A Cloud Based Interactive Setting for Medical Simulation

https://doi.org/10.3991/ijac.v16i3.35741

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Abstract—This article is about a use-case from a medical education program delivered online, into a cloud-based platform called e-REAL Online. The learning activity requires teamwork and is based on the visual exploration of an alpine environment, a sequence of actions compliant with a crisis resource management procedure known as Name-Claim-Aim, and on a dialogue with a patient who is an avatar performing as a woman injured during a hiking activity performed alone and who was found by chance by an interprofessional rescue team. The process of learning by doing within an online interactive setting—accessible by a single and simple click of the mouse, without downloads of software or other technical procedures—is highly effective and leaves learners with a memorable experience, if the experience is multiplayer, cooperative, and glasses-free. That is the case with the e-REAL Online experience introduced in this article, which revolves around a case of multiple injuries acting in an alpine environment. Within this scenario, the learners are challenged to recognize a situation requiring rapid intervention, communication, knowledge sharing, decision-making, and management of an unforeseen event—while taking into consideration critical contextual factors such as a lack of time, scarcity of resources and tools, and a multitude of additional impactful factors (weather conditions, broadband availability, etc.).

Keywords—medical simulation, cooperative learning, glasses-free

1 Learning by doing within a glasses-free online interactive setting

This article is about a use-case from a medical education program delivered online, into a cloud-based platform called e-REAL Online. The learning activity requires teamwork and is based on the visual exploration of an alpine environment, a sequence of actions compliant with a crisis resource management procedure known as Name-Claim-Aim, and on a dialogue with a patient who is an avatar performing as a woman injured during a hiking activity performed alone and who was found by chance by an interprofessional rescue team. The process of learning by doing within an online interactive setting is

highly effective and leaves the learners with a memorable experience, if the experience is multiplayer, highly cooperative, and glasses-free. Such a hypothesis was tested during five online synchronous experiences of medical simulation, delivered into the e-REAL Online cloud platform with students from different medical and nursing schools based in Italy and Switzerland.

The experience revolves around a case of multiple injuries placed in an alpine environment, co-designed by the instructional design team from Logosnet (Houston, Texas, USA, and Turin, Italy) and the subject matter experts from the Center of Medical Simulation (Boston, Massachusetts, USA). In this scenario, the learners are challenged to recognize a situation requiring rapid intervention, communication, knowledge sharing, decision-making, and management of an unforeseen event—while taking into consideration critical contextual factors such as a lack of time, scarcity of resources and tools, and a multitude of additional impactful factors (weather conditions, broadband availability, etc.).

The entire experience is based on the visual exploration of an alpine environment and on a dialogue with the patient, a woman that was injured during a hiking activity performed alone and was found by chance by an interprofessional rescue team [1].

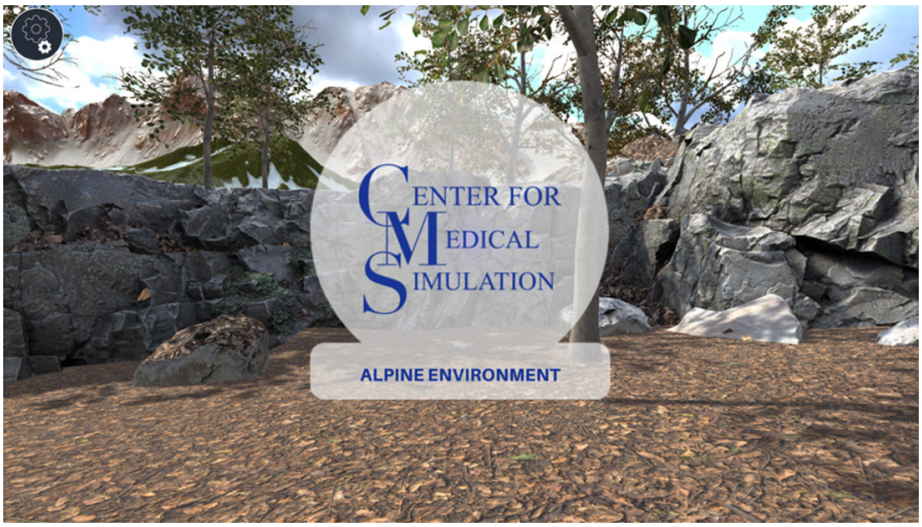

Fig. 1. Alpine environment within the e-REAL® Online platform in the cloud: A case regarding multiple injuries, codesigned by the instructional design team from Logosnet (Houston, Texas, USA, and Turin, Italy) and the subject matter experts from the Center of Medical Simulation (Boston, Massachusetts, USA)

