Exploring the potential of immersive technologies to meet the evolving needs of the health and social care sector

A White Paper from Metaverse Learning

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About Metaverse Learning

Metaverse Learning is a global leader in the transformation of education and training through Extended Reality (ER), including Virtual Reality (VR), Virtual Environments (VE) and Augmented Reality (AR). We work with education and industry partners to co-create immersive learning programs. By working in collaboration, we evenly share the time, resources and money needed to produce new and innovative learning experiences.

Our virtual programs are then used by education providers to enhance learner engagement, accelerate knowledge and skills development, improve attainment, and provide a clear progression pathway to employment, as part of a blended learning approach.

Hilary Gupte, RN, BSC (Hons), PGCE

Working as a registered nurse and clinical educator in acute care settings for 13 years, Hilary moved into a more permanent career in education in 2017.

Initially working as a simulation and skills manager at a large teaching hospital, Hilary contributed to the advancement of curriculum and extracurricular programmes for both regional and national post-graduate medical trainees. Hilary now works part-time in a regional multi-professional education team for NHS England and teaches undergraduate skills in the medical school at a large University.

Beyond these permanent roles, Hilary has embraced a portfolio career, developing, and delivering educational content for various companies and creating her own materials. Her notable interest lies in simulation-based learning and extended reality, innovating healthcare education with these methods.

Ann Sunderland, RN, BSc (Hons), MMedSci, SFHEA

With a clinical career in general practice nursing, Ann entered full-time academia, designing, and delivering postgraduate courses/modules for clinicians.

After becoming involved in the design of the University's £1.2 million clinical skills and simulation suite and gaining a distinction in her MMedSci in medical education, her focus shifted to designing and delivering bespoke training, including clinical skills using differing modes of simulation.

Her interests are now firmly planted in the realms of research and enterprise with regards to simulation-based education and clinical skills and in 2018, she left full-time employment to concentrate on her own consultancy business as well as working freelance for several organisations both within education and industry. She is also studying for a doctorate in education, exploring learner perceptions of the use of virtual reality simulation in high-stakes assessment.

Executive summary

The following paper introduces the concept of mixed reality (MR), with a specific focus on virtual reality (VR) simulation within clinical education. It has been written from the perspective of experienced educators in simulation-based education (SBE) with a clinical background and is aimed at assisting those wishing to begin using VR or wishing to enhance their current VR offering within clinical education.

It explores the catalysts for its rapidly increased use, in particular, the impact of the COVID-19 pandemic and goes further to highlight the pros and cons of this mode of delivery, along with some of the challenges faced concerning its implementation and integration. Example solutions to these issues are offered in the form of four case studies which highlight distinctly different ways of harnessing the magic of VR simulation.

It explores the transformative impact of VR simulation, examining its historical context and key drivers. The advantages of VR simulation, including its applicability in rare and diverse scenarios, deliberate practice and mastery learning are highlighted. The versatility of VR enabling scalable educational solutions to support the current climate in healthcare is emphasised.

While comparing VR simulation with traditional methods of SBE, the paper underscores the immersive experience it offers, providing a first-person perspective for learners. Multisensory elements, immediate personalised feedback and real-time physiological changes further distinguish VR simulation. The need for team collaboration and drawing upon expert developers such as Metaverse Learning, in the development is acknowledged.

The paper offers suggestions on how best to implement and deliver VR learning experiences within clinical education and poses questions about organisational readiness.

The integration of VR into a curriculum is presented as a six-step process, introducing the ILQAFF model (Sunderland, 2019), with steps covering learning needs, objective setting, ensuring quality, faculty development, the use of simulation for assessment and obtaining feedback to continuously improve educational offerings. A blended approach to integration is promoted, emphasising the importance of faculty development and learner onboarding. In addition to the model of integration, platform selection, infrastructure readiness and adherence to simulation-based education standards are discussed.

The paper explores the suitability of VR for assessment, suggesting acceptability from both learners and faculty, with careful mapping against learning outcomes.

A summary of the key findings

Along with the four case studies, this paper illustrates that:

- VR simulation is found to be an acceptable, scalable tool in healthcare education.
- Technology advancements, such as haptics and voice control contribute to enhancing the learning experience.
- Embracing digital technology is seen as crucial for future healthcare education although potential challenges such as reduced human-to-human interaction, and initial cost are acknowledged with offered solutions.

In summary, the paper advocates for the transformative potential of immersive technologies in addressing the evolving needs of health and social care education. It calls for meticulous planning, faculty expertise and digital literacy to fully leverage the benefits of mixed reality and VR approaches in enhancing the clinical education landscape.

Introduction

The term "virtual reality" was first coined in 1987 by Jaron Lanier, a US scientist and musician (Furht, 2008). Lanier contributed to this emerging industry, where initial research and technological development was led by the US federal government, focusing initially on the fields of defence and aeronautics, before a wider educational and social context emerged. While there are numerous definitions of virtual reality within the literature, one which particularly stands out is:

"Virtual reality is an artificial environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer in which one's actions partially determine what happens in the environment."

The key here is the fact that the user has a part to play in what happens within the virtual reality (VR) scenario by both their actions and inactions.

Adding to that, Bailenson (2018 p1) suggests that *"virtual reality is able to effectively blur the line between reality and illusion, pushing the limits of our imagination and granting us access to any experience imaginable."*

Considering the above, VR simulation provides an ideal vehicle for health and social care education. It allows learners to be exposed to scenarios that occur rarely in practice, but where rehearsal in a safe environment has the potential to save lives.

