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Three principles for the progress of immersive technologies in healthcare training and education

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The challenge of providing training and education in healthcare has never been greater. The COVID-19 pandemic has highlighted the weaknesses of methods that rely on master–apprentice models, face-to-face delivery and patient access. The emergence of a new generation of 'immersive technologies' (eg, augmented and virtual reality) presents an opportunity to overcome existing weaknesses and radically transform the healthcare education landscape.[1]

While digital simulations have been available for decades, recent large-scale investments coupled with breakthroughs in low-cost computing and artificial intelligence make this feel like a watershed moment for immersive simulation technologies. Yet, improper implementation and poorly designed evaluation could risk future growth and place a considerable burden on the healthcare system. With this in mind, we recently brought together a collection of clinicians, researchers and industry under the banner of the 'Immersive Healthcare Collaboration'. We sought to generate a set of guiding principles to maximise the utility of these technologies for training and education. The result of this cross-disciplinary effort is the creation of a report laying out three evidence-based principles for safe, efficient and effective progress for immersive technologies in healthcare training and education. To understand the rationale and evidence behind each principles, we refer readers to the full report.[2] Here, we provide a summary to encourage the broader immersive healthcare community to implement in their own work and practice. We believe adoption of these principles will help realise the enormous potential of these technologies and in turn, benefit the healthcare community and ultimately, patient care.

PRINCIPLE 1: DESIGN AND DEVELOPMENT SHOULD BE DRIVEN BY LEARNING NEEDS

Numerous technological revolutions in education have failed to improve learning outcomes, with purchasing decisions too often ignoring the needs of learners. To maximise the potential of immersive technologies, we must answer a number of critical questions: (1) Which learning tool, immersive or otherwise, is best suited to achieve the learning outcome? (2) Which immersive experiences have been shown to improve outcomes in high-quality research? (3) How do we design and implement immersive technologies to achieve specific learning objectives? (4) Why do immersive systems accelerate the learning of specific outcomes when compared with other tools? Or, in summary, answer the question: 'Immersive—so what?'

Considering the resources associated with developing and implementing these technologies, it is critical that we consider the pedagogical purpose and decide which features are necessary to address the learners needs and improve learning outcomes. For example, it seems intuitive that haptic feedback would improve the learning of surgical procedures,[3] but how might these technologies best be implemented? An answer to this question is hampered by our limited understanding of how sensory feedback is used in different learning contexts. This makes it difficult for a developer to understand where such a feature would be helpful and where it might hinder. Thus, we need to advance our theoretical understanding of the sensory processes underlying learning in parallel with technology development and implementation.

PRINCIPLE 2: IMPLEMENTATION MUST GO HAND-IN-HAND WITH RIGOROUS EVALUATION

Most of today's immersive systems have a degree of face validity (ie, they present relatively realistic simulations of the real-world task), but this does not necessarily translate to learning. Some systems may show construct validity (demonstrating that the system measures what it claims to be measuring) and while this is a critical step in the development of an effective tool it should not be the last. We need more demonstrations of how learning carries over from simulation to the real world,[4] and an emphasis on outcomes relevant to the clinical environment (eg, technical and non-technical skills, as well as social and emotional learning) is crucial to establishing the value of immersive technologies as learning tools.[5]

In the majority of cases, we accept that acquisition of new technology is not driven by validity or outcomes, but dictated by finances. And because many studies take place only because of a local opportunity, they are rarely well resourced and appropriately powered. To ensure that research in the implementation and evaluation phase is held to high levels of scientific rigour, we encourage journals, funders and institutions to incentivise stakeholders to engage in transparent, open-science practices, such as pre-registration of research methods and publicly available analysis protocols.

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PRINCIPLE 3: A CULTURE OF COLLABORATION SHOULD BE FOSTERED TO ENSURE EFFICIENT AND EFFECTIVE USE OF IMMERSIVE TECHNOLOGIES

The value of collaboration through multisite randomised controlled trials to health sciences is well established, but such studies come with considerable logistical challenges and resource requirements. The digital nature of immersive technologies could overcome such barriers. They also present an opportunity for harvesting 'big data' in ways that could boost collaboration and efficiency. The increased adoption of remote working practices in a post-pandemic world is likely to accelerate the development of the infrastructure, knowledge and bandwidth that allow routine sharing of anonymised large-scale data. If this culture is supported by a quality assurance system administered by an appropriate body, this could increase the motivation from industry to share data and in doing so, more closely align the independent goals of academia, industry and healthcare education.

With widespread roll-out possible and the increasing ubiquity of these systems, wider issues around diversity and inclusivity come to the fore. Biases in the technology development process (eg, discriminatory algorithms) are well documented and there are specific concerns about system inclusivity for people with disabilities. If immersive tools are ultimately to become mandatory for training and education, co-design with industry will be necessary to develop accessible solutions for all users.

LOOKING FORWARDS

It is clear that we need a combination of a bottom-up drive (from clinicians, educators, researchers, developers) complemented by top-down initiatives (organisations, funders, journals) that facilitate work across disciplines, institutions, fields, sectors and countries to build capacity and change perspectives through the use of immersive technologies. Through the publication of our report, and this summary letter, we hope to initiate a cultural shift towards collaboration and the creation of inclusive tools that have pedagogical purpose at the forefront of the development process, generating an evidence-base founded on robust and open science.

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