **immersive storytelling** can empower creative learners with authentic learning experiences, foster collaboration with social spaces or leverage the power of narrative.
- Help learners **project themselves into a role** by facilitating the psychosocial moratorium principle and promoting identity play and self-development.



Use cases

Simulations / role-play / Game Based Learning. XR has applications in interpersonal and intercultural soft skills training and assessment. It has been used with great success **to teach skills where a real-world approach is either too expensive**, e.g. virtual laboratory and virtual fieldtrips, too dangerous, e.g. heavy industry skills training, or unethical (e.g. animal research / vivisection)

Benefits

Immersive learning experiences that inspire students' creativity and spark their imaginations
Increased engagement and retention of learning

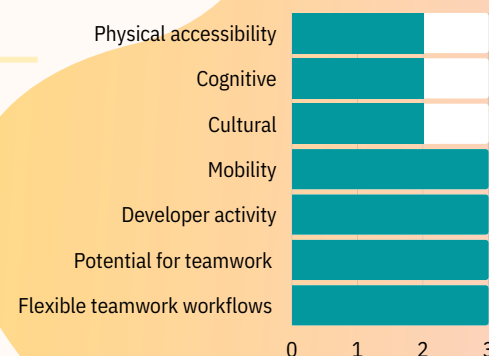
Costs & efforts

Low-end / low-immersion experiences only require a phone, tablet or desktop with any number of free apps.
Mid-range experiences can be cheap, e.g Google Cardboard plus a modern phone.
Higher fidelity experiences will require a dedicated headset, with scaling costs.

Literature

[L. B. Kiat, M. B. Ali, N. D. Abd Halim and H. B. Ibrahim, "Augmented Reality, Virtual Learning Environment and Mobile Learning in education: A comparison," 2016 IEEE Conference on e-Learning, e-Management and e-Services \(IC3e\), Langkawi, 2016, pp. 23-28, doi: 10.1109/IC3e.2016.8009034.](#)

[Steffen, Jacob & Gaskin, James & Meservy, Thomas & Jenkins, Jeffrey & Wolman, Iopa. \(2019\). Framework of Affordances for Virtual Reality and Augmented Reality. Journal of Management Information Systems. 36. 683-729. 10.1080/07421222.2019.1628877.](#)



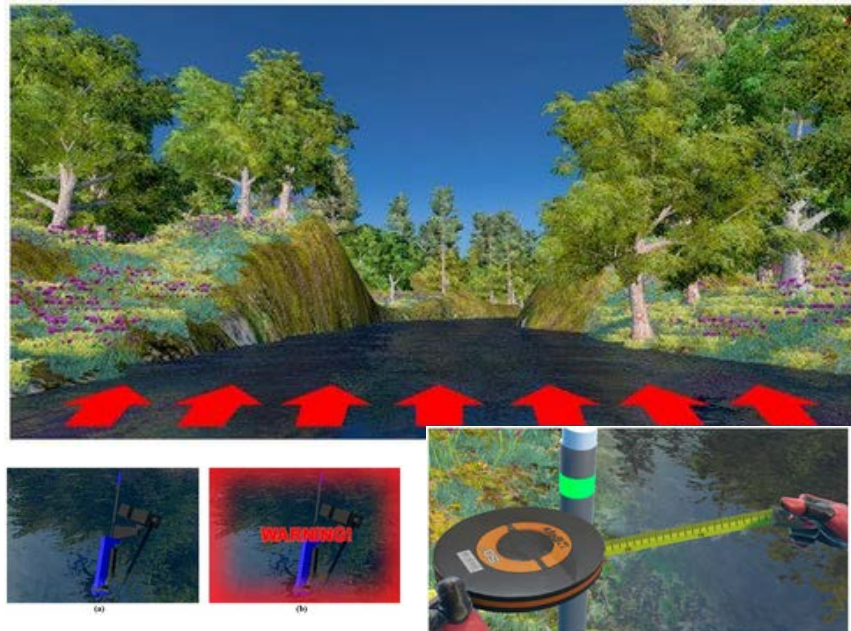
AR and VR Showcases

Basilicata University - Italy

VR for sustainable water management

The tool represents a **Virtual Laboratory** able to train on the standard techniques for the accurate monitoring of the water discharge in open-channel flows and was **successfully tested on a sample of people from the private and public water sector**.

