

Virtual reality enhancing medical education and practice: Brief communication

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Abstract

The COVID-19 pandemic has become a major cause of rapid globalization and digitization of educational institutions, including medical education. The adaptation to digital technologies is the purpose of best education and training practices in the development of the academic medical curriculum. Virtual reality (VR) is embraced by the 3D environment and network resources which allow the expansion of VR from the entertainment industry to the education industry. This brief communication explains our understanding and the challenges in adopting VR technologies for medical training at an academic medical center. Advancement in VR technology assists medical institutes to strategize for the further development of medical training and education. There is a timely need for persistence to make the VR content accessible widely and open source. There is an urgent need for collaboration of medical institutes and technology industries on the development of education-related VR content and simulations.

Keywords

Medical education, virtual reality, medical simulations, healthcare training

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Introduction

In recent years, studies have unveiled the evidence for the benefits of virtual reality (VR) in various domains such as entertainment, gaming, real estate, tourism including healthcare. It is high time for the healthcare industry to harvest the potential uses of VR simulation for various medical education programs as well as clinical practices. VR system is a combination of various hardware and software, including a head-mounted display with head tracking systems, sound, and navigation devices, which provides the feeling of immersion in VR. These characteristics are the main reason for expanding VR applications from the entertainment industry to the healthcare and education industry which allows students and doctors to explore the effects of VR simulations in medical training, as well as in the clinical practices for diagnostics, therapeutic, and rehabilitation purposes.^{1–4} With the introduction of the metaverse, VR technologies are embraced by medical educators with a focus on 3D environments and network resources.

The strategies for the development of academic medical centers arise from their core values and missions that aim to

provide unmatched education, training, research, and clinical practices. These missions drive the introduction of new

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strategies and technologies toward the development of medical education. The outbreak of the covid-19 pandemic caused rapid digitalization of the healthcare industry in research and training making it one of the great transformations in healthcare. Incorporation of digital health approaches such as VR and metaverse in medical training and clinical practices makes healthcare professionals and medical students better understand the physiology and anatomy of human beings in a risk-free environment. VR has the power to make educational training more engaging and inspiring for the trainers uniquely and powerfully. Currently, academic medical centers are affected due by covid-19 which has led them to adopt digital tools for real-life-based medical education experience. This article aims to explain our understanding and the challenges in adopting VR technologies for medical training at an academic medical center.

Advancement in the 360° immersive reality platform has provided a unique experience to the learners. Pre-clinical subjects such as anatomy and physiology have become interactive like never before.⁵ Now a learner can immerse in the blood cells, wander around the heart chambers, and pass through any organ in the body for a better understanding of complex human anatomy and physiology in a risk-free environment. Moreover, VR technologies promote early clinical exposure for medical students as early as their first year, whereas previously, they were only introduced in the fourth and fifth years of medical school. At Taipei Medical University, we have used 360° video for the last four years to teach our junior medical students and to experience the following:

- (I) *Emergency room (ER) experience to resuscitate patients.* This provides a unique opportunity to feel a real-world ER scenario.⁶ We make junior medical students get immersed in the ER. They need to answer multiple-choice questions to decide what they will do and make clinical decisions depending on the given scenario. The position of a 360° camera should allow the learner to investigate the environment and choose their position in the ER. 360° videos are easy to apply in teaching now because they are getting cheaper and more accessible.
- (II) *VR anatomy to enhance sonography learning.*⁷ We use the 3D strength of VR to help students capture the sonography slice image. Students can cut and rotate the 3D animation image and learn better from 3D structure than from 2D images.
- (III) *Thoracentesis VR training.*⁸ Thoracentesis, also known as pleural tap, is an invasive medical procedure to remove fluid or air from the pleural space for diagnostic or therapeutic purposes. TMU Center for Education in Medical Simulation provides the expertise of clinic knowledge and simulation learning theory to design the app and the HTC response for the 3D modeling and interaction engineering.

Discussion

VR plays a leading role in the improvement of the medical profession. The immersive reality 3D computer technology in VR helps healthcare professionals to analyze the different medical conditions and compare of healthcare-related information. Imparting VR simulation in the initial stages of medical training allows medical institutes to give a better understanding of clinical practices. The content can be tailored to each learner's preferences and needs, which is one of the benefits of VR learning. It is more interactive and engaging, with hands-on learning opportunities such as "learn by doing." Moreover, immersive experiences which are created by VR allow students to understand the 3D structure modeling of the human organs and handling of the instruments in a risk-free environment without compromising the patient's safety as the real patients are not involved. Few limitations include the higher cost of VR system installation, technical limitations, urgent need for a software/content development team, lack of scientific evidence, and lower cognizance among faculties and students. An ideal VR technology for the medical training program must satisfy several conditions, including multimodal training plans, an artificial platform as well as the assessment criteria.^{9,10}

Future expectations

The future expectation of VR is to introduce different training and advanced certification programs. The content of VR programs could be accessible as an open-source which can help to lower the cost of learning. It is necessary to improve the performance of VR, in terms of realism and capabilities, which requires designing advanced hardware and developing more intuitive and user-friendly software to achieve a better understanding of training programs. With the help of this technology, healthcare professionals will easily understand the status of diseases. It will assist the doctors and nurses in the view the biological mechanisms of patients in the virtual world. Future VR simulation and training program development will necessitate joint research collaborations between the healthcare industry and the VR industry.

Conclusion

In conclusion, in the current situation of the COVID19 pandemic, with restrictions on face-to-face meetings and online courses, VR training has become the substitute. In this pandemic situation, where cadavers are hard to obtain, VR simulations will be the best option for training and teaching. The current healthcare scenarios ensure that VR is valuable in the domains of medical training and clinical practice, and its adoption in the healthcare industry is inevitable.

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