

Co-creative Virtual Reality Content Development in Healthcare; Evaluation Methods and Curricular Integration.

Panagiotis E. Antoniou¹, Daphne Economou² and Panagiotis D Bamidis¹

¹ Lab of Medical Physics and Digital Innovation, Aristotle University of Thessaloniki, Thessaloniki, Greece

² School of Computer Science and Engineering, University of Westminster, London, UK
antoniope@auth.gr

Abstract. Virtual Reality (VR) has evolved prolifically in healthcare education. Through participatory design methods, an iterative design process can cater to highly complex bespoke themes and learning objectives. However, another key challenge for VR in healthcare education remains open and this panel session aims to explore. Higher education institutions (HEIs) are reluctant to integrate VR and other immersive media in their curricula. Vocational education and continuous professional development actors in healthcare are using these resources but only experimentally. Individuals usually consider these educational resources novel but also, at times, something of a novelty. Two are the core challenges in the acceptance and curricular integration of these immersive learning resources. The first and primary, is the establishment of a valid, uniform, pedagogically sound evaluation framework for all dimensions of VR resource utilization in healthcare education. The second challenge, tied to the first, is the accreditation of educational episodes that contain VR resources as core instrument of instruction. These challenges, their theoretical underpinnings and a glimpse on emerging trends are going to be tackled in this panel. Taking cues from the considerations of real-world anatomy resources developed for the ENTICE project, experts in the fields of medical education, immersive resource evaluation and healthcare policy-making will explore these themes. Short introductory opening statements from the panel will serve as jumping – off points for practitioners in healthcare education, technologists and learners to exchange views and synthesize a collaborative position regarding these important challenges for immersive healthcare resources.

Keywords: Virtual Reality, Evaluation, Healthcare, Education, Curricular integration.

1 Relevance

Virtual Reality and other immersive media are established as a recognized immersive learning modality in the field of healthcare education. Both its cognitive and affective impact is identified ([1]-[4]). VR facilitates engagement, affectively, but it also is unrivaled in building a scientific paradigm through visualization of complex, sometime abstract concepts and mechanisms ([5], [6]). This audiovisual immediacy, however comes at a price.

The global healthcare market even within the COVID-19 financial hardship stabilized in 2021 at USD 1.207 billion with an estimate for 2028 at USD 11.658 [7]. To put the cost side of these numbers into perspective, the cost of a VR evacuation protocol training exercise in 2019 was priced at \$106387.00 [8]. This resource was made sustainable due to the reusability of the material against the recurring costs of each live training exercise.

In that context, participatory design approaches further reduce overheads, time and resource-wise, in digital content development [9]. Several toolsets and iterative development strategies like SCRUM and AGILE have been implemented to support co-creative methods ([10], [11]). Furthermore, visual programming and brainstorming tools, together with semantic back-ends facilitate this process technologically [12].

Moving past the content creation challenge, the next hurdle that emerges is that of educational acceptance. While bespoke VR resources can and have been individually evaluated/accepted for purpose, a complete, valid, uniform, pedagogically sound evaluation framework for VR resources, even within the scope of healthcare education is not yet prolific.

2 Purpose and Objectives

Healthcare education is one of the most rigorously regulated fields regarding accreditation of curricula, training resources and programs. Out of 195 countries in the world, 183 of them have at least one national body that is responsible for accreditation of either healthcare-specific or general educational activities [13]. Of course, there are several transnational or international institutional stakeholders, which advise or even federate national regulatory bodies such as the World Federation of Medical Education under the auspices of the World Health Organization [14]. The end goal of this rigorous environment is the prevalence of Competence Based Medical Education and Entrustable Professional Activities, that is verifiable, results oriented curricula that will reliably create a capable and effective healthcare workforce [15]-[17].

In that environment, VR resources are sometimes viewed at best as a luxury and at worse as a technological novelty by veteran medical educators. That is why a rigorous, evidence-based evaluation endeavor is always necessary for every healthcare education resource.

Even beyond that, as VR resources become more prolific in healthcare education, the necessity emerges for a consistent, if not rigorously validated, streamlined evaluation framework for VR resources. Several endeavors have been conducted to adopt general instruments of technology evaluation (e.g. TAM [18]) with significant progress [19] a VR-specific “360o evaluation” framework for healthcare education is still missing. Such a framework, validated towards competence based medical education, adopted for VR in healthcare, but not resource specific would be the core prerequisite for a massive shift in scale of proliferation for these immersive media in healthcare curricula.

3 Context and Theoretical Framework

The core problem one faces when tackling the “VR powered educational episode” evaluation, as a holistic use case and not as a single novelty, is the fact that there is not a “one size fit all” evaluation methodology. One can evaluate the technology using standardized instruments and questionnaires. Alternatively, they can evaluate knowledge retention through topical bespoke questionnaires. However, they are not able to create a “one size fit all” validated instrument that evaluates the efficacy of a VR empowered educational episode. This does not mean that it is impossible to endeavor towards a holistic framework of evaluation for immersive educational episodes. The fact of the matter remains that from its inception technology enhanced learning, even more so VR, was deemed a constructivist’s tool of instruction. It should easily follow, then, that to manufacture the holistic framework for its educational evaluation, one should resort to a qualitative-mixed methods approach, the arsenal of choice for evaluating constructivist pedagogical endeavors [20],[21].

