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Virtual worlds and augmented reality: The enhanced reality lab as a best practice for advanced simulation and immersive learning

Mondi virtuali e realtà aumentata: l'Enhanced Reality Lab come best practice per la simulazione avanzata e l'apprendimento immersivo

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Abstract

e-REAL is enhanced reality for immersive simulation. It is a system where physical and digital objects co-exist and interact in real time, in a real place and not within a headset. e-REAL allows for an advanced simulation within a multisensory scenario, based on challenging situations developed by visual storytelling techniques. The e-REAL immersive setting is fully interactive with 3D holographic visualization, talking avatars, electronically writable surfaces and more: people can take notes, cluster key-concepts or fill questionnaires directly on the projected surfaces. Learners rapidly circle between deliberate practice and direct feedback within a simulation scenario until mastery is achieved. So far, the early findings show that visualization, if linked in interactive ways to the learners, allows for better neural processes related to learning and behavior change.

Keywords: enhanced reality; augmented reality; virtual worlds; advanced simulation.

Abstract

e-REAL è realtà potenziata per la simulazione immersiva. E' un sistema dove oggetti fisici e virtuali coesistono e interagiscono in tempo reale, in un luogo reale e non all'interno di un visore. e-REAL consente una simulazione avanzata all'interno di uno scenario multisensoriale, basato su situazioni sfidanti progettate attraverso tecniche di storytelling visuale. Il setting immersivo di e-REAL è pienamente interattivo con visualizzazioni olografiche in 3D, avatars parlanti, superfici sulle quali è possibile scrivere elettronicamente e altro ancora: le persone possono prendere note, raggruppare concetti-chiave, compilare questionari direttamente sulle superfici proiettate. L'applicazione della tecnica denominate Rapid Cicle Deliberate Practice (RCDP), basata su feedback diretti e mirati, consente di migliorare le performance già nel corso della simulazione. I primi risultati mostrano che la visualizzazione interattiva potenzia i processi neurali associati all'apprendimento e al cambiamento comportamentale.

Parole chiave: enhanced reality; realtà aumentata; mondi virtuali; simulazione avanzata.

1. The Enhanced Reality Lab: an applied research project with a number of educational outputs

The Enhanced Reality Lab (e-REAL, www.e-real.net) helps create interactive virtual and augmented reality environments for advanced simulation in education and training, medicine and healthcare, business and industry. It is a system where physical and digital objects co-exist and interact in real time (mixed reality), in a real place and not within a headset: for example a real electrocardiograph and a virtual ultrasound, or a virtual 3D printer and a real engineer in training, or even an office virtualized by projections on three walls and real people interacting with both virtual and real objects (Figure 1).

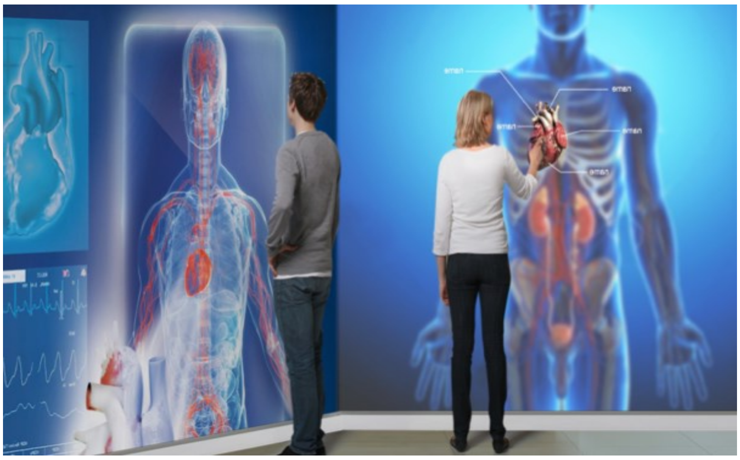

Figure 1. e-REAL interactive wall with 2D and 3D visualization.

