

In this article...

- How augmented reality can be used in clinical simulation scenarios
- Why this approach emerged as a response to the Covid-19 pandemic
- How a more seamless learning process can be achieved by introducing virtual resources

Opportunities for augmented reality in clinical simulation education

Key points

Face-to-face clinical simulation can be enhanced by augmented reality

Augmented reality involves digital media content being embedded in the physical environment

The technology can make it easier to use simulation with large numbers of students

Challenges include technical issues and the complexity of the situation facing the learners

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Abstract This article presents the use of augmented reality – a mixed-reality technology that combines virtual content overlaying real-world objects – to support clinical simulation in a university mock ward clinical simulation and skills suite. We describe the innovative use of augmented reality in high-fidelity simulation education as a mechanism to increase realism, improve efficiencies and promote learner engagement.

Citation Bellamy E et al (2022) Opportunities for augmented reality in clinical simulation education. *Nursing Times* [online]; 118: 5.

The Covid-19 pandemic has led to rapid change, massive pressure on health services and drastic reform in almost all workplaces. One result of this is that innovation has been stimulated in a range of arenas, including clinical simulation in health education. This article focuses on augmented reality (AR) supporting clinical simulation in a university mock ward clinical skills suite. The AR element is a way to enhance and support the physical teaching and learning.

Use of an AR approach of blending reality and digital reality was stimulated by the shift to virtual learning in higher education, which was brought on by the restrictions introduced at the start of the Covid-19 pandemic in 2020. This required a complete redesign of learning activities to engage students in the learning process. However, we have now moved back to clinical simulation education in person as students return to face-to-face teaching.

The model of simulation education was developed at the University of Derby to embrace new and emerging technologies. AR enables the teacher and learner to gain the best of both in-person education and digital learning.

