

LEARNING IN SHARED VIRTUAL SPACES

A case study of the use of networked XR-environments for co-creative collaboration at the Design Academy Eindhoven and Utrecht University of Arts in Utrecht.

WHAT CAN YOU EXPECT FROM THIS PUBLICATION?

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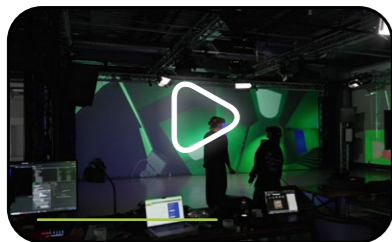
ABOUT THIS PUBLICATION

WHAT CAN YOU EXPECT FROM THIS PUBLICATION ?

Education is undergoing a period of fundamental transformation. Extended Reality (XR) technologies¹ combined with networked XR environments for co-creative collaboration² offer unprecedented opportunities for interaction, collaboration and experiential learning.

In this case study, it is essential to distinguish between standalone XR applications³ on the one hand, and the use of XR technologies (such as VR headsets and sensors) on the other, in combination with networked XR environments for co-creative collaboration. Practical use in education raises important questions regarding infrastructure, teaching methods and organisation.

The collaboration between the XR labs at the Design Academy Eindhoven (DAE) and the Utrecht School of the Arts (HKU) is an innovative response to these developments. This XR-mediated learning environment enables students to collaborate on complex design challenges across geographical boundaries.



- 1 Extended Reality (XR) technologies: an umbrella term for Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) – technologies that combine digital and physical realities.
- 2 Networked XR environments for co-creative collaboration: XR technologies (VR headsets, sensors) connected via a network to shared virtual worlds, in which multiple users in different locations can collaborate in real time. This differs from standalone XR, where users work in isolation.
- 3 Standalone XR applications: XR applications in which a single user experiences a virtual environment in isolation, without a real-time connection or interaction with other users in different locations.

Students from various disciplines work and learn together in multiple interconnected physical and virtual spaces. Together, the students form a single collaborative learning community. The project connects two different virtual environments (Resonite and Unreal^{4,5}) with the physical lab spaces in Eindhoven and Utrecht. Participants can observe and work within the virtual environment via live video feeds and projection screens.

Through this case study of collaboration between the two XR labs, SURF aims to deepen understanding of of XR implementations in education. More specifically, it focuses on networked XR environments that allow students to learn and work together across two locations. As a cooperative organisation for ICT in Dutch education and research, we aim to help institutions make informed decisions about future-proof learning environments.

“This isn’t just a technological development – it’s about new ways of collaborating where Zoom and Teams fall short”

- Ian Biscoe (Design Academy Eindhoven)

To contribute effectively to the development of XR learning environments – in technical, pedagogical and organisational terms – it is essential to learn from the experiences of pioneers. Networked XR implementation is more than just a technological investment: it is a dynamic process involving pedagogical design, infrastructure choices and organisational coordination.

SURF’s exploratory study focuses on an integrated approach to networked XR environments for co-creative collaboration. Our aim is to understand how educational institutions, with varying budgets and starting points, can create effective, scalable and pedagogically sound networked⁶ and collaborative XR⁷ learning environments that contribute to meaningful learning.

- 4 Unreal Engine is a powerful game and real-time 3D engine used to develop interactive, visually stunning environments and simulations for games, film, architecture and XR applications.
- 5 Resonite is a social VR platform that allows users to create, customise and explore virtual environments together in real time for collaborative projects, education and social interaction.
- 6 Networked XR: Extended Reality environments in which multiple users in different geographical locations collaborate simultaneously within a shared virtual space, with real-time interaction and synchronisation.
- 7 Collaborative XR: Extended Reality in which multiple users work together in a shared virtual space, with direct interaction and real-time synchronisation of actions between participants.



Focus and scope of this study

This research focuses primarily on the XR labs at the Design Academy Eindhoven (Trans Realities Lab) and the Utrecht School of the Arts (*HKU Artistic Extended Reality Lab*). These two institutions have been closely observed, and both students and lecturers have been interviewed. Together, this forms the core of this case study.

Kim Kamphuis from Utrecht University of Applied Sciences was also interviewed about the IX-lab run by the 'Organisations in Digital Transition' research group. Although the IX-lab was not ultimately included in the observations, Kim's experiences provide valuable insights into alternative implementation strategies for those with limited budgets and space. This is relevant for institutions wishing to implement XR education within various financial frameworks.

By studying the implementation processes of various organisations, we can:

- Provide insight into the technical, pedagogical and organisational prerequisites for successful networked XR environments for co-creative collaboration.
- Provide practical advice for organisations with varying budgets and ambitions.
- Share lessons on inter-institutional collaboration in networked collaborative XR environments.
- Identify potential challenges and propose strategies to address them.

"I felt there was so much untapped potential in XR. Whilst experiencing the whole thing in XR, I realised that the world can actually be changed through it – in real life. With the right context and the right reason to use it, XR becomes a truly powerful tool for design."
- Saeneul Song, student at Design Academy Eindhoven

1. POSITION OF XR ENVIRONMENT IN CAMPUS DEVELOPMENT

The aim of the collaboration between DAE and HKU is to research and develop networked XR environments to facilitate collaboration and education across geographically dispersed locations. On the one hand, this enables participants to work together in a shared physical and virtual space. On the other hand, spatial design concepts can be collectively experienced, tested and immediately adapted from multiple perspectives.

