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## HETL Frontiers

The aim of the International Higher Education Teaching and Learning Association (referred to as HETL) is to bring together higher education professionals and thought leaders from around the world to dialogue, network, and collaborate on

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Extended Reality (XR)  
for learning

## Message from the President of the International Higher Education Teaching and Learning Association (HETL)



Dear HETL members and global education community,

I am pleased to present to you HETL Frontiers Volume 3, Number 1: Extended Reality (XR) for Learning. This volume explores how our learning spaces are evolving and growing more sophisticated, networked, and diverse. Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) are unified under the term Extended Reality (XR). These technologies extend the possibility to enhance the way we learn, interact, and experience education.

The issue's articles introduce new practices from around the world. Collectively, they invite us to reflect on how XR has the potential to transform not just what we learn, but how we learn and why we wish to learn. HETL's larger mission is to enhance student-centered teaching practices and global well-being. This issue is the perfect illustration of the conversation that HETL offers—a place in which learning is continuous, connected, and iterative.

Looking forward, we must collaborate with technologists, instructional designers, educators, and learners in concert to improve teaching and learning. We'll have to introduce new ideas, solutions that involve all the stakeholders, and a commitment to making these technologies promote equity, sustainability, and success for everyone. This issue marks a step in this direction.

I would like to express a huge thank you to the authors, reviewers, and editors who have contributed time and expertise to this issue. They embody the innovative thinking and collaboration of the HETL international community. We hope this edition will be an inspiration to thinking about the future of learning in a world where what is real—both natural, virtual, and artificial—is increasingly shaped by, and designed by, our collective imagination.

Regards

Dr Patrick Blessinger  
President, HETL

## Message from the Editor of HETL *Frontiers*



Dear HETL members and global education community,

I am excited to share the release of the fifth edition of HETL Frontiers. This magazine aims to deeply explore emerging trends in higher education development, innovation, sustainability, and the future of education. It addresses the fundamental roles of higher education, including teaching, research, and service. This edition features contributions from distinguished educational leaders and scholars worldwide, including several HETL Country Directors (<https://www.hetl.org/country-delegates>).

This particular issue focuses on the use of extended reality in learning.

I would like to take a moment to express my sincere gratitude to Patrick Blessinger for his steadfast leadership and dedication to ensuring that HETL provides valuable insights into various facets of higher education. His initiative has fostered a platform for colleagues to share their work through different channels. I would also like to thank the HETL Publicity and Promotions Committee—comprised of Sameera Saeed, Taisir Subhi Yamin, Raket Kavena Shaleyefu, and Mojca Kukanja Gabrijelčič—for their hard work in bringing this edition to publication. HETL Frontiers is published twice a year, and a call for submissions for the next edition will be shared via HETL's communication channels.

I hope you find this edition as engaging and insightful as we did during its preparation.

We look forward to your contributions to future editions.

Warm regards

Dr Martina Jordaan

## HETL *Frontiers* – Content

HETL *Frontiers* is published twice a year in English. You may circulate and reproduce as you see fit. Kindly cite the authors and refer to the International Higher Education Teaching and Learning Association. We are looking forward to receiving any suggestions, comments and new articles.

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## 1. Enhancing Learning Outcomes: The Impact of XR on Student Engagement and Retention



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### Introduction

XR encompasses real-and-virtual combined environments and human-device exchanges generated by computer technology and wearables, including, augmented reality (AR) and virtual reality (VR) and the areas interposed among them. Studies have shown that immersive learning experiences facilitated by XR can significantly enhance learning retention and skill acquisition compared to traditional training methods. Studies also show that VR learning improves focus and reduces distractions, as students' vision and attention are engaged by immersive experiences. In addition, XRs are immersive learning technologies that offer authentic learning experiences in controlled conditions and allow students to experience real-world scenarios without risks, through simulated environments. Inclusion of XRs in the classrooms are not without challenges, as the instructors need to invest in additional preparatory time for incorporating the

educational technologies in their lesson plans. Instructors also need to ensure that students remain engaged and are extending their learning through the use of XRs. This article will focus on the increasing use of XRs in higher education and its impact on student engagement and retention.

### **Student Learning Experiences using XR**

AR and VR train students to adopt immersive digital experiences that cannot be experienced through traditional teaching methods, enabling them to participate better with complex study material beyond lectures and learning resources. Extended reality (XR) is a technology with proliferating advanced development that can be applied in education to increase student engagement and student learning (Guo et al., 2021). XR can be utilized in real-and-virtual combined environments and human-device interactions generated by computer technology and wearables such as, augmented reality (AR) and virtual reality (VR) and mixed reality (MR), the areas intercalated among them. XR permits learners to control their learning strategies that focus on instructor-student interactions and connectivity.

Today, more than one aspect of XR impacts whole communities and societies, ranging from partially sensory inputs to immersive virtuality (Slater et al., 2019). Studies show that when people face personal problems they usually give better advice to others than to themselves, a phenomenon described as 'Solomon's Paradox', named after the biblical King Solomon who dispensed wisdom to others, but was not so good when it came to making decisions that would have an impact on his own standing. Slater et.al (2019) extended the knowledge from previous studies that showed how it is possible to portray internal dialogues in virtual reality (VR) through participants occupying two different virtual bodies- one that represents themselves and the other Sigmund Freud (the acclaimed Austrian neurologist and founder of psychoanalysis (1856-1939)). In the study, participants could maintain a self-conversation by explaining their problem to a virtual Freud, a Scripted Freud character, and also listen to a virtual doppelganger, and then give some advice to themselves. The results showed that the self-conversation method resulted in a greater perception of change and assistance compared to the Scripted Freud character. Slater et.al (2019) consider this method as a possible strategy for self-counselling. This could be particularly useful in situations where access to counsellors or psychologists is constrained.

XR is continuously evolving alongside the smartphone technology that is advancing and as a result, immersive learning technologies that depict authentic experiences in controlled or low-risk environments, are growing. In laboratories that are not well-equipped, students could now avail of XR resources for learning state, Penn & Ramnarain (2019), whose studies showed that students achieved higher scores post virtual lab learning interventions than traditional lab interventions, and that VR applications in labs offer complementary learning support to students to understand abstract chemistry concepts.

### **Challenges Involving the Use of XR in Learning**

Augmented and virtual reality technologies indicate promise for improved immersive learning experiences by overlaying digital content onto physical environments and creating fully simulated scenarios. However, integrating AR/VR into education poses challenges that can hamper adoption and impact outcomes. Some of the main challenges include high development costs, limited device availability among students, technical complexity in content creation, and a shortage of standardized pedagogical frameworks. In addition, obsolete hardware and interoperability platforms, coupled with equity, privacy, and data security concerns may pose slow down the use of AR and VR in learning. Institutions need to focus on providing adequate training and support for faculty adopting XR in teaching and learning.

Creating high-quality AR and VR learning content involves specialized skills, knowledge and resources that

are not available in most educational institutions, as instructional teams need access to 3D modelling and professional game engines to implement interactive scripting and optimize performance on multiple platforms. Integrating pedagogical goals adds to the complexity as discipline specialists have to work closely with software developers and user experience (UX) designers to ensure that simulations are working efficiently and are aligned with learning objectives. In addition, fitting in AR/VR modules with learning management systems and analytics platforms requires security auditing and application programming interface (API) permitting different software applications to communicate with each other, which are cost-intensive and beyond the capabilities of most school IT departments.

## Conclusion

In summary, Augmented reality (AR) and Virtual reality (VR) are redefining education by offering immersive experiences that can enhance learning. XR applications have demonstrated benefits across numerous fields, with education evolving as one of the most promising areas for these technologies. Further, studies have shown that XR applications can increase student engagement, and encourage students to focus more without distractions and assist students in understanding complex concepts in lab situations as well as facilitate learning seamlessly. However, the use of XR in learning can be complex as institutions need to invest in continuous professional development (CPD) for faculty as well set aside budget for the acquisition of specialized equipment and platforms that are interoperable, as well as train content creators to work with discipline experts to align learning content with program and course objectives.

## References

- Guo, X., Guo, Y., and Liu, Y. (2021). The Development of Extended Reality in Education: Inspiration from the Research Literature. *Sustainability* 2021, 13, 13776. <https://doi.org/10.3390/su132413776>
- Penn, M. and Ramnarain, U. (2019). A comparative analysis of virtual and traditional chemistry laboratory learning. *Perspectives in Education*, 37(2), <https://doi.org/10.38140/pie.v37i2.4030>
- Slater, M., Neyret, S., Johnston, T. *et al.* (2019). An experimental study of a virtual reality counselling paradigm using embodied self-dialogue. *Sci Rep* 9, 10903. <https://doi.org/10.1038/s41598-019-46877-3>
- 10 Challenges of AR VR in Education and How to Overcome (2025). - DigitalDefynd, <https://digitaldefynd.com/IQ/ar-vr-in-educating-teaching/>

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## 2. Collaborative and Social Learning in Virtual Environments



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## Introduction

Virtual environments are revolutionizing the way people work and learn by offering interactive and immersive experiences that are free from the limitations of a physical location. In education and vocational training, social learning is the cornerstone of sharing and exchanging knowledge, resulting in an overall enhancement of participation in peer-to-peer communication. System for simulation-based collaborative learning in virtual environment, becoming an emerging way to achieve real-time communication, shared experience, and realistic digital display and interactions, is rendering a dynamic learning space.

Given that technology is manipulating the way learning takes place (Oyedele & Iember, 2021), there is a need to know how virtual environments (VE) support collaborative learning, social interaction and instruction effectiveness. In this article, we share some key areas of social learning in the virtual environment and offer hints and best practices that can be followed to ensure better engagement and cognitive absorption.

## The Role of Collaboration in Virtual Learning

In addition to virtual space, peer interaction, debate, and joint problem solving are the core of the collaborative learning process. Collaboration is also often restricted in face-to-face work due to geographical and physical constraints, but in the VE, the whole world could potentially be a meeting space for students and working professionals to connect and meet synchronously and in time together.

Once in the virtual space, participants will engage with one another through virtual meetings, interactive simulations, and group experiences to stimulate peer learning and play team-based problem-solving and building activities. Incorporating tools like virtual reality (VR) and augmented reality (AR) and AI-powered collaboration spaces makes it possible to simulate, discuss and practice skills and scenarios in a way that feels real. In addition to being interactive and fun, these technologies also encourage motivation, interpersonal engagement and comprehensive learning.