Virtual reality is a communication medium that makes virtual experiences feel real and appear unmediated. Since the 1960s, virtual reality has been used by the military and medicine for training and simulations, but it has also become fertile ground to evaluate social and psychological dynamics in academic settings. For example, journalists use virtual reality to situate their readers within stories, educators use virtual technologies for experiential learning, and psychiatrists leverage virtual reality to mitigate the negative effects of psychological traumas (Markowitz & Baileson, 2019). The term *virtual reality* has been widely used and often creatively exaggerated by Hollywood producers and science-fiction writers for decades. Consequently, there are many misconceptions and expectations about the nature of the technology (Bailenson, Blascovich, Beall & Noveck, 2006). Other exaggerated term is *augmented reality*. For the purposes of this article, we define *virtual environment* as synthetic sensory information that leads to perceptions of environments and their contents as if they were not synthetic (Blascovich et al., 2002). Regarding the *augmented reality*, we define it as an interactive experience of a real-world environment where the objects that reside in the real-world are augmented by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory, and olfactory; the overlaid sensory information can be constructive (i.e. additive to the natural environment) or destructive (i.e. masking of the natural environment) and is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment (Rosenberg, 1992). Augmented reality is related to two largely synonymous terms: mixed reality and computer-mediated reality. *Mixed reality*, sometimes referred to as hybrid reality, is the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time. Mixed reality takes place not only in the physical world or the virtual world, but is a mix of real and virtual, encompassing both augmented reality and augmented virtuality via immersive technology (De Souza e Silva & Sutko, 2009; Milgram & Kishino, 1994). From this perspective, in a nutshell we can say that augmented reality alters one's ongoing perception of a real-world environment, whereas virtual reality completely replaces the user's real-world environment with a simulated one.

e-REAL, as a mixed reality environment, can be a stand-alone solution or networked between a few or even many places that can be linked in order to reach common goals, thanks to the advanced simulation: so both multiple localization and language options are available. A number of educational outputs are also reachable thanks to e-REAL as a smart classroom, both face-to-face and in telepresence.

e-REAL is an applied research project started and supported by Logosnet in 2011, developed in collaboration with top research and simulation centers – mainly in Italy and in the US. Among them are the Design Department and the Environmental Design and Multisensory Experience (EDME) Lab from the Polytechnic School of Milan, the Simnova Center from the University of Eastern Piedmont in Novara, the dauin Department from the Polytechnic Schools of Turin, the Training Center Gusmeroli of the Red Cross of Italy in Bologna, and the Master in Communication of Science Macsis from the University Bicocca of Milan. Since 2017, e-REAL is also in the US at the Harvard Center for Medical Simulation in Boston, a world renowned landmark for medical simulation.

e-REAL is quite a futuristic solution, designed to be *glocal*, liquid, networked, augmented, mixed, virtual and polycentric like the current world: that is why e-REAL is becoming a best-practice and a cornerstone for advanced simulation and immersive learning. The main drivers are visual thinking, computer vision, advanced simulation, multimedia communication, immersive and interactive learning, augmented and virtual reality, human and artificial intelligence, cognitive psychology and neurosciences, anthropology and sociology of culture, hermeneutics and narratology, design thinking, epistemology and philosophy of science (Salvetti & Bertagni, 2018).

The e-REAL system enables a multilayer vision: the many levels of the situation are made available simultaneously, by overlaying multisource info – e.g. words, numbers, images, etc. – as within an augmented reality display, but without being in need to wear special glasses. By visualizing relations between topics, contextual factors, cognitive maps and dynamic cognitive aids, e-REAL allows learners for the better use of the neural processes and for storing information into memories based on experiences. At the same time, it helps instructors to immediately identify errors and difficulties of the trainees facilitating an effective debriefing (Eppler & Burkhard, 2004; Gardner, 2018; Gardner & Salvetti, 2019; Guralnick, 2018; Salvetti, 2015; Salvetti & Bertagni, 2014; Salvetti & Bertagni, 2018; Salvetti, Gardner, Minehart & Bertagni, 2019; Scuderi & Salvetti, 2019).

