Archives of Academic Emergency Medicine. 2024; 12(1): e63

LETTER TO EDITOR

A Guide to Opportunities and Challenges of Developing a Virtual Reality Simulation for Disaster Medicine Courses: A Letter to Editor

Mohsen Masoumian Hosseini[1,2], Seyedeh Toktam Masoumian Hosseini[2,3]*, Karim Qayumi[4]

1. Department of E-learning in Medical Sciences, SMART University of Medical Sciences, Tehran, Iran.
2. Department of medicine, Canadian Virtual Medical University, Vancouver, BC, Canada.
3. Department of Nursing, School of Nursing and Midwifery, Torbat Heydariyeh University of Medical Sciences, Torbat Heydariyeh, Iran.
4. Centre of Excellence for Simulation Education and Innovation, Department of Surgery, University of British Columbia, Vancouver, BC, Canada.

Received: June 2024; Accepted: July 2024; Published online: 25 August 2024

Cite this article as: Masoumian Hosseini M, Masoumian Hosseini ST, Qayumi K. A Guide to Opportunities and Challenges of Developing a Virtual Reality Simulation for Disaster Medicine Courses: A Letter to Editor. Arch Acad Emerg Med. 2024; 12(1): e63. https://doi.org/10.22037/aaem.v12i1.2388.

Dear editor,

The advancement of technology has significantly impacted the student population, with many young people now spending a large portion of their time engaging with various forms of technology (1). As such, it is imperative for educational systems to adapt and integrate new technologies into their frameworks in order to meet the evolving needs of students (2). Virtual reality (VR) technology has gained substantial popularity among students and addressing its integration could be a crucial step towards bridging educational gaps (3). VR technology presents promising opportunities for the training and education of disaster medicine practitioners. VR simulations provide realistic, immersive environments that allow for frequent, cost-effective practice of disaster response skills, in contrast to traditional live drills (4). These simulations can be adapted to various scenarios, including infectious disease outbreaks like Ebola, and can incorporate physiological models to mimic patient conditions and treatment outcomes (5). The applications of VR in disaster medicine span basic education, professional training, and psychotherapy (6). Research has demonstrated that VR simulations can enhance knowledge acquisition, boost confidence, and realistically simulate clinical environments for different disaster scenarios (4). While VR technology shows potential as a competitive, cost-effective supplement to existing training approaches, further development is needed to cover a wider range of disaster scenarios in hospital settings (4).

However, this poses the question: does the current educational system possess the capacity to embrace this expansive platform? Extensive investigations have revealed that for an educational system to effectively incorporate virtual reality technology, it must address key issues including educational needs assessment, defining clear educational goals, implementing effective game design patterns, assessing practicality and applicability within the system along with providing necessary support and opportunities, while also grappling with implementation challenges as well as ethical considerations related to integrating such advanced technologies into curricula (7). Consequently, this letter aims to delve deeper into these critical concerns surrounding designing virtual reality games specifically tailored for medical courses.

There exist three kinds of these gadgets, with the initial group pertaining to web browsers typically created by Adobe Captivate. The second type is reliant on mobile phones and the third category consists of desktop devices. Currently, mobile-centric headsets are widely used and highly conducive to individual learning. Nonetheless, they may not be ideal for educational use as they do not relay game information to educators and hinder effective feedback provision on students' performance along with their strengths and weaknesses (8). Nevertheless, there are methods for leveraging these devices in the context of learning.

Augmented reality (AR) and VR games need to be customized based on the skill level of the players. It is essential to assess the required infrastructure for designing and developing these games. If we have both the necessary infrastructure and skilled professionals, then we can proceed with producing such games; otherwise, efforts should be directed toward preparation and provision (9). It's important to note that a single VR device may not suffice for an educational center or classroom. Ultimately, substandard or insufficient infrastructure will have negative consequences as learning progresses.