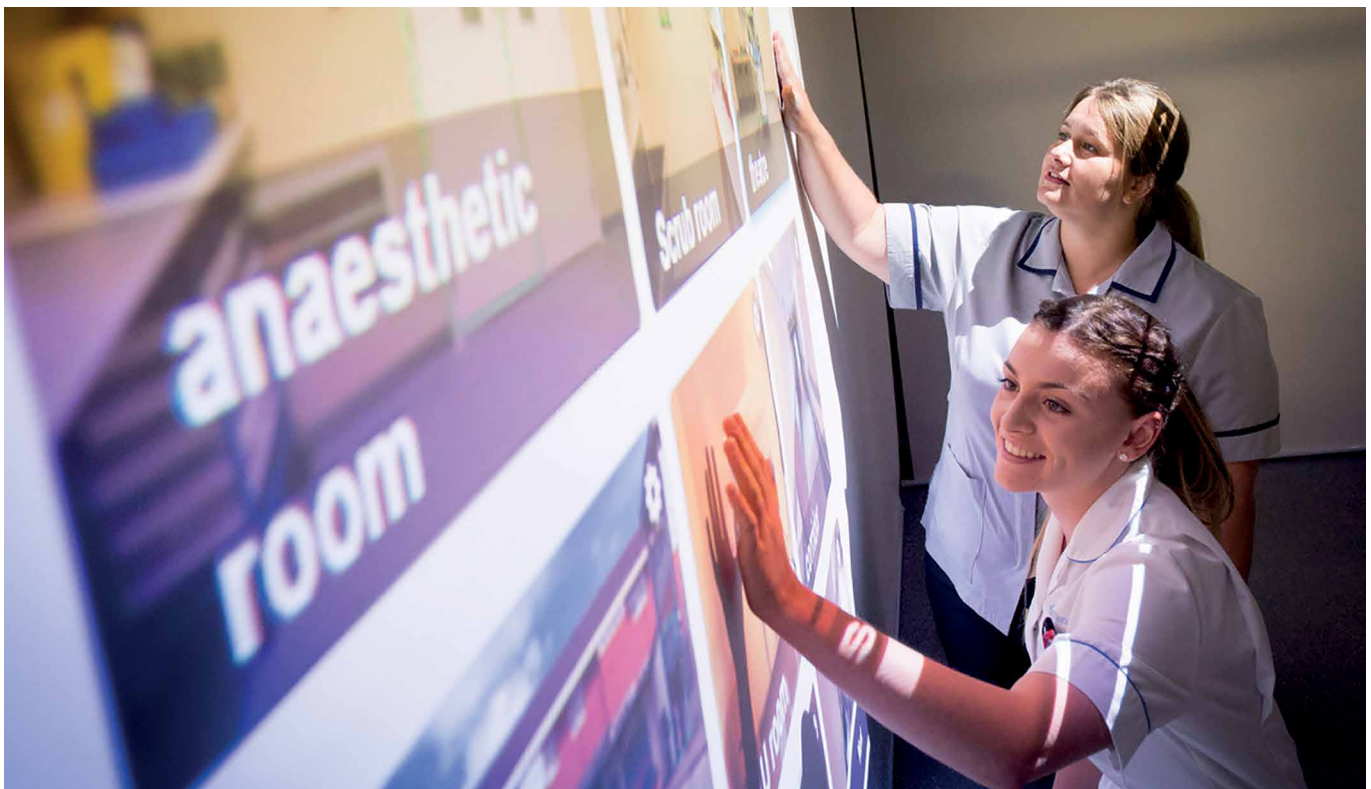
Investment in simulation

Increasingly, clinical simulation is growing in importance out of a desire to encourage the use of evidence-based practice when acquiring clinical skills. This has led to many universities and health service employers investing in clinical simulation resources, including:

- Highly trained and experienced clinical educator staff;
- High-cost physical estate, such as mock wards and operating theatres;
- Equipment such as manikins and immersive projected simulation suites (Whitehead, 2019).

The restrictions on face-to-face learning triggered by the pandemic led to the use of such physical resources being severely limited and, for long periods, prohibited. Further restrictions on placement capacity have impeded the ability to develop clinical assessment skills, and limited patient interaction has proven a barrier to the implementation of theoretical understanding through clinical reasoning. This has encouraged the development of virtual learning (Laerdal, nd) and other innovative methods of skills teaching during the pandemic. One such innovative teaching method is that of clinical skills

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Student nurses in immersive simulation suite

boxes, as described by Ansell and Whitehead (2021), which involve students collecting a box of equipment, with which to practise a clinical skill at home. For example, a stethoscope and sphygmomanometer could be acquired to practise pressure measurement.

Students and educators have become more used to virtual reality and high-fidelity technology for clinical simulation – and this increasing familiarity with digital technology is what encouraged us to

blend the physical and digital worlds in an AR-supported educational environment.

What is AR?

AR is an established technology that blends virtual technology with the real world to bring the advantages of both environments together. The advantage of using AR in simulation teaching scenarios is that students can learn in the simulated ward, home environment or other physical environment, with AR to guide them. This

provides consistency in teaching and can increase the volume of students that can be safely educated under the supervision of a clinical educator.

We outline an example of how we plan to implement AR in onsite clinical simulation scenarios at the University of Derby.

Using AR for clinical training

The university's simulation is based on a spiral curriculum model (Dowding, 1993; Bruner, 1965) and involves a fictitious patient, who has an ongoing series of health and social issues with which students engage at different stages in their life, matched to the nursing curriculum. This allows the student to follow the patient on their health journey through their programme of study. This familiarity increases learner confidence in the simulation classroom.

The spiral simulation curriculum at the University of Derby was developed to make sure the scenarios incorporate a variety of healthcare settings to contextualise the clinical environment and provide curriculum alignment to professional and regulatory standards. The delivery of simulation at the university takes place in areas that recreate an acute hospital ward setting (Fig 1). This is supported by immersive suites – rooms enabled for projection on to three walls (Fig 2). The immersive

Fig 1. Mock ward, University of Derby clinical simulation suite



Fig 2. Immersive suite, University of Derby



suites are instrumental in delivering realism in the learning environment, as they can simulate any environment projected on to the walls, though the size of the suites limits capacity.

Student feedback, while positive about the experience of using the suites, has highlighted the struggle to visualise the reality of the scenario, yet simulated training experiences have been shown to improve critical thinking in healthcare students (McCormick et al, 2013). It could be argued that the challenges experienced by learners are due to the aesthetics of the environment, as well as the use of manikins over real patients. Anecdotal feedback from students has highlighted that they feel overwhelmed in the simulation room, which affects their recall and their application of skills. It is

hoped that integrating AR will promote active learner engagement in simulation by providing further variety and connecting the student with a more realistic environment, thereby helping to overcome this perceived environmental barrier to learning.

AR facilitates the integration of virtual resources in the physical environment. This results in a synthesised reality of part real-world objects (such as a table, bed or poster) combined with virtual content (including videos, text, imagery and other media) that is overlaid and integrated into the real environment (Olwal, 2009). Unlike virtual reality, AR superimposes virtual content around real-world components to complement the host environment, rather than replace it (Milgram and Kishino, 1994). AR technology provides a

hybrid combination of digital media content embedded in the physical environment, with the purpose of:

- Improving learning;
- Reducing cost;
- Refining efficiencies.