### **Social Learning and the Power of Peer Interaction**

With a grounding in social learning theory, which emphasizes that learning takes place not just through direct instruction but through observing and interacting with others. Structured yet flexible spaces, virtual classrooms can provide learners with a space in which they can communicate, work together, reflect and challenge their ideas through discussion and group work. This peer communication of knowledge helps to develop creativity, leadership and problem-solving skills, which in turn results in having a more positive outcome during the learning process.

Gamification, dashboards, interactivity and team challenges also drive excitement through friendly competition and community building. There are also AI-driven virtual tutors and group forums to help learners have their way through complex subjects and access the learning to be found in different perspectives. These online conversations, parallel to classic teaching and learning relationships, as well as creating new participatory pathways for the virtual learning environment.

### **Overcoming Challenges in Virtual Collaborative Learning**

Certainly, there are advantages that virtual contexts offer (as well as challenges to be overcome) to maximize learning. Differences in technical access, digital literacies, and engagement can create barriers to collaboration, especially in spaces where people have different levels of comfort using virtual resources. To address these challenges, institutions should invest in easy-to-navigate interfaces, emancipated technology, and digital training programmes to promote fair participation. Explicit communication and collaborative norms, and structured group dynamic features, facilitate social learning and reduce misunderstandings. Approached with a strong emphasis on inclusivity and engagement (Apata & Oyenuga, 2025), these virtual spaces become powerful instruments for cross-cultural collaboration and global dialogue.

### **Best Practices for Maximising Collaborative Learning in Virtual Spaces**

Social learning can be improved by inserting into the course interactive modules that incorporate either synchronous or asynchronous (in real time) discussions, cooperative exercises or case-based problems. By setting peer-based mentorship systems, the experienced learners can help the new learners to increase knowledge sharing and collaboration. Furthermore, game-inspired mechanics such as challenges, group tasks, and leaderboard incentives make learning fun and even rewarding. AI-enabled feedback and analytics can deliver personalized insights into learner progression and engagement, allowing educators to personalize their approach. Finally, adopting multi-modal learning methods like video-conferencing, AI-driven simulations, discussion forums, etc, pledges an enriching and engaging learning experience that addresses various learning preferences and promotes experiential learning (Noichun, 2022).

## Conclusion

Collective and social learning in virtual space represents a key transformation of paradigms in education, as it encourages engagement of the whole world in terms of interactive knowledge transfer. With the evolution of technology, these virtual environments will become increasingly immersive, versatile, and efficient, delivering a transformative learning experience which fosters interaction, peer learning, critical thinking and problem-solving. By facing hurdles, sharing best practices, and working with cutting-edge tools, educators and organizations can create affordable, accessible, and effective learning environments. The future of social learning in virtual space is people-driven and built on accessibility, creativity, and community.

## References

- Apata, S. B. & Oyenuga, M. O. (2025). Revolutionizing Employability: The Intersection of Digital Literacy, Inclusive Education, and Gen Z's Skill Set in the 21st Century. In O. Ajani (Ed.), *Empowering Pre-Service Teachers to Enhance Inclusive Education Through Technology* (pp. 155-182). IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3693-8759-7.ch006>
- Noichun, N. (2022). Reflection-based learning in virtual environments for pre-service teachers. *International Journal of Information and Education Technology*, 12(10), 1071-1077. <https://doi.org/10.18178/ijiet.2022.12.10.1722>
- Oyedele, O. M., & Iember, A. A. (2021). COVID-19 and the Future of Higher Education. *IEEE Technology Policy and Ethics*, 6(4), 1–3. <https://doi.org/10.1109/ntpe.2021.9778140>

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### 3. VR in Higher Education: Hype or Breakthrough?



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Virtual reality (VR) has long promised to reshape education. The Idea of immersing students in interactive, three-dimensional learning environments sounds like something from the future. Yet that future is unfolding in classrooms today—form medical students practising complex surgeries in virtual operating rooms to history students touring ancient Rome without leaving their desks. But VR genuinely transforms higher education, or is it simply an expensive experiment dressed up in cutting-edge tech? A close look at the global data reveals a nuanced picture: one of both promise and peril, opportunity and overstatement. The global education sector has not been immune to the disruption of immersive technologies. According to a report by PwC (2020), employees in VR-enabled soft skills training learned four times faster than those in traditional classrooms.

Translated to higher education, this suggests immense potential: students can absorb difficult content more efficiently and retain information longer. In healthcare education, for instance, a 2022 study published in *BMJ Simulation & Technology Enhanced Learning* found that VR-trained surgical residents performed 29% better in accuracy and 32% faster in time compared to their traditionally trained peers. The University of California, San Francisco (UCSF) and Harvard Medical School have begun integrating VR modules in anatomy and emergency response training, where students interact with hyper-realistic 3D human bodies and simulated trauma cases.

Architecture and engineering schools have also been early adopters. At Delft University of Technology in the Netherlands, students use VR headsets to simulate construction site management and structure integrity analysis, allowing real-time modifications and instant feedback. Similarly, the University of Illinois uses VR in civil engineering labs to train students in bridge inspection and fault detection, reducing lab costs and risks associated with fieldwork. These examples are not isolated. According to the XR Association and IDC Education Report (2023), 44% of U.S. higher education institutions surveyed are piloting or scaling extended reality (XR) programs, with VR as the core tool.

However, while the benefits are tangible, VR in education faces undeniable hurdles, starting with cost. A Meta Quest 3 headset alone costs around \$500, and that does not include specialized educational software, licensing, or the necessary IT infrastructure. For cash-strapped public universities and colleges in emerging economies, this can be prohibitive. A 2021 World Bank report revealed that fewer than 20% of higher education institutions in low-and middle-income countries have access to the broadband internet and hardware needed to deploy immersive technologies at scale. Even in advanced economies, maintenance, content updates, and technical training pose significant logistical burden.

Another limitation is cognitive overload. In contrast to passive video lectures, VR demands active engagement from students—which, while beneficial in moderation, can lead to fatigue and disorientation during long sessions. As study by Stanford University's Virtual Human Interaction Lab (2021) found that 60% of students using VR for more than 30 minutes at a time experiences symptoms of "Zoom fatigue", including eye strain, dizziness, and reduced confrontation. These challenges suggest that VR cannot be a blanket replacement for traditional methods but must be integrated judiciously into the curriculum.

Pedagogically, not all subjects lend themselves well to VR. While STEM disciplines such as biology, medicine, and engineering benefit from visual and spatial simulations, abstract subjects like philosophy or mathematics often do not. The effectiveness of VR in these cases depends on creative content design, which is both time-intensive and costly. Moreover, some faculty members remain sceptical. A survey by EDUCAUSE (2022) found that only 36% of professors felt confident using immersive tools, and less than 25% believed VR improved learning outcomes in their subjects. Without proper institutional support, including faculty training and curriculum alignment, VR risks being relegated to an expensive novelty.

Equity concerns further complicated the picture. Students with disabilities, particularly those with visual impairments or sensory sensitivities, often find VR inaccessible or even overwhelming. As institutions rush to innovative, inclusive design must remain a priority. The European Union's "Accessible Immersive Education" initiative (2023) is attempting to set standards for inclusive VR learning, but adoption remains uneven across institutions.

Yet, dismissing VR as a fad would be shortsighted. Technology is evolving rapidly, and prices are falling. Companies like zSpace and ClassVR are offering all-in-one classroom solutions that bundle headsets, content libraries, and analytics dashboards, making it easier for institutions to adopt immersive education at scale. Additionally, cloud-based VR platforms now allow students to participate using basic laptops and

smartphones, mitigating the hardware barrier. As AI-generated content improves, developing VR learning modules is becoming faster and more affordable, increasing customizability for various disciplines.

Perhaps the most pragmatic approach is to treat VR not as a silver bullet as a strategic supplement. When used in combination with flipped classroom, project-based learning, or blended models, VR can be a powerful enhance. For instance, business schools at INSEAD and London Business School are using VR to simulate boardroom negotiation and crisis management, helping students develop soft skills in lifelike settings. These scenarios are difficult to recreate authentically through textbooks or lectures.

Ultimately, the question is not whether VR will replace traditional higher education methods—it won't—but whether it can augment them meaningfully. When thoughtfully deployed, VR offers not just engagement, but depth: it makes abstract concepts tangible, allows safe experimentation, and encourages active learning. For institutions that are willing to invest strategically, not just financially, but in infrastructures, training, and inclusive design, VR can move from hype to breakthrough.

The challenges lie not in technology itself, but in the system's readiness to embrace it. As with any educational innovation, success depends not on novelty, but on thoughtful integration. The path forward is not to ask whether VR is the future of education, but to decide when and where it deserves to be part of the present.

## References

- BMJ Simulation & Technology Enhanced Learning. (2022). *Performance of VR-trained vs. traditionally trained surgical residents*. [https://futureofsurgery.rcseng.ac.uk/wp-content/uploads/2022/08/FOS\\_Test\\_Report\\_2022.pdf](https://futureofsurgery.rcseng.ac.uk/wp-content/uploads/2022/08/FOS_Test_Report_2022.pdf)
- EDUCAUSE. (2022). *Faculty Perspectives on Immersive Technologies*. <https://library.educause.edu/resources/2022/4/2022-educause-horizon-report-teaching-and-learning-edition>
- PwC. (2020). *The Effectiveness of VR Soft Skills Training*. <https://www.pwc.com/us/en/services/consulting/library/virtual-reality-study.html>
- Stanford Virtual Human Interaction Lab. (2021). *The Effects of Prolonged VR Use on Students*. <https://er.educause.edu/articles/2023/4/future-prospects-and-considerations-for-ar-and-vr-in-higher-education-academic-technology>
- XR Association & IDC. (2023). *State of XR in Higher Education*. <https://xra.org/xr-association-releases-mini-report-on-survey-of-xr-teaching-and-learning>

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## 4. Virtual Reality (VR) in Learning - Cognitive and Emotional Impact



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### Abstract

Virtual reality (VR) is an opportunity in today's higher education learning that risks ending up in a polarized approach where teachers are either for or against it. Instead, we need nuanced discussions about what VR can add to learning, cognitively and emotionally. In research, there are examples of how VR is used as a substitute for or as a complement to physical laboratories. The advantages of using a virtual laboratory are for example that certain rather costly and risky processes in physical laboratories can be handled safely and without wasting resources, something that promotes a sustainability perspective. In addition, research shows that the use of virtual environments sometimes simulates gaming experiences, which can both arouse positive emotions and increase motivation. Something that needs to be considered, however, is that the learning that takes place in the virtual and physical laboratories is different and that strong negative emotions can also arise.