Games hinge on competition, and without all students engaging in the same setting, it's unfeasible to foster this competitive spirit and assess its outcomes (10, 11). Many VR

* **Corresponding Author:** Toktam Masoumian Hosseini; Department of Nursing, School of Nursing and Midwifery, Torbat Heydariyeh University of Medical Sciences, Torbat Heydariyeh, Iran. Email: masoumiant99@gamil.com, TEL: +989158279655, ORCID: https://orcid.org/0000-0003-3093-8799.

products have limited user accessibility and fail to facilitate student collaboration.

In the best type of VR model, characters play various roles including instructor/guide, learner/player, supporting characters, antagonists, experts/specialists, narrator, and bystanders (12). The guide can take the form of a teacher outside the system or be integrated as a character within it through artificial intelligence in VR. For instance, the CyberPatientTm simulator has successfully brought real-world scenarios to web platforms with accompanying Artificial Intelligence (AI) guides that assist students throughout patient evaluations. The learner is a crucial focal point closely tied to both content and interface within VR settings; their experience holds substantial influence over the effectiveness of VR applications. Meanwhile supporting characters add depth by embodying other roles in simulations like additional medical personnel thereby enhancing realism. Introducing antagonistic characters serves to create challenges and heighten complexity within virtual environments, while experts hold significant responsibility in evaluating student performance. Additionally, narrators provide essential explanations and guidance for learners, while bystanders contribute to creating a realistic environment by portraying other patients or individuals interacting within the simulation setting (12).

Advanced VR products offer a new level of user interaction and immersion. These cutting-edge technologies utilize advanced headsets such as HoloLens 2 Microsoft and Apple Vision Pro, which incorporate eye-tracking capabilities, providing valuable insights for analysts. For instance, educators can gain a deeper understanding of student engagement and decision-making processes within simulated scenarios, leading to more comprehensive assessments of the learners' behavior - akin to decoding the "body language" exhibited in real-world situations. However, this advancement also presents moral complexities. Potential concerns include students grappling with fear of failure or making mistakes even within virtual environments designed for learning and experimentation. Furthermore, depending on the nature of these VR experiences, researchers may encounter additional ethical dilemmas that must be navigated carefully (13).

When designing or implementing VR, it is crucial to prioritize evaluating the experience and satisfaction of learners before assessing their knowledge and performance. It is advisable to initially gather feedback from a small group of users to address any system issues and enhance user experience (14). Only after ensuring that the VR environment is user-friendly should measurements for knowledge and performance be conducted. A VR interface that poses challenges for learners or lacks adequate feedback can adversely impact their learning outcomes. Therefore, prioritizing the evaluation of user experience prior to other assessments is essential. Nonetheless, established VR systems with a track record of high user satisfaction may not require extensive assessment in this aspect unless they are being modified or replaced by new designs.

The incorporation of VR, AR and AI into the educational curriculum for students has been extensively discussed in numerous studies (7). However, these studies have not delved into the potential drawbacks of this integration. It is essential to consider various factors such as funding, expertise in relevant subjects and technology, academic support, and student motivation and familiarity with VR before implementing its use in education. As today's generation gravitates toward technology, it is important to recognize that utilizing VR devices requires proper training for students (2, 3). The procurement or development of high-quality AI-based VR technology would be prohibitively expensive for universities to undertake independently. Furthermore, many existing studies involving these devices have only engaged a limited number of users in training scenarios. Within university settings that encompass diverse fields including medical studies, emergency medicine, dentistry, nursing, and psychiatry among others; acquiring a sufficient quantity of devices to meet demand presents an ongoing challenge. Moreover, additional consideration involves securing dedicated resources for maintenance and updates on these devices. Incorporating VR into the curriculum could potentially lead to disruptions if equipment malfunctions arise, thereby compelling students to postpone their coursework. In this letter, we have meticulously incorporated a myriad of essential considerations for the design and implementation of VR simulations in Figure 1. We aim to provide valuable assistance in developing an educational framework tailored for professionals operating within this dynamic field.

1. Declarations

1.1. Acknowledgements

We express our gratitude to the National Agency for Strategic Researches in Medical Sciences Education (NASR) for supporting the appropriate execution of this study.

1.2. Conflict of interest

The authors have no conflicts of interest.

1.3. Authors' contributions

All the authors met the standard criteria of authorship based on the recommendations of international committee of medical journal editors.