The e-REAL Online platform submerges learners in an immersive reality where the challenge at hand is created by sophisticated, interactive, computer animation. The platform allows for live and real-time interaction among peers and the medical simulation instructor—as well as with the injured patient, which is an avatar programmed to dialogically interact with the participants [2].

Fig. 2. The avatar is programmed to perform as an injured female patient within the e-REAL® Online platform: The avatar is a digital human enhanced with artificial intelligence, able to call for help and to interact dialogically with learners and simulation instructors

Dialogues with avatars can be automated and based on artificial intelligence, as was the case during the five online synchronous experiences, or can be based on a real discursive interaction with a patient animated by a simulation instructor—as is the case in other experiences at the Center for Medical Simulation.

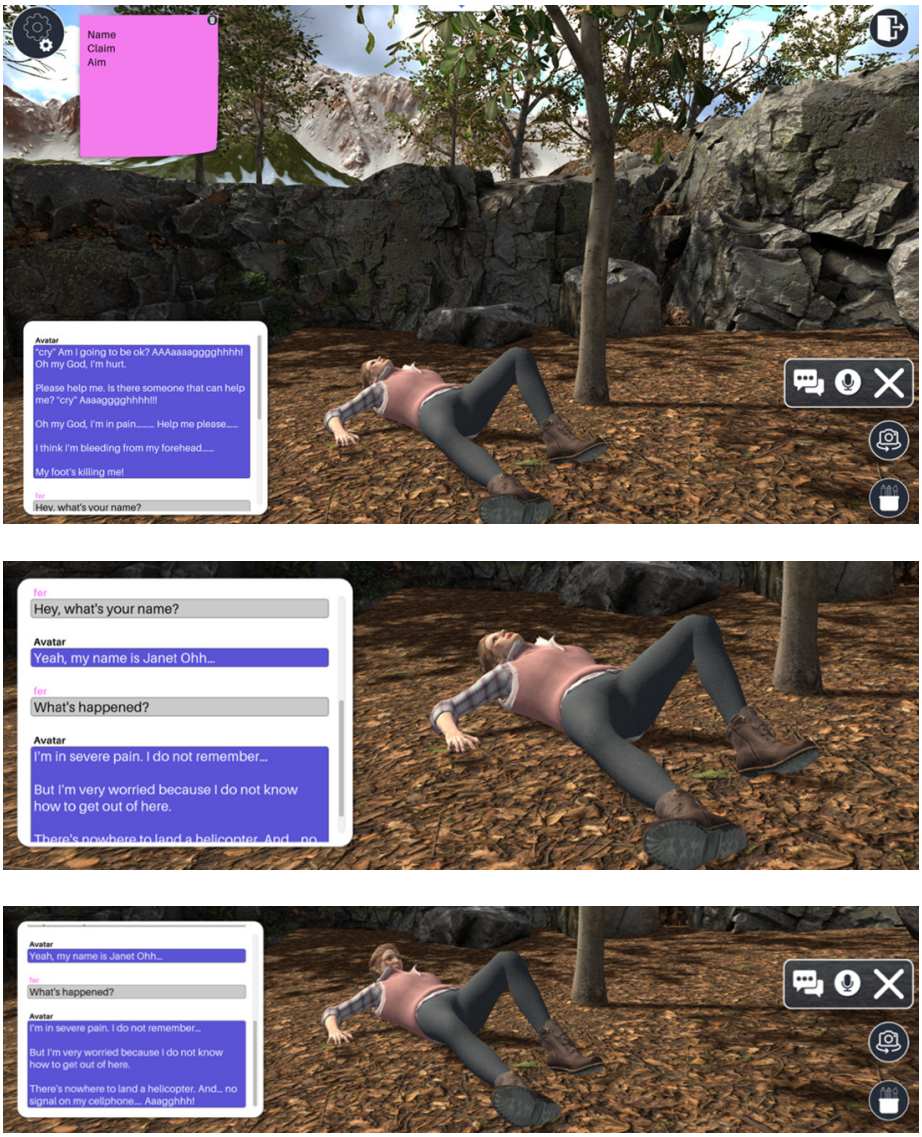

Fig. 3-4-5. Representative dialogue with the avatar, programmed to interact autonomously with the learners

The e-REAL simulation setting is highly immersive, and learners may interact together in real time among themselves, as well as with the patient's avatar. Learners can also take notes, overlay key concepts, rotate virtual objects, or move them point to point.