In 2025, the SURF report 'Future Campus: Research into 14 Campus Innovations' was published. This report discusses themes related to campus innovations. These themes have emerged from trends in the field of campus innovation. This research on collaboration in XR environments aligns with four of the campus innovation themes identified in SURF's 2025 report 'Future campus, research into 14 campus innovations' (2025):

This case study demonstrates that successful campus innovation goes beyond simply acquiring technology. By combining digitalisation, interdisciplinary collaboration, blended learning and links to the real world, it shows how networked XR environments for co-creative collaboration can transform (higher) education. The initiative serves as a 'living lab' from which other institutions can learn, regardless of their budget or infrastructure.

"You can't innovate if you work only before you start to figure out exactly where you want to end up. You have to be prepared to take a different turn along the way"

- Joris Weijdom (HKU Utrecht)



2. THE 3 LABS

This case study describes the collaboration between two complementary networked XR environments designed for co-creative collaboration: the Trans Realities Lab (TRL) at the Design Academy Eindhoven (DAE) and the Artistic Extended Reality Lab (AXR-lab, networked XR environments for co-creative collaboration) at the Utrecht School of the Arts (HKU).

HU's IX Lab is also described here as it acts as the third partner in the development of scalable, networked XR environments for co-creative collaboration. The research focuses primarily on DAE and HKU, which took part in the observations and interviews.

Each lab has its own focus, scale and budget. DAE's TRL serves as a high-end anchor⁸ lab (€600,000+), HKU's AXR AER Lab positions itself in the mid-range segment with networked XR environments for co-creative collaboration,

technological infrastructure and affordable XR technology, whilst HU's IX-Lab opts for a low-end CAVE-based small-scale setup with four projection screens. This diversity makes it possible to develop networked XR environments for co-creative collaboration that suit different educational contexts and budgets.

Segment	High-end	Mid-range	Low-end	Mobile
Example	DAE (TRL Lab)	HKU (AXR lab) & HU	A classroom equipped with VR headsets, PCs and possibly some basic tracking and projection	Flight case containing VR equipment
M2 full lab	>400m2	150 m ² & 50 m ²	Various	Various
Development budget	~600.000	~150.000	~20.000	~5.000

Table 1: Four levels of XR

⁸ Anchor Lab is a leading, technologically advanced research and innovation hub that serves as a central facility, attracting talent, businesses and projects within a specific field.

| The Trans Realities Lab (TRL) (DAE)

The Trans Realities Lab (TRL) at Design Academy Eindhoven is a state-of-the-art laboratory for networked XR research. Recognised as one of the leading facilities for hybrid digital and networked XR research in the Netherlands, the lab supports all research and educational-activities of the Transdisciplinary Design Networks (TDN) research group, led by Professor Dr Ian Biscoe.

Technical infrastructure

The lab is equipped with state-of-the-art broadcasting-grade equipment. The infrastructure includes a comprehensive range of tools for motion capture, high-performance visual computing and media production. The space features a truss system with cameras, projectors, sensors, multiple high-end computers and VR headsets. The floor area is 80m², with a flat, open floor that offers optimal freedom of movement for *motion capture* and VR experiments.

The lab utilises professional motion capture systems, 4K projectors, a 30m² LED wall, spatial audio setups, DMX lighting systems and an advanced network architecture with 10 Gbps connections. This high-end setup enables real-time synchronisation between multiple geographical locations with minimal latency, which is essential for natural interaction in *networked XR environments*.

Digitalisation (technology): The Trans Realities Lab is built around advanced digital technologies such as virtual production, motion capture and high-performance visual computing.

Hybrid teaching and research: DAE is investigating *networked* XR environments for hybrid collaboration and teaching. Through projects such as Hybrid Lab, the boundary between physical and digital learning environments is being explored, enabling students to collaborate with peers from all over the world.

Linking industry with theory and practice: The lab works closely with regional networks such as High Tech Campus Eindhoven and Brainport, and has partnerships with academic and industrial partners. The research finds direct application in industry, education, the media and the arts.

“One day they’re soldering, the next day they’ve got a headset on and they’re working in Unreal, and then they’re dancing around the studio with the camera.”

- Ian Biscoe
(Design Academy Eindhoven)

Research focus

The TRL focuses on the challenges posed by networked XR environments for co-creative collaboration. Among other things, the lab conducts research into overcoming the technical complexities involved in connecting multiple physical locations within a single shared virtual reality: synchronising real-time data, ensuring low latency in audiovisual communication, and developing robust network architectures. The main objective is to research and develop networked XR environments for co-creative collaboration.

Transdisciplinary approach

The TRL combines technologies and approaches from Design, Systems Engineering, the Performing Arts, X-Reality, Virtual Production, Animation, Cinema and Games. This lab serves as a transdisciplinary hub, offering students an environment in which to explore new technologies, discover design possibilities in XR, and collaborate on research with fellow students worldwide. External lecturers (14–16 per semester), often artists or owners of independent studios, use the lab for both teaching and their own research practice, with the focus varying between technical and educational aspects.

Funding and growth

Thanks to substantial external funding, largely in the form of research grants, DAE was able to continue investing in its facilities. By 2024, the research team had grown to a peak of fourteen staff members, researchers and interns, supported by a further eight people working on the Digital Focus teaching module. The lab received approximately €600,000 in new funding.

“Before you can get down to the substance of the work, you first need to learn about each other’s skills. The technician learns bodystorming, the theatre maker learns technology.”