### A Nuanced Picture

Discussions about the use of technology in education tend to be polarized so that it is either clearly opposed or advocated, often without the parties presenting, for example, pedagogical arguments. To get a nuanced approach in higher education, teachers need to be given the opportunity to try technology and learn more about, for example, VR to then be able to discuss when and how technology can be used to promote learning. One area described in research where there are pedagogical benefits is the use of VR as a replacement or at least a complement to the physical laboratory (Cronqvist et al., in process).

Through VR glasses, various processes can be carried out repeatedly as training without the need to use resources such as water and ink. Students can practice in a protected environment that does not expose them to dangers. With the educational advantage of being able to practice repeatedly and become confident in performing a process without wasting resources, there are also benefits for the economy and the environment.

Emotions and motivation

The use of VR has also been shown to create joy among students, which in turn motivates them to learn. The safe environment and similarities with different games contribute to making learning enjoyable. In

interviews with students, a desire was expressed to further develop applications in learning based on experiences from games. The similarities with the gaming experience can create excitement and engagement that drives the student's own desire to continue the pleasurable learning, at least for students who like to play and who may already be accustomed to games. However, there was also another experience expressed by students, namely that they felt abandoned in the virtual world and did not receive help and support.

Although they were in place with teachers, the glasses became an obstacle to communication because they were alone in the virtual laboratory. If the students were not particularly used to the gaming environment and using VR glasses, it may have become too challenging to both try to manage the controls and complete the instructions in the laboratory at the same time. The different experiences are interesting from a pedagogical perspective to discuss how technology can be used in varying contexts and work for different students based on their experiences.

### **Learning Objectives**

If technology is to function pedagogically to promote specific learning objectives, its use needs to be well-reasoned based on didactic choices. There are opportunities to let the virtual laboratory simulate the physical one as much as possible, which can be pedagogical if the learning aims to be able to handle processes in a physical laboratory. In that case, the conditions that exist in the physical laboratory in terms of, for example, equipment, materials and access to instructions need to be simulated. One suggestion from students was that access to the VR lab should be controlled by various protection and safety measures being carried out before the laboratory work begins. Another approach involves less focus on simulation and more on using digital possibilities with resources such as arrows, sound effects, and short continuous instructions that guide the students step by step.

To simulate games, different levels can be unlocked as certain goals are achieved. Suggestions like these will create a pedagogical learning environment that differs markedly from the physical laboratory. The conditions of the physical learning environment are different from those of the virtual environment, which also contributes to the difference in learning. For example, the physical environment offers learning using different senses such as touch, taste and smell, while the virtual environment provides the opportunity to overview a process and practice its different parts frequently.

### **Didactic Choices**

Different approaches to virtual and physical lab need to be moderated in relation to the concrete teaching situation, which places demands on applications that are flexible and combined with various forms of support in real life. Whether the virtual simulates the physical or develops with other pedagogical advantages and opportunities for partially different learning will be important for didactic choices about whether the laboratories can be used separately or in different combinations in practical teaching. Prerequisites for teachers to be able to make reasonable didactic choices are that they have solid knowledge of what the technology can contribute, that the technology is available and can be used flexibly, and that teachers offer various forms of support that students need but that the technology does not provide.

### **Conclusion**

In summary, virtual reality's opportunities for learning become a very complex issue that includes many considerations regarding sustainability and pedagogy. Further research is needed along with collegial

discussions to enable teachers to make nuanced and knowledge-based didactic decisions.

## References

Cronqvist, M., Curtis R., Iyer, S.N., Seipel S., Morshed M.N. and Nierstrasz, V. (submitted for publication 2025). Learning through virtual reality lab, trial and error with potential application in textile research and education.

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## 5. Collaborative and Social Learning in Virtual Environments



by **Associate Professor, Dr Pauline A M Bremner,**  
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### Abstract

#### Introduction

The Higher Education Institution (HEI) sector is changing, driven by digital advancements and social expectations. Educators must reflect on how, what and why they teach ensuring it is meaningful and relevant. Experiential learning (Kolb, 2014) has been heavily prioritized in UK HEI's, where integrating the 'real world' into the classroom is positive, enhancing students skills development and employability. However, as the workplace becomes more virtual, accelerated by the pandemic, there is a need to consider **collaborative** and **social learning**. Collaborative Online International Learning (COIL) attracts attention as an innovative pedagogy that empowers students to engage meaningfully in virtual, cross-cultural learning spaces, preparing them for the interconnected world of work (Swartz, *et al.*, 2020).

Having originated in the early 2000s at the State University New York (SUNY), COIL has evolved through international partnerships. It seeks to connect students from different universities through collaborative assignments, adding a cultural skill dimension to degrees. It has been intertwined with the term Virtual Exchange (VE), and at best the VE may only be the tip of the 'learning iceberg' whereas COIL is much more holistic. **Social learning** seems juxtaposed to the term virtual as the nature of any VE platform may distort the 'social', depending on perception. Despite COIL's benefits there can be barriers to its success, and some of those will be discussed in terms of **collaboration** and **social learning**.

#### Barriers to COIL

Despite the pandemic 'COIL boom' and the VE's panacea for learning, barriers for a successful COIL project exist. '*Stepping out of the classroom*', considers a move away from the 'norm' into the 'unknown' for

educators who may be more conditioned to their modular in person approaches to teaching. It is noted for educators, that COIL when used to enhance **collaboration** and **social learning** is a change in their teaching approach which may interfere with student satisfaction, topic relevance, public body regulations and assessment practices. Hence for some this barrier will outweigh the positives of delivering COIL.

The VE itself becomes a barrier, as some universities have extensive VE platforms with many Virtual Learning Environments (VLE's) such as Zoom, MS teams and their own internal platform. There is a lack of global synergy on VLE's and as COIL requires use of a VLE to assist in providing **collaboration** and **social learning**, the misalignment makes it harder for educators to navigate and make it a success. Access to other universities systems to share space with students is a problem as data protection and firewalls, slow the approval process down.

Time and language can impact on effective student engagement in COIL. Depending on university location time difference can become an issue for **collaboration**. Where day and night are juxtaposed often gives rise to students being less keen to add to their studies outside normal 'times', yet this replicates the global workplace. Language difference often means COIL projects are sought across English speaking universities, therefore missing important global social learning aspects. Often these types of barriers need more detailed ground rules for student engagement, to ensure there is a fair system of assessment if that is one of the end goals of a COIL project.

### **The Barriers to Social Learning and Collaboration in Virtual Environments**

Bandura's (1997) 'social learning theory' highlights people learn from others through observation and use imitation to develop their learning. The experience part is modelled through the development of new behaviours which on one hand is a good thing for COIL **collaborations**. However, the student's *cultural divide* may be too wide for them to feel comfortable partaking in a COIL project, as it takes them further outside their comfort zones. Cultural understanding is one of a graduates' skill requirements for global business **collaboration** (Hofstede, *et al.*, 2010) but taking a COIL innovative approach becomes complicated.

The concept of **social learning** is further challenged with the VE itself, as complexity arises where observation and imitation of behaviours is hard to 'see'. This is compounded when students don't put cameras on, use slang language terms in any written communication and use the opportunity to 'hide more' as in the VE it is easier to avoid participation. One could say it will be the keen, more dominant, students who will 'take over' the project, leaving the others to pick up the pieces. The same happens during in person classes, but the visual and written communication can be facilitated more easily.

**Collaboration** is a key skill for graduates for the workplace VE which is more interconnected. When using COIL for **collaboration** it is hard to develop ground rules which are fair, inclusive and consider the contribution of students. To ensure student understanding of **collaboration** aspects, teamwork practices, such as the use of Belbin team roles and project management practices need overlaid into the process for measuring contribution. This often results in the use of blanket student peer reviews which can be subjective to an extent, although representative of the 'real world'.

### **Conclusion**

It is clear that HEIs are trying to be as innovative as possible in the VE space recognizing the need to incorporate **social learning** and **collaboration** as two areas for graduate development. However, innovative pedagogy alone is not enough to encompass the development required. To be effective in the two contexts

noted it becomes a necessity for industry and the workplace to be much more integrated into the university space than it is at present. Getting access to real-world examples is key to developing these contexts if we wish graduates to be fit for purpose.

It has perhaps never been more important than to ensure the development of **social learning** is prioritized as the Pandemic itself has caused so much damage to **social learning**. Educators have a responsibility to ensure this socialization is clear in graduates minds both for in person and the VE spaces. Integrating the 'real-world' into the classroom has never been more relevant and key to societies future and the barriers to using innovative pedagogy must be broken.

## References

- Bandura, A. and Walters, R. H. (1977). *Social learning theory* (vol 1). Englewood Cliffs, NJ: Prentice Hall.
- Hofstede, G., Hofstede, G. J. and Minkov, M. (2010). Culture and Organizations: Software of the Mind, Intercultural Cooperation and its Importance for Survival. *International Studies of Management & Organization*, 10, 11656300.
- Kolb, D. A. (2014). 'Experiential Learning: Experience as the Source of Learning and Development', FT press.
- Swartz, S., Barbosa, B. and Crawford, I. (2020). 'Building Intercultural Competence through Virtual Team Collaboration across Global Classrooms', *Business and Professional Communication Quarterly*.

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## 6. The Future of Virtual Reality Technology in Education: Trends and Predictions



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## Introduction

Virtual Reality (VR) in education is being hailed as transformative and turning traditional forms of learning into interactive experiences. With educational institutions adopting VR, opportunities to keep students engaged, recall what they learn, and access learning are continually growing. In addition to providing a new way for users to experience learning, VR can serve as a bridge to connect theoretical knowledge and practical application, and complex knowledge can be learned in an active environment. The implications of such an instructional and student achievement pedagogy are profound and could mark the beginning of a new era of educational innovation.