1.4. Financial support

This research received a grant from the National Agency for Strategic Researches in Medical Sciences Education (NASR) with the number 4020277.

1.5. Using artificial intelligence chatbots

The research process for this study, encompassing the writing and conceptualization stages, was conducted without the utilization of any artificial intelligence technologies.

References

1. Masoumian Hosseini M, Masoumian Hosseini ST, Qayumi K, Hosseinzadeh S, Sajadi Tabar SS. Smartwatches in healthcare medicine: assistance and monitoring; a scoping review. BMC Medical Informatics and Decision Making. 2023;23(1):248.
2. Masoumian Hosseini M, Masoumian Hosseini ST, Qayumi K, Ahmady S, Koohestani HR. The Aspects of Running Artificial Intelligence in Emergency Care; a Scoping Review. Arch Acad Emerg Med. 2023;11(1):e38.
3. Masoumian Hosseini M, Hooshmandja M, Masoumain Hosseini T. Ethical Dilemmas of Mixed and Extended Reality. J Med Edu. 2023;22(1):e133854.
4. Jung Y. Virtual Reality Simulation for Disaster Preparedness Training in Hospitals: Integrated Review. J Med Internet Res. 2022;24(1):e30600.
5. Gout L, Hart A, Houze C, Sarin R, Ciottone G, Bounes V. Creating a Novel Disaster Medicine Virtual Reality Training Environment. Prehospital and Disaster Medicine. 2020;35:225-8.
6. Duan Y-y, Zhang J-y, Xie M, Feng X-b, Xu S, Ye Z-w. Application of Virtual Reality Technology in Disaster Medicine. Current Medical Science. 2019;39(5):690-4.
7. Masoumian Hosseini M, Masoumain Hosseini T, Qayumi K. Integration of Artificial Intelligence in Medical Education: Opportunities, Challenges, and Ethical Considerations. J Med Edu. 2023;22(1):e140890.
8. Pedro LFMG, Barbosa CMMdO, Santos CMdN. A critical review of mobile learning integration in formal educational contexts. International Journal of Educational Technology in Higher Education. 2018;15(1):10.
9. Marougkas A, Troussas C, Krouska A, Sgouropoulou C. How personalized and effective is immersive virtual reality in education? A systematic literature review for the last decade. Multimedia Tools and Applications. 2024;83(6):18185-233.
10. Masoumian Hosseini M, Sadat Manzari Z, Gazerani A, Masoumian Hosseini ST, Gazerani A, Rohaninasab M. Can gamified surgical sets improve surgical instrument recognition and student performance retention in the operating room? A multi-institutional experimental crossover study. BMC Medical Education. 2023;23(1):907.
11. Masoumian Hosseini M, Masoumian Hosseini T, Qayumi K, Baeradeh N. Game-based vs. Case-based Training for Increasing Knowledge and Behavioral Fluency of Nurse Students Regarding Crisis and Disaster Management; a Quasi-Experimental Study. Arch Acad Emerg Med. 2022;10(1):e77.
12. Katifori A, Lougiakis C, Roussou M. Exploring the Effect of Personality Traits in VR Interaction: The Emergent Role of Perspective-Taking in Task Performance. Frontiers in Virtual Reality. 2022;3.
13. Kharoub H, Lataifeh M, Ahmed N. 3D User Interface Design and Usability for Immersive VR. Applied Sciences. 2019;9(22):4861.
14. Gim G, Bae HK, Kang SA. The Effect of Self-Determination and Quality of VR-Based Education in the Metaverse on Learner Satisfaction. In: Lee R, editor. Emotional Artificial Intelligence and Metaverse. Cham: Springer International Publishing; 2023. p. 41-54.