2. e-REAL as a CAVE-like environment enhanced by augmented reality and interaction tools

e-REAL, as a mixed reality system, uses ultra-short throw projectors and touch-tracking cameras to turn blank walls and empty spaces into immersive environments. It helps create interactive virtual and augmented reality environments. It is designed in order to evolve from the old CAVE environments (too rigid, difficult to be managed and expensive) to an easy, user-centered and cost-effective solution.

Computer-Assisted Virtual Environment (CAVE) is an immersive virtual reality environment where projectors are directed to between three and six of the walls of a room-sized cube; usually the image projections change as the user walks around and moves his or her head. The name is also a reference to the allegory of the Cave in Plato's Republic, in which a philosopher contemplates perception, reality and illusion. These systems come in a variety of geometries and sizes, including multisided (or multiwalled), rear-projection, or flat panel-based displays, single and multi-projector hemispherical surfaces, and more, each typically displaying field sequential stereo imagery ah high resolutions. Most are designed to accommodate multiple users, each of whom wear LCD shutter glasses controlled by a timing signal that alternately blocks left- and right-eye views in synchronization with the display's refresh rate.

Most systems incorporate some method of tracking the positions and orientation of a lead user's head to account for movement and to adjust the viewpoints accordingly. In such multiuser scenarios, all other participants experience the simulations in 3D, but passively (Aukstakalnis, 2017; Cruz-Neira, Sandin, DeFanti, Kenyon & Hart, 1992).

There are a number of critical reasons explaining why we were in need to develop e-REAL as a better alternative to the CAVE for immersive simulation in education and training: 3D visualization reached only by having the users wearing polarized glasses, joysticks or other devices in order to interact with the visual content, passive attitude generated during the session because only one person at a time is allowed to content management, pure visualization without the chance to perform actions like in a realistic scenario, and the hard limitation that no one is allowed to interact with the virtual objects by the flick of the hands, or in another way. Last but not least, the cost.

e-REAL is a sophisticated, easy to use system: so simple that two buttons are enough to manage it all, without the need for 3D glasses or joy-sticks to interact with the virtual objects. So e-REAL offers a unique user experience, a combination of visual communication and direct interaction with the content (by gesture or spoken words), immersing people in an entirely interactive ecosystem. And the e-REAL system enables both face to face and synchronous e-learning, as well as remote communication across the globe, by using a proprietary telepresence system designed in order to merge real human beings with avatars and virtual objects within the screen (Figure 2).

Each e-REAL lab comes packed with a starter kit that enables countless activities using gestures and spoken commands. A number of apps and contents are available off-the-shelf, and many others can be quickly tailored. So each e-REAL can be customized with a number of exceptional multimedia contents and augmented reality tools:

- multimedia libraries;
- interactive tutorials;
- holographic visualizations;
- real-time and live holograms;
- podcasts and apps;
- wearable devices such as glasses, headsets, watches and gloves.

Figure 2. e-REAL speech analysis and telepresence tools.

In a nutshell, e-REAL allows an advanced simulation within a multisensory scenario based on challenging situations – developed by visual storytelling techniques. In the e-REAL scenarios, people live realistic situations: observe, analyze, act. The e-REAL immersive setting is fully interactive with 3D holographic visualization, avatars that are able to talk, writable surfaces and more: people can take notes, cluster key-concepts or fill questionnaires directly on the projected surfaces.

With both portable and permanent fixtures available, e-REAL is a system made by 3D holographic visualization and vivid life-size images, rich training materials and augmented reality tools to boost advanced simulation in all its phases.

e-REAL integrates tools and objects from the real world on one e-Wall or within a multisensory scenario made of two or more e-Walls (Figure 3):

- one e-Wall makes the system visual and interactive;
- two or more e-Walls make the setting immersive – shaped as a corner, a trapezoid or a cube;
- a Dome is also possible, as well as solutions enabling special effects on the floor and, or, on the ceiling.