- Joris Weijdom (HKU)

Educational integration

The lab supports the Digital Focus teaching module for fourth-year undergraduate students. Students work with a range of technologies, from soldering to VR headsets in Unreal Engine⁹ to dancing with cameras to understand spatial perspectives. External lecturers coordinate with lab technicians in advance regarding the necessary equipment, enabling them to get straight to work on the day itself.

“Our teachers presented this project as an opportunity for us to collaborate with students from other universities— . Anyone who wanted to could join – there’s no points system or extra credit.”

- Sarp, product design student,
Design Academy Eindhoven

Role within the network

As a high-end anchor lab¹⁰, the TRL demonstrates what is technically possible with optimal resources. The setup serves as a benchmark for other institutions and as a test environment for advanced functionalities. At the same time, the lab recognises that not every institution requires this scale. The lab is actively involved in developing modular solutions (flight cases) in which different technological levels can work together effectively. The next steps involve integrating these capabilities and making them available to business and academic partners in the region, through collaboration with High Tech Campus, Brainport Eindhoven and European funding programmes.



⁹ Unreal Engine is a powerful game and real-time 3D-engine used to develop interactive, visually stunning environments and simulations for games, film, architecture and XR applications.

¹⁰ Anchor Lab is a leading, technologically advanced research and innovation hub that serves as a central facility, attracting talent, businesses and projects within a specific field.

| The HKU Artistic Extended Reality Lab (HKU)

The HKU Artistic Extended Reality Lab (AXR Lab) at the Utrecht School of the Arts (HKU) is positioned in the *mid-range* category. This positioning makes the lab suitable for testing scalable solutions and experimenting with different levels of technical complexity. It demonstrates that meaningful networked XR collaboration is possible without broadcast-level equipment, which lowers the barrier to entry for other educational institutions.



The AXR Lab focuses on research, education and development in the emerging field of XR experience design within the arts, both within and outside HKU. This field incorporates XR technologies for media-related, so-called *virtual production pipelines* and the development of interactive *immersive content*, and covers the full spectrum of artistic interactive installations, simulation environments for training, immersive media and games, and *location-based* entertainment.

The networked XR environments for co-creative collaboration offer HKU lecturers, students and alumni, as well as professionals, organisations and companies from various sectors, a space to further develop the field of XR experience design through co-creation. It ties in with structural collaboration within national networks, such as the Creative Industries Immersive Impact Coalition (CIIC) and the Npuls XR programme, and also focuses on international developments, research and partners.

Research focus

The networked XR environments for co-creative collaboration serve as a practice-led technological research environment for research activities both within and outside HKU. The Research Group ‘(Dis)Connected: Technology and Creativity’, where Joris works as an Associate Lecturer, plays a key role in initiating and shaping the networked XR environment for co-creative collaboration. This research group focuses on two key technological domains with an impact on the creative industries and society: *immersive experiences* (IX) and generative artificial intelligence (GenAI).

Various XR labs are already being set up in the Netherlands and beyond to develop innovative applications. The HKU networked XR environment distinguishes itself in this field primarily through its roots in the arts and its in-depth knowledge of embodied co-creative making processes. This enables practice-led artistic design research to discover, investigate and develop innovative forms of experience and application both within and beyond the arts. In addition, the technological development of XR design tools and XR design environments within the networked XR environment enables process innovation through which both innovative networked XR experiences can be realised and XR can be used as a design- and experience-oriented prototyping environment for non-XR applications. (Example: Incentive Fund)

Technical design

The lab uses high-quality yet affordable user equipment in a so-called sandbox environment.¹¹

The space has been designed with a modular setup that allows various video, audio, tracking and projection equipment to be easily and intuitively mounted, connected and adjusted; this approach is similar to DAE’s TRL, but on a smaller scale and featuring a networked XR environment for co-creative collaboration and network infrastructure. The environment utilises high-end 3D PCs and laptops, and features various types of VR headsets, simple Vive tracking, and a range of additional affordable AV equipment¹² and XR devices¹³. In addition, the networked XR environment for co-creative collaboration offers the possibility of utilising the adjacent BlackBox, where a 12-camera OptiTrack system can be used and linked for live interactions and performances.

Just like DAE’s TRL, the lab provides a space for research where participants can engage using their whole bodies. This means that the floor is clear and not cluttered with tables and chairs topped with computers. In addition, projections can be made in all directions of the space, making it possible to visualise for the other participants what users see in VR or what is happening at other physical locations. This also creates multiple perspectives, which are an essential part of the working method of the networked XR environment. Finally, like DAEs TRL, the lab utilises high-end 3D engines

11 A sandbox environment is a protected, secure space for experimentation where students or teachers can test and develop ideas without risk.

12 Audiovisual equipment such as cameras, microphones, loudspeakers, mixing desks and projection screens for recording, broadcasting and displaying sound and images.

13 Extended reality (VR, AR and MR) devices, such as headsets, glasses and controllers, which allow users to experience and interact with virtual and mixed environments.

such as Unity 3D¹⁴ and UNREAL¹⁵, but also incorporates Social VR platforms¹⁶ that are suitable for live multi-user collaboration both within and outside VR, such as the Resonite platform.

Educational integration and support for students with special educational needs

The HKU has a range of workshops, such as the so-called 'BlackBoxes', where students and lecturers can learn and innovate through practice-led education. The HKU AXR lab was established specifically to provide a space for practice-led research involving lecturer-researchers and professionals from various professional fields and societal domains. That said, HKU programmes such as the Minor in Artistic Immersive Experiences regularly connect with the lab's research activities, as illustrated by the case described in this report.