[more information](#)




LOW IMMERSION  FULL IMMERSION

Department of Industrial and Systems Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

Evaluating the effectiveness of learning design with mixed reality (MR) in higher education

A study that investigated and compared the learning effectiveness of Mixed Reality versus traditional teaching tools for Design students.

[more information](#)

LOW IMMERSION  FULL IMMERSION



AR and VR Showcases

The Mozilla foundation

Mozilla Hubs, Altaspace VR & VR Chat

Virtual spaces where people can create an avatar and chat, cooperate, share contents and more. Real-time communications platform for Virtual Reality, Augmented Reality, Desktop, Laptop, Mobile, or however else you browse the internet.

Mozilla hubs are part of a new set of mixed reality products that enable cross-platform experiences.

Numerous free platforms such as AltaspaceVR, VR Chat and Mozilla Hubs provide desktop, mobile or full immersion VR experiences, where users can connect and interact within the same virtual space.

This approach lowers the barrier to entry considerably and **makes these types of experiences available to a mass market.**

[Mozilla hub](#)

[Altaspace VR](#)

[VR chat](#)



Institute for Research in Open-, Distance- and eLearning (IFeL)

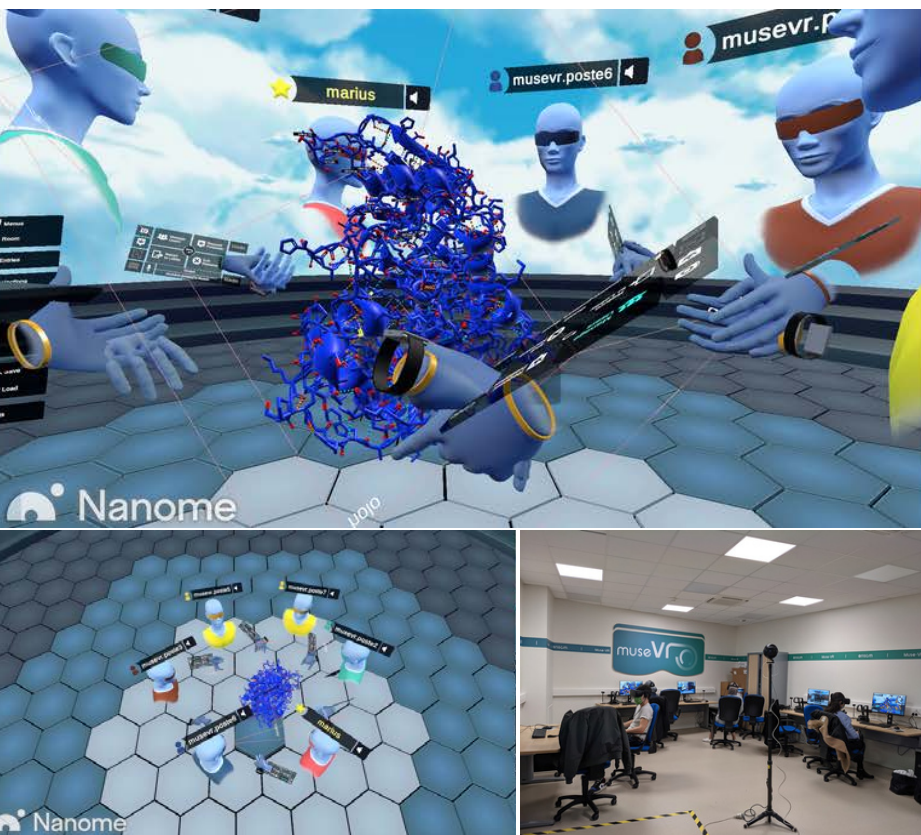
Group Decision-Making in Multi-User Immersive Virtual Reality

A study focused on evaluating the potential for Immersive Virtual Reality to support groupwork, based on cognitive load and social presence factors.