The future of VR in education rides on the evolution of hardware, software pedagogy. Once academics and educators have thoroughly explored best practices around immersive learning, VR should be a feature in academia rather than an experiment. This article considers emerging and pending trends for VR in edtech and looks to how the future of personalized learning, hybrid models and equality of opportunity may well set the tone for its application in this millennium.

## Enhancing Immersive Learning and Engagement

Experiential learning is one of the biggest strengths of VR in education. Legacy teaching methods are largely passive, absorbing information; VR puts students right into the thick of it, rather than passively watching static environments. Areas such as medicine, engineering, and environmental sciences stand to gain significantly from simulations, which allow students to perform procedures, carry out experiments and see abstract concepts in a real-world setting.

VR has been proven to increase engagement and retention in learning (Liu et al, 2020). Students exposed to simulation that is interactive simulation learn more about complex content, and are more motivated. With the advancement of VR platforms, real-life simulation will create an opportunity for students to improve their skills before they can get hired in the field. This is where VR serves as an essential link between studies and readiness for a job.

## Personalized Learning through AI and VR Integration

The usage of artificial intelligence (AI) in virtual reality (VR) has brought an era of individualized learning. Adaptive learning algorithms also adjust the educational material according to the student's pace, competency, and weaknesses. AI-driven VR simulations, by learning from how users interact with virtual objects, can modify the difficulty of tasks, suggest close-coupled lessons, and even offer up immediate feedback, making any one-size-fits-all curriculum fit for each unique learning pathway.

Such personalization is especially valuable for varying learning styles. Some students excel in hands-on experiential learning, while others may need multiple exposures to a concept to internalize learning. AI-increased VR ensures that educational experiences are customized to maximize the learning for each individual learner. One of the benefits of educational simulations is the capability to tailor them to meet the specific learning objectives of the course and to promote self-directed learning.

## Hybrid Learning Models and the Future Classroom

As virtual reality technology evolves, more institutions are experimenting with hybrid models of education, combining classroom training with immersive learning. Virtual field trips, online simulations, and remote laboratories provide students the opportunity to connect with courseware without leaving the locations

where they study in a globe. The move to a blended approach is providing learners with the freedom to gain access to world-class instruction, without constraints of geography, potentially democratizing education at a global scale (Oyedele & Lember, 2021).

Accordingly, social virtual reality environments are appearing as strong candidates for social interaction and cooperative work. Once virtual cars and planes are racing in the same lane, students will be able to participate in discussions and teamwork in virtual worlds, which are not limited by geographical boundaries, as professional fields now often are not either. Hybrid models like these are likely to be a presence in mainstream classrooms as educators continue to fine-tune their strategies for teaching in a virtual world, connecting the dots between virtual and in-person learning.

### **Equity, Accessibility, and Future Considerations**

Although VR in education can be transformative, concerns about access and equity must be confronted (Apata & Oyenuga, 2025). High prices of hardware and software for VR can keep it out of reach for impoverished communities and schools. Both technology companies and policymakers need to seek to find affordable and scalable solutions which will allow all students to engage in immersive learning experiences rather than socio-economic ones.

Efforts at producing budget VR alternatives and increasing access to digital resources are on the rise, and programs designed to enmesh VR into public educational systems are in the works. It could also be the rise of cloud-based VR streaming that removes the hardware barrier, enabling students to engage in immersive learning with a standard computer and Internet connection.

### **Conclusion**

The course of VR in education is paved with innovation, personalization growing access. As immersive learning environments become more common in institutions, students will receive more individualized experiences, which will in turn increase engagement and understanding. Hybrid classroom models will transform classrooms from the quaint antiquity of the past to interconnected spaces that connect students to digital content and global peers.

While accessibility and cost challenges persist, ongoing technological advancement and thoughtful policy making will pave the way to a more equitable future where VR is used as a mainstream learning tool. Through adopting immersive education, universities have the power to equip the generation of tomorrow with immersive learning experiences that leave them increasingly well prepared for new demands, in an ever more digitally focused world.

### **References**

- Apata S.B. & Oyenuga, M. O. (2025). Revolutionizing Employability: The Intersection of Digital Literacy, Inclusive Education, and Gen Z's Skill Set in the 21st Century. In O. Ajani (Ed.), *Empowering Pre-Service Teachers to Enhance Inclusive Education Through Technology* (pp. 155-182). IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3693-8759-7.ch006>
- Liu, R., Wang, L., Jing, L., Wang, Q., & Ren, Y. (2020). Effects of an immersive virtual reality-based classroom on students' learning performance in science lessons. *British Journal of Educational Technology*, 51(6), 2034-2049. <https://doi.org/10.1111/bjet.13028>
- Oyedele, O. M., & Lember, A. A. (2021). COVID-19 and the Future of Higher Education. *IEEE Technology Policy and Ethics*, 6(4), 1–3. <https://doi.org/10.1109/ntpe.2021.9778140>

## 7. Immersive Futures: How Extended Reality Is Reimagining Education



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Extended Reality (XR) refers to the umbrella term used to classify Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). XR has proven a highly effective pedagogic tool used in higher education as well as K-12. This article discusses the transformative capability of XR to deliver immersive, inclusive, and meaningful education experiences.

Citing current studies, e.g., Hattie's influence ranking and pedagogy models, the article advances XR as one of the core technologies of Education 5.0 and advocates for its ethical and inclusive adoption into universities and schools (Hattie, 2023; Johnson-Glengerg, 2018).

Just as with all new technological revolutions, the way that humans think, communicate, and make sense of what they are perceiving all gets restructured. Technology innovation goes hand-in-hand with education, from the invention of writing to the printing press to computers to artificial intelligence (Luckin et al., 2016).

We are standing at the cusp of yet another paradigm shift—one that's immersive, embodied, multidimensional: the new reality of Extended Reality (XR). While not a new interface per se, XR itself designs a breakout pedagogy—one which redefines the very nature of knowing itself, and shifts the passive reception to active engagement, abstract thinking to lived experience (Radianti et al., 2020).

### **Passive to Immersive: A Shift in Teaching Practice**

Traditional lecture, print, and 2D graphic instruction have been the standard mode of formal instruction for a long time. Conventional media, however, are sometimes not the optimum way of responding to all the varied individualized needs of learners. Hattie's (2023) work on Visible Learning details strategies that involve visualization, feedback, and learning through experiences. These strategies show significant effect sizes when increasing students' achievement (Hattie, 2023).

XR extends these proven approaches by providing fully interactive lessons. Under XR's direction, students don't learn about the circulatory system from a book or lecture; they explore the circulatory system. History doesn't become a recall of the past—it becomes navigable. Geometry becomes kinesthetic. Chemistry becomes kinetic.

This immersive pedagogy supported situated cognition, a cognitive theory that assumes knowledge itself is contextual, experiential, and social. Using knowledge as it gets used outside the classroom—the context of real-world application—students recall concepts better and transfer them more effectively (Brown, Collins, & Duguid, 1989; Blessinger, 2023).

### **Closing Gaps, Opening Worlds**

Integrating XR is gaining traction all over the world. Students can investigate virtual coral reefs, learn about natural disasters, or interact with ecosystems from their own classrooms or homes (Radianti et al., 2020). Students dissect virtual frogs through XR, learn about molecules in 3D, or witness historical events unfold in engaging ways (Radianti et al., 2020). Above all, XR holds the power to behave as an equalizer.

Those students who don't have access to the use of laboratories, field study, or field trips to museums can now benefit from these rich, interactive worlds. XR supports Universal Design of Learning (UDL). It ensures that XR can empower the diversified requirements of an inclusive learning population, e.g., disabled students, language students, as well as students with varying neurological profiles (CAST, 2018).

As a case in point, autistic learners are taught XR simulation, which helps them practice their social interactions safely. ADHD learners are provided the material through multisensory modalities, which are effective at capturing their attention (Parsons & Cobb, 2011). For others, XR could be a lifeline.

### **The XR Ecosystem**

It can provide a transformative effect when used for higher education. Stanford University, the University of Glasgow, and the University of Arizona were some of the first institutions to use XR technology for medical, architectural, educational, and engineering uses (Educause Horizon Report, 2023).

Medical students practice with VR platforms such as Osso VR virtual surgeries that provide haptic feedback (Andreatta et al., 2020). Engineering students design, build, and validate things in real-time. Environmental science students overlay ecosystem data into the real world through XR. It enhances the way students learn.

XR facilitates interdisciplinarity. Through virtual laboratories, students of various fields can collaborate through interdisciplinary simulations, bridging the academic siloes and enabling more effective problem-solving approaches, a key characteristic of Education 5.0 (Blessinger & Anchan, 2023).

## Challenges

Even though XR holds promise, XR, too, carries risk. XR implementation raises the same questions about access, ethics, and equitable learning. Advanced XR systems are still out of the budget for the average school. Advanced XR, therefore, becomes a privileged technology. (Gonzalez-Zamar et al., 2020). School leaders and policy leaders need to place XR implementation as part of a comprehensive digital equity strategy.

XR systems are already capturing biometric data—gaze, voice, hand gesture, and emotional expression. That data, though adequate for adaptive learning, has serious privacy, consent, and information ownership issues. There needs to be ethical controls put into place for all XR systems (Madary & Metzinger, 2016).

Good learning, as noted in *Making Sense of Pedagogy* (Blessinger, 2023), isn't about the novelty of the tool, but the excellence of the instruction. XR needs to become embedded in good pedagogical designs. It needs to be consistent with the intended learning outcomes, the application of feedback, and authentic assessments.

## Preparing Educators for the XR Era

Transformative XR potential will not materialize until teachers themselves are empowered. Teachers need to become learners as well as designers of immersion learning. Professional teacher courses, apart from purely technical training, e.g., instruction design, storytelling, and cross-curriculum planning, are essential (Lamb et al., 2018).

Instructional programs must build XR literacy. Teachers must become comfortable seeing technology as an amplifier, and not a substitute for human connection. Where XR will have the biggest impact is when used as a complement to high-impact instructional approaches such as feedback, metacognition, and cooperative learning. These are established strategies that continue to show high effect sizes (Hattie, 2023).

More seriously, XR must add to, not take away, the human aspects of learning. The success of the technology depends upon values and vision, which prescribe how it must be used.