This solution allows simulations in a virtual environment that display challenging situations; unlike other VR solutions, e-REAL allows users to experience full immersion without the need for glasses or goggles. And it is easy to use: an Internet connection and a browser are the only requirements, because the website hosting this experience is in the cloud and is accessible by a single and simple click of the mouse, without downloads of software or other technical procedures.

Fig. 6. Representative time management, writing and overlaying features available in the e-REAL Online platform

The e-REAL teaching and learning approach is designed to have the learners working on tasks that simulate an aspect of expert reasoning and problem-solving, while receiving timely and specific feedback both from fellow students and the instructor. These elements of deliberate practice and feedback are key for actively involving the learners and making the learning experience effective [3]. Another key factor is the use of a mnemonic known as Name-Claim-Aim, developed by faculty at the Center for Medical Simulation, which encompasses a strategy to help health care professionals effectively organize a team for managing critical clinical events [4]. Last but not least, a key take away from this experience is the ability to have complex decision making, an artificially intelligent avatar, and communications with other learners in an online format easy and intuitive, without requiring downloads and or limiting the ability for collaboration.

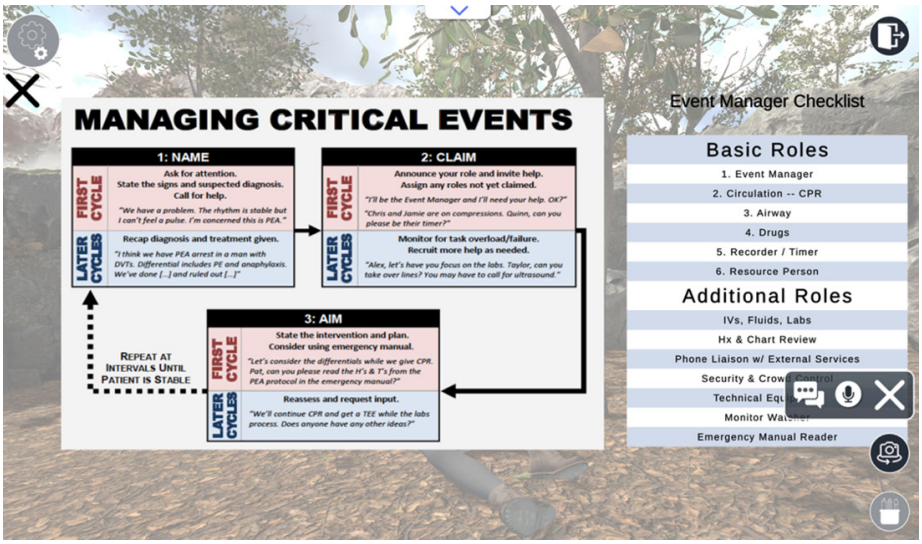

Fig. 7. Name-Claim-Aim©: A mnemonic device and check-list developed by faculty at the Center for Medical Simulation (Boston, Massachusetts, USA), that encompasses a strategy to help health care professionals effectively organize a team for managing critical clinical events