It can also offer an opportunity to experience deliberate practice (Ericsson et al., 2009; Saab et al., 2023) and mastery learning, where rehearsal of essential skills can happen both before clinical care and as a means of preventing skills decay thereby enhancing patient safety (Bayram & Caliskan, 2020; Kneebone, 2020).

While thinking of simulation-based education (SBE) in more broad terms i.e. replicating real-life scenarios using manikins, simulated patients, or part-task trainers for example, as well as VR and augmented and mixed reality, there is a plethora of evidence to demonstrate how these methods are closely linked to adult learning theories such as constructivism (Tryphon & Vonèche, 1996), experiential learning (Morris, 2020) and cognitive apprenticeship (Tomsett, 2021) for example.

In terms of preferred learning styles, SBE can incorporate visual, auditory, kinaesthetic, and reading/writing components (Kulkarni et al., 2022; Tutticci et al., 2016), enabling deep learning to occur (Wang & Ji, 2021). Experiential learning, or learning through doing, can also be achieved through other methods such as clinical placements, problem-based learning, and case studies to name a few, and all are greatly enhanced with the addition of reflection or well-facilitated debriefing afterwards (Kolb, 1984; Chmil, 2015).

Background and context

Rapid advances in technology and the COVID-19 pandemic are two drivers which have led to increased use of VR simulation within health and social care education (Duffull et al., 2020; Fu et al., 2022).

The need for rapidly scalable educational solutions that conformed to COVID-19 restrictions provided an ideal bedrock for this mode of simulation delivery. Following the COVID-19 lockdown, universities saw a significant increase in applicants for healthcare courses (Health Education England, 2021; NHS England, 2020; Papapanou et al., 2021).

Potentially due to the positive exposure of the NHS throughout the pandemic, this rise in student numbers in turn increased pressure on existing clinical placements (Medical Schools Council, 2021; Szabó et al., 2022; Williamson et al., 2020), leading to gaps in practice between classroom and the clinical setting (Pottle, 2019).

Even with creative ways of maximising placement capacity, the requirement by professional body regulators for students to undergo a set number of clinical placement hours further increases demand. Additionally, the recent NHS long-term workforce plan (NHS England, 2023c), will add to this issue, supporting a dramatic expansion in training places across the healthcare professionals with, as an example, a 92% increase in adult nursing places.

One way to enhance and supplement clinical placement hours is to utilise simulated practice learning (SPL).

In nursing, students are required to undertake 2300 clinical hours as part of their training. Recently, the Nursing and Midwifery Council advocated that up to a maximum of 600 of these clinical hours can be undertaken in SPL if the educational institution meets its standards (Nursing and Midwifery Council, 2023).

SPL refers to a form of education or training where learners engage in activities that simulate real-world experiences, which are designed to replicate the conditions and challenges of actual clinical practice, allowing them to develop and enhance skills in a controlled, safe environment. Simulated practice, however, encompasses the broader, more generic concept of engaging in activities that imitate real-world scenarios. The distinction therefore lies in the focus on learning within the context of clinical practice.

VR simulation can offer a transformative and innovative solution to these challenges, offering a dynamically scalable alternative mode of simulation that can enhance existing simulation offerings.

Having the ability to be delivered via both 2D (on a computer screen) and 3D (in a headset) platforms, remote access by learners is a possibility, fitting in with the post-covid trend of hybrid and blended approaches to educational delivery (Singh et al., 2021).

Utilising VR scenarios offers a consistent experience for learners. It allows them to gain exposure to diverse clinical situations that they may not otherwise experience, as well as having the opportunity for repetitive practice aiding the acquisition of mastery learning.

From a faculty perspective, VR simulation use is less resource intensive than traditional simulation methods however, both learners and faculty will need initial support on using the technology with learners requiring supervision, albeit in a different format to the norm, to meet professional body requirements (Nursing and Midwifery Council, 2023; Singh et al., 2021).

The pros, cons, challenges, and solutions of using VR simulation in healthcare education

There is no doubt that traditional simulation using a simulated patient or manikin, aids learning, however, these modes of simulation are designed with individuals or small groups of learners in mind (Hooper et al., 2015). This poses a problem with large cohorts of learners where most of the group observe others undertake the scenario, meaning there is less opportunity for individuals to be exposed to them.

The nature of VR allows all learners to experience the scenario through a first-person perspective, which has the benefit of encouraging a personal connection with the environment, supporting the "suspension of disbelief," allowing learners to respond as they would in a real clinical setting (Brent, 2009; Muckler, 2017). Engaging as many of the senses as possible further enhances this ability.

While audiovisual stimuli are readily available via the VR scenarios, faculty can additionally augment the realism or fidelity by adding simulated smells which help to evoke realistic emotions, empathy, and reactions from the learner (Andonova et al., 2023; Marques et al., 2022). This can be particularly useful in scenarios where learners may be encountering unpleasant conditions or situations for the first time that have the potential to evoke negative reactions and emotions. Having the ability to experience such situations in simulation, will better prepare the learner for practice, reducing the potential for reacting negatively in the presence of their patients (Andonova et al., 2023; Kent et al., 2016). In addition, evidence suggests that learning experiences evoking emotional reactions aid memory retention (Serin, 2020).