In addition, all HKU researchers involved in the AXR Lab are also active in teaching, whereby the knowledge gained through their research activities is translated into insights on the meaningful use of technology in creative making processes. Furthermore, the AXR Lab works closely with the workshops to ensure that the knowledge, tools and systems developed there can be incorporated into mainstream teaching.

Joris emphasises that hardware becomes obsolete quickly (headsets, computers, graphics cards), and that even robust equipment does not last longer than 4–5 years. For innovation and the development of new capabilities, software (open-source middleware) that links systems together is therefore more important than purchasing the latest hardware. Most of the development time is spent on establishing connections between existing equipment, which makes the system more flexible and accessible to other organisations.

The IX Lab at Utrecht University of Applied Sciences (HU): CAVE-based social immersion for education and research

The Immersive Experience Lab (IX-Lab) at Utrecht University of Applied Sciences, part of the ' ' research group 'Organisations in Digital Transition', is investigating how people-centred digitalisation can contribute to broad prosperity. Immersive Experiences (IX), such as Extended Reality (XR), offer new opportunities to enhance learning, collaboration and innovation.



In education and professional practice, there is a growing need for hybrid learning environments that not only impart knowledge but also create meaningful experiences. XR technology makes this possible through realistic simulations, interactive and sensory elements, and personalised learning pathways.

The IX-Lab opened in early 2025 and serves as the physical home for, amongst other things, the Immersive Design specialisation within the Communication & Multimedia Design programme. Since 2016, this specialisation has been training around fifty students a year in the use of XR technology.

Technical design

The IX-Lab focuses on multisensory, embodied, interactive and multi-user XR experiences. At the heart of the lab is a CAVE system: an immersive 5x5-metre space equipped with four projectors for 360-degree projection (excluding the floor and ceiling). The system is equipped with DMX lights that allow the physical space to change colour in sync with the virtual environment, and features an integrated audio system.

14 A game engine and development platform for building 2D and 3D applications, widely used for VR, AR and XR environments due to its real-time rendering, physics and broad hardware support.

15 Epic Games' advanced 3D game engine for developing real-time visuals, games and XR applications, renowned for its high-quality graphics, realistic lighting and support for VR/AR.

16 Online virtual environments in which multiple users meet in real time as avatars to collaborate, give presentations or socialise, often using speech, gestures and shared 3D objects.

17 Motion capture suit: a suit fitted with sensors that records the wearer's movements and converts them into digital data. This allows body movements to be transferred in real time to an avatar or digital character in a virtual environment.

In addition to the CAVE system, the lab has VR headsets and a motion capture suit¹⁷ at its disposal, with the available space for VR varying depending on the application. Unlike individual VR experiences, the CAVE offers a shared physical space in which several people can be present at the same time and enjoy immersive experiences together. What students see in 360 degrees through their headsets is projected by the CAVE system onto four screens surrounding the participants.

Research focus

The lab combines design-led research with educational integration. The research focuses on multisensory perception, embodiment and presence: how do users experience the virtual environment when the physical environment remains visible? Key questions explore how interaction works without VR headsets, what motion capture adds within a CAVE setting, and how hybrid forms of VR and AR function in such an environment.

One key aspect is co-presence: when several participants are in the CAVE at the same time, their physical bodies and movements remain

visible to one another (unless they are wearing VR headsets). This social dimension, in which users can physically perceive one another whilst sharing a virtual space, fundamentally distinguishes the CAVE from individual VR experiences.

A threefold role in education

The lab fulfils three complementary functions. Firstly, the team conducts design-based research into the possibilities of CAVE systems. Secondly, the lab supports researchers from various research groups within HU University of Applied Sciences and other degree programmes in using XR technology for specific learning objectives, such as creating historical 360-degree environments for history teaching. Thirdly, students from (technical) programmes (Digital Technology and Media, Communication and Multimedia Design, ICT, MBO Mimeto) act as content creators for the lab, with lecturers delivering workshops on specialised software such as Mattermaker for 360-degree projections.

Collaboration with Trans Realities Lab

The HU lab collaborates with DAE and HKU, offering a complementary perspective to the networked VR environments developed by DAE and HKU. Whilst DAE and HKU focus on networked VR headset environments, HU is exploring the possibilities of CAVE-based social immersion, which ties in with the broader research agenda on organisations undergoing digital transformation.

Organisational challenges

The implementation of the HU lab illustrates that technical feasibility does not automatically guarantee operational viability. Although the lab technically meets the XR-IT requirements for inter-institutional collaboration, it was initially unable to participate in a networked XR session. The cause lay in restrictive security settings on the PCs used, a standard that educational institutions apply to safeguard data.

These computers are so *tightly restricted* that even authorised staff can barely install new applications or change essential settings.

Any educational institution wishing to participate in networked XR sessions will need to comply with similar security protocols. To this end, it is essential to consult with IT departments in advance to determine which specific settings, port access and exceptions are required. At HU, this was ultimately resolved through a registry adjustment outside the IT department, enabling participation on the final day after all. It was precisely through experimenting and encountering problems that the team gathered detailed knowledge about all the 'micro-settings' required for successful implementation, including which other software was causing conflicts by using the same ports.