## A New Learning Imagination

XR pushes us to escape industrial models of education. XR invites us to co-create new worlds wherein learners are actively engaged with knowledge, are free to fail, the practice of empathy becomes a scholarly mode, and imagination becomes a practice of scholarship. In such new immersive worlds, learners are not merely watching the world as spectators; they are actively engaged in the world and reshaping it for a better future.

## References

- Andreatta, P. B., Maslowski, E., Petty, S., Shim, W., Marsh, M., & Hall, T. (2020). Virtual reality simulation to improve surgical performance: A meta-analysis. *Surgical Endoscopy*, 34(12), 5414–5424.
- Blessinger, P. (2023). *Making Sense of Pedagogy*. LinkedIn. <https://www.linkedin.com/pulse/making->

sense-pedagogy-patrick-blessinger-ed-d-

- Blessinger, P., & Anchan, J. P. (2023). *Democratizing Higher Education: International Comparative Perspectives*. Routledge.
- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32–42. <https://doi.org/10.3102/0013189X018001032>
- CAST. (2018). *Universal Design for Learning Guidelines version 2.2*. Center for Applied Special Technology (CAST). <http://udlguidelines.cast.org/>
- Educause. (2023). *Horizon Report: Teaching and Learning Edition*. EDUCAUSE.
- Gonzalez-Zamar, M. D., Abad-Segura, E., López-Meneses, E., & Gómez-Galán, J. (2020). Managing ICT for Sustainable Education: Research Analysis in the Context of Higher Education. *Sustainability*, 12(19), 8254. <https://doi.org/10.3390/su12198254>
- Hattie, J. (2023). *Visible Learning: The Sequel*. Routledge.
- Johnson-Glenberg, M. C. (2018). Immersive VR and Education: Embodied Design Principles That Include Gesture and Hand Controls. *Frontiers in Robotics and AI*, 5, 81. <https://doi.org/10.3389/frobt.2018.00081>
- Lamb, R., Annetta, L., Firestone, J., & Etopio, E. (2018). A meta-analysis with examination of moderators of student cognition, affect, and learning outcomes while using serious educational games, serious games, and simulations. *Computers in Human Behavior*, 80, 158–167. <https://doi.org/10.1016/j.chb.2017.10.040>
- Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence Unleashed: An Argument for AI in Education*. Pearson Education.
- Madary, M., & Metzinger, T. K. (2016). Real virtuality: A code of ethical conduct. Recommendations for good scientific practice and the consumers of VR technology. *Frontiers in Robotics and AI*, 3, 3. <https://doi.org/10.3389/frobt.2016.00003>
- Parsons, S., & Cobb, S. (2011). State-of-the-art of virtual reality technologies for children on the autism spectrum. *European Journal of Special Needs Education*, 26(3), 355–366. <https://doi.org/10.1080/08856257.2011.593831>
- Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education*, 147, 103778. <https://doi.org/10.1016/j.compedu.2019.103778>

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## 8. Questioning Learner Performance in Immersive VR



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## Introduction

Immersive VR is here to stay! Its universal appeal to Gen Z has cemented its dominating position as the solution to all learning issues. With its diverse wide-reaching impact on learner outcomes, motivation, learner engagement, social presence, and meaningful learning, immersive VR has emerged as the modern mantra of higher and K-12 education! It does not seem to have any pitfalls as such. Its significant impact on learner performance cannot, and should not be questioned (Ki et al., 2024). But is this golden solution leading to positive learner performance?

Immersive VR is like an iceberg where  $\frac{1}{4}$  of its total mass is visible and the remaining  $\frac{3}{4}$  mass is invisible but forceful and impactful. As such only the visible part is studied, and analyzed. The invisible part which shapes and drives the structure and function of immersive VR is often overlooked. To date, despite its overwhelmingly positive reviews, education institutions have been slow to adopt immersive VR as the mainstay of education policy, technology, and function. It remains an optional and not mandatory feature of our education systems. Why? In this paper, I adopt a scholarly-practitioner perspective and critique immersive VR's impact on learner performance.

### The visible mass: Immersive VR and learning performance

Indeed, it is no surprise that immersive VR's impact on learner performance has been widely studied and analyzed. Research on immersive VR's impact on learning and learning performance spans a continuum. On one end of the continuum are research and theoretical studies that demonstrate the significant and positive effect of immersive VR on learner performance. Study findings, explained through the lens of the cognitive load theory (CLT) show that learners experience less cognitive load leading to positive learning when intervening, moderator variables of engagement, involvement, social presence, and instructional content levels are high (Huang et al., 2020).

In their experimental study on 360 VR video-based lectures (2024), Ki et al stated that learners experienced less or minimal conflict between mental load and effort leading to positive deep learning and learning outcomes. Learners found it easier to focus on relevant knowledge and skills when instructor's image and content were embedded within the video. Learner collaboration increased social presence negating mental load and led to positive learner outcomes. In their study findings, Peterson and colleagues (2023) reported a significant increase in learning when learners were exposed to collaborative reflective activities which used generative AI (artificial intelligence) prompts.

But, at the same there is research which shows that immersive VR has minimal and insignificant impact on learner performance. These studies claim that high levels of involvement, engagement, and social presence as shown by head-mounted displays and virtual classrooms generate high levels of cognitive load leading to poor learner outcomes. In fact, EEG scores showed a high level of involvement but low level of learner performance (Makransky et al., 2019). In their meta analytic study, Yang and team said that a high level of involvement and social presence exposed learners to multiple visual stimuli contributing to higher mental load and providing less opportunity to focus and learn new material. Thus, the visible portion of the immersive VR iceberg is a conflicting mass which points piques an analytical discussion.

### The invisible mass: Design of immersive VR

The invisible mass constitutes the design of immersive VR which shapes and drives how it impacts learning. Immersive VR design is not a novel and complicated process. It simply requires re-visiting and re-focusing on processes and principles that exist already in education systems. Immersive VR design behooves scrutiny

and adoption of instructional design (ID) approaches and principles. The foundation approach of ADDIE (Analysis, Design, Development, Implementation, Evaluation) is key to immersive VR design. First is the analysis phase which comprises the intervening moderator variable of learner characteristics which is identified as the ID principle of learner needs analysis (LNA).

Doing an extensive LNA informs learner characteristics which enable a designer and subject-matter expert (SME) outline and write relevant instructional content, and engaging immersive learner activities. A comprehensive LNA allows focal decision-making regarding degree and frequency of learner collaborative activities using multi-media or AI technology. Design and development, thus, create learner social presence and learner confidence and satisfaction. And the implementation and evaluation phases speak to constant improvement of the instruction design enhancing its relevance thereby increasing learning and satisfaction.

Another ID approach to consider would be the community of inquiry framework (COI) which speaks to the importance of social, teaching or instructional, and cognitive presence for achievement of deep learning and positive learner outcomes. The presence of social, collaborative, instructional as well as interface variables comprise the elements of social and instructional presence which lead to effective cognitive presence or deep learning. Thus, rigid adherence and alignment with ID principles and approaches will move the invisible mass of immersive VR to visibility. Recognition of ID approaches and elements as essential to VR design also points to a significant shift in the instructional design profession as core staff driving, designing, and disseminating positive learner performance.

## References

- Huang, C. L., Luo, Y. F., Yang, S. C., Lu, C. M., & Chen, A. S. (2020). Influence of students' learning style, sense of presence, and cognitive load on learning outcomes in an immersive virtual reality learning environment. *Journal of Educational Computing Research*, *58*(3), 596-615.
- Ki, S., Park, S., Ryu, J., Kim, J., & Kim, I. (2024). Alone but not isolated: social presence and cognitive load in learning with 360 virtual reality videos. *Frontiers in Psychology*, *15*, 1305477.
- Juliano, J. M., Schweighofer, N., & Liew, S. L. (2022). Increased cognitive load in immersive virtual reality during visuomotor adaptation is associated with decreased long-term retention and context transfer. *Journal of NeuroEngineering and Rehabilitation*, *19*(1), 106.
- Makransky, G., Terkildsen, T. S., & Mayer, R. E. (2019). Adding immersive virtual reality to a science lab simulation causes more presence but less learning. *Learning and instruction*, *60*, 225-236.
- Petersen, G. B., Stenberdt, V., Mayer, R. E., & Makransky, G. (2023). Collaborative generative learning activities in immersive virtual reality increase learning. *Computers & Education*, *207*, 104931.
- Yang, C., Zhang, J., Hu, Y., Yang, X., Chen, M., Shan, M., & Li, L. (2024). The impact of virtual reality on practical skills for students in science and engineering education: A meta-analysis. *International Journal of STEM Education*, *11*(1), 28.

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## 9. The Virtual Classroom of Tomorrow: Virtual Reality Trends and Predictions



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### Abstract

Virtual reality (VR) has emerged as a promising technological innovation with the potential to transform educational practices along with other cutting-edge technologies. Recent advancements in VR hardware and software, combined with growing interest among educators and students, indicate that VR could significantly enhance learning through immersive, interactive experiences (Koolivand et al., 2024, Bala and Gupta, 2024). This paper examines emerging trends and future predictions regarding the integration of VR technology in education. It specifically explores implementations of VR in classroom settings.

Analyzing qualitative data from online educational and VR-related forums, including discussions on platforms such as Reddit, the paper identifies some themes related to personalized learning, increased engagement, and global collaborative opportunities in virtual learning environments. These findings suggest that VR has the potential to revolutionize traditional educational models by offering customizable learning experiences that transcend physical classrooms. However, this depends on professional development that will equip educators with necessary skills and knowledge to support both synchronous and asynchronous learning.

## Introduction

Virtual reality (VR) is rapidly moving from novelty towards a mainstream educational tool. Recent Reddit discussions (n = 4 885 posts/comments, spanning a period of over 10 years from 2014 to 2025) reveal that practitioners, students, and VR enthusiasts alike are engaging with its potential to transform learning. In particular, analyses show conversations frequently centred on student engagement ( $\approx 2\%$ ), educator readiness ( $\approx 1.6\%$ ), global collaboration ( $\approx 0.5\%$ ), personalized learning ( $\approx 0.5\%$ ) and technical or cost-related challenges ( $\approx 9\%$ ). These insights reflect both enthusiasm for VR's immersive benefits and anxiety over its practical adoption. This article synthesizes those online perspectives to identify key trends, potential future directions, and the professional development needed to support meaningful implementation.