Exposure to scenarios that appropriately stretch their skills for their level of training, can help build resilience and decision-making skills by reflecting on their performance in a safe and supportive environment (Lavoie et al., 2021).

While the standardisation in delivery and the range of scenarios that can be delivered in VR has already been mentioned, the advantage of being able to offer immediate personalised feedback provides an opportunity for learners to harness the immediacy of reflection on action (Schön, 1991). Computer-generated feedback/marking also eliminates examiner inter-rater reliability, which is a definite advantage if using VR for assessment (Sanchez et al., 2022; Sunderland, 2023).

Another clear advantage of VR over other modalities is the ability to enable physiological changes in the patient to happen in real time. While moulage is a wonderful medium to use with both manikin and simulated patient-based simulation, scenarios must be paused to make such changes which can interrupt the clinical decision-making processes of the learners. In VR, the patient can suddenly develop a rash or start haemorrhaging or vomiting for example and begin to deteriorate or improve without the need for the scenario to be paused, supporting the fidelity of the activity in relation to real clinical practice (Soyuer, 2022).

In comparison to traditional simulation methods e.g. manikin or simulated patient-based scenarios, it has typically been more difficult to achieve learning outcomes related to team collaboration, simply because the scenarios have been designed for individuals to explore. With advances in technology, the ability to provide "multiplayer" scenarios, allowing small teams to collaborate synchronously within the same simulated episode of care, is becoming more commonplace (Schild et al., 2018).

Similarly, the introduction of voice control and artificial intelligence into VR simulation is allowing for a richer development of communication skills, which was previously limited due to the nature of learner/software interaction (Combs & Combs, 2019; Yang et al., 2020).

With the advent of the NHS Equality, Diversity, and Inclusion Improvement Plan (NHS England, 2023b), anecdotal and published evidence is emerging to support the fact that VR within clinical education can be beneficial in supporting neurodiverse learners (Drigas et al., 2022; Luxford-Moore, 2023; Soccini et al.; Weeks et al., 2023). As these learners have difficulties adjusting to sensory stimuli, the immersive nature of 3D VR both limits external stimuli and provides a controlled environment, meaning learning is more easily achieved (López-Carral et al., 2022).

Interestingly, VR scenarios have also been developed to allow individuals to experience what autism is like first-hand, to enhance understanding to positively impact the equality, diversity, and inclusion (EDI) agenda (López-Carral et al., 2022).

Care should be taken however, in learners and faculty who have a history of claustrophobia or severe motion sickness, as there is a risk that using a VR headset may exacerbate symptoms. While the incidence of motion sickness in VR headsets is suggested to be about 38%, studies undertaken were looking mainly at people taking part in fast-paced gaming, where a lot of physical movement is required as well as fast reaction times. Reducing head movement and limiting the time within the headset to 15-20 minutes, dramatically reduces the incidence of symptoms (Saredakis et al., 2020). As clinical scenarios typically run within this timeframe with limited movement required, motion sickness is rare.

When considering introducing VR simulation into the curriculum, decisions will need to be made with regards to either developing bespoke scenarios or purchasing ready-made scenarios.

While developing bespoke scenarios allows them to be tailored specifically to the required learning outcomes, the skills required to turn a written scenario into a VR experience are not always available in-house and can therefore be a costly and time-consuming option. Purchasing subscriptions to access existing scenarios may be both a more cost-effective and timely option. Access to the scenario can be part of a package of learning, rather than a standalone activity, which provides more flexibility to achieve the required learning outcomes (see page 12-13 for more information on the hybrid approach to teaching).

Regardless of using bespoke or “off-the-shelf” scenarios, the ability to be delivered either on screen (2D) or via a headset (3D), aids prompt scalability, allowing for increased student numbers where needed.

As previously mentioned, VR simulation delivery is less faculty-heavy than more traditional modes once learners are familiar with the concept, but the importance of spending time onboarding both new faculty members and learners, should not be underestimated. For learners, one way of doing this is to incorporate access to the VR platform via a “sandbox” i.e. practice area, or tutorial scenario, during the pre-brief (Chidume, 2023). Providing this opportunity also helps to identify any individuals prone to motion/cybersickness, so they can be managed appropriately.

There is often an assumption that younger learners are “digital natives,” and will be experienced in using technologies via mobile phones, laptops, and VR headsets, but this is not always the case, particularly in areas of deprivation (Weeks et al., 2023). Allowing for a generic onboarding avoids the stigma of poverty deprivation and supports a consistent approach to learning and teaching.

The technological infrastructure of the educational institution also needs considering. Involving the information technology/learning support/simulation teams from the outset will help to support a smooth introduction of using VR into the curriculum (Lowther & Armstrong, 2023).

As well as knowing how to use the chosen VR software and related hardware, faculty development about the pedagogy of simulation-based education is a must to facilitate best practice standards (Association for Simulated Practice in Healthcare, 2023; INACSL, 2021). Two potential dangers that learners may encounter with poorly facilitated simulation experiences are the acquisition of training scars and disengagement from the notion of simulated practice.