Case study: ADHD simulator

A specific development plan involves an ADHD simulator that allows people without ADHD to experience what it is like to have the condition. The lab pairs researchers from the ' ' research group with students who are responsible for the technical implementation. Students learn not only how to use the software, but also how to produce high-quality video and audio recordings, which are then tested and optimised in the CAVE.



3. THE PROJECT: A COLLABORATIVE VIRTUAL SPACE

The collaboration took place within four mixed project groups, comprising students from both the Design Academy Eindhoven and the Utrecht School of the Arts. These cross-institutional teams deliberately brought together students with diverse backgrounds and levels of expertise: ranging from 3D sculpture and animation to 2D design and Communication & Multimedia Design. For DAE students, participation in the project was entirely voluntary and extracurricular. They took part without receiving any credits or assessment, purely out of interest in the

experiment. At HKU, however, the project was part of the regular curriculum, specifically the Artistic Immersive Experiences (XR) minor, for which students did receive credits. The groups worked intensively together remotely for a month, with each location taking on different roles. HKU students primarily built the virtual environments in Resonite, whilst DAE students experienced them in Unreal Engine and steered the narrative.

Name	Setting	Course/Programme
Charlotte Meinicke	DAE (Design Academy Eindhoven)	Design – Digital Focus programme
Saeneul Song	DAE (Design Academy Eindhoven)	Design – Digital Focus programme
Sarp Abenhabiub Buyukersen	DAE (Design Academy Eindhoven)	Design – Interior/spatial & product design, Digital Focus programme
Kirsten Appelman	HKU (Utrecht School of the Arts)	Minor in Artistic Immersive Experiences (XR)

The project culminated in late October 2025 in a joint, networked XR test session in which all students actually experienced the designed virtual environments, each from their own location. This test session was deliberately designed as a first iteration, with the aim of evaluating the prototypes in terms of user experience, technical stability and narrative effectiveness. Technical challenges such as scale differences between Resonite and Unreal Engine literally created holes in walls through which avatars walked.

What the students learnt

Dealing flexibly with unexpected events and anticipating them .

Kirsten discovered that the perception of time in VR differs radically. “We thought we were creating short experiences, but in hindsight it felt like a long experience for users.” For their project, the students wanted users to feel as though they were trapped. However, within the time available, they were unable to achieve this. “We had to guide them towards the exit within the time frame by having them follow a blue light. As a result, we were unable to create that feeling of being trapped.”

Teaching approach and guidance

The project addressed several learning objectives, including both technical and cross-disciplinary skills¹⁸. Students from various disciplines (animation, theatre, programming, engineering) were required to collaborate as equals and work together to determine which technology and spatial layout were required, without a hierarchical division of tasks. Collaborative learning is central to this project.

Communicate frequently.

Charlotte learnt about managing expectations within multidisciplinary teams. Even within that team, there were varying levels of expertise, which meant that many discussions centred on what was technically feasible. Visual cues in the virtual environment were interpreted in different ways, forcing students to communicate more explicitly.

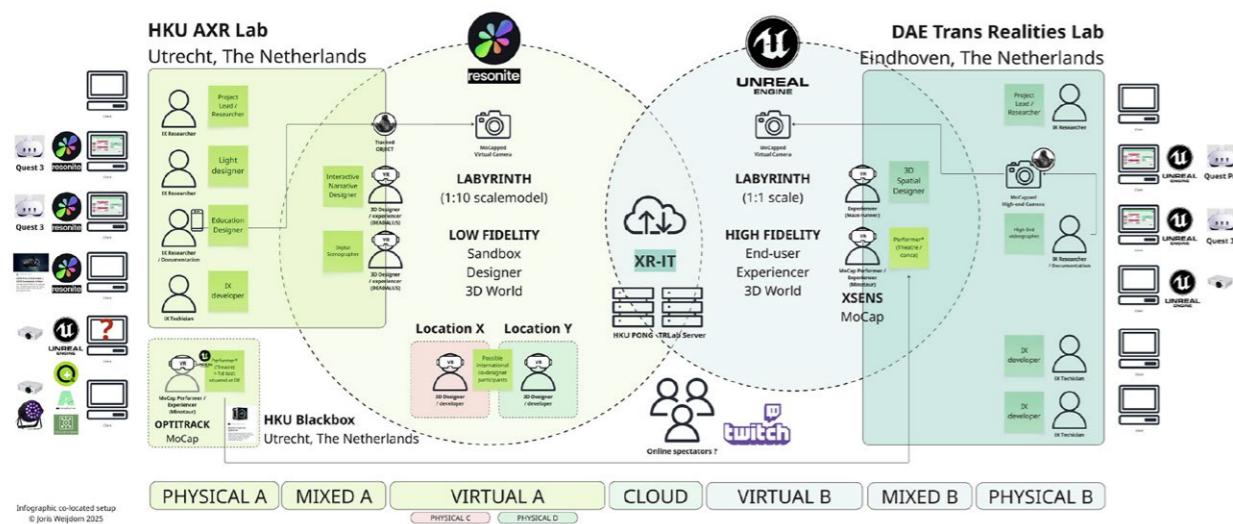


Figure 1: Network architecture for collaboration between DAE and HKU. Source: Joris Weijdom, HKU, 2025. This figure illustrates how HKU Utrecht and DAE Eindhoven collaborate in real time within shared XR environments via a central cloud infrastructure (Resonite, Unreal Engine, Twitch).

18 Transversal skills: transferable skills that can be applied across different disciplines and contexts, such as collaboration, communication, problem-solving and critical thinking.

