



# Digital Learning: Healthcare Training by Tele-simulation and Online Cooperation

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## Abstract

How can we design engaging and effective online learning? How can we perform tele-simulation? How can we make digital learning authentic and not over-produced? How can we apply gamification strategies to enhance online cooperation? Tele-simulation and online cooperation are essential today for medical simulation: The e-REAL<sup>®</sup> online platform for healthcare simulation, aimed at fostering effective teamwork, knowledge sharing and cooperation, is a solution that we designed to work within a highly immersive setting where learners and simulation instructors may interact all together in real time among themselves, as well as with virtual objects and avatars. This solution allows simulations in a virtual environment that display challenging situations; unlike other VR and AR solutions, e-REAL allows users to experience full immersion without the need for glasses or goggles, providing a memorable experience with a robust learning outcome. e-REAL is user-centric and easy to use: an Internet connection and a browser are the only requirements.

**Keywords:** Tele-simulation, Online Cooperation, e-REAL.

## 1. Healthcare Training by Tele-simulation and Online Cooperation

### 1.1. Key Questions About Online Simulation And First Answers

How can we design engaging and effective online learning?



How can we perform tele-simulation? How can we make digital learning authentic and not over-produced? How can we apply gamification strategies to enhance online cooperation?

Tele-simulation and online cooperation are essential today for medical simulation. The main challenge, in our experience, is really enhancing learners' online cooperation and proactive participation. To do so, we created a number of scenarios for healthcare simulation aimed at fostering effective teamwork, knowledge sharing and cooperation into a platform called e-REAL® Online.

The simulation setting is highly immersive, and learners may interact together in real time among themselves, as well as with virtual objects and avatars. Users can also take notes, overlay key concepts, rotate virtual objects, or move them point to point, and complete questionnaires directly in the online environment that works as a sketch-board. Usability also extends to content, as it is easy to import and show a user's existing content, as well as create and edit new content. It is truly a totally customizable solution, partnered with a powerful multimedia editor that is provided on demand as a premium feature.

This solution allows simulations in a virtual environment that display challenging situations; unlike other VR and AR solutions, e-REAL [1] allows users to experience full immersion without the need for glasses or goggles. What this solution mainly provides is a memorable experience with a robust learning outcome. It is really easy to use: an Internet connection and a browser are the only requirements.



Fig. 1. The e-REAL® Online Platform for the Center of Medical Simulation, Boston, MA. A case regarding an injured ankle within an alpine environment, made available online into the platform that is

configured displaying a room, to recreate a setting similar to the one where the learners are in a brick-and-mortar e-REAL classroom that acts as an immersive and interactive “phygital” environment (both physical and enhanced by digital objects).

The feedback we receive most often—both by the learners and by the simulation instructors invited to coordinate and facilitate the online sessions—is that they didn’t expect such easy access to an intensely engaging and meaningful experience. This is a very important 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.

We believe that flexible and user-friendly solutions are needed in learning, so we designed the e-REAL online platform to include ready-to-use courses, courses co-designed with our team, or creating and uploading existing content with a dedicated editor in a very simple way—even last minute.

Our immediate goal is to build significant learning solutions that help educators and “simulationistas” integrate into their practice new technologies to boost learning in easy and effective ways. Feedback and outputs from the field are pointing out that tele-simulation based on online cooperation within the e-REAL immersive learning environment makes for engaging and effective healthcare simulations. In particular, immersive and interactive experiences that can be performed without special glasses, joysticks, or other “augments” to allow authentic and hands-on experiences. e-REAL is specifically designed to be properly produced and easy to use; those are the two main concerns usually regarding online learning.

## 1.2. Further Answers to the Key Questions

Designing and delivering online learning as a cooperative tele-simulation, within an easy-to-use environment that works like a virtual reality setting but not requiring head-mounted displays or other augments to interact with—is essential for an effective experience. A good user experience (UX) is expected to be among the main targets for the instructional design team, and this means a focus on having a deep understanding of users, what they need, what they value, their abilities, and also their limitations.

Another essential success factor is mastering simulation techniques is the use of simulation

growing exponentially in academic and service settings because it can enable students, new graduates, and experienced clinicians to develop clinical competence and confidence in a number of clinical situations, far more than a learner can be exposed to in a live environment [2].

To be effective, the instructional design supporting the tele-simulation experience has to be state-of-the-art, which is unfortunately not the standard in the online learning industry.

### 1.3. Can Online Learning Be Effective?

What did you do during your recent online course?

“I fell asleep.”  
 “I was playing an online game.”  
 “I was watching TV.”  
 “I was chatting with friends on social media.”  
 “I haven’t seen the last three lectures.”

These could be the answers from student feedback [3]. As the use of online learning worldwide has continued to grow, the perception of most online learning has often been less than positive. As David Guralnick pointed out, while of course there are exceptions, the negative comments about online learning programs have been generally well-founded. There is no single way to create learning experiences that are effective and that the target audience enjoys and connects with, but there are common success factors and active online learning methods that have been successful [4].

How can we design engaging and effective online learning? First of all 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 into 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 [5, 6].

We suggest designing the online learning experiences by involving learners in authentic 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.