[more information](#)



AR and VR Showcases



MUSE VR, Montpellier University - France

Working on the same molecule in "real" VR

Many students, interacting with the same molecule, in a VR environment. A use case that shows the high potential of VR use **to show and interact a content** together with peers.

[360° video of the experience](#)



MUSE VR, Montpellier University - France

360° virtual visit of chemistry school

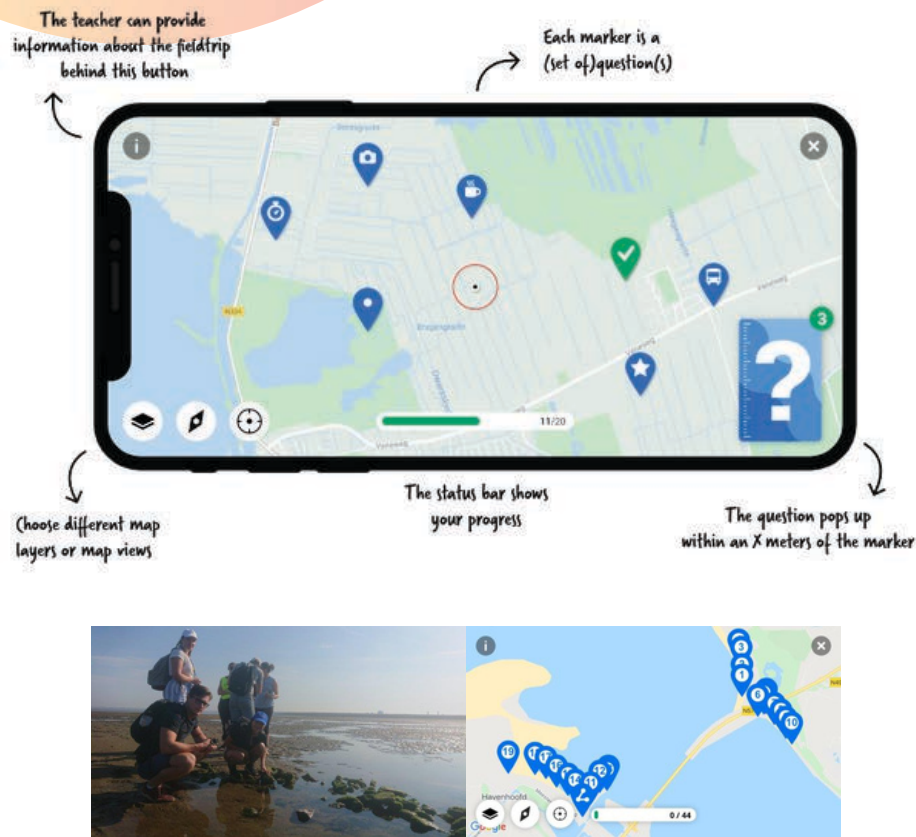
A 360 degree visit of the entire building: laboratories, teaching rooms and school spaces. An inspiring example of **how to use VR to enhanced *situated learning* principle of CHARM EU.**



[more information](#)



AR and VR Showcases



peek-app.nl

Peek

App that helps teachers **organize effective and efficient field trips gamified in real maps.**

A case use: students were taken to the Haringvliet by buses. Here, they received their bike which they could use to cycle from location to location. During the trip, the students learned about NatureConservation in the Haringvliet, looking at different perspectives and specifically focusing on the potential effects of climate change in the future.