Training scars can occur when the fidelity of simulation experiences are not upheld and are the unintended consequences of repetition of an error that then becomes second nature (Hall & Bertsch, 2013; Neveu & Pavoni, 2019; VirTra, 2023) e.g. if sterile dressing packs are reused "because it's only simulation," learners who are perhaps undergoing repetitive practice, may inadvertently reuse a sterile pack in practice due to the muscle memory that has developed. The consequences of this could potentially be the introduction of infection, which could be avoided by ensuring that simulation mimics reality as much as possible, including the equipment and props used. Any errors identified, should be corrected immediately and practice modified accordingly. Ensuring an appropriate faculty-learner ratio can aid with this process. The inherent nature of VR simulation reduces the risk of faculty-induced training scars but highlights the need for learner supervision both to meet professional body requirements, but also to pick up on and address any learner errors or omissions, the most common of which, appears to be a lack of hand hygiene; "I didn't wash my hands because its only simulation."

Typically, a lack of engagement in simulation activities occurs when clear links between the activities and real practice are not made explicitly clear. The chances of this happening can be reduced by integrating simulation into the curriculum, so it is part of a package of learning, highlighting its links to real clinical practice. Again, faculty education around simulation-based education highlights the importance of the debrief in linking theory to practice. While incorporating this is commonplace with traditional modes of simulation, it is often neglected or at least viewed as less important in terms of immersive virtual and augmented reality simulation, highlighting the need for a comprehensive and consistent approach to pre-briefing when using these methods (Cieslowski et al., 2024).

Utilising a blended learning approach to curriculum delivery

A blended approach to learning i.e. using a combination of face-to-face and online learning has been utilised since the early 1990s (Güzer & Caner, 2014; Poon, 2013; Zhonggen, 2015). This approach caters to diverse learning needs and styles, which in turn, can lead to a broader reach and improved engagement (Saab et al., 2021).

Out of necessity, the COVID-19 pandemic was the catalyst to a dramatic increase in online/remote learning as educational providers had to explore new ways of working to keep learners, faculty, and patients safe (Boardman et al., 2021; Major et al., 2020; Moynihan et al., 2022; Nursing and Midwifery Council, 2020; Sunderland, 2020). While international educational institutions are essentially back to pre-lockdown status, a legacy of the increased use of blended learning remains (Razali, 2022; Yerimpasheva et al., 2022).

While this approach is more flexible than didactic learning and appears to be positively accepted by learners and faculty alike (Al-Fodeh et al., 2021; Yerimpasheva et al., 2022), it comes with its challenges, namely poor internet connectivity and lack of orientation programmes (Brenya, 2021). While little can be done to support internet connectivity for learners off campus, ensuring that the institutional infrastructure is robust about the use of information technology is paramount in achieving positive learner experiences.

Seamless integration of VR into the curriculum requires meticulous planning. One model of curriculum integration is the ILQAFF model, which comprises the following six steps:

1. Identify – the learning need, resources required, and cost-benefit ratio of using simulation
2. Learn – Identify learning objectives, do these lend themselves to simulation and what modes might work best
3. Quality – faculty development, learner: faculty ratio, fidelity, orientation
4. Assessment – Will the simulated experience be used for assessment? Will it be formative or summative? Will learners be assessed individually or as a group?
5. Feedback from learners – How will this be obtained and who will review it?
6. Faculty feedback – Were the learning outcomes achieved? How will learning be applied to practice? Are any changes to the scenario required?

Adapted from Sunderland (2019).

Learning outcomes of the VR scenarios should be mapped against the curriculum and thought given to how they will fit into a blended learning approach.

Let's use the management of asthma as an example of how this can be undertaken. Figure 1 outlines an example. This stepwise blended approach could utilise a single case study and follow a patient's journey from diagnosis to successful self-management. A pre-requisite to delivery would be ensuring faculty have at least baseline knowledge of simulation-based education and that they have provided learners with adequate orientation to the formats of delivery, including the use of VR headsets and/or the use of VR onscreen.