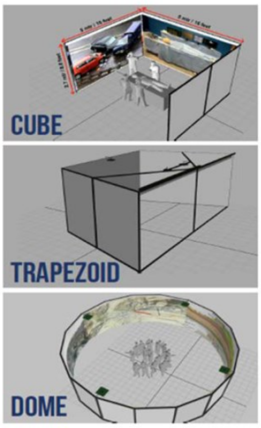

Figure 3. e-REAL's portable and permanent layouts.

Summarizing:

- it is virtual and augmented reality that happens in the real world (mixed reality) using 3D projections on the walls, not within special glasses;
- it is 2D and 3D interactive, immersive and augmented visualization;
- speaking avatars and natural speech recognition are part of the adventure as well;
- users do not need to wear special glasses, gloves, head-mounted displays, etc.;
- it is very easy to use: 2 buttons or a few spoken commands are enough;
- the system comes packed with a number of pre-loaded scenarios;
- it is easy to import and show existing content (images, videos);
- it is easy to create and edit new content, thanks to a powerful multimedia editor.

3. Visual storytelling, contextual intelligence and learners' engagement

Visual storytelling techniques and dynamic cognitive aids, based on virtual and augmented reality, are essential elements for the specific instructional design that makes e-REAL unique.

Effective visualization is the key to help untangle complexity: the visualization of information enables learners to gain insight and understanding quickly and efficiently. Examples of such visual formats include sketches, diagrams, images, objects, interactive visualizations, information visualization applications and imaginary visualizations such as in stories and as shown in the frames below (Figure 4).

Figure 4. e-REAL's visual storytelling, immersive interaction and contextual analysis.

Visualizations within e-REAL show relationships between topics, activate involvement, generate questions that learners didn't think of before and facilitate memory retention. So visualizations act like concept maps to help organize and represent knowledge on a subject in an effective way.

Half of human brain is devoted directly or indirectly to vision and images are able to grab our attention easily. Human beings process images very quickly: average people process visuals 60,000 times faster than text. This is why we, as humans, are confronted with an immense amount of images and visual representations every day: digital screens, advertisements, messages, information charts, maps, signs, video, progress bars, diagrams, illustrations, etc. If we have to warn people, symbols and images are excellent: they communicate faster than words and can be understood by audiences of different ages, cultures and languages. Images are powerful: people tend to remember about 10% of what they hear, about 20% of what they read and about 80% of what they see and do (Arnheim, 1969; Collins, 2015; Fields, Hjelmstad, Margolis & Nicola, 2007; Friedlander et al., 2011; Gazzaniga, 2009; Kandel, Schwartz, Jessell, Siegelbaum & Hudspeth, 2013; Rizzolatti & Sinigaglia, 2008; Salvetti & Bertagni, 2016; Yeo & Gilbert, 2017).

Also, contextual factors matter a lot because they are key to learning. Learners practice handling realistic situations, rather than learning facts or techniques out of context. Context means *related factors*, that can be influential and even disruptive. The most effective learning occurs through being immersed in context. Experience is lived and perceived as a focal point and as a key crossroad (Guralnick, 2018; Khanna, 2014).

Much like being immersed within a videogame, people are challenged by facing real cases within complex scenarios that present a *more than real* wealth of information. This is because the many levels of the situation are made available simultaneously, by overlaying multisource info (words, numbers, images, etc.) like within an augmented reality display (Figure 5).

Figure 5. e-REAL's overlaying of multisource info.

e-REAL submerges learners in an immersive reality where the challenge at hand is created by sophisticated, interactive computer animation in three dimensions and holographic projections. It further includes live and real time interaction with peers, trainers, tutors, facilitators and mentors. Thus, it adds a very important social component that enhances learning outputs, as well as metacognitive processes (and skills). The primary concepts and issues of a particular case can be tackled by visualizing them with the use of holograms (to be seen without 3D glasses or any particular tool), on big screens, or by projecting them directly on walls, ceilings and floors. Users can interact with dynamic holograms, 3D images, sound and vision by moving the body, or with a flick of the hands.