[peek app website](http://peek-app.nl)

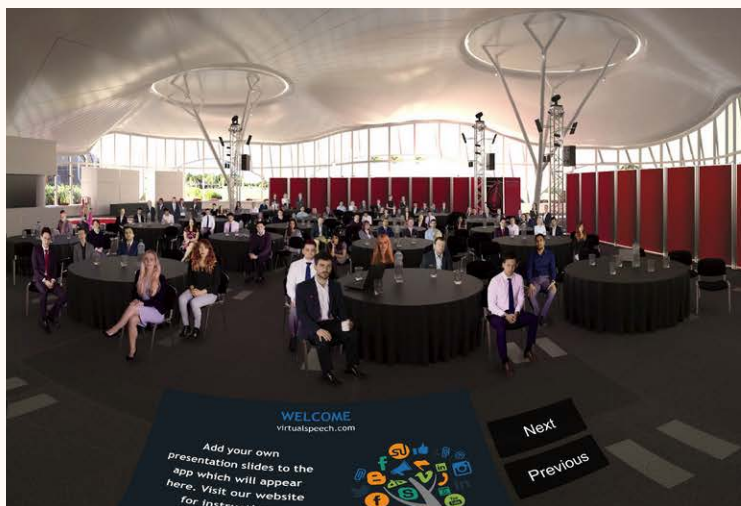


Vodafone

Presentation skills training

How VirtualSpeech replicated the Vodafone UK Pavilion in VR for employees to practice presentation skills in their Learning Week and beyond.

[more information](#)

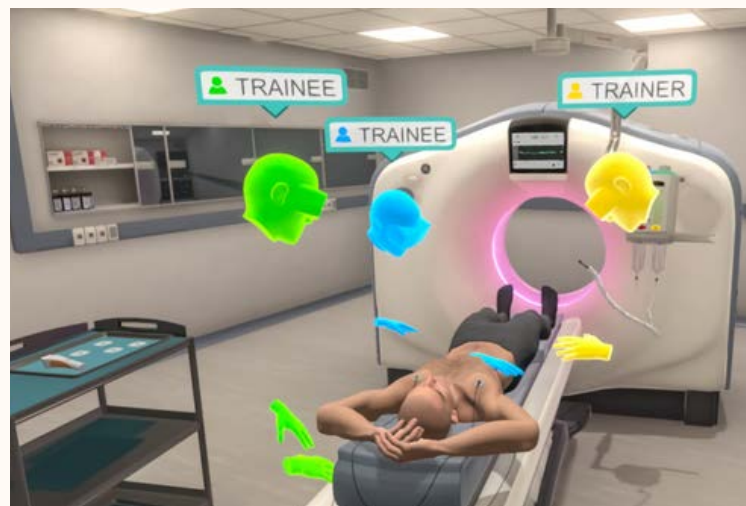


GE healthcare

Radiography training

Access to radio scanners is very limited due to their relative scarcity and patient demand. A VR environment that opened up more opportunities for trainees.

[more information](#)



WP4.5 Emerging Technology presents:

Assessment

*Which technologies can support assessment and how?
A new era of tools are facing up, ready-to-use.*

SkillTrack!



An unfinished but promising student reflective tool to **support transversal skills**. Students work with interactive, computer-based prompts that help them record reflections after completing any (unspecified) learning activity.

Affordances

- **Cultivate skill-literacy, cognition and reflection** in an explicit
- **Gamified** context



Use cases

Trialled with great success in secondary level schools to address the problem of 'assessment for 21st Century Skills'



Benefits

Students take ownership of their learning.
Reduces time taken to identify problems.
Improved engagement and enhanced learning

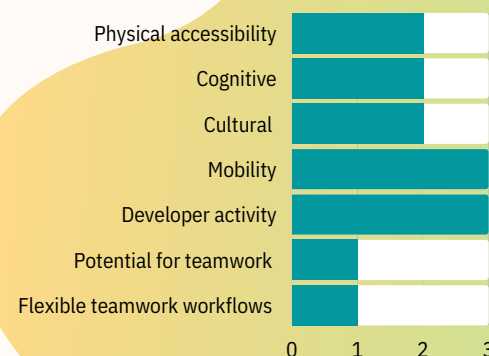
Costs & efforts

Prototype already developed via the TCD Technology Office.
Some effort will be required to complete as the backend is still a work-in-progress.
Adjustment of the content for a master level will take place.