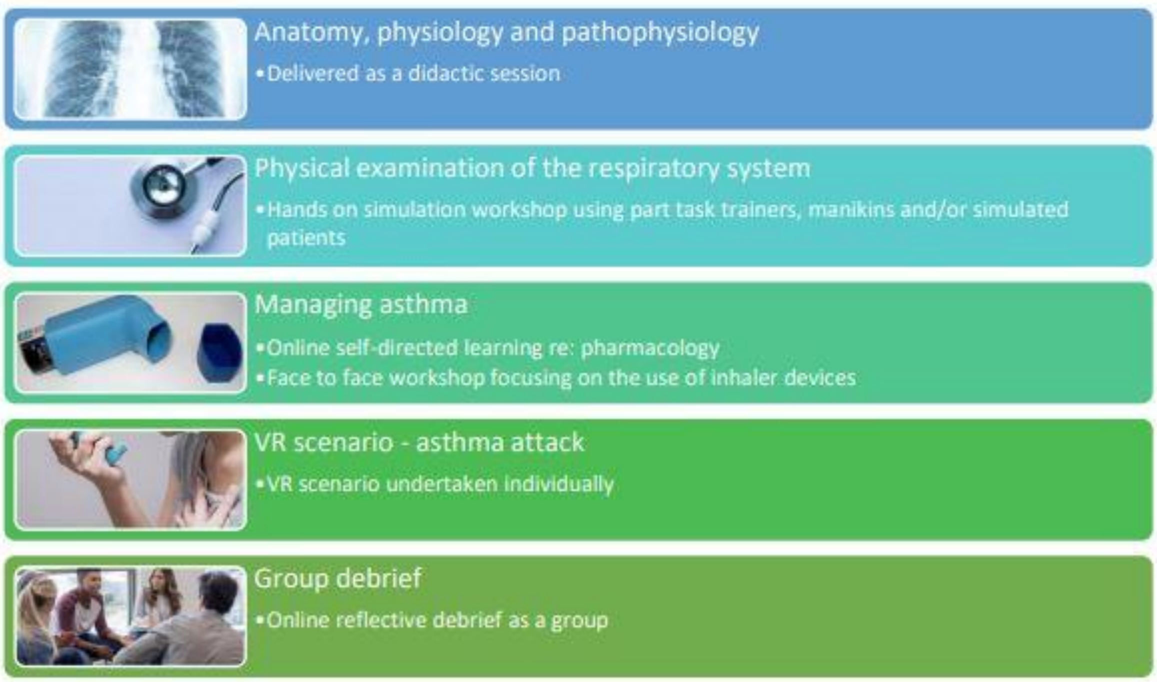


Figure 1: Example of a blended learning approach

As can be seen from Figure 1, VR and other immersive forms of learning should be considered as a supplement to conventional teaching rather than a standalone delivery method (Da Woon et al., 2021; Muda et al., 2021).

Case studies and success stories

A brief review of current literature provides some interesting case studies highlighting the successful integration of VR simulation into healthcare education. Using three very different examples, the following narrative focuses on key learning points from introducing this mode of clinical simulation.

Sheffield Hallam University

Being one of the UK's largest providers of nursing and midwifery education, the COVID-19 pandemic, and its associated lockdown, played havoc with clinical placements.

With third-year nurses spending most of the year in clinical placement, a rapid solution was needed to attempt to compensate learners for lost clinical time during the lockdown and prepare them for clinical practice post-registration.

The university purchased a subscription to an existing clinical VR platform that provided a range of scenarios for healthcare professionals at all levels. Following faculty and learner onboarding, only third-year nurses were provided with individual access to carefully chosen scenarios that they could work through in either 2D or 3D format. Built-in analytics provided faculty with the means to track simulation hours for both individuals and groups of learners, thereby providing evidence of clinical exposure, required to bridge the shortfalls from clinical placement, allowing learners to graduate on schedule.

The second phase of implementation involved first and second-year learners who undertook VR sessions in a group setting, led by a faculty member. The benefits of this mode of delivery were identified as:

- The ability to better prioritise clinical care
- Increased knowledge sharing across learners
- Development of confidence and better communication skills
- Tangible performance improvement in each series repetition

At the end of the year, and nearly 2000 scenarios being undertaken, the university achieved a 74% reduction in staffing and estate costs by integrating VR. Feedback from both learners and faculty was extremely positive with key points being the ability to preserve fidelity and standardisation across learners/groups, the ability to scaffold learning and to rapidly scale delivery as and when needed (Sheffield Hallam University, 2022).

Calderdale College

Calderdale College is one of the largest providers of further education and apprenticeships in the country and one of the first institutions to provide T-Level education focusing on health and social care.

After successfully winning funding from NCFE (NCFE, 2022), the college brought together a team of clinical, simulation, research and technical experts and designed three prototype scenarios that could be delivered in both VR and in a simulation centre using a full-body manikin. The overall aim was to explore the use of immersive technology in assessment, with the scenarios incorporating care certificate standards. Learners undertook scenarios in both settings with pre- and post-scenario interviews with a researcher taking place. A qualitative approach using template analysis was then undertaken.

Most comments were positive about both modes of delivery. The "gamification" of the VR scenarios seemed to elicit reduced feelings of anxiety in relation to the assessment element of the VR experience. Further research is required to determine if this has a positive impact on performance.

Key learning points from the case study are:

- The need for learner orientation to the mode of simulation delivery being used
- The importance of faculty development in simulation-based education
- The need for organisational infrastructure to be able to support the use of immersive
- technology enhanced learning
- The importance of pre-brief and debriefing in reflective practice
- VR simulation is a preferred mode of educational delivery for neurodiverse individuals

While interim reports and articles from this project are available (Brown-Adams, 2023; Sunderland & Weeks, 2023), the full report is due to be published in January 2024.

Coleg Cambria

Based in North Wales, Coleg Cambria partnered with Metaverse Learning's collaborative consortium to develop tailored educational packages that would address individual and collective curriculum challenges.

With nearly 200 students across three educational levels, the college wanted to offer a resource that could support its learners while harnessing the unique learning style of immersive technologies.