The process of learning by doing within an immersive lab, based on knowledge visualization by interactive surfaces (walls, mobile devices, electronic tables, etc.), leaves the attendees with a profound and memorable experience. Attendees are challenged both cognitively and behaviorally in a fully-immersive and multitasking learning environment. Moreover, e-REAL is an environment that immerses the learners in an *augmented* or enhanced reality where real life situations can be really experienced – within an advanced simulation setting – and the necessary lessons learned without the disadvantage of a negative impact in case of mistakes (Figure 6).

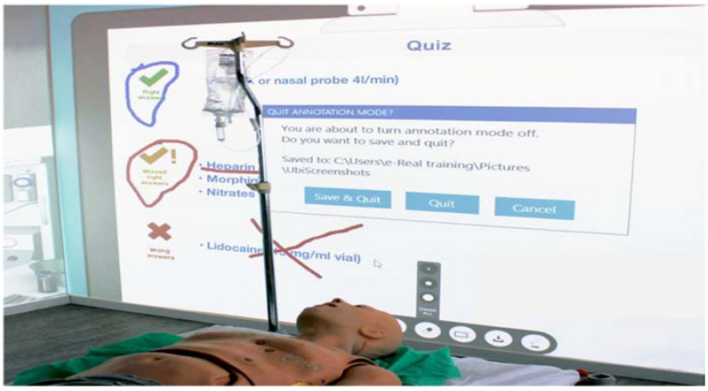

Figure 6. e-REAL's knowledge visualization by interactive surfaces.

In e-REAL, learners are not assumed to be passive recipients and repeaters of information, but take much more responsibility for their own learning. The trainer functions not as the sole source of wisdom and knowledge to them but more as a coach or mentor, whose task is to help them acquire the desired knowledge and skills for themselves.

While the 19th and the 20th centuries were, in education, mainly about standardization, the 21st century is about visualization, interaction, customization, *cheapification*, gamification and some other relevant trends such as the flipped teaching. Critics argue that the flipped classroom model has some drawbacks for both learners and trainers. A number of criticisms have been discussed. In a nutshell: flipped classrooms based mainly on videos suffer some of the same challenges as traditional classrooms; learners may not learn best by listening to a lecture, and watching instructional videos at home is still representative of a more traditional form of teaching.

A constructivist approach is more beneficial, and that is why – as well the way – e-REAL is at the forefront by design. From a constructivist point of view, knowledge is mainly the product of personal and inter-personal exchange. Knowledge is constructed within the context of a person's actions, so it is *situated*: it develops in dialogic and interpersonal terms, through forms of collaboration and social negotiation. Significant knowledge – and know-how – is the result of the link between abstraction and concrete behaviors, in order to make the intangible more tangible. Knowledge and action can be considered as one: facts, information, descriptions, skills, know-how and competence – acquired through experience, education and training. Knowledge is a multifaceted asset: implicit, explicit, informal, systematic, practical, theoretical, theory-laden, partial, situated, scientific, based on experience and experiments, personal, shared, repeatable, adaptable, compliant with socio-professional and epistemic principles, observable, metaphorical, linguistically mediated. Knowledge is a fluid notion and a dynamic process, involving complex cognitive and emotional elements for both its acquisition and use: perception, communication, association and reasoning. In the end, knowledge derives from minds at work. Knowledge is socially constructed, so learning is a process of social action and engagement involving ways of thinking, doing and communicating (Bertagni, La Rosa & Salvetti, 2010; Licci, 2011; Morin, 1986; Popper, 1972; Robilant, 1991; Salvetti, 2015; Salvetti & Bertagni, 2010; Salvetti & Bertagni, 2018; Salvetti & Bertagni, 2018b; Wieman, 2018). That is the e-REAL why.

According to the first tests made by our applied research teams within the Harvard Center for Medical Simulation (CMS) in Boston, Mass. and at the EDME Lab from the Design Department of the Polytechnic School of Milan, the learner performance gain is 43% (in terms of faster and easier learning, as well as in better exam/assessment results) and 88% of learners have more engagement and even fun. Moreover, due to the ten times decreased cost of the e-REAL immersive room compared to the CAVE-like environments, the added value that e-REAL already brings to the field of education is pretty evident.

