The impact of e-learning on healthcare education

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Abstract—E-learning is being adopted rapidly in different areas because of its ability to deploy knowledge quickly and efficiently to a large number of dispersed people. In healthcare, medical educators are increasingly using electronic learning (e-learning) to support their curriculum design, delivery and evaluation. However, the real benefit of e-learning to healthcare education is still under study. The aim of this paper is to review published literature and uses case study method to evaluate the impact of e-learning on healthcare education. Study results show that e-learning has positive impact and can improve healthcare education.

Keywords— healthcare education, e-learning, on-line learning

1. Introduction

Healthcare, as with any other service operation, The development of computer and networks has led us into an e-learning era which will deeply influence the knowledge economic environment. E-learning can easily create a free personal learning space. For these reasons, it may become the most popular technology and media for education.

Over the past several years, medical educators have faced increasing challenges associated with changes in healthcare delivery, and advances in medical science and technology. For example, education has shifted from hospital acute care settings towards community-based and long-term care settings (Nair & Finucane, 2003). These changes have increased the clinical demands on medical educators, resulting in less time available for teaching (Ozuah, 2002). To overcome these challenges, medical educators are increasingly using IT and networking to support their curriculum design, delivery and evaluation (Ward, Gordon, Field, & Lehmann, 2001; Whitcomb, 2002; Lau & Bates, 2004; Barzansky & Etzel, 2005). E-learning has already moved from textbooks in electronic format to a truly interactive medium that can meet healthcare educational needs.

Through literature reviews, this paper examines the impact of e-learning on healthcare education. It defines e-learning, describes e-learning components and provides relevant examples.

2. What is e-learning

2.1. Definition

The e-learning program (or web-based learning), which is carried out with digital tools and access to teaching materials through wired and wireless networks, involves learning activities, either on-line or off-line. Stuparich (2001) refers to e-learning as the use of digital technologies to support and deliver some or all of the teaching and learning for a particular unit of study. Mainly this is the use of the communications power of the Internet to deliver an interactive learning environment to learners without constraints of time or geography. Kirschner and Paas (2001) point out that e-learning includes online, Web-based training and computer-based training.

E-learning technologies offer learners control over content, sequence, pace of learning, time, and often media, allowing them to tailor their experiences to meet their personal objectives, encompassing all aspects of machine-based learning and technology-enhanced education. The more conventional methods of distance education delivery can also be included in the category of e-learning, such as videoconferencing, videotape, TV, CD-ROM/DVD, and even satellite broadcast, in contrast to traditional face-to-face (F2F) classroom or laboratory lecturing.

2.2. The difference between e-learning and traditional lecturing

While many studies stress the increasing adoption of e-learning, they often fail to compare its elements with those of traditional methods. To

remedy this, this paper reviews published literature on their comparisons and contrasts.

Mikulecky's study (1998) explored differences in the range and types of graduate students in a campus-based and a Web-based graduate course on teaching adolescent literature. The study found useful discussion in all class settings. Case studies are an important component of many business curricula; however, in-class discussion of case studies suffers from temporal and geographical limitations, whereas computer-mediated communication systems (CMCS) overcome these constraints.

To test the concept, Benbunan-Fich & Hiltz (1999) conducted a field experiment on the effectiveness of an Asynchronous Learning Network (ALN) vs. traditional manual methods in individuals and groups discussing and solving a case study. They indicated that groups working in an ALN environment produced better and longer solutions to the case study, although students were less satisfied with the interaction process. Further, Haytko (2001) implemented an Internet-enhanced marketing planning hybrid course which was designed to combine the best aspects of traditional and Internet teaching. He taught both hybrid and traditional courses in the same semester. Teaching evaluations and written comments showed that the students still preferred the traditional method. His conclusion was that universities should consider their goals, target markets and competitive differentiation before deciding how the Internet can best be integrated into the curriculum.

Bartley & Golek (2004) emphasized the cost effectiveness of e-learning. They showed that even if the initial costs for an e-learning platform are high for many universities, the operational costs are lower. Such programs do not require extensive travel cost or time (either for instructors or for learners), while overcoming the problems of distance and scheduling.