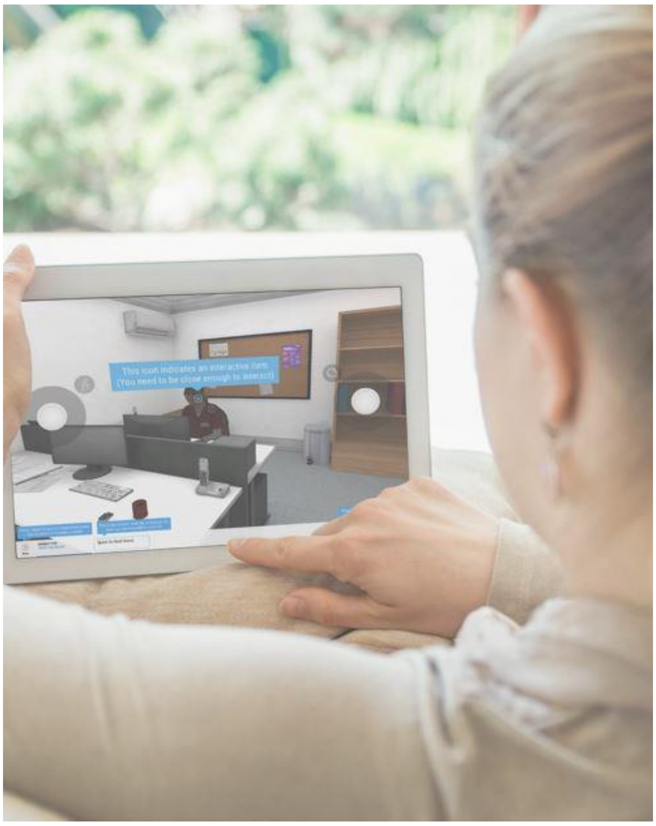
For level 1 learners, the goal was to provide insights into various roles within health and social care. For levels 2 and 3, the focus shifted to simulating specific situations and challenges that may present themselves in future clinical practice.

Accessed through the college's learning management system using tablets or Chromebooks, students continually engaged with and embraced the programmes, repeatedly practising and refining their skills.

Key learning points from this case study are:

- Collaborating with Metaverse Learning and consortium partners allowed the college to design and deliver bespoke VR packages to their learners, drawing on the collective technical expertise of the group
- The college viewed the collaboration as a valuable and exciting journey, witnessing the development process come to life
- Collaboration with the consortium resulted in a resource that not only aligned with the curriculum but exceeded expectations in terms of learner engagement and skill development

(Coleg Cambria, 2023).



NHS England

The final case study focuses on the faculty perspective of delivering curriculum requirements for post-graduate doctors by delivering simulation through the medium of VR headsets. Designed and delivered for Yorkshire and Humber trainees, two pilot courses, each involving eight scenarios, were run and their evaluation was presented to the regional teaching bi-annual event for NHS England (Gupte & Storey, 2023).
The pilot aimed to develop awareness of human factors and non-technical skills. By designing and delivering 180-degree filmed scenarios through VR headsets the benefits of scalability and reduced faculty numbers would support the well-documented increased need of the current UK healthcare education demand. It became evident during the pilots that this innovative simulation experience could benefit both faculty and trainees within the region and potentially beyond.

One common thread that wove through the immersive nature of the VR scenarios was that faculty noticed a shift in the dynamics of the debrief sessions immediately following the thought-provoking simulated scenarios. The key changes noted were:

- Trainees achieved deeper, more personalised reflection than following previous simulation sessions. This was attributed to each trainee having first-hand concrete experience of the scenario, all designed specifically for the stage of their career. Previous SBE experiences of traditional simulation had included passive observation of scenarios and therefore inconsistent experiences.
- The debrief was more contextualised bringing previous experiences to life. This highlights how the technology triggered trainees to draw upon concrete, lived examples from their practice.

- Trainees appeared to express their emotions more openly than in traditional simulation. This could be due to having less faculty present during a debrief but may also be that the trainees had a more shared experience of navigating the same challenging scenarios in VR, creating a unique bond among them.

Because of the mode of delivery, it was noted by faculty experienced in SBE, that adaptation of their debriefing skills was needed as trainees were observing rather than participating in the scenarios. This required a more enquiring approach as opposed to advocacy but was embraced as an opportunity for professional growth as opposed to a challenge.

Anecdotal accounts shared during the presentation to NHS England painted a compelling picture of VR's potential to innovate and meet the growing demands to support the way doctors are trained. This pilot offered a dynamic and immersive learning experience that goes beyond the limitations of traditional methods, with avenues being explored and secured for potential growth and refinement. This scalable implementation incorporating better efficiency of resources, will continue to be shared across the region in the coming year.

Case study summary

These four case studies demonstrate different ways of procuring VR experiences for learners in health and social care i.e. purchasing “off the shelf” scenarios, 180-degree filming, building bespoke scenarios independently and collaborating with experienced industry partners to develop interactive immersive learning experiences tailored to individual requirements.

All have their merits, but the unique opportunity to partner with Metaverse Learning allows the creation of bespoke educational offerings with the support and collaboration of experienced professionals. It negates the need to source expertise that may not be available in-house and speeds up the development process, saving costs (Foronda et al., 2023) and, similarly to the other case studies, encompasses stakeholder involvement ensuring scenarios align with current clinical practice.

Future direction, recommendations, and conclusions

There is no doubt that VR simulation in healthcare is a readily acceptable and easily scalable learning and teaching tool that can be utilised across clinical specialities and professional groups (Pottle, 2019; Satava & Jones, 1998).

It provides cost-effective, standardised, repeatable training and has the potential to transform how education is delivered to future clinicians.

As well as healthcare education, there is a growing trend for VR use in patient education, particularly in rehabilitation and health promotion (Pillai & Mathew, 2019), and so is a medium that both patients, learners, and clinicians will no doubt become more familiar with in the future.

With rapid advances in technology, headsets are becoming more affordable while their quality and functionality are improving (Ciccone et al., 2021; Joo & Brongersma, 2022). This suggests that mixed reality, i.e. the merger of VR and AR, for example, is something we are likely to see more of in the future.