## VR for Enhanced Student Engagement

Discussions consistently emphasize that VR's most immediate benefit is heightened student engagement. Nearly 104 mentions spoke of how immersive, interactive environments replace flat-screen passivity with embodied learning. For instance, navigating an anatomy simulation where students can literally walk through a beating heart, making cardiac physiology impossible to forget is a good example. VR's "gamified modules" that turn algebra into a puzzle world, boosting motivation and attentiveness are yet another example. While traditional screen fatigue can be an issue, many learners find that wearing VR headsets and interacting directly with virtual objects offers a different, often less fatiguing, visual experience.

However, while engagement is widely lauded, contributors caution that novelty alone will not sustain attention over the long term. Several individuals reported that after initial excitement, students revert to passive behaviours unless lessons are carefully designed with scaffolding and clear learning objectives. In other words, VR's interactivity must be guided by sound pedagogical frameworks. VR can be amazing for 3D geometry as kids will remember concepts better but still need to guide them through reflection and debriefing afterwards.

## Personalized Learning with Adaptive VR

A smaller subset of posts ( $\approx 22$  instances) flagged VR's potential for personalized instruction. Here, the focus shifts from one-size-fits-all delivery to adaptive, student-centred experiences. For example, AI-driven VR platforms that adjust difficulty in real time based on learner performance may lead to a positive result. Taking for instance, a student that struggles with molecular bonding in chemistry, VR can offer extra 3D visual hints with zooming capabilities until mastery is achieved. This capacity for on-the-fly differentiation contrasts sharply with traditional classroom constraints, where teachers often juggle multiple proficiency levels simultaneously.

Most VR systems are able to log user metrics, time spent on tasks, error rates, progression speed, and then tailor subsequent challenges accordingly. For instance, medical students can view a virtual cadaver dissection; replay sections where a student had difficulties identifying anatomical landmarks. Those "rewind" features is similar to or replicate the self-paced tutoring once possible only through expensive, private coaching. Evidently, VR can support truly individualized pathways, provided that institutions invest in platforms designed with those adaptive algorithms (Zhu and Su, 2025).

## Global Collaborative Opportunities

A noteworthy theme, though less frequent ( $\approx 25$  mentions), centres on VR's ability to transcend physical

and geographic boundaries. Redditors described how learners from different countries can inhabit a shared virtual classroom, collaborate on group tasks, and present findings in real time. For instance, a joint physics experiment between students in the UK and other countries where learners can collectively build a molecule in VR, each member holding a piece of the structure and simultaneously observing how different bond angles affect stability could be impactful. Such cross-border partnerships are only impossible with exorbitant travel or complex scheduling without VR.

Collaborative VR experiences can also foster cultural exchange. If VR is deployed in a classroom, pupils can interview classmates in another country via VR avatars, exploring social studies topics through authentic, first-person interaction. Seeing a classmate's home city in VR can create empathy in a way video calls never will. While bandwidth and time-zone coordination remain hurdles, it is possible that VR's social presence encourages a sense of global citizenship and deepens intercultural understanding, objectives long sought by international education programmes (Dunmoye et al., 2024).

### **Professional Development - Equipping Educators for VR**

Central to any successful VR initiative is educator readiness based on the literature (Zhu and Su, 2025). About 80 posts referenced "teacher training," "professional development," or "instructor support." Many individuals lamented the steep learning curve, noting that buying headsets is the easy part; knowing how to integrate them pedagogically is the real challenge. A common recommendation: institutions must provide sustained, hands-on training rather than one-off workshops.

Several VR-savvy instructors recommended peer-mentoring models, where experienced teachers demonstrate lesson planning, classroom management in VR, and troubleshooting common technical glitches. For instance, a VR lesson with a mentor that shows how to navigate the virtual environment could free the mentee to focus on student interactions rather than learning the menu at the same time. Such apprenticeship approaches ensure that novice educators learn in context. Additional suggestions included sandbox environments for teachers to experiment, detailed how-to guides, and ongoing online communities of practice, especially on Reddit, where educators both share successes and request advice.

### **Technical and Cost-Related Challenges**

Despite optimism, no discussion is complete without addressing VR's technical and cost barriers (Zhu and Su, 2025). Challenges surfaced in nearly 446 posts, over 9%, far outnumbering any single positive theme. High-end headsets remain costly (often £250–£500 per unit), plus the expense of compatible computers or software licences. For instance, K-12 schools with tight budgets, buying 20 headsets may mean sacrificing other key resources like updated textbooks or STEM lab equipment. Cheaper headsets such as Oculus Go are no longer being supported by Meta's latest app, Meta Horizon, as noted by redditors who are frustrated with such a move by Meta.

Moreover, technical issues, bandwidth constraints, headset maintenance, insufficient IT support, frequently stymie pilot programmes. Compounding cost and IT hurdles are health concerns. Reports of eye strain, motion sickness, and ergonomic issues are known and need to be addressed. Though newer headsets reduce weight and motion lag, those improvements come at an even higher price point. Finally, equity and access issues arise. Some students lack stable home internet to download large VR modules; others with disabilities require adapted controllers or alternative input methods. Collectively, these factors serve as significant deterrents to widespread adoption. Most redditors agreed that, until governments budget for infrastructure changes, robust Wi-Fi, mobile device carts, accessible VR designs, VR stays a promising concept, not a daily reality.

## Future Predictions and Policy Implications

Looking ahead, Redditors speculated on VR's trajectory over the next five to ten years. Many anticipate that as hardware prices decline and headset resolutions improve, VR will become a routine component of blended and remote learning. With the rapid development and widespread adoption of technology, even small rural schools will have lightweight, all-in-one headsets that stream content via cloud VR, making local hardware less critical in the nearest future. Others predicted deeper integration with AI. Envision VR tutors that converse naturally with students, offering personalized scaffolding on-demand.

At the policy level, if ministries of education recognize VR's potential, we might see funding mandates for digital infrastructure, inclusion of VR literacy in teacher standards, and public-private partnerships to develop low-cost VR curricula. It is important for ministries to pilot VR in STEM, evaluate learning outcomes rigorously, then scale where evidence shows student gains rather than simply purchasing technology en masse with no clear strategy. In summary, community voices call for a strategic approach that align VR adoption with clear objectives, monitor outcomes, and iterate which also agrees with the literature on VR and education (Zhu and Su, 2025).

## Conclusion

Reddit-sourced insights confirm that VR in education is no longer theoretical as practitioners are already piloting immersive lessons, tackling both the promise and pitfalls head-on. While engagement and global collaboration appear as strong motivators, the most persistent obstacle remains cost and technical readiness. Crucially, teacher professional development emerges as a linchpin; without it, VR's immersive affordances cannot translate into improved learning outcomes.

For VR to fulfil its transformative potential, institutions must (1) invest in sustainable infrastructure, (2) prioritize rigorous, scaffolded training for educators, and (3) develop clear policies that balance innovation with equity. As hardware evolves, becoming lighter, more affordable, and seamlessly integrated with AI, VR can shift from "novelty" to "norm." The virtual classroom of tomorrow, if thoughtfully implemented, promises not only to engage students more deeply but to democratize access to experiential learning across global contexts.

## Reference

- Bala, R. & Gupta, P. (2024). Virtual Reality in Education: Benefits, Applications and Challenges. *Transforming Education with Virtual Reality*, 165-180.
- Dunmoye, I. D., Rukangu, A., May, D. & Das, R. P. (2024). An exploratory study of social presence and cognitive engagement association in a collaborative virtual reality learning environment. *Computers & Education: X Reality*, 4, 100054.
- Koolivand, H., Shooreshi, M. M., Safari-Faramani, R., Borji, M., Mansoor, M. S., Moradpoor, H., Bahrami, M. & Azizi, S. M. (2024). Comparison of the effectiveness of virtual reality-based education and conventional teaching methods in dental education: a systematic review. *BMC Medical Education*, 24, 8.
- Zhu, Y. & Su, Y.-S. (2025). Virtual reality trends and challenges in teacher education: a systematic literature review. *Interactive Learning Environments*, 1-22.

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## 10. The New Frontier of Learning



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Technological progress is a defining attribute of modern civilization. We've witnessed computers evolve from massive, slow machines with limited capabilities to compact devices with immense processing power. Smartphones now outperform early supercomputers and are ubiquitous in our daily lives. As we stand on the edge of a new digital frontier, enhanced computational power enables breakthroughs in simulating the human brain through neural networks, deep learning, and artificial intelligence (AI). These advancements are paving the way for new forms of knowledge, more responsive and tailored than ever before.

At the center of these changes is AI, technology designed to emulate human cognitive functions. As machines become trainable and capable of interpreting real-world contexts, we are moving beyond traditional computing. AI, once confined to science fiction, is now an integral part of daily life and holds tremendous promise for education. The ability to understand and respond to student needs on an individual level has the potential to revolutionize the classroom.

### **AI and Its Educational Potential**

AI has experienced rapid growth and continues to transform many sectors, including education. Already, it powers applications like voice assistants, recommendation engines, and autonomous systems. Its foundational strength lies in machine learning algorithms that identify patterns in data and use them to make predictions or decisions. In an educational context, this means that AI can analyze student performance data to personalize instruction.

With AI, the traditional "one-size-fits-all" model of education can be replaced by adaptive learning systems. These platforms use AI to assess students' strengths, weaknesses, and learning preferences. Content can be tailored in real time, offering targeted exercises, challenges, and feedback. This personalization allows students to progress at their own pace, deepening understanding while minimizing frustration or boredom. Such systems also support teachers by highlighting areas where students struggle and recommending interventions.

### **Virtual Reality in the Classroom**

Another powerful tool entering the educational sphere is Virtual Reality (VR). Unlike traditional media, VR creates immersive environments that allow learners to engage directly with content. Students can explore historical sites, conduct science experiments, or practice foreign languages in simulated settings. This level of interactivity encourages experiential learning, students retain information more effectively by doing, not just observing.

VR also provides a safe and controlled space for skills training. Medical students can practice procedures without risk, pilots can fly virtual aircraft, and engineers can test prototypes before physical creation. This practical experience helps bridge the gap between theory and application, a challenge in many academic disciplines. Furthermore, the gamified elements of VR, such as challenges and progress tracking—can boost motivation and engagement.