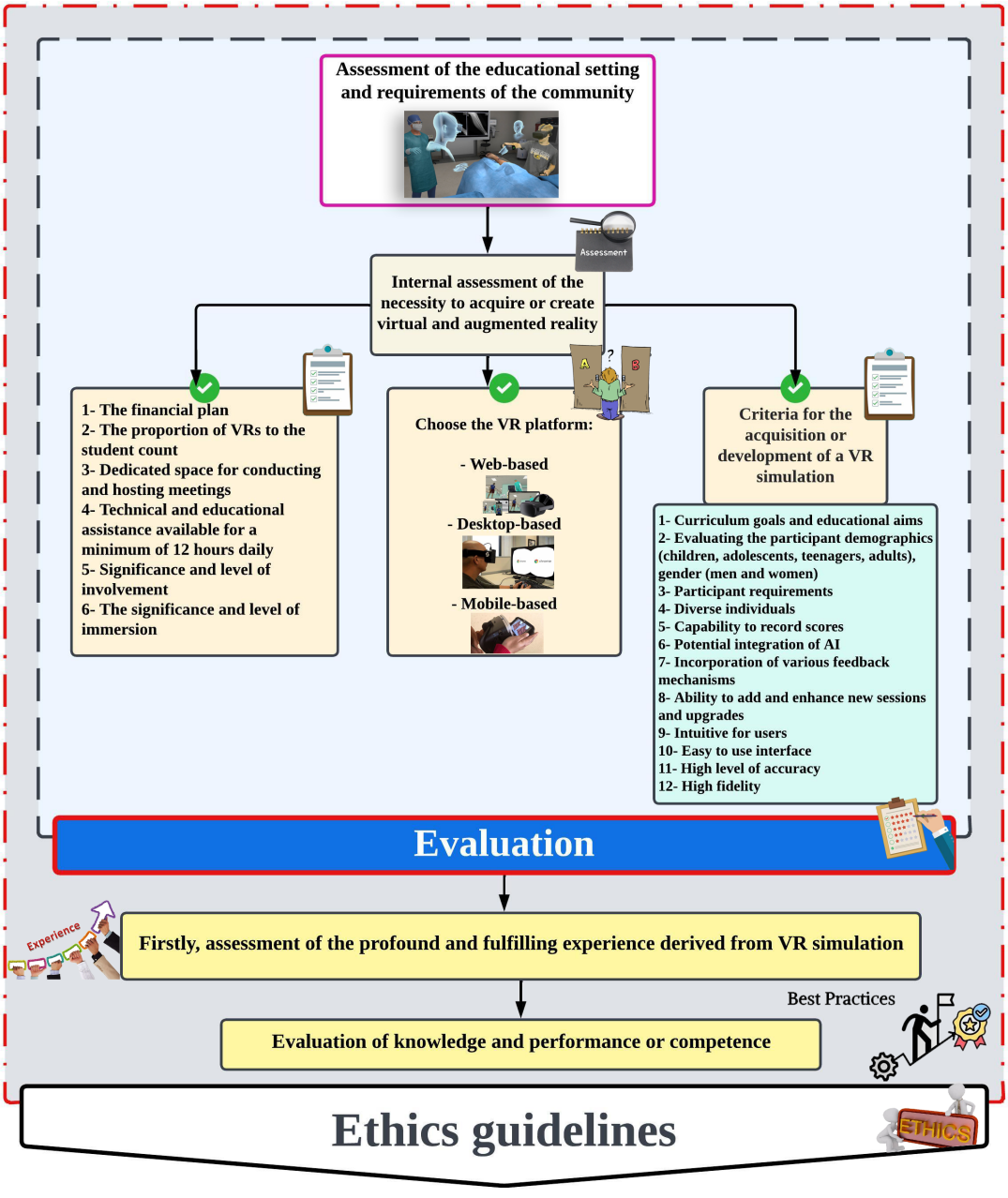

Figure 1: Essential considerations for the design and implementation of virtual reality (VR) simulations. When designing and implementing VR-based simulations, there are several key considerations. First, it is crucial to assess the institution's available facilities and whether there is a need to utilize these simulation tools. The institution's budget and the welfare need of the students should also be evaluated. Next, the selection of the appropriate platform should be based on the initial needs assessment. Additionally, the educational objectives should guide the design process. Before full implementation, it is recommended to conduct a pilot study to identify and address any system issues. Finally, ethical requirements must be carefully considered throughout all stages of the development and implementation. AI: Artificial Intelligence.