2 Boosting teamwork, verbal communication, and crisis resource management

Principles of crisis resource management, as described in 1992 by Howard, Gaba, and Fish [7], encompass those cognitive and interpersonal skills required to facilitate dynamic decision-making and effective teamwork during a crisis situation in complex environments. Effective verbal communication ensures a shared mental model and taps into the cognitive processes of the entire team [5]. Poor teamwork and communication are common factors contributing to errors and adverse events, especially while managing critical clinical events [6]. Health care professionals often find it challenging to effectively organize a team and establish explicit team leadership when managing critical events. When a crisis has been identified, an abrupt rise in cognitive load is triggered by the autonomic nervous system when even mild acute stress occurs simultaneously with increased tasks [7].

Opportunities to train and practice managing critical clinical events in simulated environments have existed since the early 1990s. The emergence of virtual reality-based training in procedural and surgical simulations was described in 1997 [8]. Since then, the use of virtual, augmented, or mixed reality environments has grown exponentially [9].

The e-REAL Online platform is a teamwork and communication booster, able to provide a memorable experience with a robust learning outcome. The process of learning by doing within the e-REAL Online interactive setting is highly effective as a multiplayer experience, highly cooperative, and glasses-free: 100% of the learners involved into our activity agreed with our hypothesis after having been involved in

the above described activity and in two other different learning settings in order to compare the results (first alternative control setting: VR head-mounted displays—second alternative control setting: online, glasses-free, individual, and not cooperative).

From an educational perspective, within the e-REAL Online experience, learners are not assumed to be passive recipients and repeaters of information but individuals who collectively take responsibility for their own learning [10]. The feedback we received most often—both by the learners and by the simulation instructors invited to coordinate and facilitate the online sessions—was that they didn't expect such easy access to an intensely engaging and meaningful experience. This is critical feedback because our efforts are aimed at designing solutions that empower learning with a strong focus on the user experience, both for learners and trainers.

How can we design engaging online learning? First by designing experiences to connect with, and not "to-do-lists" or "medical prescriptions" working one way, from the teacher to the student. It's all too easy for a subject matter expert to distill "core content" down to a list of abstract concepts, but even if there is someone who memorizes everything, this doesn't mean that he or she knows how to apply the concepts in real life. We suggest designing the online learning experiences by involving learners in stories that address key issues and realistic concerns, because human beings respond well to things that are relevant to them, concrete, and context related. We suggest adopting the situation-impact-resolution (SIR) format to establish story context for each simulation. This derives from Aristotle's *Poetics* and focuses on the sequence drama, suspense, and resolution—to use with epistemological acumen, within a systemic paradigm [1].

How can we make online learning effective? By encouraging learners to learn by doing and allowing them to cross conceptual and theoretical boundaries within a simulation's setting. In an online learn-by-doing simulation, the learners are asked to play specific roles and must make decisions in realistic situations. It's critical that learners then receive feedback as to the results of their decisions.

To share a more articulate answer, we can say that to make online learning effective, it is essential to consider the following tips:

- Provide interactive and engaging content: Online courses should include interactive and engaging content, such as videos, animations, and quizzes, to keep students engaged and interested.
- Encourage collaboration and interaction: Online learning can be isolating, so it is essential to encourage collaboration and interaction among students. This can be achieved through discussion forums, group projects, and virtual teamwork activities.
- Provide timely feedback: Provide regular and timely feedback to students to help them identify areas where they need improvement and to keep them motivated.
- Use technology effectively: Use technology tools such as video conferencing, chat, and instant messaging to keep students connected and engaged.
- Create opportunities for reflection: Provide opportunities for students to reflect on their learning, such as journaling or self-assessment, to help them consolidate their knowledge.
- Provide support and resources: Online learning can be challenging, so it is important to provide students with adequate support and resources, such as tutoring, academic advising, and technical assistance.

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This is a revised and extended version of a presentation given at The Learning Ideas Conference 2022, held in New York and online June 15-17, 2022. Article submitted 2022-10-01. Resubmitted 2023-02-24. Final acceptance 2023-03-02. Final version published as submitted by the authors.