Can et al. (2007) compared the exam results obtained by two groups of students: one in a traditional learning environment, the other using an e-learning method. They conclude that the exam grades of e-learning students were higher. However, they are not totally comfortable with this conclusion because comparing the exam results of traditional and distance students is like comparing apples and oranges. There are consistent differences between these two categories of students that impede the implementation of this evaluation method. Firstly, distance students have practical experiences. Most of them will choose to study the same domain as they are employed, so they have a solid practical background to accumulate theoretical knowledge. In contrast, the traditional students have more time to study, they can gather many explanations during the traditional classes and don't have as many distractions. This makes test-result comparisons difficult.

A summary of the comparison of e-learning with traditional lecturing is provided in Table 1.

3. COMPONENTS OF E-LEARNING

E-learning involves five components: participants, content, management, delivery, and standards (Littlejohn 2003). Participants include learners and instructors. Learners control their own learning pace while instructors play the assistant and the guide. Content comprises any group of digital materials which can range in complexity from discrete, self-contained units of instructional material assembled and reassembled to build larger educational materials to meet the requirements of a specified curriculum in a meaningful way and tied to an educational objective (Smith, 2004). Examples include tutorials, case-based learning, multimedia, simulations, and game-based learning modules. Content creators use instructional design and pedagogical principles to produce learning objects and instructional materials.

E-learning has different delivery forms, either synchronous or asynchronous. The former delivery refers to real-time, instructor-led e-learning, where all learners receive information simultaneously and communicate directly with other learners. Examples include teleconferencing (audio, video, or both), Internet chat forums, and instant messaging. The latter means the transmission and receipt of information do not occur simultaneously. The learners are responsible for pacing their own self-instruction and learning. Using e-mail, online bulletin boards, newsgroups, and Weblogs or feedback technologies is the methods to be used to communicate between the instructor and learner, but not in real time.

Table 1: A comparison of e-learning with traditional lecturing

Item	e-learning	Traditional lecturing
Material	- Electronic content - Updates on a timely manners - Just in Time (JIT) learning style - Easy distribution - Easy access to educational materials - Revises simply and quickly - Standardizes course content and delivery - unlimited data retrieve space	- Printed material - Update: delayed - Just in Case (JIC) learning style - Data retrieval limited
Cost	- International scale, higher initial costs but lower operational costs	- smaller scale, higher operational costs
Measure Effect	- Self tests through on-line evaluation - Automated tracking and reporting of learners' activities - May include outcomes assessment to determine if learning has occurred	- Not easy to measure - Paper tests and examinations to measure progress
Learning Centric	Learner-centried	Instructor-centried
Interactive	- Learners gain knowledge, skills, and attitudes faster - Helps to maintain learner's interest and provides a means for individual practice and reinforcement	will be tied to the more rigid structure of a typical class that meets in a particular place on a regular basis
Learning Resources	Easy access to abundant information through web	Knowledge comes from instructor and texts
Environment	Electronic platform	F2F lecture
Instructor's Role	Role of assistant and guide	Knowledge transmitter
Learner	- Must be active to gain knowledge - Has the flexibility to complete work when and where it is convenient	Likely to be more passive, dependent on instructor
Administrative	Less burdensome	Needs more clerical help
Impact/Outcome	Literature claims improved motivation, performance, retention and utilization of content	The need to record lectures may impede grasp of detail and scope of material for some students
Strengths	Computer-mediated environment (Asynchronous text-based discussion) - Flexibility: can contribute to the discussion at the time and place that is most convenient - More participation because time and place constraints are removed - Depth of Reflection: learners have time to consider more carefully and provide evidence for their claims and provide deeper thoughtful reflections. (Mikulecky, 1998; Benbunan-Fich & Hiltz, 1999)	F2F environment (In-class discussion) - human connection: easier to bond and develop a social presence - Spontaneity: allows for the generation of rapid chains of associated ideas and serendipitous discoveries (Mikulecky, 1998)
Weaknesses	- Spontaneity: declined - Procrastination: may be a tendency towards procrastination (Benbunan-Fich & Hiltz, 1999) - Human Connection: the medium is considered to be impersonal by many and this may cause a lower satisfaction level with the process (Haytko, 2001)	- Participation: Can't always have everyone participate, especially if there are dominating personalities. - Flexibility: limited time, which means that you may not be able to reach the discussion depth that you would like.