Technical challenges

The difference between the Resonite and Unreal Engine platforms was fundamental. Both systems were deliberately designed to fulfil different functions: Resonite served as a ‘sandbox’ in which HKU students could build, move and duplicate objects in real time, whilst Unreal Engine functioned as a high-end ‘final experience’ where DAE students could experience the detailed lighting and textures. This design principle, combined with the inherent technical limitations of both platforms, created complex interoperability issues. DAE students could see HKU avatars, but not vice versa. Charlotte: “In Resonite, they saw lower resolution, just blocks and simple shapes. They couldn’t see our detailed lighting. When we asked for brighter light, it was difficult for them to understand what that looked like.”

Calibration issues caused spatial dissonance. Charlotte: “We could hear each other in real space, but saw each other on opposite sides of the virtual space.” A system update had shifted the predefined origin point of the

environment, meaning spaces no longer aligned. Furthermore, both engines use different Cartesian coordinate systems, meaning objects had to be rotated by 90 degrees during translation. Kirsten: “Walls in Resonite weren’t to scale. In Unreal, there were gaps between them. I saw the student walking through the wall.”

Support

The tutors remained nearby and within earshot. Their role was to provide Socratic coaching and technical support, thereby giving students the freedom to experiment. The Socratic coaching method proved effective. Saeneul: “They kept asking me what the aim was. Once I was in the room, I kept forgetting the aim.” The tutor’s questions helped me avoid getting bogged down in technical details.

Learning pathway

The project offered a learning programme in four areas:

- 1. A diverse range of expertise:** Students from various disciplines (3D sculpture, 2D animation, CMD) worked together. Sarp said that collaborating with people from other disciplines was the most valuable thing he had learnt.
- 2. Technical translation:** Kirsten worked with Unreal, Unity and Resonite, which were new to her. She learnt that clear agreements are essential. Saeneul helped her clarify her narrative because she didn’t understand the technical aspects.
- 3. Cross-platform communication:** HKU students could not see the DAE students in the VR environment and were working at a lower resolution, which made collaboration difficult. To facilitate communication, video streams from the physical spaces were shared and there was a continuous audio link between the students to allow for discussion. In addition, a liaison officer was on hand to indicate where the other students were located.
- 4. Iterative working:** Within a month, the students had produced an initial iteration. They identified which results were not yet working. During this initial iteration, HKU students wore VR headsets to experience the changes immediately.

VR creates unique psychological effects in terms of spatial perception. At the same time, VR is an intensive and tiring experience. For the students, XR became a tool: powerful in certain contexts, but limiting in others. The question was no longer “What is XR?” but “When is XR the right choice?” After this experience, all the students interviewed wanted to continue using XR in their future careers.



4. POTENTIAL FOR THE FUTURE IN EDUCATION

At present, it is mainly research and, to a lesser extent, education that takes place in the networked XR environment. However, education in this environment offers many opportunities for cross-location collaboration and learning. At present, for example, design courses require holistic, immersive experiences that are not limited to VR, such as augmented reality for contextual design feedback, mixed reality for combining physical prototypes with digital designs, and hybrid environments.

- **Radical connectivity:** The long-term vision is to create an infrastructure in which any institution in the world can be invited to participate, thereby facilitating intercultural collaboration and the contribution of specialist knowledge without the need for travel.
- **AI and 3D worlds:** The role of AI is expected to grow increasingly significant, enabling users to generate and share real-time 3D worlds more easily using prompts, which will greatly accelerate creative processes.
- **Ethical considerations:** There is an ongoing tension between reliance on commercial technology (such as Unreal or Meta Quest) and the values held by educational institutions regarding privacy, security and the public interest.



SURF

Future plans for DAE and HKU Labs

Both institutions have ambitious plans for the further development of their XR facilities and educational programmes.

Design Academy Eindhoven is looking forward to a major turning point with its move to a new building in Eindhoven's Kanaalzone in mid-2028. Until then, the Trans Realities Lab is based at the High Tech Campus Eindhoven, with support from 3EALITY¹⁹ and HTCE²⁰. This location strengthens the link with the regional tech industry (ASML, Philips, Heijmans, NXP, AcceleraAI) and offers students direct exposure to real-world challenges. The new building provides space for further expansion of the TRL and strengthening of the research infrastructure. DAE is making a structural commitment to the growth of practice-oriented research by strengthening both research groups with additional researchers and research support for the technological process within the TRL.

DAE is stepping up its international partnerships, including through European research programmes (the Horizon/EMIL XR-IT project and the Creative Europe Hybrid Lab project). The focus on networking within the Brainport region is being further strengthened, with the aim of seamlessly integrating design and technology.

The networked XR environments for co-creative collaboration at HKU Oudenoord (established in 2023) are deliberately operating

in an exploratory phase. In the short term (2025–2026), Joris Weijdom anticipates an expansion into applied research projects involving various professional XR experience designers. For example, in the aforementioned HEFT project, developing partnerships with, for instance, Utrecht University of Applied Sciences and Utrecht University, and with vocational training programmes focusing on XR, in collaboration with OASIS and the XR Lab in Hilversum, which develop highly practice-oriented programmes based on project-based learning.

In the medium term, the aim is to develop a national and international network of co-located hybrid learning and experimentation spaces that can be linked together for research, education and development. In parallel with this, international partnerships will be strengthened with, for example, partners in Helsinki, Coventry and Vancouver, for cross-border design projects.