[Skilltrack's website](#)

Literature

Anderson et al. 2020. Reflection as a core student learning activity in higher education - Insights from nearly two decades of academic development. *International Journal for Academic Development*. Routledge. doi 10.1080/1360144X.2019.1659797



Assessment and mixed reality - XR



Mixed reality (the merging of real and virtual worlds) can be used for assessment to check students understanding and comprehension in a realistic environment.

Affordances

- support **role-play** or **simulation-based** assessment, e.g. soft skills training.
- And **interaction/engagement with the represented object.**



Use cases

Has been used with great success to do **assessment when a real-world approach is expensive.**
e.g. virtual laboratory or dangerous, e.g. heavy industry skills training.

Benefits

Immersive experiences that inspire students' creativity and spark their imaginations
Increased engagement and retention of learning

Costs & efforts

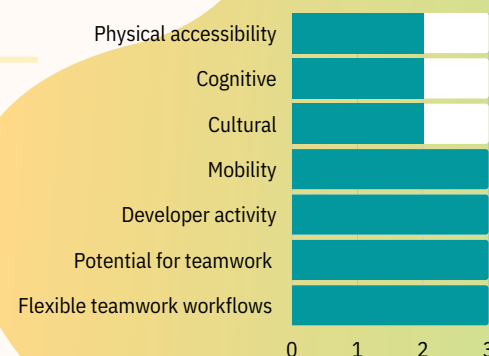
Low-end / low-immersion experiences only require a phone, tablet or desktop with any number of free apps.

Mid-range experiences can be cheap, e.g Google Cardboard plus a modern phone.
Higher fidelity experiences will require a dedicated headset, with scaling costs.

Literature

[L. B. Kiat, M. B. Ali, N. D. Abd Halim and H. B. Ibrahim, "Augmented Reality, Virtual Learning Environment and Mobile Learning in education: A comparison," 2016 IEEE Conference on e-Learning, e-Management and e-Services \(IC3e\), Langkawi, 2016, pp. 23-28, doi: 10.1109/IC3e.2016.8009034.](#)

[Steffen, Jacob & Gaskin, James & Meservy, Thomas & Jenkins, Jeffrey & Wolman, Iopa. \(2019\). Framework of Affordances for Virtual Reality and Augmented Reality. Journal of Management Information Systems. 36. 683-729. 10.1080/07421222.2019.1628877.](#)



WP4.5 Emerging Technology presents:

Inclusion

*Let's break barriers with common devices and incredible inventions.
Let's do it now.*

Inclusion

Image recognition

AI based technologies that can **identify and describe the content of a photographic image.**

Use cases

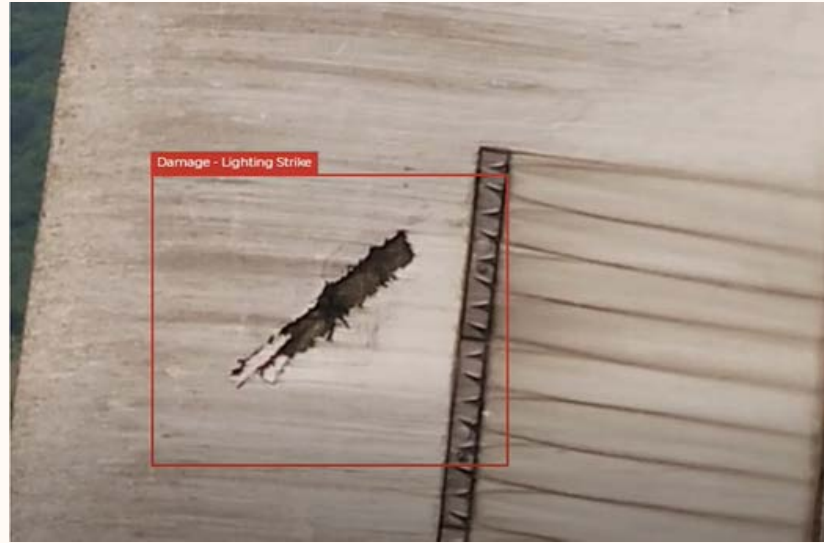
Offer additional, contextual information to improve access and/or understanding.

