

Simulation for Medical Training



Cecilia Dias Flores

Federal University Health Science of Porto Alegre, Brazil

Ana Respício

Universidade de Lisboa, Portugal

Helder Coelho

Universidade de Lisboa, Portugal

Marta Rosecler Bez

Feevale University, Brazil

João Marcelo Fonseca

Federal University Health Science of Porto Alegre, Brazil

INTRODUCTION

General Perspective

In a recent meeting held in London in April, Wired Health 2014, it was discussed the future of medicine, along the fusion of healthcare with technology and under the motto “What gets measured gets done”. Three elements are key now for envisaging artifacts, namely data, technology and design. Sensors, algorithms, big data, machine learning, nanotechnology, neurosciences, behavioral psychology and economics, are now adequate triggers for changing radically health and putting it under new tracks. All these topics are within the so-called Social Computation area where several disciplines come together to support aggressive applications for education, entertainment, business or healthcare. The goal is to build social systems, kind of artificial structures, designed and transformed by human action. In what concerns health, these systems may be very complex covering behaviors (predictions and explanations) and artifacts (e.g. for policies, methodologies for organization change, or transition management projects).

The aim is to boost efficiency in the services (monitoring vital signs remotely to detect impending problems) and, at the same time, to transform patient experiences with innovative tools capable to predict dis-functions before they happen (the data uploaded to distance servers where it is run through preprogrammed rules that flag up early signs of trouble). The idea is taking earlier decisions before things have actually gone wrong, and builds interventions we have never had the opportunity to consider before, tailored to a person’s profile. The vision of a connected and intelligent approach covers the ability to deal with illness, aging and fitness, by articulating detect with intervene and prevent.

Objectives

Part of the illness around us may be mitigated by education and changes of our own behaviours. But it is also necessary help patients to move from physical to digital (and connected) healthcare, by getting them to take their medicine when alarms are activated on account of simple symptoms. A policy of

DOI: 10.4018/978-1-4666-9978-6.ch064

early indicators (disrupted patterns) with tacking technology insures the follow-up of new diagnostic and therapeutic approaches. The innovation drive consists of moving from conservative and traditional social information processes toward emphasizing social intelligence, and by inventing new roles for information, Internet and mobile technology. Social intelligence and technology improves also our understanding about human behave and social interactions in human society at the individual, interpersonal and community levels.

This chapter focus on simulation for medical training. The literature review examines simulators in the area of healthcare and medical simulation. The chapter describes SimDeCS, the Intelligent Simulator for Decision Making in Health Care Services (in Portuguese, Simulador Inteligente para a Tomada de Decisão em Cuidados de Saúde) which is an end result of a large project for medical learning (Flores, Fonseca, Bez, Respício, & Coelho, 2014). Special focus is given to its architecture and the methodology employed in building clinical cases. SimDeCS plays the role of a virtual patient (Orton & Mulhausen, 2008; McLaughlin et al., 2008) and has been extensively evaluated (Barros, Cazella, & Flores, 2015; Flores et al., 2014; Maroni, Flores, Cazella, Bez, & Dahmer, 2013). Examples of clinical cases are presented. In addition, the chapter proposes future research directions in simulation for medical training and draws final conclusions.

BACKGROUND

Many studies have confirmed the effectiveness of simulation in the teaching of medicine and clinical knowledge as well as in the assessment at the undergraduate and graduate medical education levels (Okuda et. al., 2009). Several currently existing simulators propose to offer students safe virtual environments, where they can test and consolidate recently acquired theoretical knowledge in simulated clinical situations (Brookfield, 2005; Botezatu et al., 2010; Holzinger et al., 2009).

Table 1 presents examples of several types of simulators for healthcare from the literature.

Simulators provide learning environments for the playful application of acquired knowledge and eventually the evaluation of that process. The simulator can also be an open space where students exercise the decision making process in a more realistic framework; not only achieving a goal – such as making a diagnosis or choosing a therapy – but also understanding that different decisions will imply different financial costs, risks to the virtual patient and time expenditures. A simulation can, therefore, also show the student that although excessive research can lead to the correct final result, shorter and cheaper strategies may also lead to adequate results.

The development of simulators for healthcare is to a large extent on the use and refinement of Artificial Intelligence (AI). Simulators integrate AI in the form of algorithms that can handle concepts, heuristics use, knowledge representation, support for computation with inaccurate data, multiple solutions, and integrate machine learning mechanisms. According to Bourg and Seemann (2004), AI techniques can be divided into two groups: deterministic and non-deterministic. The first are predictable, easy and quick to implement, however, predictability restricts the simulation, after a few iterations the users realizes what the next states and events. Non-deterministic techniques facilitate learning by providing an unpredictable end to the simulation. Their difficulty lies in the implementation, computational tests, and validation of specific events. The types of simulators using AI are divided by Machado et al. (2009) according to their performance on two levels: the upper level control, referring to the decisions related to the course

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