



Application of Virtual Reality Simulators and Virtual Labs in Medical Education

Majid Zare Bidaki^{1,*}

¹Social Determinants of Health Research Center, Medical Microbiology Department, Faculty of Paramedical Sciences, Birjand University of Medical Sciences, Birjand, Iran

*Corresponding author: Majid Zare Bidaki, Social Determinants of Health Research Center, Medical Microbiology Department, Faculty of Paramedical Sciences, Birjand University of Medical Sciences, Birjand, Iran. E-mail: m.zare@live.co.uk

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Dear Editor,

For centuries, medical education has concentrated on learning theoretical concepts, followed by clinical experience through direct student-patient communication. However, development of new technologies has led to a revolution in learning methods, known as “simulation”. The first published studies on the use of simulation in medical education date back to the 1960’s (1). The first widely accepted medical simulation was adopted in the early 1960’s by Asmund Laerdal. His simulation included a doll, which was designed and constructed to enable students to teach mouth-to-mouth resuscitation (1). Because of the significant success of this method, teaching concepts in basic sciences and clinical medicine according to simulated models have expanded quickly, particularly along with the use of digital technology.

Introduction of digital simulations in medical education highlights the design of “Sketchpad”, presented by Ivan Sutherland in 1964, as the first model of graphical interaction between man and computer (2). NASA introduced the first surgical computer simulator in 1989. This device could be used to simulate orthopedic procedures and to view results on a computer (3). Overall, application of computer simulators in medical education, especially virtual reality technologies, has been significant in recent years (4, 5).

Virtual reality signifies a simulated reality developed by computer systems in a digital format. Creation and realization of reality in a virtual format requires hardware (e.g., computers, head-mounted devices, motion sensors, and virtual gloves) and software programs, which can provide the viewer with a profound experience of the real world (360°, 3D space). In 1997, Rosenblum and Cross proposed 3 important qualities for each virtual reality system, including immersion, interaction, and visual realism. Basi-

cally, virtual reality simulates the user’s physical presence in a virtual environment.

Currently, some universities employ virtual technologies worldwide to teach basic medical subjects, such as anatomy, physiology, and microbiology via simulation of theoretical concepts or experimental procedures, which are difficult to present in the real world (4, 5). Virtual reality simulation is also used in clinical training, especially to practice and facilitate learning of surgical, anesthetic, endoscopic, orthopedic, and laparoscopic procedures. Obviously, in the absence of such simulators, it is not possible to train or practice these procedures (6, 7).

Besides universities, several knowledge-based companies have been established in recent years for the production of virtual reality-based educational simulators, which are appropriate for medical and biological sciences. Labster is one of these companies, which develops virtual labs in cooperation with several faculties of reputable universities in the United States and Europe. A consortium of some Indian universities has also simulated a series of virtual biotechnology labs (www.vlab.co.in) under the supervision of the Indian ministry of human resources development. Knowledge-based companies, including Immersive-touch, Medicalrealities, and Virtamed are some examples of companies involved in the development of virtual reality simulators for surgical training.

The greatest advantage of virtual simulation is the possibility of laboratory training for learners without the need to be present in the laboratory, besides the possibility of clinical training in the absence of patients. Repeatability is another positive feature of virtual simulation. In addition, inclusive skills can be assessed more accurately through simulation. While it is costly to design and develop virtual reality simulators, it is beneficial to invest in virtual labs in the long run because of the reduced consumption of ex-

pensive materials, reduction of risks associated with the absence of real-life encounters, and ultimately preparation of microorganisms, laboratory animals, or cadavers.

Use of virtual reality simulation technologies has become inevitable for qualitative development of education in modern universities although it is only at the beginning of its path. For the first time in Iran, virtual reality-based learning contents in basic medical sciences were designed and developed with the aim of teaching theoretical and laboratory concepts of medical microbiology at Birjand University of Medical Sciences. A few subjects, including simulation of bacterial cell structure, simulation of virus structure, and simulation of microbiology labs, are available on www.aparat.com/learningbums. To watch these virtual-reality contents and incorporate them into the learning process, head-mounted devices are needed.

Application of simulators is especially important when it is virtually impossible to visualize the same scenarios objectively (e.g., in a classroom or an educational laboratory). For instance, simulation of a 360° cytoplasm space for a bacterium and 3D visualization of its components from the perspective of an internal observer can make the learning of bacterial cell structure extremely interesting and engaging for the learner. Moreover, access to a virtual lab allows users to be familiarized with advanced laboratory instruments and devices and subsequently enables them to perform stage-by-stage experiments and work with chemicals and harmful microorganisms in a simulated environment.

At the beginning of the twentieth century, the most common advice for skill learning and development in medical education was “see one, do one, teach one” (8), while the recommendation in years to come will be “simulate, simulate, and simulate again.”

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