This simple realization is behind the evaluation planning of the ENTICE project. Since its inception we focused in evaluating the VR empowered educational episode and not the resource itself. In that context our approach and our aim for a holistic VR medical education evaluation framework will revolve around a mixed methods approach with overarching context provided by qualitative evaluation and technical details, or refinements provided by formal quantitative instruments (e.g., TAM etc. [19]).

4 Conclusions

The previous discussion about the theoretical underpinnings and the technical necessities of evaluation, usefulness and subsequent, curricular integration is not yet closed. Immersive medical education through VR and other such modalities comprises a multitude of diverse stakeholders. Even the dimensions of evaluation of these resources cannot be categorically defined without taking into account the context of the educational episode. That is why, in the ENTICE project, edu-centric anatomy VR and 3D printed

resources are evaluated framed in the educational episodes for which they will be deployed. That is why a mixed methods approach, starting from formal questionnaire instruments but incorporating, as a matter of protocol, not ad-hoc, qualitative instruments like semi- structured interviews is necessary. Qualitative results provide the correct “positioning” of both technical and pedagogy- oriented instruments and allow for a true competence based medical education with these resources. Mixed methods reveal VR resource’s applicability scope, facilitating both fitness for purpose and repurposing potential in the context of competence-based education in healthcare.

References

1. Antoniou, P. E., et al. (2020). Biosensor Real-Time Affective Analytics in Virtual and Mixed Reality Medical Education Serious Games: Cohort Study. *JMIR Serious Games*, 8(3), e17823. <https://dx.doi.org/10.2196/17823>
2. Antoniou P., et al. (2020) Real-Time Affective Measurements in Medical Education, Using Virtual and Mixed Reality. In: Frasson C., Bamidis P., Vlamos P. (eds) *Brain Function Assessment in Learning. BFAL 2020. Lecture Notes in Computer Science*, vol 12462. Springer, Cham. https://doi.org/10.1007/978-3-030-60735-7_9
3. Dolianiti F., et al. (2020) Chatbots in Healthcare Curricula: The Case of a Conversational Virtual Patient. In: Frasson C., Bamidis P., Vlamos P. (eds) *Brain Function Assessment in Learning. BFAL 2020. Lecture Notes in Computer Science*, vol 12462. Springer, Cham. https://doi.org/10.1007/978-3-030-60735-7_15
4. Kyriakidou MR., Antoniou P., Arfaras G., Bamidis P. (2020) The Role of Medical Error and the Emotions it Induces in Learning – A Study Using Virtual Patients. In: Frasson C., Bamidis P., Vlamos P. (eds) *Brain Function Assessment in Learning. BFAL 2020. Lecture Notes in Computer Science*, vol 12462. Springer, Cham. https://doi.org/10.1007/978-3-030-60735-7_1
5. M. Dunleavy, C. Dede, and R. Mitchell, “Affordances and Limitations of Immersive Participatory Augmented Reality Simulations for Teaching and Learning,” *J. Sci. Educ. Technol.*, Feb. 2009, vol. 18, no. 1, pp. 7–22.
6. H.-K. Wu, S. Wen, -Yu Lee, H.-Y. Chang, and J.-C. Liang, “Current status, opportunities and challenges of augmented reality in education,” 2013.
7. “Virtual Reality (VR) in Healthcare Market Size, Share & COVID-19 Impact Analysis, By Component (Hardware, Software, and Content), By Application (Pain Management, Education & Training, Surgery, Patient Care Management, Rehabilitation & Therapy Procedures, and Post- Traumatic Stress Disorder (PTSD)), and Regional Forecast, 2021-2028” [Online]. Available: <https://www.fortunebusinessinsights.com/industry-reports/virtual-reality-vr-in-healthcare-market-101679> [Accessed: 14- Mar-2022]
8. Farra, S. L., Gneuchs, M., Hodgson, E., Kawosa, B., Miller, E. T., Simon, A., ... & Hausfeld, J. (2019). Comparative cost of virtual reality training and live exercises for training hospital workers for evacuation. *Computers, informatics, nursing: CIN*, 37(9), 446.
9. Antoniou, P. E., Bamidis, P. D., (2018). Devising a Co-creative digital content

development pipeline for Experiential Healthcare Education (2018). CC-TEL/TACKLE@EC-TEL Leeds September 2018

10. K. Schwaber, AGILE Project Management with SCRUM, Microsoft, 2004.
11. "Scrum Alliance Certification" SCRUM [Online]. Available <https://www.scrumalliance.org> [Accessed: 15-Feb-2021]
12. Antoniou, P. E., Chondrokostas, E., Bratsas, C., Filippidis, P. M., & Bamidis, P. D. (2021, May). A Medical Ontology Informed User Experience Taxonomy to Support Co-creative Workflows for Authoring Mixed Reality Medical Education Spaces. In 2021 7th International Conference of the Immersive Learning Research Network (iLRN) (pp. 1- 9). IEEE.