As mentioned previously, increasing fidelity within simulation by engaging as many of the senses as possible, aids the process of learning. The increased use of haptics, voice control and artificial intelligence within VR is already being seen and is evaluated positively by learners (Lee et al., 2020; Wang et al., 2019).

Enhancing digital literacy should be something to be embraced and not feared, as current literature suggests that the future of technology-enhanced learning in clinical education will be characterised by a diverse range of tools and approaches, with a focus on professional development, patient safety and comprehensive integration into the curriculum. The use of mobile technology as well as artificial intelligence is currently the focus within clinical education (Iqbal et al., 2021; Shrivastava & Shrivastava, 2020). The combination of these two technologies is expected to enhance the efficiency and effectiveness of clinical education, improving problem-solving and information-seeking skills as well as providing individualised, interactive, and efficient learning experiences.

The further implementation of these technologies may however pose challenges such as the potential reduction in human-human interaction, leading to a drop in communication skills. This potential risk could perhaps be mitigated by undertaking VR scenarios that focus on the enhancement of such skills, particularly with the use of voice control rather than menu-driven platforms. Additionally, employing a blended approach to educational delivery helps to mitigate other potential pitfalls that may be encountered (Singh et al., 2021). Using more than one delivery method provides greater flexibility regarding meeting specified learning outcomes and aligning with student's preferred learning styles.

The ability to access digital modes of delivery on a range of devices e.g. computers, laptops, tablets, and smartphones, not only further supports this notion of aiding accessibility, but reduces initial financial outlay as additional hardware is not required. Considering platforms that offer this flexibility, such as Metaverse Learning is therefore key to successful integration.

Despite these challenges, the advance in technology-enhanced learning is expected to catalyse a shift towards individualised learning, with the role of educators changing to focus more on learning facilitation and competency assessment (Khaleq & Najah, 2022). This poses another question – is VR simulation a suitable mechanism of assessment? Research around this topic is currently limited but does suggest that it is an acceptable method from both the learner and faculty perspectives (Coyne et al., 2021; Minty et al., 2022; Pal et al., 2022). It should, however, be carefully mapped against the learning outcomes being assessed and only used where it can supplement existing methods e.g. using scenarios that would be difficult to replicate using other modes of simulation, such as where physical signs change rapidly or where changing moulage is required (Sunderland, 2023).

Before considering the use of VR for assessment, Figure 2 summarises the key recommendations when considering the implementation of VR simulation within the curriculum. This can be considered in six stages:

1. Consider the VR platform to be used and justify the decision made. Consider your priority here. Is it rapid adoption and implementation, where purchasing off-the-shelf scenarios may be the best solution, or is it bespoke scenarios where collaboration with Metaverse Learning may be more cost-effective than sourcing independent VR experts.
2. Ensure that the infrastructure is in place to support the use of VR i.e. do you have the appropriate hardware for learners to access it? Does the information technology team have the capacity to support faculty and students in using this mode of education? How will your chosen platform be accessed? Does it need integrating into your learning management system? Is the Wi-Fi signal strong enough to support access? Is this method of delivery accessible to all learners?
3. Ensure all faculty that will be using/supporting the use of VR have had training both in simulation-based education and in the relevant software and hardware. Health Education England has developed a package of free basic SBE modules that can be accessed via e-learning for Health (Health Education England, 2022).
4. Map VR use against the curriculum learning outcomes and embed the use of VR as part of a blended learning approach, rather than using it as a stand-alone "nice add-on" to existing teaching.
5. Ensure that the development of scenarios as well as their delivery and evaluation meet SBE standards of best practice.
6. Ensure that evaluations from both learners and faculty are reviewed and reflected upon and any required changes to delivery are made. Initial evaluation will likely focus on Kirkpatrick levels 1 and 2 (Kirkpatrick & Kirkpatrick, 2009). Over time, this should move to levels 3 and 4. While it is more challenging to determine the impact of VR education on direct patient care, demonstrating the merits of this mode of delivery to stakeholders, fundholders and policymakers, will aid its future sustainability.

Once these stages are in place and faculty and learners have become familiar and comfortable with this mode of delivery, then its use in assessment could be considered.

To conclude, VR simulation is an acceptable and effective method of immersive, interactive educational delivery that dovetails with most learning style preferences. Its use within the curriculum should, however, be meticulously planned and evaluated by faculty with SBE experience. The use of new and innovative developments within this pedagogy should be embraced and digital literacy should become an integral part of clinical education and practice.