### **The Synergy of AI and VR**

When AI and VR are integrated, their combined impact on education becomes even more powerful. AI can personalize the VR learning experience by adapting scenarios in real time to match a student's pace or performance. For example, in a language VR simulation, an AI tutor could adjust the complexity of conversation based on how well a student is speaking. In a biology lab simulation, the AI might introduce new challenges only once the foundational concepts are mastered.

This synergy supports an adaptive learning ecosystem where content is both engaging and instructional. These intelligent, immersive environments allow students to learn in ways that align with their natural curiosity and preferred styles. The feedback loop created by AI monitoring and adjusting VR scenarios helps students build confidence and skills incrementally, without fear of judgment or failure.

### **Equity and Access through Technology**

Perhaps one of the most important contributions of AI and VR in education is the potential to address learning disparities. Students come from diverse backgrounds, with varying access to resources and support systems. Adaptive technologies can help bridge these gaps. For instance, AI tutors are available 24/7 and can serve students in under-resourced areas or during off-hours. VR environments can simulate access to tools and experiences that might otherwise be unavailable.

While internet access and device availability remain challenges in some communities, the cost of these technologies continues to decrease. Many platforms are being optimized for low-bandwidth environments, and educational institutions are starting to invest in scalable solutions. In the long term, adaptive technologies can offer consistent, high-quality education regardless of geography, socioeconomic status, or individual learning needs.

### **Moving Forward Responsibly**

The integration of AI and VR in education represents a new era of learning—one that is personalized, immersive, and equitable. These tools offer more than novelty; they bring measurable benefits to student engagement, understanding, and performance. However, responsible implementation is crucial. Educators must be trained to use these systems effectively, and issues such as data privacy, bias, and ethical use must be taken seriously. Transparency and collaboration will be key in ensuring these technologies are used for good.

As we look to the future, AI and VR will not replace teachers but will empower them. They will provide new ways to reach students, tailor instruction, and bring abstract concepts to life. If embraced thoughtfully and inclusively, these technologies will help education evolve into something far more dynamic and effective than we've ever known. The classroom of the future is not just digital, it is intelligent, interactive, and designed to help every student succeed.

## The Future of Intelligent Education

The classroom of the future is not digital, it is intelligent and interactive, AI and VR provide teachers with powerful tools to deliver personalized and engaged instructions. These technologies enhance rather than replace traditional methods, creating a richer more flexible learning environment. As these innovations continue to mature, they will play a pivotal role in shaping education systems worldwide.

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### 11. Extended Reality for Inclusivity in Higher Education



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#### Introduction

Extended Reality (XR) has advanced in terms of its accessibility and quality over the past decade. Augmented reality, virtual reality and mixed reality technologies fall under the umbrella term extended reality (XR) (Salvetti et al., 2024). Augmented reality (AR) is a technology that uses software or hardware like AR glasses to superimpose a computer-generated image on a user's view for interactivity. Virtual Reality (VR) is a technology that creates simulated three-dimensional environments which allows users to be immersed in the environment through specialized devices like headsets. Mixed Reality (MR) is a technology that blends real-world environments with digitally generated objects, allowing users to interact with both physical and virtual elements simultaneously, such as using a virtual tool to work on a physical object in the class.

XR has the potential for addressing the diverse needs of students in higher education. The implementation of XR for inclusivity and accessibility in higher education can be explored through the Universal Design for Learning Framework (UDL). UDL is defined as a "scientifically valid framework for guiding educational practices that provide flexibility in ways information is presented, in ways students respond or demonstrate knowledge and skills and in ways students are engaged" (US Higher Education Opportunity Act, 2008, p.110). The Act stipulates that the UDL framework 'reduces barriers in instruction, provides suitable accommodations, support and maintains high expectations for all students, including students with disabilities and students who have limited English proficiency' (HEOA, 2008, p.110).

Emerging technologies can be implemented using a research-informed strategy by connecting these tools such as VR to the framework of UDL (CAST, 2011). XR has the potential to support the implementation of UDL in higher education. Research on XR has discovered its usefulness for cognitive skills development by enhancing the ability to remember and understand visuospatial information. Furthermore, studies have

found that XR is useful for affective skills acquisition pertaining to controlling emotional responses to challenges (Gutiérrez-Maldonado et al., 2015; Jensen and Konradsen, 2018). For example, VR offers an immersive experience through simulations of psychopathological explorations to develop the ability of students who wish to work in the clinical field to perform diagnostic interviews in eating disorders (Gutiérrez-Maldonado et al. 2015).

However, XR has also proved to be counterproductive due to the immersive experience distracting from the learning task and the challenges that come with technological difficulties (Jensen and Konradsen, 2018). XR has been used for inclusion in education and training thus far, especially with students with diverse needs, by creating immersive learning experiences which foster collaboration among students (Salvetti et al., 2024). This article will explore how XR can be applied in multiple modes of engagement, representation and expression to promote inclusivity of diverse students in higher education, particularly those with autism, physical and developmental disabilities.

### **Multiple means of representation**

XR supports the application of UDL for diverse learners by providing options for perception through physics, text, audio and image (Salvetti et al., 2024). For instance, text and audio are used to provide information in a game called 'Street Simulator', so that the option of listening is available when individuals have difficulties with reading text (Aguir et al., 2023). XR supports implementation of UDL in higher education by offering ways of customizing the display of information which optimizes the recognition networks or the 'what' of learning (McMohan and Walker, 2019). XR creates inclusive educational environments by enhancing the sensory multimodality and agency for students with autism (Videla et al, 2025). However, immersive contexts and presentation of digital content may present challenges by causing sensory dysregulation for students with autism (Videla et al, 2024).

### **Multiple means of action and expression**

Tangible interface of XR enables multiple forms of action and expression (Salvetti et al., 2024). According to the guidelines from CAST, implementation of XR in higher education can optimize the 'how' of learning by providing options for physical actions which involve varying the methods for response (McMahon and Walker, 2019). Digital tools such as virtual reality can be environmental scaffolds that support learning through problem-solving in situated activities (Coninx and Stephan, 2021).

Moon et al. (2024) conducted a study which found that there were statistically significant differences in solution effectiveness, task performance and incorporation of feedback among with individuals with autism participating in virtual reality-based training than those who did not. The students took the role of engineers used VR tools for hands-on engagement in designing a 3D drawbridge within a simulated island ecosystem based on a situated problem involving the need to transport food to an island. XR provides interest-driven immersive experiences which are more responsive to the individual needs of individuals with autism (Videla et al, 2024).

### **Multiple means of engagement**

The engagement of students with physical impairments in the learning process can increase because XR provides options for alternative input methods such as eye-tracking and voice commands (Page et al., 2021). For example, in the game 'Street Simulator', various missions, rewards and challenges encourage multiple means of engagement through gamification (Aguiar et al., 2023). Inclusion and participation can be fostered through VR platforms which can facilitate the engagement of students with physical and

developmental disabilities in physical activities (Chalkiadakis et al., 2024). The effectiveness of XR increases when their use is complemented with the assistance of a human practitioner, difficulties arise when the applications are used without guidance (Chalkiadakis et al., 2024).

XR provides options for recruiting interest through the optimization of autonomy, choice and increasing relevance for diverse students, thereby providing multiple means of engagement to stimulate the 'why' of learning – the affective networks (McMahon and Walker, 2019). For example, an educator can use Google Earth in virtual reality to gather interest by having pupils "walk the streets" of a particular country they are studying in the classroom (McMahon and Walker, 2019). XR provides immersive experiences with multisensory tools for the engagement of students with diverse needs. XR can enhance comprehension by enabling the accessibility of abstract concepts because of the capacity of XR to provide students with hands-on experiences in simulated real-world scenarios (Chalkiadakis et al., 2024). However, XR is costly which can be a deterrent factor in acquiring these multisensory applications (McMahon et al, 2020).

## Conclusion

The utilization of XR technologies serves as a means for more interactive and experiential learning. The potential of these technologies is in their capacity to provide personalization of learning experiences and adaptation to the diverse needs of students, which aligns with the framework of UDL. The engagement of students through immersive learning environments with multisensory tools enables educators to tailor their teaching methods to the needs and preferences of diverse students. These adaptive learning platforms, which adjust content based on student performance provide opportunities for real-time feedback. XR is costly, requires human assistance and its use must consider the diverse students' challenges. Nevertheless, XR technologies provide an avenue to implement a variety of means of representation, expression and engagement for learning and inclusion in higher education, particularly for students with diverse backgrounds.

## References

- CAST. (2011). Universal Design for Learning Guidelines Version 2.0. Wakefield, MA: CAST.
- Chalkiadakis, A., Seremetaki, A., Kanellou, A., Kallishi, M., Morfopoulou, A., Moraitaki, M., & Mastrokourou, S. (2024). Impact of Artificial Intelligence and Virtual Reality on Educational Inclusion: A Systematic Review of Technologies Supporting Students with Disabilities. *Education Sciences*, 14(11), 1223. <https://doi.org/10.3390/educsci14111223>
- Coninx, S., and Stephan, A. (2021). A Taxonomy of Environmentally Scaffolded Affectivity. *Danish Yearbook of Philosophy*, 54, 38–64. doi: 10.1163/24689300-bja10019
- Gutiérrez-Maldonado, J., Ferrer-García, M., Plasajuanelo, J., Andrés-Pueyo, A., & Talarn-Caparrós, A. (2015). Virtual Reality to Train Diagnostic Skills in Eating Disorders. Comparison of Two Low Cost Systems. *Studies in Health Technology and Informatics*, 219, 75–81.
- Higher Education Opportunity Act. (2008). Public Law 110-315 U.S.C.
- Jensen, L., & Konradsen, F. (2018). A Review of the Use of Virtual Reality Head-Mounted Displays in Education and Training. *Education and Information Technologies*, 23(4), 1515–1529. <https://doi.org/10.1007/s10639-017-9676-0>
- McMahon, D. D., & Walker, Z. (2019). Leveraging Emerging Technology to Design an Inclusive Future with Universal Design for Learning. *CEPS Journal*, 9(3), 75–93. <https://doi.org/10.26529/cepsj.639>
- Moon, J., Ke, F., Sokolikj, Z., and Chakraborty, S. (2024). Applying Multimodal Data Fusion to Track Autistic Adolescents' Representational Flexibility Development During Virtual Reality-Based Training. *Computers and Education- X Reality*, 4, 100063. <https://doi.org/10.1016/j.cexr.2024.100063>
- Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff,

