Chapter 19
Virtual Tools in Medical Education

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ABSTRACT

Technology has become ubiquitous throughout medical education. Currently there is a wide range of tools that can be used to supplement traditional classroom and clinical learning. Simulators and mobile devices are among the tools that may make an especially significant impact on educating medical practitioners. Simulators range from simple part-task trainers to complex high-fidelity human patient simulators. Internet-enabled handheld portable computers such as the iPad® have begun to revolutionize and expand the medical classroom to even further reaches. Instructional design principles maintain that these technologies can and should be used to allow practitioners to learn by playing. Blind investment in these technologies, however, can quickly turn these technologies into a waste of time and money. We present principles intended to ensure that factors such as cost, size and technological expertise are taken into consideration when investing in such technologies for medical education. Following these principles will allow a medical department to optimize the cost-benefit ratio of an investment in simulation and portable computer technology for medical education.

INTRODUCTION AND BACKGROUND

The old adage in medicine was "see one, do one, teach one" whereby a medical trainee was given limited opportunities to observe a procedure before being asked to perform one on a patient and subsequently teach it to others. In the Internet age, we have the opportunity to improve upon that educational model to one where undergraduate and postgraduate students become more fully engaged in the participatory learning paradigm. Using cutting edge technological tools, medical educators can provide residents and medical students with the ability to have immediate point of care assess to seminal texts and references while on the wards, to practice procedural and decision making skills without endangering patients, to participate in real-time discussion of the latest

DOI: 10.4018/978-1-4666-3930-0.ch019

breakthroughs in medical care and to become educators, perfecting their communication skills, while sharing their medical knowledge with their colleagues around the world.

The use of simulation in medicine was actually born out of the field of aviation (Bradley, 2006). The thought process was that both fields were "expert domains" and that participants in these fields had to be prepared to handle a nearly unlimited number of potential problems that could arise. Furthermore, these obstacles could only be appropriately overcome by rigorous honing of motor skills and decision-making (Shaffer, 2001). Originally to accomplish this means of simulated practice in the hopes of sharpening skill, Edwin Link created the first aircraft simulator in the late 1920's (Doyle, 2002). Simulators eventually became mainstay in the aviation industry and soon would become more pervasive through other fields.

Mannequin-based simulators were first adapted from aviation simulators for use in medical education in 1960 with the development of Laerdal's Resusci® Anne mannequin was produced to teach resuscitation skills (Rodgers, 2007). Initially the mannequins were very rudimentary; they were merely used to train specific tasks, such as basic life support and airway management. Eventually however, the industry grew and the tools became more complex. The first computer-controlled simulator was created in 1967 by Judson Denson and Stephen Abrahamson and entitled SimOne™ (Denson & Abrahamson, 1969). The fidelity of the human simulator and its applications in medical education were immediately touted throughout the literature (Abrahamson & Denson, 1969; Hoffman & Abrahamson, 1975). The SimOne™ was eventually surpassed by several other simulators, each providing upgrades and new innovations compared to its predecessors.

Modern simulator technologies have evolved to include remarkably complex high-fidelity life-size mannequins, sophisticated immersive or computer and internet-based virtual reality devices and environments. The breadth of current simulators varies greatly in size, setup and maintenance costs, as well as educational fidelity. The simplest simulators in today's medical education world are the mannequin part-task trainers like intubating heads and arms to practice intravenous placement. These are straightforward, small-scale physical devices created to teach the learner one or two specific, hands-on isolated tasks. Increasing in complexity from the mannequin part-task trainers are the current virtual based part-task trainers. These remarkably sophisticated tools integrate the ability to teach hands-on tasks in a more immersive virtual computer generated environments with haptic (virtual touch and feel) feedback. Such simulators can replicate the minimally invasive surgical (laparoscopy, arthroscopy etc.) and procedural (colonoscopy, bronchoscopy, and endovascular) environments. Though these tools can be considered less complex than the more historical full-body simulators, they do confer advantages such as cost, space effectiveness and portability.

Although the SimOne™ eventually became obsolete, that does not mean that the human simulator has left the market, far from it in fact. The current landscape is rife with options to choose from including a full range of male and female adult, pediatric and infant simulators. Given the numerous choices integrating the variety of available tools into a cohesive medical education curriculum requires a thorough understanding of the needs of the department as well as a firm grasp of the advantages and challenges inherent in the available tools.

As noted by Horton, the difference between "learning games" and "learning simulations" is mostly one of semantics (Horton, 2012). While simulations often look and feel more realistic while games tend to focus on scorekeeping, the importance is that something is being taught in an interactive fashion. Simulators can teach users how to operate a new piece of equipment a new task or practice decision-making through