How can we make digital learning authentic and 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 particular roles and must make decisions in realistic situations, sometimes with the assistance of a coaching or mentoring component. It’s critical that learners then receive feedback as to the results of their decisions.

In e-REAL, learners practice handling realistic situations, rather than learning facts or techniques out of context. Context refers to the circumstances that form the setting for an event, statement, or idea. Context related factors can be influential and even disruptive: for example, a loud background noise within a virtually recreated operating room in e-REAL negatively impacts the surgical team’s ability to communicate and may consequently contribute to surgeons committing an error. The most effective learning occurs through being immersed in context, requiring the ability to understand the limits of our knowledge and action, and to adapt that knowledge to an environment different from the one in which it was developed.



Fig. 2. Representative realistic situation into the e-REAL online platform.

Ultimately, as research in the area of video games has noted, there is another key factor that works as a motivator for participants: by providing a dramatic, realistic storyline with difficult decisions for the learners to make, and

providing feedback so the learners can see how things are going, a simulation can create a true challenge for learners. Game-like elements can play a substantial role in the success of an online learning experience [7].

A context related experience within an e-REAL setting is similar to being immersed within a videogame. Characteristics of games that facilitate engagement can be grouped into two general categories: those that create a rich mental model of the game environment, and those that create consistency between the things in that environment. The richness of the mental model depends on having a cognitively demanding environment and a strong and interesting narrative. A bird flying overhead is good. Hearing it screech is better. Cognitively demanding environments in which players must focus on what's going on in the game will occupy mental resources. The richness of the mental model promotes engagement and immersion into the scenario, because if the brain power is allocated to understanding or navigating the world, players are too occupied to notice all of the game's shortcomings that would otherwise remind them that they're playing a game. Finally, good stories with interesting narratives (which are credible because they are as intrinsically congruent as possible) attract attention to the game and make the world seem more believable. Good stories tie up mental resources.

Turning to game traits related to consistency, believable scenarios, and behaviors in the game world ensures that virtual characters, objects, and other creatures in the game world behave in the way learners expect. Game developers strive for congruence among all these elements. In this way, learners are challenged both cognitively and behaviorally in a fully immersive and multitasking learning environment, within interactive scenarios that usually present a wealth of information: the many levels of the situation are made available simultaneously, by overlaying multisource—words, numbers, images, etc.—within an environment designed by AR techniques [8].



Fig. 3. Multimedia storytelling enhanced with features allowing mnemonics and checklists, as well as drawings: in this case the overlaying is about the positions taken by the first responders within the simulation scene in an e-REAL online tele-simulation platform.

e-REAL submerges learners in an immersive reality where the challenge at hand is created by sophisticated, interactive computer animation. Importantly, the system includes live and real time interaction with peers, instructors, tutors, facilitators, and mentors—as well as with avatars or digital humans. Thus, it adds a very important social component that enhances learning outputs, skills, cognitive processes, and metacognitive processes. The process of learning by doing within an immersive setting, based on multimedia and visual storytelling, leaves both the learners and the simulation instructors with a memorable experiences and produces robust learning outputs.

Our contribution to this growing approach enables a multilayer vision, based on cooperative communication and learning; the many levels of the situation are made available simultaneously by overlaying multisource information—e.g. words, numbers, images and by visualizing relations between topics, contextual factors, cognitive maps, and dynamic cognitive aids—but without AR and VR head-mounted displays.

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 trainers. These elements of deliberate practice and feedback are general requirements for developing expertise at all levels and disciplines [9, 10, 11].

## 2. Tele-simulation and Online Cooperation as Enhanced Learning

We are fortunate to be able to work with a wide array of simulation instructors from all around the world. We understand that helping an instructor formulate an effective or innovative experience or assignment is only part of our job. We're also here to help the instructor bring that idea to life, whether that means offering specialized training to teaching fellows, a custom-built web resource, or workshops where learners receive direct training in the skills where they need to demonstrate their understanding of a key course concept.

If anything, this has become critical in these times of remote teaching. e-REAL is at the forefront of a trend that COVID-19 is accelerating: reality in the digital age is becoming more and more virtual. We are mixing up the latest trends from digitalization, virtualization, and artificial intelligence with the goal of building powerful solutions for medical simulation, including a focus on organizational behavior and leadership.

Nothing is revolutionary within a simple VR or AR headset, but if virtual and augmented content and scenarios are “actualized” [12]—or enhanced—within an online simulation setting, this adds value to the digital learning process. In such a way, e-REAL can contribute to enhancing our learning experience.

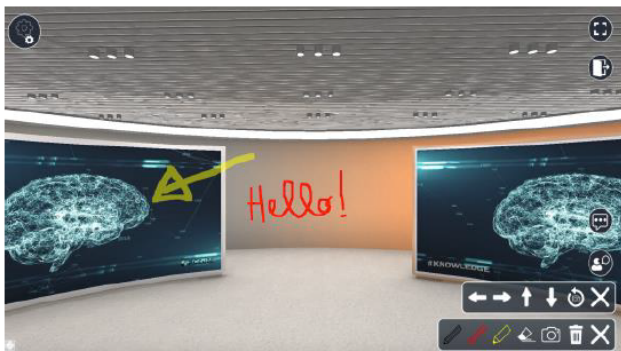


Fig. 4. Representative multimedia visualization within the e-REAL platform.

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