Once content is developed, it must be managed, delivered, and standardized. Management includes all the administrative functions, such as storing, indexing, cataloging, needed to make e-learning content available to learners. Examples include portals, repositories, digital libraries, learning-management systems (LMS), search engines, and ePortfolios. LMS is Internet-based software that facilitates the delivery and tracking of e-learning across an institution (Johnson et al. 2004; Phelps & Michea, 2003). In addition, it provides a virtual learning environment to simplify and automate administrative and supervisory tasks, track learners' achievement of competencies, and operate as a repository for instructional resources twenty-four hours a day.

Standards are becoming increasingly clear and needed for the creation of new e-learning materials (Fallon & Brown, 2003) which raise accord and usability of products across many computer systems, speeding the prevalent use of e-learning materials. Several organizations have been engaged in creating broad e-learning standards (Fallon & Brown, 2003). The most well-known set of standards is the Advanced Distributed Learning (ADL): Sharable Content Object Reference Model (SCORM). ADL is to standardize and modernize training and education management and delivery. SCORM integrates a set of related technical standards, specifications, and guidelines designed to meet SCORM's high-level requirements - accessible, reusable, interoperable, and durable content and systems. SCORM content can be delivered to learners via any SCORM-compliant LMS using the same version of SCORM.

4. CASE STUDY

This paper reviews published articles that reported application examples of e-learning to healthcare education. This may help later to evaluate the impact of e-learning on healthcare education.

Case 1:
Department of Health (DH), Royal College of Radiologists and the National Health Service (NHS), the Radiology Integrated Training Initiative (R-ITI) devised LMS and delivered a national standard, quality persistent online, interactive learning solution in the entire radiology curriculum in which novice radiologists can learn, record and evaluate their progress. R-ITI e-learning has improved medical training for them with the expert on your desk regardless of location and enable them to be part of a national community, sharing learning experiences and high quality cases across the UK. The innovation of R-ITI e-learning represents the most positive development in medical education which enhances learners' confidence on their practice. (E-lfh, 2009)

Case 2:
In Canada, an online dementia-care training program was designed to assist workers in long-term care (LTC) facilities to provide quality care for patients with dementia disorders. Through this learning program, most workers developed a better understanding of dementia and the know-how to interact with the residents more effectively. In Ontario, it is estimated that approximately 100,000 people per day work and interact with residents with cognitive disorders in LTC facilities (Ontario Ministry of Health and Long-term Care Communications Office, 2003). This online learning program demonstrated a feasible and cost effective strategy for delivering consistent, high quality training in the healthcare field. (MacDonald, Stodel, & Casimiro, 2005).

Case 3:
Teaching physical-exam skills to medical students is increasingly difficult. The Medical College of Wisconsin uses the course-management platform called ANGEL to teach cardiopulmonary and physical-exam psychomotor skills, physical-exam findings and relationship to pathophysiology. Its tutorial features hyperlinks to physical-exam skills videos and clinical skills websites. Subsequently, case-based lessons with video interviews, audio of normal and abnormal cardiac and pulmonary auscultatory sounds, pictures of abnormal physical exam findings and X-rays for individual cases is introduced. This e-learning module has improved the knowledge and skills of medical students in cardiopulmonary testing, and assesses their ability to accurately identify cardiac and pulmonary auscultatory sounds by using an interactive e-module in the setting of limited teacher and patient resources. (Jevtic, Torre, & Sebastian , 2007)

