Learning and training in Virtual Reality

How can immersive virtual reality be used for learning and training and what are the barriers to this?

The first attempts to create an immersive virtual reality began more than 50 years ago. However, it is only within the last 5-10 years that the use of VR has spread from entertainment to workplaces, education, and research. This is mainly because VR headsets have become lighter, more flexible, more powerful, and not least more affordable. Artificial intelligence is expected to push further on the prevalence and applicability of VR in the coming years. (Lee et al., 2021, p. 11-12)

3 main uses of immersive virtual reality for learning and training

When it comes to learning and training, the use of immersive virtual reality can be organized into three main categories:

1. VR is used for simulating environments that are too difficult, dangerous or expensive to visit in real life
2. VR is used for empowering learners as creative designers and makers
3. VR is used for enhancing collaboration and creating a sense of physical and social presence

VR is used for simulating environments that are too difficult, dangerous or expensive to visit in real life

When you put on a VR headset, you step into another reality where a 360-degree view and sounds create a feeling of being there. This can be used in teaching, where students can visit the pyramids explore the rainforest or experience London in the 1850s. In many VR applications, you can interact with the environment, and this can enhance the students' experience and change their roles into the role of an explorer, scientist, or poor child in the Victorian era. These opportunities support authentic learning and let students explore and understand complex subjects and concepts through realistic scenarios and interactions (Lee et al., 2021, p. 24-25).

An example of this kind of use can be found in Jensen (L. X. Jensen, 2017) who describes how Danish university students went on a virtual field trip to refugee camps in Iraq and France. According to Jensen, virtual field trips can create a shared understanding and experience that can form the basis for learning tasks and discussions in class.

VR simulations are also used for developing workforce skills. Especially in cases where errors can lead to high costs in terms of human lives or money. For example, in airports, in the wind turbine industry and in shipping. Through VR, employees can train how to escape a burning wind turbine tower and how to handle conflicts on a container ship (https://virsabi.com/maersk-behavioral-training/).

But VR training is also used for training young apprentices in more ordinary everyday settings as it is seen in the Danish retail company Coop Danmark A/S. In this case, the use of VR is an attempt to attract young employees through training that differs from that of competitors (Batchelor, 2018).

VR is used for empowering learners as creative designers and makers

There are more examples of how students use VR for creation. VR introduces students to new 3D and XR creative tools, allowing them to express themselves in new ways. Both when they make new creations inside a virtual world, and when they create content or designs to be used in VR.

When VR is used in this way, it is no longer the computer that acts as the teacher for the students, but conversely the students who learn through programming computers or creating content for the virtual worlds. This way of using VR in teaching can be seen as a form of constructionism as defined by Seymour Papert in 1980 (Papert, 1993).

An example is described by Majgaard and Lyk (Majgaard; G. & Lyk, 2015) who let 5th-grade students develop three-dimensional figures in cardboard, sand, and other materials whereafter the students could experience these figures in a VR environment. Majgaard and Lyk conclude that

combining creative design processes and VR strengthened the foundations of the students' experience-based learning.

VR is used for enhancing collaboration and creating a sense of physical and social presence

Finally, VR can be used as a platform for collaboration, knowledge sharing and social networking. Thanks to the immersive all-encompassing reality, VR can create a feeling of physical closeness and a sense of presence - even if the people you meet in VR are hundreds of kilometres away.

This kind of teaching can take place in existing VR platforms like MeetinVR (https://www.meetinvr.com) and Facebook's Horizon Workrooms (https://www.meta.com/dk/en/work/workrooms/).

Steinicke et al. (Steinicke et al., 2020) have made a small pilot study in which they compare virtual group meetings using video conferences and VR meetings with and without head-mounted displays (HMDs). The pilot study was conducted with nine participants which were all members of the same research group at Universität Hamburg, Germany. Even with the low sample size, the study found a significant effect on social presence in immersive VR compared to other virtual group meeting platforms.

Sadeghi et al. (Sadeghi et al., 2021) describe a study of the use of VR meeting platforms in the setting of multidisciplinary heart team meetings in a Dutch hospital. Five cardiothoracic surgeons and five cardiologists participated in the study which was accelerated by the COVID-19 pandemic and the hereby following requirement of social distancing. The study concludes that the user experience was rated positive and that there was a positive attitude towards the use of VR meetings. An advantage that was mentioned frequently was the engagement in the meeting. The participants felt actively involved in the meetings and did not experience distractions from their surroundings. In addition, communication was reported as good as in a physical meeting.