Learners are completely immersed in a 3D scenario where they can interact by natural gestures and experience the world from different perspectives at the same time (systems thinking) without experiencing cognitive overload. A 3D environment to be experienced without special glasses has an added value, because it allows to reduce the extensive use of the brain's working memory that is overloaded (De Leeuw & Mayer, 2008; Mayer & Moreno, 2003; Sweller, Ayres & Kalyuga, 2017) by traditional lectures, as well as during conversion of a 2D to a 3D representation as usually happens with common images used during traditional teaching (Salvetti and Bertagni, 2016).

e-REAL further includes live and real time interaction with peers, trainers, tutors, facilitators or mentors. And thus, this adds a very important social component that enhances learning outputs, as well as metacognitive processes and skills.

4. Rapid Cycle Deliberate Practice and the epistemology behind e-REAL

The e-REAL's active learning approach is designed to have the learner working on tasks that simulate an aspect of expert reasoning and problem-solving, while receiving timely and specific feedback from fellow students and the trainer that guides them on how to improve. These elements of authentic practice and feedback are general requirements for developing expertise at all levels and disciplines and are absent in lectures.

What today we know about learning from cognitive psychology is that people learn by practicing, with feedback to tell them what they're doing right and wrong and how to get better. That is why Rapid Cycle Deliberate Practice (RCDP) is at the core of the e-REAL's learning and training approach: RCPD is a novel simulation-based education model that is currently attracting interest, implementation, exploration and research mainly in medical education. In RCDP, learners rapidly cycle between deliberate practice and directed feedback within the simulation scenario until mastery is achieved (Taras & Everett, 2017). Common RCDP implementation strategies include: splitting simulation cases into segments, micro-debriefing in the form of *pause, debrief, rewind and try again* and providing progressively more challenging scenarios. For example, during an e-REAL session learners are shown short dynamic videos: they are challenged to recognize a situation requiring rapid intervention, communication, knowledge sharing, decision-making and management of unforeseen events – taking into consideration critical contextual factors such as a lack of time, scarcity of resources and tools, and a multitude of impactful factors. Augmented and virtual reality technology is being used, enabling learners to interact with multimedia scenarios reproducing very different situations: so, learners are requested to be compliant with mnemonics or check-lists in order to perform specific tasks (Salvetti et al., 2019).

The e-REAL lab offers an enhanced-reality ecosystem that is heretofore unparalleled. As a result, learners' engagement and performance is expected to grow and it's easy measuring the outputs with the most demanding traceability standards.

During an e-REAL session, both clinical and behavioral aspects of performance are addressed, so a number of skills and competencies – both technical and non-technical (behavioral, cognitive and meta-cognitive) – are challenged. Feedback is provided throughout sessions with a focus on soft skills related to KPIs such as leadership and fellowship, team-work facilitation, team spirit and effectiveness, knowledge circulation, effective communication, relationships and power distance, fixation's errors management and metacognitive flexibility.

The e-REAL system allows trainers to give feedback about non-technical aspects of performance, such as situational awareness, decision making, communication and leadership. The system also allows multi-source feedback during the simulation-based session, combining a self-assessment with the feedback of the other participants and that from the trainer. This activity improves the learner's self-awareness about their competencies and is a good occasion for soft skill assessment practice.

Behind those pillar elements there is an overall vision and an epistemology that we are about to summarize here. Humans are physical, biological, psychological, cultural, social, historical beings. This complex unity of human nature has been so thoroughly disintegrated by education and divided into disciplines. Restoring this complex unity means moving away from an influent paradigm – the mind-body dualism – formulated by Descartes and imposed by developments in European history since the 17th century. The Cartesian paradigm disconnects subject and object, each in its own sphere: philosophy, epistemology and reflective research here, science and objective research there. It is indeed a paradigm that unconsciously irrigates and controls our conscious thought, making it also super-conscious. This paradigm determines a double vision of the world, in fact a doubling of the world and of educational systems (usually divided in the science or humanities curricula). One is a world of objects that can be observed, experimented, manipulated; the other is a world of subjects that raise problems of existence, communication, conscience, destiny.