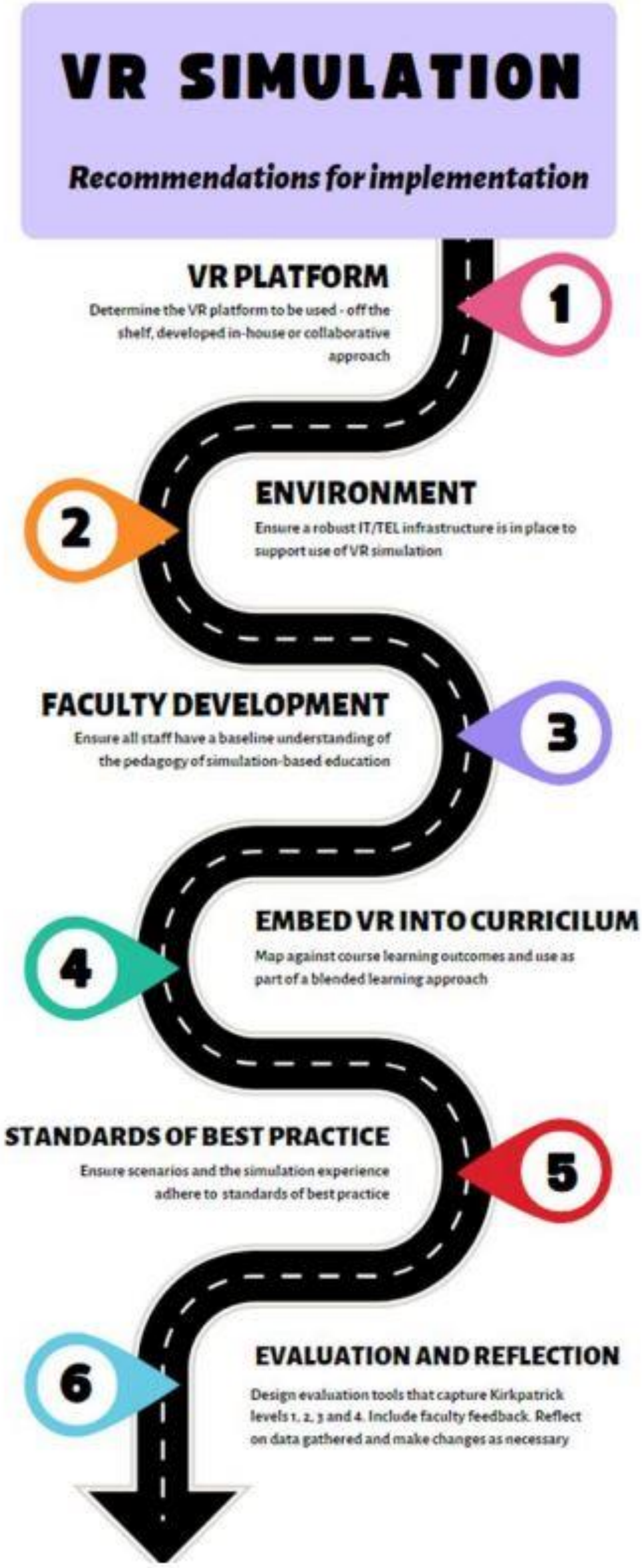


Figure 2: VR simulation - The road to success

Glossary

Augmented reality

Augmented reality (AR) is where digital content is seamlessly overlayed and mixed into our perception of the real world. AR can be 2D and 3D objects, audio, and video files, and tactile and olfactory information. Users can perceive real-world experiences with added data as one single environment (Yuen et al., 2011).

Blended learning

Blended learning is a flexible and innovative approach that combines traditional face-to-face instruction with electronic and online learning activities (Saliba & Rankine, 2010).

Deliberate practice

The individualised highly structured training activity is specifically designed by a coach or teacher to improve an individual's performance of a particular task through repetition and successive refinement. It often involves the provision of immediate feedback, time for problem-solving and evaluation, and opportunities for repeated performance to refine behaviour (Ericsson & Charness, 1994; Ericsson & Lehmann, 1996).

Extended Reality (XR)

An umbrella term for immersive technologies that blend the digital world with the real world. This can be on a small scale such as visual overlays, to entire simulated worlds. Examples of XR include AR, VR and MR (NHS England, 2023a).

Haptics

The use of technology that stimulates the senses of touch and motion simulates the sensations that would be felt by an individual interacting directly with physical objects (Escorcia Hernández et al., 2023).

Manikin

A manikin is a full-body training device used in healthcare education which can vary from the basic shape and size of a person to a high-fidelity manikin with palpable pulses, realistic airways, and bodily functions. It enables learners to practice and refine their skills in simulation, away from actual patients (Handeland et al., 2021).

Mastery learning

Mastery learning is a model where educational progress is not dependent on time, but rather on performance. The learner is constantly assessed until mastery is achieved. All students can achieve the same level of learning, although the amount of time required is variable (Shamsi & Dorri, 2019).

Mixed reality (MR)

Blends the real and virtual worlds using cameras, sensors, and artificial intelligence. It seamlessly merges physical and digital elements, providing immersive experiences such as interacting with shared documents or prototypes and going beyond augmented reality by integrating and interacting with both realities (Microsoft Learn, 2023).

NCFE

Previously known as the Northern Council of Further Education, NCFE is one of the largest technical and vocational awarding organisations in the UK (NCFE, 2023).

Part-Task trainer

Part-task trainers are specialised models designed to help a learner practice a specific skill. Where high-fidelity manikins are invaluable in practising an entire patient encounter, part-task trainers allow for the refining of psychomotor skills in isolation (Grenvik & Schaefer, 2004).

Neurodiversity

Neurodiversity describes the idea that people experience and interact with the world around them in many ways. There is no one “right” way of thinking, learning, and behaving and differences should not be viewed as deficits e.g. in autism (Baumer & Frueh, 2021).

T-level education

T-levels are new 2-year courses taken after GCSEs that are broadly equivalent to three A levels. They were launched in 2020 and were developed in collaboration with employers and educational providers. They are designed to prepare learners for entry into skilled employment, apprenticeship, or further education (Department of Education, 2023).

Training scar

A bad habit is picked up in training, often repetitively, that then goes on to become an error in practice (Hall, 2013; Neveu & Pavoni, 2019).

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