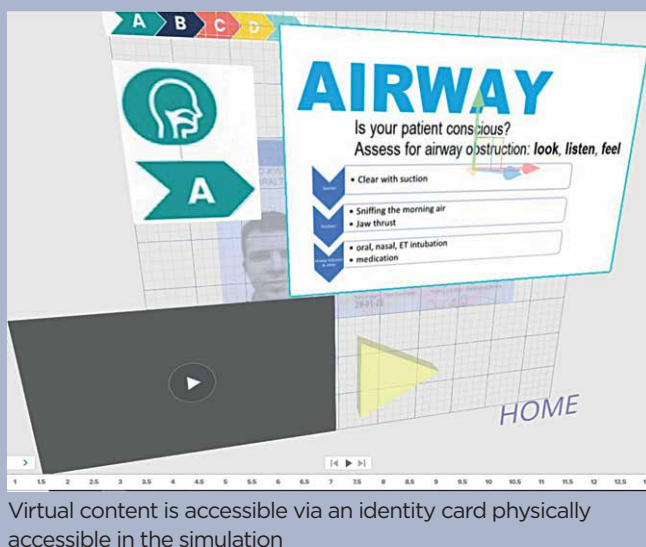
During clinical simulation scenarios, the laminated handover documents previously used by educators at the university lack the interactivity of real-world clinical scenarios and have lost relevance assimilated to modern healthcare environments. In the educative arena, the use of AR can compensate for these limitations, providing combined interactive content with tangible commodities, such as the identity card shown in Fig 3. As such, we determined AR as the optimum technology to integrate with the university's health education simulation package to supplement, without replacing, clinical instruction.

AR has the capacity to engage learners in simulation activities to develop their depth of understanding. Our AR resources are intended to provide a more seamless learning process, with increased learner control over the stages of clinical assessment – and, therefore, more control over their learning process (Lee, 2012).

An AR handover was created for patient scenarios to transform the simulation learning experience (Fig 4). A range of virtual content was integrated as supplementary material to support the assessment and decision-making process of learners, with several scenes created to guide them in an interactive immersion through the patient scenario.

Capturing the immersive element of learning in patient scenarios used across

Fig 3. Identity card



Virtual content is accessible via an identity card physically accessible in the simulation

Fig 4. AR handover



Action triggers are integrated in the AR resource as prompts for the simulation scenario

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simulated education is inherently challenging (Pollock and Biles, 2016; Kable et al, 2013). The intended outcome of this AR handover is that it will help learners to engage with the simulated patient scenario. The augmented simulation provides:

- A safe environment in which learning is contextualised;
- Learner freedom to process evidence-based practice aligned to theoretical understanding;
- Peer collaboration through an authentic scenario.

This learner-centric process facilitates knowledge integration to formulate plans for care and develop clinical reasoning skills.

Technical challenges

Englund (2017) determined that optimal student experiences and educational outcomes are only possible using technologies if educators are confident and competent in the development and delivery of such digital resources. Also, technical difficulties – such as connectivity issues, low-quality media and dysfunctional hardware – can interrupt the simulation process and devolve the learning experience (Englund, 2017; Foronda and Bauman, 2014; De Gagne et al, 2013). This would detract from the potential of technologies to augment the learning process; as such, priorities for implementation have been identified as:

- Making sure educators are adequately trained in the use and implementation of the newly developed AR technologies;
- Providing adequate technical support to both learners and simulation facilitators, should troubleshooting help be required.

The physical environment and safety of users and facilitators is also an important consideration for integrating AR into the simulation area. Nonetheless, the practicalities considered in the use of AR are outweighed by its potential value for students.

Trial

The AR simulation will be trialled with a cohort of second-year healthcare students, as they are not novices to the simulation room. At their stage of study, the cohort remains a mixture of fields of nursing, thus supporting a valid and robust evaluation of its use.

Introducing the concept of AR will be carefully managed to make sure the students are empowered to use the technology. It is perceived that this will occur at the beginning of the scheduled simulation in the introductory lecture,



Student nurses in simulated ward scenario (top) and discussing vital signs observations in interactive immersive simulation suite

supplemented with further reading. Lecturers will be given preparatory training and be supported by health and social care technicians in the mock ward.

Conclusion

Our experience of implementing AR at the University of Derby has been positive and indicates that this is a useful resource for enhancing the quality and quantity of clinical simulation education. Based on our experiences so far, we would recommend the replication of this approach elsewhere. We look forward to delivering a follow-up article to share our findings through an evaluation of the implementation of AR in health simulation. **NT**

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