A paradigm institutes primordial relations that form axioms, determine concepts, command discourse and/or theories. It organizes their organization and generates their generation or regeneration. A paradigm may elucidate and blind, reveal and obscure. There, deeply ensconced inside the paradigm, lies a crucial factor in the game of truth and error. In short, a paradigm determines the sovereign concepts and prescribes the logical relation of disconnection. Disobedience to this disconnection is necessarily clandestine, marginal, deviant.

Even if the Cartesian body-mind dualism historically lost its attraction very early on, the notion that mental life is *internal* and separate from behavior, which is *external*, survived much longer and can still be found today in many psychological, pedagogical and andragogical approaches. This situation results in a uniting and managing of impoverished, simplified models and conceptual human action that cannot be used in the dense and polysemic dynamics of our daily lives. Perhaps it is no coincidence that we still often bring into account learning environments that, doing a little *archaeology of knowledge*, we could trace back to the model of the Panopticon – or rather prison, hospital, factory or school – that shows everything thanks to the spoke shape of the building: an environment where ideally a single observer may watch everything all the time, adding to the perceptions of the inmates (or patients, workers, students), a sort of omniscience and generalized control by the guardian. This occurs in an environment – the Panopticon – where learning is conceived as a passing of information from the lecturer to the student, following a communicative process that tends to be one-way (top-down) and within which the *retroactions*, the feed-back (bottom-up), take on the role of interrogations (Salvetti & Bertagni, 2018b).

Panoptism is a philosophy and a vision-guide, the discipline as a base assumption of the psycho-pedagogical procedures; taylorism (and its many *neo* variations) as an organizational model. But the Panopticon is not exactly the type of benchmark to look towards for inspiration, unless you wish to *re-edit* Charlie Chaplin in *Modern Times*, or any other form of neo-taylorism. We live in a 4.0 world, where cooperative learning interaction, that is not too structured and is a little centralized, helps a lot in terms of flexibility and enrichment of the cognitive maps. Instead of being inspired by the Panopticon, we should consider both educational environments as well as the human mind to be complex systems. In particular, the human mind works as a meeting point for a wide range of structuring influences whose nature may only be represented on a much larger canvas than that provided by the study of individual organisms. People are *agents* who must produce their own constructive interpretations and the expressive acts starting from the contexts in which they are rooted and within which we all live, move and realize our being.

5. Conclusions

e-REAL is a set of innovative solutions aimed at enhancing learning with a systemic, multilayer and multi-perspective approach. Tools are part of the solution, such as speech analysis, visual communication or conceptual clustering.

Integrating *soft skills* training with technical ones is a major aim. By utilizing e-REAL, a myriad of skills are fostered: both behavioral and cognitive, as well as metacognitive skills. Finally, technical skills are also honed, because it is mainly by fostering technical and job-related skills that soft-skills are developed as well. Innovations based on visual thinking and immersive learning, such as e-REAL, as well as some other augmented reality tools, advances in tablet technology and mobile applications, wearable devices and multimedia libraries, are successful because they upgrade people’s knowledge, skills and abilities.

The main goal within e-REAL is allowing a multi-perspective mindset during a simulation session: visualizing the *invisible* and going back and forth between specific observations and overall paradigms, merging real and virtual, looking inside and out pretty much at the same time, and focusing on both technical and behavioral aspects of a performance. Even if the word *virtual* in the common language is often meant to signify the absence of existence, whereas *reality* implies a material embodiment, within e-REAL virtual is something that may be easily actualized. So the virtual interacts with the actual reality, contributing to a better understanding: multilayer and so augmented, multi-perspective and systemic.

That is the revolutionary potential of virtual (and augmented) reality, if and when it's merged and mixed with the real world. So nothing is revolutionary within a simple virtual reality headset, but if virtual reality contents and scenarios are actualized within a real simulation setting, the merging of the real and virtual world is really adding value to the learning process. e-REAL is more than real!

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