Benefits

Improves access and situational learning

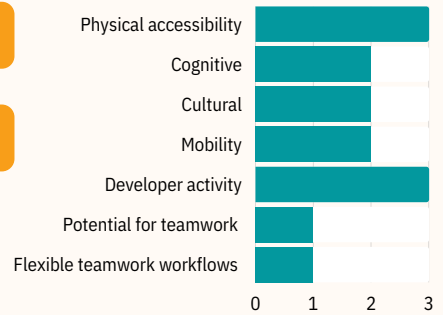
Costs & efforts

Service based models such as Google's Vision AI with pricing that scales up with usage.



[Google cloud vision](#)

[OrCam my eye](#)



Speech Recognition and Synthesis

Speech-to-text and text-to-speech technologies. Adds extra modalities to media, i.e. present text vocally, or annotate/sub-title audio or video files.

Use cases

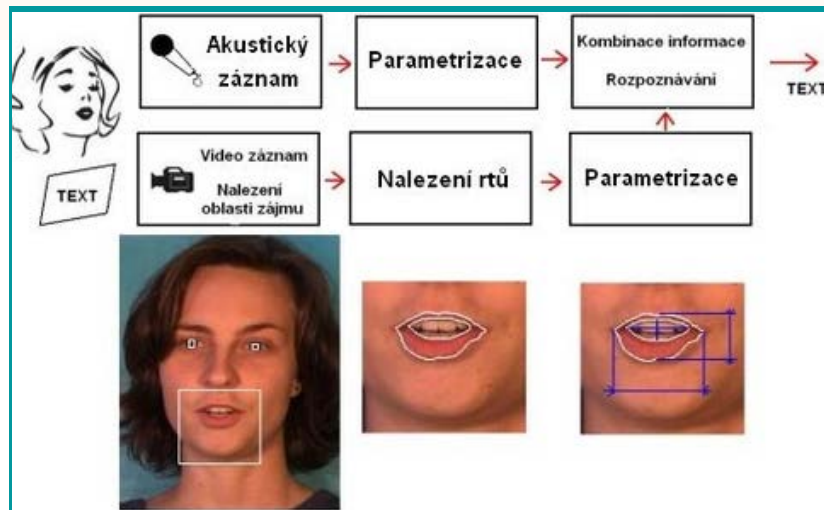
Help to mitigate access barriers for hearing or visually impaired persons.

Benefits

Improves access

Costs & efforts

Minor costs and some training required.



[more information](#)

WP4.5 Emerging Technology presents:

Future vision

*Coming soon!
A taste of what's around the corner.*

Future vision

Exciting and sometimes disruptive, proof-of-principle emerging technologies that are on the near to medium horizon and maturing quickly.

Automatic Grading

Very useful for assessment of technical content. Shows promise for other types of content when used in conjunction with Adaptive Comparative Judgement techniques.

Micro-credentials

Poor compatibility with Programmatic Assessment but useful for informal and formative feedback.

Remote Labs

Network enabled laboratory tools that a student can connect to and use remotely.

Open Learner Model

Learner models that can be viewed or accessed in some way by the learner or teacher.

Student centred course planner and curriculum overview

A UU project that helps students to plan their courses.

Cloud computing environments

A personal virtual machine that offers standardized computing experiences to all students.

Virtual Teaching Assistant

A UU project that employs AI to help teachers understand their students learning requirements.

Incremental grading & new tech

A student-driven assessment approach where students have the responsibility to grade their own work. This approach can easily be supported by IT technology.

Thank for your attention

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