- J.M., Akl, E.A. and Brennan, S.E.(2021). *The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews*. *BMJ*, 372, n71.<https://doi.org/10.1136/bmj.n71>
- Ramos Aguiar, L. R., Álvarez Rodríguez, F. J., Madero Aguiar, J. R., Navarro Plascencia, V., Peña Mendoza, L. M., Quintero Valdez, J. R., Vázquez Pech, J. R., Mendieta Leon, A., & Lazcano Ortiz, L. E. (2023). Implementing Gamification for Blind and Autistic People with Tangible Interfaces, Extended Reality, and Universal Design for Learning: Two Case Studies. *Applied Sciences*, 13(5), 3159. <https://doi.org/10.3390/app13053159>
- Salvetti, F., Gardner, R., Rudolph, J., Minehart, R., Bertagni, B., & Contardo, I. (2024). Fostering Diversity and Inclusion in Medicine: Collaborating with Extended Reality and Medical Simulation in the Metaverse. *International Journal of Advanced Corporate Learning*, 17(3), 68–77. <https://doi.org/10.3991/ijac.v17i3.45435>
- Videla, R., Aros, M. B., Parada, F., Kausel, L., Sandoval-Obando, E., Jorquera, D., Ibacache, D., Maluenda, S., Rodríguez-Herrero, P., Cerpa, C., González, M. J., Chávez, M., & Ramírez, P. (2025). Neurodiversity: post-cognitivist foundations of the 3E approach for educational inclusion of autistic students with technology. *Frontiers in Human Neuroscience*, 18, 1493863. <https://doi.org/10.3389/fnhum.2024.1493863>

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## 12. Expanding Community Access Through Self-Created Extended Reality Environments



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## Introduction

The transition from formal educational settings to independent community living constitutes a critical developmental milestone for individuals with intellectual and developmental disabilities (IDD), presenting complex challenges that extend beyond academic preparation. Despite federal mandates requiring comprehensive transition planning through individualized educational programs (IEPs), significant structural barriers persist in preventing the successful realization of community integration goals. Transportation accessibility emerges as a particularly salient obstacle as limitations in public transit navigation skills create cascading effects on personal autonomy and community participation. This transportation barrier systematically excludes individuals with IDD from essential life experiences, including independent social engagement and competitive employment opportunities, thereby perpetuating social isolation and economic marginalization. The inability to access reliable, independent transportation thus represents a fundamental constraint on the exercise of self-determination and full community integration for this population.

Extended Reality (XR)—encompassing virtual reality (VR), augmented reality (AR), and mixed reality (MR)—offers a framework for addressing accessibility barriers in skills development for individuals with disabilities. By simulating authentic transportation environments within immersive digital contexts, XR provides a secure setting in which users can acquire and practice navigation competencies. This method mitigates the logistical challenges and safety concerns inherent in conventional, community-based training approaches. Furthermore, XR facilitates opportunities for individuals with disabilities to record and disseminate their personal experiences, thereby promoting agency and self-advocacy throughout the educational process.

## **The Challenge of Community Access and Transportation Training**

Community mobility extends beyond the mere function of transportation; it serves as a critical mechanism for promoting autonomy and facilitating social inclusion among individuals with disabilities. When designed with accessibility in mind, public transportation systems present cost-effective avenues for mitigating social isolation and enhancing access to employment, education, and community participation. However, effective use of these systems necessitates a multifaceted set of competencies, including the interpretation of schedules, route planning, landmark recognition, and adaptive problem-solving in response to service disruptions. These demands are particularly acute for individuals with intellectual disabilities to make informed decisions in fluctuating and often unpredictable transit environments.

Traditional community access training is frequently hindered by a range of logistical and structural barriers that undermine its efficacy. Conflicts in scheduling between instructional programs and public transportation services often limit opportunities for consistent practice. Moreover, variability in the availability and accessibility of transit routes and vehicles presents additional challenges. Safety concerns also constrain the extent and depth of training, as the dynamic and often unpredictable conditions of real-world transit environments impede the delivery of structured, sequential skill development, especially for individuals with physical disabilities.

The complexities of public transportation navigation extends beyond basic route knowledge to encompass sophisticated problem-solving skills. Individuals must learn to identify community landmarks that signal appropriate bus stops, communicate effectively with drivers and other passengers, manage timing for boarding and exiting, and adapt to unexpected changes in service, among other unforeseen issues that may arise.

## **Extended Reality as an Equitable Learning Tool**

Extended Reality (XR) technologies invite new paradigms of embodied learning that challenge conventional constraints of time, place, and physical safety. As immersive environments, XR tools offer rich possibilities for reimagining pedagogical practices, particularly for learners whose engagement is enhanced through experiential modalities. These digitally mediated spaces foreground the role of narrative, simulation, and repetition, allowing students—especially those with disabilities—to inhabit scenarios that encourage reflection, experimentation, and agency without the material consequences of error. In this way, XR not only augments accessibility but also reconfigures the boundaries of knowledge production and experiential meaning-making.

The integration of XR technologies into disability education reflects a meaningful alignment with established pedagogical frameworks, such as the Four Quadrant Model of Facilitated Learning, which foregrounds task specification, decision-making, memory recall through practice, and the cultivation of learner autonomy. XR environments are particularly well-suited to supporting the decision-making and recall phases, offering learners the ability to engage repeatedly with structured scenarios in ways that foster both confidence and competence. For individuals with intellectual disabilities, this iterative and immersive approach is especially beneficial, as it accommodates diverse cognitive processing styles and reinforces learning through sustained, experiential engagement.

Creating truly equitable XR experiences requires careful attention to accessibility principles and universal design. Developers must consider the diverse needs of their audiences, ensuring that virtual environments accommodate various abilities and learning styles. This involves implementing design heuristics that prioritize authenticity, embodiment, empathy, accessibility, usability, and immersion while remaining

mindful of the potential for technology to either bridge or widen existing gaps in access and opportunity.  
Research Findings and Practical Implementation

A comprehensive study involving transitioning adults with intellectual disabilities demonstrated the practical potential of XR technology for community access training. Participants, ranging from ages 19 to 22 and enrolled in a community training program, used smartphones to document their public transportation experiences through photographs, videos, and audio recordings. These materials were then incorporated into virtual reality environments using accessible platforms that prioritized storytelling over technical complexity, allowing participants to focus on sharing their lived experiences rather than mastering complicated software.

The research revealed significant positive outcomes in participant perceptions and confidence levels. Nearly all transitioning adults reported enjoying their bus riding experiences and expressed intentions to continue using public transportation independently. Participants demonstrated increased awareness of safety considerations, with many preferring front seats for both security and ease of boarding. Notably, several individuals developed positive relationships with bus drivers, indicating successful social integration within the transportation environment. These findings suggest that XR-supported training can effectively build both practical skills and social confidence necessary for independent community navigation.

Staff perspectives provided additional insights into the program's potential and limitations. Educators and transition specialists recognized the value of XR technology for building participant confidence and providing safe practice opportunities, while also identifying needs for additional technological training and support. The research highlighted the importance of creating manageable group sizes and providing adequate supervision during community-based activities, suggesting that XR training could help optimize limited staffing resources by preparing individuals more thoroughly before real-world experiences.

### **Implications and Future Directions**

The implications of XR-facilitated community access training extend well beyond the immediate acquisition of practical skills, inviting critical examination of broader issues related to accessibility and agency for individuals with disabilities. By affording participants the means to record and disseminate their lived experiences, XR technologies reconfigure the educational landscape, positioning individuals as active agents in the construction of their own learning narratives rather than as passive recipients of externally imposed instruction. This reorientation toward self-advocacy and narrative authorship signals a fundamental transformation in the conceptualization and delivery of support, foregrounding the necessity of attending to and amplifying the perspectives of marginalized communities.

The transformative potential of extended reality (XR) technologies transcends narrow applications, offering substantive possibilities for diverse constituencies including aging populations, vocational training contexts, and broader educational populations. As XR platforms achieve greater accessibility and intuitive design, their integration within disability services frameworks represents a paradigmatic shift toward enhanced community participation and autonomous living. Nevertheless, the actualization of this technological promise necessitates deliberate interventions: cultivating awareness among service practitioners, securing sustainable funding mechanisms for both technological infrastructure and professional development, and prioritizing human agency over technological determinism. The ultimate efficacy of XR-mediated community access pedagogies depends not merely on technological sophistication but on an institutional commitment to fostering genuinely inclusive educational praxis that acknowledges and amplifies the inherent capabilities and aspirations of individuals with disabilities. This approach requires a fundamental reconceptualization of disability services from deficit-based models toward

strength-based frameworks that position technology as a tool for empowerment rather than remediation.

## References

- Bezyak, J. L., Sabella, S. A., & Gattis, R. H. (2017). Public transportation: An investigation of barriers for people with disabilities. *Journal of Disability Policy Studies, 28*(1), 52–60. <https://doi.org/10.1177/1044207317702070>
- Duin, A. H., Armfield, D. M., & Pedersen, I. (2019). Human-centered content design in augmented reality. In *Content strategy in technical communication* (pp. 89-116). Routledge.
- Greber, C., Ziviani, J., & Rodger, S. (2011). Clinical utility of the four-quadrant model of facilitated learning: perspectives of experienced occupational therapists. *Australian occupational therapy journal, 58*(3), 187–194. <https://doi.org/10.1111/j.1440-1630.2010.00901.x>
- McDonnell, A., Benham, S., Fleming, C., & Raphael, A. (2021). Community-based public transportation training with the integration of assistive technology: A pilot program for young adults with intellectual disability. *Technology & Disability, 33*(2), 109–121. <https://doi.org/10.3233/TAD-200306>
- Pfeiffer, B., DeRita, J., Giacomucci, E., Gubler, J., Halteman, T., O'Donnell, E., Seifried, G., & Pompano, A. (2021). Barriers and facilitators to public transportation use for individuals with intellectual and developmental disabilities. *Occupational Therapy in Mental Health, 37*(1), 1–14. <https://doi.org/10.1080/0164212X.2020.1832013>



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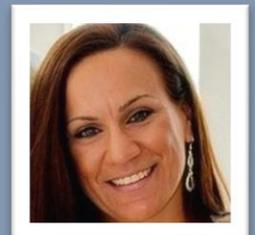
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