By involving an increasing number of lecturers, directors and support services in co-located working days, the lab is becoming organically embedded within broader educational practice. With creative technology as one of HKU's five key priorities, there is administrative support for the further development of the experimental research environment into a versatile facility, whilst maintaining an artistic and experimental approach.

¹⁹ A technology company specialising in immersive media and virtual production, known for its high-end 3D and VR solutions for sport, events and entertainment (including volumetric video and real-time XR productions).

²⁰ A Taiwanese technology company and manufacturer of products including the HTC Vive range, offering hardware, software and platforms for VR and XR applications in education, industry and entertainment.

5. LESSONS LEARNED

Based on the experiences with the Trans Realities Lab, the collaboration between DAE and HKU, and the interview with HU, key lessons have emerged for institutions wishing to launch networked XR environments for co-creative collaboration.

| Funding and sustainability

- **Diversify funding sources.** The TRL demonstrates that successful XR labs require multiple streams of funding. Ian Biscoe combined internal DAE funding, Dutch Design Week grants, Surf research funding, Creative Europe funding (Creative Lab and Hybrid Lab) and a substantial Horizon Europe contract (€500,000+) for the XR-IT project. This diversified approach prevents reliance on a single source and enables further development.
- **Funding is not a one-off.** A crucial lesson: technological developments move quickly, and innovation requires structural investment. Kim Kamphuis (HU) emphasises: “Funding is needed, and it is

not a one-off. If you make a one-off budget available, it will get you through for a while, but then it runs out and what you are doing has become old news.” Institutions must therefore set aside structural budgets for maintenance, upgrades and management in order to continue working innovatively with XR technology.

- **Linking to research groups promotes continuity.** For all three labs, the link to a research group has proved crucial for organisational integration, structural funding and future-proofing.

| Organisational requirements

- **Support from management is essential.** Without support at a strategic level, XR innovations will come to nothing. This support does not necessarily have to come from a large group, but there must be people who are interested in exploring and implementing the initiative.
- **IT infrastructure requires flexible management rights and early coordination.** Initially, HU was unable to

participate in networked sessions because the PCs were configured so restrictively that authorised staff could not adjust the necessary firewall settings. A more relaxed and flexible approach is needed from IT departments to support innovative use of networks. Involve IT departments from the outset and ensure dedicated workstations with sufficient configuration rights for XR applications.

- **Professional development for teachers:** Joris (HKU) warns: “Just because you bring a particular technology into the classroom doesn’t mean that the teacher automatically knows what to do with it.” Technology alone

is not enough. Teachers need training, guidance and pedagogical frameworks to use XR effectively.

| Technical implementation

- **Iterative development takes precedence over perfection.** Joris: “We’re still experimenting a great deal. We’re making things terribly difficult for ourselves by trying to do everything at once. The key is not to focus on whether ‘a brilliant design has emerged here’, but rather to recognise that this complex process will generate a wealth of insights that we can then build upon in terms of knowledge, methods and technological approaches.”
- **Network infrastructure is critical.** Low-latency connections, sufficient bandwidth (10–100 Mbps per node), wired connectivity and high-quality WiFi 6E/7 access points are non-negotiable for networked XR. Technical specifications must be clearly defined in advance.

- **Maintenance and management are often underestimated.** Kim emphasises that technical equipment needs to be maintained and that lending procedures must be properly organised. “These are additional tasks that you can’t simply fit into your teaching hours.”
- **Successful management of networked XR labs requires more than just technical expertise.** It is also important to have a team structure in which roles are clearly defined, so that academic staff can be physically present for students without having to shoulder all the technical and organisational tasks.

| Teaching insights

- **This environment is ideally suited to experimental and project-based learning, with a focus on collaborative learning.** Joris: “Project-based learning, gaining knowledge through physical experience, and all teaching methods that involve the body in the learning process and are based on the premise that students learn better through discovery than simply by being told what to do and carrying it out.” This is in line with the nature of XR environments.

- **Stay flexible with your learning objectives.** When innovating, you can’t predict the outcome. Joris: “If you realise along the way that you need to take a different turn after all, you have to be prepared to do so.” Organisations must allow room for adjustment during the process.

- **Keep supervision accessible.** Students appreciate accessible, frequent supervision where lecturers are physically present in the room. Student Kirsten describes Joris (HKU)'s supervision as: "accessible. He was also in the classroom very often, so that made it really easy to approach him."

This physical presence and accessibility compensates for the technical complexity of the lab and lowers the barrier for students to ask for help.

Cooperation between institutions

- **Breaking down political barriers:** Ian highlights a major obstacle: "Universities basically compete: they're all saying 'come to TU Delft, come to TU E, come to Fontys'. So, for some of these people, the idea that they're now going to collaborate remotely might undermine the vision of a particular university." Successful collaboration requires institutions to overcome this competitive pressure and start recognising the power of collective action.
- **The diverse expertise across institutions enriches the whole:** Kim Kamphuis: "It's also very interesting to look at how institutions complement one another precisely because of their different areas of expertise. It's perfectly fine for your focus to differ – whether based on your discipline, lab or research – as long as you arrive at a shared *experience* that can truly achieve

something new."

- **Don't isolate yourself; networking is essential:** Kim emphasises: "You really must make sure you keep looking around you. You can't just sit on an island. You need to collaborate with vocational colleges and within your own educational institutions."

