Using Holograms to Enhance Learning in Health Sciences and Medicine

Christian Moro¹ · Charlotte Phelps¹ · Dominique Jones¹ · Zane Stromberga¹

Published online: 24 August 2020

© International Association of Medical Science Educators 2020

Abstract

With the increasing volume of information for students to learn in a health sciences and medicine degree, tertiary educators need teaching resources that can maintain up-to-date information and educate effectively across a range of diseases and illnesses. Holograms may be the disruptive technology that can assist in this goal.

Keywords Disruptive technology · Mixed reality · HoloLens · Holograms · Future learning · Augmented reality

There has been a recent shift in tertiary education from traditional lectures and tutorials to more self-paced, visual methods of learning [1]. This brings interesting challenges to education in health sciences and medicine. Technology, in the form of holograms, presents an opportunity to package content in an easy-to-comprehend way that enhances the student learning experience.

Students nowadays are experienced with handling many technological devices, including computers, smartphones and tablets. However, the introduction of more modern visualisation technologies, such as augmented and virtual reality, offers additional tools for educators wishing to provide engaging 3D content for students. Researchers have investigated the effectiveness of incorporating this technology into the training of forthcoming health professionals to enhance knowledge acquisition and understanding of anatomical structures [2], with students reporting it to be useful and engaging for self-directed study. Furthermore, the use of this technology enables improved educational practices as these 3D visualisations can be used on devices that are already available for the general public [3–5].

One of the most recent advancements in educational technology is the introduction of mixed reality holograms, which is a platform combining augmented and virtual reality to provide a real-world experience with virtual objects. The most

supported mixed reality device is Microsoft's HoloLens, which provides users with a holographic platform of seeing and hearing the augmented world through a head-mounted computer. This link between the real and virtual environments should help to reduce adverse health effects, such as cybersickness, blurred vision, and disorientation, experienced in virtual reality applications using head-mounted displays [6].

Holograms demonstrate the potential to significantly improve knowledge scores and spatial awareness compared with traditional teaching methods, particularly for anatomical learning [7, 8]. The HoloLens presents high-precision holographic images, allowing students to visualise human anatomical structures from all perspectives [4], and can also detect precise shapes or objects in real space to accurately align the hologram with these structures [9]. Additional advantages of this mixed reality tool include the hands-free nature of the device for students to take notes while learning, as well as the ability to manipulate the holographic images via hand gestures to virtually dissect structures for advanced anatomical learning, without the constraints associated with the use of cadavers. The benefits of using 3D holographic visualisations compared with printed images were recently investigated in a study by Hackett and Proctor [10] who investigated a population of nursing students during a cardiac anatomy course. The authors reported a significant improvement in anatomical knowledge from the hologram intervention compared with printed images due to a suspected reduction in cognitive load. Students were able to actively learn content presented in their studies with the aid of the HoloLens, which increased their

✉ Zane Stromberga
zstrombe@bond.edu.au

¹ Faculty of Health Sciences and Medicine, Bond University, Gold Coast, Queensland 4229, Australia

spatial understanding and overall engagement with the course material.

The mixed reality platform has demonstrated success as a delivery mode within health professional course curricula. Hologram technology via the HoloLens may become a powerful tool [2], that has the potential to allow transferability of education and training programs to health professionals, institutions, and faculty staff.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval NA

Informed Consent NA

References

1. Moro C, McLean M. Supporting students' transition to university and problem-based learning. *Med Sci Educ.* 2017;27(2):353–61. <https://doi.org/10.1007/s40670-017-0384-6>.
2. Birt JR, Stromberga Z, Cowling MA, Moro C. Mobile mixed reality for experiential learning and simulation in medical and health sciences education. *Information (Switzerland).* 2018;9(2):31.
3. Moro C, Stromberga Z, Birt JR. Technology considerations in health professions and clinical education. In: Nestel D, Reedy G, McKenna L, Gough S, editors. *Clinical Education for the Health Professions: Theory and Practice*. Clinical Education for the Health Professions: Theory and Practice: Springer; 2020. p. 25.
4. Moro C, Gregory S. Utilising anatomical and physiological visualisations to enhance the face-to-face student learning experience in biomedical sciences and medicine. In: Rea P, editor. *Biomedical visualisation, advances in experimental medicine and biology*. Switzerland: Springer Nature Switzerland; 2019.
5. Moro C, Stromberga Z, Stirling A. Virtualisation devices for student learning: comparison between desktop-based (Oculus Rift) and mobile-based (Gear VR) virtual reality in medical and health science education. *Australas J Educ Technol.* 2017;33(6):1–10. <https://doi.org/10.14742/ajet.3840>.
6. Moro C, Štromberga Z, Raikos A, Stirling A. The effectiveness of virtual and augmented reality in health sciences and medical anatomy. *Anat Sci Educ.* 2017;10:549–59.
7. Moro C, Smith J, Stromberga Z. Multimodal learning in health sciences and medicine: merging technologies to enhance student learning and communication. In: Rea PM, editor. *Biomedical visualisation*. 5th ed. Cham: Springer International Publishing; 2019. p. 71–8.
8. Moro C, Stromberga Z, Raikos A, Stirling A. Combining virtual (Oculus Rift & Gear VR) and augmented reality with interactive applications to enhance tertiary medical and biomedical curricula. *SIGGRAPH ASIA 2016 Symposium on Education: Talks*; Macau: Association for Computing Machinery; 2016. p. Article 16.
9. Mitsuno D, Ueda K, Hirota Y, Ogino M. Effective application of mixed reality device HoloLens: simple manual alignment of surgical field and holograms. *Plast Reconstr Surg.* 2019;143(2):647–51. <https://doi.org/10.1097/PRS.0000000000005215>.
10. Hackett M, Proctor M. The effect of autostereoscopic holograms on anatomical knowledge: a randomised trial. *Med Educ.* 2018;52: 1147–55.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.