Case 4:
Modern medicine is very complex. Health-science students gain specific and realistic details in the various health specialties. But they get

little in team skills. The Norwegian Better & Systematic Trauma Care project (BEST) has been using a low-tech simulation set-up for training inter-professional trauma teams in 90% of the acute hospitals in Norway. The one-day inter-professional course is organized locally at each hospital, and the training takes place in each hospital's own trauma room. The training program starts with an interactive lecture on crew resource management (CRM) theory as an introduction to inter-professional collaboration. Then each team views the video including a short clinical history which demonstrates several errors leading to an injury. Subsequently, the discussion focuses on the students' knowledge related to the clinical problems presented in the video, how this could occur, and how to avoid patient harm in this situation. Overall, students report that this team-training is useful and asks for more of this in their own educational syllabus. They further state it could be an important way of avoiding prejudice between the different health professions, and improve mutual understanding. This example suggests that involving students in inter-professional team-training using simulations is a valuable tool for enhancing their learning process through reflections on their own roles and challenges their way of looking at other professions in interactions involving patient safety. (Kyrkjebo, Brattebo, & Smith-Strom, 2006)

Case 5:

In response to the educational need, technology must be integrated into medical school teaching to keep the medical curriculum from becoming outdated. Borycki et al. (2009) have developed an Interdisciplinary Electronic Health Record (EHR) Educational Portal, a learning tool which allows students of the health professions as well as practicing professionals to access and interact with a set of representative EHR HIS solutions in University of Victoria (UVic). Using this high-fidelity- simulated EHR system, students learn how to work with different EHRs and their elements prior to working in real-world clinical settings. The portal has been used successfully in the classroom, laboratory and with distance education to give hands-on experience with various Health Information Systems (HISs). Students indicated that they felt this experience has greatly informed from their classroom experience. If students master EHR navigation skills before starting their clinical rotations, they can focus the latter time on

traditional learning exercises, such as clinical reasoning, diagnosis, acquiring medical procedure skills and interacting with ancillary caregivers and patients. (Borycki et al. 2009)

Case 6:

Classification and correct identification of the disease will result in adequate preventive and therapeutic measures. The Pressure Ulcer Classification (PUCLAS) Workgroup and the Nursing Sciences Departments of the University of Ghent and the Radboud University Nijmegen Medical Center developed the e-learning program called "PUCLAS2" (http://www.epuap.org/epuap) (Defloor et al., 2005). This web-based educational tool provides information about the classification of pressure ulcers and about the differentiation between pressure ulcers and moisture lesions. A total of 214 students and 212 qualified nurses participated in the study. Results showed that these participants all improved their skills after attending the training. Moreover, the classification skills of the students in the e-learning group improved more than when they attended a traditional lecture. (Beeckman, Schoonhoven, Boucque, Maele, & Defloor, 2008).

5. CONCLUSION

Education is a fast-growing economic and social-influence in the world, and the use of new technologies is an integral and driving component of that growth. E-learning, like any type of advanced training, has played an important role in today's healthcare education. Its benefits have been accepted by many organizations and individuals. For example, a 12-year meta-analysis of research by the U.S. Department of Education found that higher education students using e-learning generally performed better than those in F2F courses (Means et al., 2009). The MIT OpenCourseWare is an initiative of the Massachusetts Institute of Technology (MIT) to put all of the educational materials from its undergraduate- and graduate-level courses online, partly free and openly available to anyone, anywhere. This program allows students to attend 'classes' across physical, political, and economic boundaries at minimum costs (MIT, 2009). Bates (2009) also states that a major argument for e-learning is that it enables learners to develop essential skills of knowledge-based workers by embedding the use of information and communications technologies

within the curriculum. He also argues that this has major implications for course design and the assessment of learners.

The healthcare environment is complex and its rapid changes demand that professionals keep pace with updated information. This study reviews published literature and uses case-study method to evaluate the impact of e-leaning on healthcare education. All of these case studies indicate that e-learning leads to a certain degree of improvement in healthcare education. This paper concludes that the e-learning style will always serve as a very rewarding and promising alternative, not only from the learners' perspective but also from the instructors'. Therefore, establishing and expanding such an alternative mode of education is well justified for the foreseeable future. However, finding a balance between two approaches - traditional lecturing and e-learning self-study package - could be very valuable for healthcare education. The Critical Success Factor (CSF) of implementing e-learning to the practical healthcare settings will be analyzed and investigated in the next paper.

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