10 top tips

Based on the interviews and SURF Future Campus best practices in campus innovation, here are the 10 key tips for launching networked XR environments for co-creative collaboration in education:

1. **Start with educational needs, not technology.** Begin with specific issues from the curriculum or research (for example, an ADHD simulator or a history experience). XR should solve problems, not the other way round. The key question is: When is XR the right choice?
2. **Start small and modular.** Begin with a limited pilot (small team, single location) and build up gradually. Not every institution needs a €600k lab; meaningful XR experiences are possible even with a budget of €30–50k. Test the feasibility before investing on a large scale.
3. **Link the lab to a research group.** In the case of the labs, linking them to a research group proved crucial for organisational embedding, structural research funding and future-proofing. This link provides access to multiple funding streams (1st, 2nd and 3rd funding streams) and embeds XR innovation within the institution's long-term strategy. This is essential because technology becomes obsolete within a few years and one-off investments are insufficient. Plan multi-year budgets for maintenance, replacement and middleware development via the research group.
4. **Build organisational buy-in and operational commitment.** Secure clear support from management, but above all: put together a small, motivated core team (2–6 people) that is genuinely committed to innovation. Without an implementation team, equipment will remain unused.
5. **Build a network; don't work in isolation.** "You can't just sit on an island" (Kim, HU). Collaborate with other educational institutions (vocational, higher vocational and university level), share knowledge and learn from each other's mistakes. Inter-institutional collaboration lowers barriers and reduces costs.
6. **Invest in middleware, not just hardware.** Most development time is spent on software that connects systems. Focus on interoperability between platforms (Resonite, Unreal) rather than fixating on specific brands or devices.
7. **Provide professional development for teachers and technicians.** Ensure training in both technical skills and the pedagogical use of XR. Teachers need to become comfortable with Socratic guidance rather than direct instruction. Technicians need time to familiarise themselves with middleware.
8. **Be flexible and embrace evolving insights.** With innovation, you cannot predict the final outcome. Allow room for course corrections, iterative work and unexpected directions. Successful XR implementation requires 3–5 years of development time.
9. **Integrate it into the curriculum, not as a stand-alone project.** Embed XR systematically within existing subjects, minor programmes or specialisations. Actively involve teaching teams. Without integration into the curriculum, it will remain a 'fun experiment' with no lasting impact.
10. **Involve IT departments in the planning from day one** and ensure a flexible approach whereby trained staff are granted permission to use specific devices on a trial basis. Consider dedicated workstations for XR applications with the appropriate configuration rights.

Contact and opportunities for collaboration

Organisations interested in networked XR collaboration can contact the relevant labs:

- Design Academy Eindhoven
 - Trans Realities Lab Dr Ian Biscoe (Professor of Transdisciplinary Design Networks) Website: <https://transrealitieslab.com/> | <https://www.designacademy.nl>
- Utrecht School of the Arts
 - XR Lab Joris Weijdom (Associate Lecturer) Research Group Website: (Dis)Connected Technology & Creativity [https://www.hku.nl/onderzoek-en-innovatie/onderzoek/lectoraten/\(dis\)connected-technology-creativity](https://www.hku.nl/onderzoek-en-innovatie/onderzoek/lectoraten/(dis)connected-technology-creativity)

Both labs collaborate within SURF networks. The TRL's XR-IT project (originally supported by the Horizon Europe EMIL programme) is developing an open toolkit to enable multiple educational institutions to participate in distributed XR collaboration. Open demonstrations and knowledge-sharing meetings take place annually, including the Trans Realities Lab Open Event and National XR Day (SURF).

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- Paul Melis - SURF
- Gijs ten Cate – HU
- All interviewees

| Interviewees

- **Dr Ian Biscoe** – Professor and Head of Transdisciplinary Design Networks (TDN), Design Academy Eindhoven. Founder of Trans Realities Lab. (16 September 2025 & 21 November 2025)
- **Joris Weijdom** – Associate Lecturer, Research Group (Dis)Connected Technology & Creativity, Utrecht School of the Arts. Involved in the HKU minor in Artistic Immersive Experiences. (3 November 2025)
- **Kim Kamphuis** – Researcher and lecturer in Communication & Multimedia Design at Utrecht University of Applied Sciences. Lead of the IX Lab with CAVE system. Background: Bachelor's degree in Journalism, Master's degree in Editorial Design (HKU).

- **Charlotte Meinicke** – Student at the Design Academy Eindhoven (DAE). Design student on the DAE Digital Focus programme. Voluntary participant in the Trans Realities Lab project (extracurricular). User/experiencer of virtual environments in Unreal Engine / XR-IT. (29 October 2025)
- **Saeneul Song** – Student at the Design Academy Eindhoven (DAE). Design student on the DAE Digital Focus programme. Voluntary participant in the Trans Realities Lab project (extracurricular). User/experiencer of virtual environments in Unreal Engine. Focus on narrative and liminal spaces. (5-11-25)
- **Kirsten Appelman** – Student at Utrecht University of Arts (HKU), studying Communication & Multimedia Design (CMD) at Rotterdam University of Applied Sciences. She is currently undertaking the Minor in Artistic Immersive Experiences (XR) at the HKU as part of her third year. (5 November 2025)
- **Sarp Abenhabiub** Buyukersen-DAE. (5 November 2025)

| Comments:

- 27 October 2025: HKU sets up a laboratory.
- 29 October 2025: HKU observation of virtual collaboration.
- 29 October 2025: Observation of virtual collaboration.



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