

# Simplexity to Improve Human-Machine Interaction in 3D Virtual Reality

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## ABSTRACT

The purpose of this paper is to present the use of the notion of simplexity to facilitate the design of virtual and immersive environments. Through ahistorical and argumentative excursus, the authors specify the motivations that have led to the introduction of the notion of simplexity as a natural support to the teaching-learning process, regardless of the environments virtual and immersive, and then explore the links with the latter. If immersiveness makes it possible to generate interactions in a physical space, projecting a world surrounding the user and proposing interactions (apt to foster the teaching-learning process), then one could adopt in the of design simplexity that takes into account cognitive, metacognitive, and motor processes, realizing a virtual reality perceived as credible explorable, interactive, and indeed, immersive.

## KEYWORDS

Cultural Heritage, Edugame, Empathy, Simplexity, Special Education

## 1. RESEARCH BACKGROUND: THE COMPLEXITY OF HUMAN-MACHINE INTERACTION IN EDUCATION

This paper attempts to present important and current reflections within the philosophy of technology; these ideas start from a series of constataions of the world in which we live: during the nineties, a historical period that took on a role of connection between the twentieth century and the new millennium, the complex face of didactic and pedagogical research emerged, marked by numerous historical events: the increase in the level of education, the exploits of technology, the spread of the media, the use of educational institutions for political, social and cultural purposes (both in democratic and totalitarian terms) and discoveries in the field of physics and biology (Cambi, 2005, pp. 3-13). Taken together, these events have profoundly marked scientific research, in every field of knowledge, including, in its own right, didactic and pedagogical research (Ibidem), influencing the researchers who have described, analyzed, modeled and faced these elements; bringing out a complex vision of the teaching-learning process. Therefore, pedagogical research inherits this multifaceted

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vision of the educational phenomenon from the last century (Todino, Di Tore, 2018). Thanks to this superimposition of points of view, the complex vision of the teaching-learning process has overcome numerous dualisms: body-mind, self-other, individual-society and teacher-learner. Furthermore, it is possible to highlight that the complex vision harmonizes (thanks to the synergy of the parts): theory and practice, the knowing subject and the object of knowledge and, finally, teaching and learning (Sibilio, 2014, p.2). This complex vision allows for a significant paradigm shift: bringing out the biological matrix of the teaching-learning process, according to the principle of educability (Sibilio, 2014, p.3). This principle takes into account the biological and cultural possibilities of the learner, being able to affirm that: The training process has taken on the characteristics of an evolutionary and developmental process that takes into accounts the biological and cultural constraints and possibilities of the subject. However, the complexity that involves the study of the teaching-learning process can trigger an interpretative loop that exponentially multiplies the analysis plans (Ibidem), generating accessory complexity and privileging the axis of description (identification and understanding of didactic phenomena and pedagogical) to the detriment of the intervention axis, to support existence and development (Todino, Di Tore, 2018). A recursive process transforms the praxis-theory-praxis circularity into a theoretical-descriptive spiral (Sibilio, 2014, p.3). To recompose this descriptive drift it is necessary to adopt a functional point of view: one that aims, through action, to decipher complexity, in awareness. The complexity depends on the size of the grain and] on the level of precision with which the system is described (Sibilio, 2014, p. 6). At the same time, the idea that living organisms have found simplifying principles for complex processes (Berthoz, 2014, p. XIV) can be used as a support for didactic theories and practices (Berthoz, 2014, p. XIII)). Therefore it would be desirable to grasp the simple and generalizable rules applicable daily in the teaching-learning process. More in detail Alan Berthoz, through his works has brought out the properties that regulate the functioning of living beings and the human brain (Berthoz, 2011), highlighting a certain regularity of behaviors and ways to act that are summarized in elegant solutions optimized to process complex situations (Sibilio, 2014). Simplifying Principles for a Complex World is not easy at all, although the physiologist Alain Berthoz proposes a primary list of straightforward features (properties) of living organism that establish the tools for them for the foundation of different “patterns of interaction among the constitutive parts of a system. In other words, these provide the theoretical underpinnings for the interpretation of the behaviour of complex adaptive systems” (Pace, Aiello, Sibilio & Piscopo, 2015, pp. 71–87) These behaviors show a certain degree of simplicity in interactions, as an adaptation mechanism that allows survival, finding identical or similar patterns (Berthoz, 2011, p. 13) that all living beings use, during their existence to relate to what surrounds them, to minimize energy or increase the speed of information transmission (Ibidem). These characteristics can also be found in the teaching-learning process which, among other things, occurs: 1) by adaptation to the environment; 2) through the projection that the learner makes in the world through his interactions (Todino, Di Tore, 2018). In summary, simple teaching (which is based on the concept of simplicity) highlights in detail a series of properties and principles that can favor the teaching-learning process by giving indications that regulate teaching and guide its] flow with originality and wisely in order to ensure a wider range of resources available to each person (Sibilio, 2017, p.12).

## 2. VIRTUAL AND IMMERSIVE ENVIRONMENTS

One of the main technologies that can support the human teaching-learning process is presumably virtual reality, which can be used in formal (e.g. at school), non-formal (e.g. museums) and informal (in everyday life) contexts (Pellerey, 2002). In fact, in recent years, the relationship between virtual and immersive environments and the teaching-learning process has emerged in the scientific community (Freina, Ott, 2015; Kavanagh, Luxton-Reilly, Wuensche, Plimmer, 2017; Radianti, Majchrzak, Fromm, Wohlgenannt, 2020). In addition, it is reasonable to identify in virtual reality and immersive spaces two possible candidates to be the next technologies that will reach global and widespread diffusion.

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