Fox School of Business, Philadelphia, USA has launched an MBA course in fintech, blockchain, and digital disruption to be held in a VR format. Instead of using an existing VR platform, the university has developed its own platform with two VR classrooms: a traditional auditorium-style lecture hall and an outside park. The students participate via an Oculus VR headset and the lecturer is live-streamed from a video studio into the virtual lecture hall.

The school sees more advantages in a VR-facilitated course: The 20 students enrolled in the course can join it from anywhere in the world and when wearing the VR headset, students will not get distracted by their phones or other disturbances. Furthermore, the technology can be adapted, so that every student can have a front-seat view of the instructor.

However, there are also challenges within this form of teaching: The VR headsets are cumbersome and eye fatigue sets in after about 45 minutes, keeping classes short (Orbanek, 2020; Rosenberg, 2021).

Barriers to adoption

According to Lee et al. (2021, p. 45-54), VR creates many new teaching opportunities, but it also faces significant barriers to adoption:

Accessibility

A very basic barrier is access to VR. One of the most sold VR headsets is Facebooks's Oculus Quest 2 but it is not available in all countries. In Germany, for instance, Facebook halted sales of all Oculus VR headsets temporarily from September 2020. It came as the German data regulator, Bundeskartellamt, started an investigation of the decision to require Oculus users to move to Facebook logins for their headsets by 2023 (Robertson, 2020).

Another example is that Oculus Quest 2 is not available in China and several Chinese XR technologies are not available in USA and Europe. (Lee et al (2021, p. 46). At the same time, VR solutions rarely offer workable solutions to people with various forms of disability.

As downloading or streaming VR content requires significant bandwidth, this may cause another obstacle to accessing VR-based courses.

A fourth accessibility challenge is the price of VR technology. In recent years, the price of VR equipment has dropped greatly. In particular, the development of stand-alone headsets has lowered the price. However, the price of an Oculus Quest headset for professional use is still 750 euros, which can constitute a significant expense when an educational institution wants to purchase VR equipment for an entire class.

An exception to the expensive equipment is Google Cardboard and other low-priced VR viewers, where you mount your cell phone in the device. However, the interaction possibilities and the VR experience are not comparable to that of a higher-end device.

Pedagogical and technical issues

The lack of educational content suitable for VR platforms is another barrier to the adoption of VR in teaching. As it is an emerging technology, only a little content and few learning materials have been developed. At the same time, only a few teachers have the necessary technical ability or practical experience to develop educational material for VR. Therefore, the use of VR as an educational technology may cause extra work for the teacher and it will require extra support of them.

So technical as well as pedagogical support is needed to assist educators in successfully integrating VR into their teaching. Unfortunately, this is lacking in most educational institutions and only a few schools and universities have the necessary knowledge and VR experience to provide this support. (Lee et al., 2021, p. 48-51).

Jensen (L. X. Jensen, 2017) argues that it is a problem that VR headsets primarily are made for entertainment. The user interface is more like a gaming console than a learning management system which makes simple management and administrative tasks time-consuming.

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Cybersickness

Based on a literature review of VR headsets in education and training Jensen and Konradsen (L. Jensen & Konradsen, 2018) points out that cybersickness is a barrier to the educational use of immersive virtual reality in teaching. The review found big differences in the reported level of cybersickness ranging from light symptoms to severe cybersickness that made study participants leave the experiment.

Future studies

There are still many things to be studied when it comes to the educational use of VR. Especially regarding the use of VR meeting rooms and classrooms, as only a few studies have been done on this.

In the Erasmus+ project WISE Offshore, we have looked at the possibilities in VR. Initially, we wanted to find out how we could make our Offshore Wind Energy MBA more flexible for the students using blended learning, but we soon realised that the social aspects of the MBA, the networking and knowledge-sharing possibilities were equally important to the students as the academic content. This has led us to consider how we can combine the flexibility of online meetings and the sense of closeness and presence that we can experience in physical meetings. Can VR meeting rooms be part of the answer? We don't have an answer yet, but during the last year, we have held more VR workshops, and they have shown us that there are possibilities in VR.

At the Business Academy SouthWest in Esbjerg, Denmark, we will continue these studies after the end of the Erasmus+ project.

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