Information and Communication Technology in Medical Education: An Experience from a Developing Country

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Abstract

This literature review was conducted using PubMed-Medline, PubMed-Central and ERIC databases, 1979- 2010, for research studies and pertinent theoretical publications including journals and texts. Key search words included general terms such as: "medical education," "information and communication technology in medical education," "medical students' computer skills" and "ICT use among medical students". Theoretical approaches were included to place the review within an educational and social context, and selected studies to demonstrate use of ICT in medical education through time and in different countries.

Keywords: Medical education, Computer technology, Telemedicine, E-learning, Information and communication technology (ICT), Computer literacy, Computer skills, Computer knowledge.

Introduction

Information and communication technology (ICT) has brought many changes in medical education and practice in the last couple of decades. Teaching and learning medicine particularly has gone under profound changes due to computer technologies, and medical schools around the world, particularly in industrialized countries, have invested heavily in new computer technologies or in the process of adapting to this technological revolution. In order to catch up with the rest of the world, developing countries need to research their options, design the necessary process, and implement essential changes in adapting to new computer technologies.

This paper provides (a) the historical overview of ICT, its enhancement, and its application in medical education from 1979 to 2010; (b) studies regarding ICT use in medical education, looking at both industrialized and developing countries, and assessment of medical students' computer skills; and (c) the role leadership plays in medical education with regard to ICT.

The literature review specifically describes some of the challenges medical schools have been facing particularly in developing countries in facilitating ICT use by their medical students.

Materials

A) Historical Overview of ICT in Medical Education:

Computer technology has a long history of enhancing medical education in many different ways. Long before the emergence of the Internet and the World Wide Web, computers were used to store and retrieve medical information using large databases, and as early as 1979 it was predicted to become more indispensable as tools in diagnosis and decision making in medicine were developed (Lashof et al., 1979).

With the advent of computers, predictions about reforming medical education from a traditional lecture/discussion curriculum to a more student-centered type of education to enhance creativity and lead to changes in the way physicians practice were common. Medical educators were predicted to spend less time delivering information in traditional settings such as lectures and more time on facilitating the learning process and research. In addition, medical students were predicted to take a more active role in their learning and alter the pace of their own education using computers.

In 1984, the American Association of Medical Colleges issued recommendations that information sciences be incorporated into medical schools so that graduates could retrieve information from published databases and have basic familiarity with computer technology (Hollander, 1999).

By the mid-1990s, ICT wasrevolutionized with the emergence of the Internet as a global connectivity tool, the emergence of the World Wide Web (WWW) as a virtual domain where individuals could post digital content for public access, and the spread of commercial web browsers that could retrieve documents or pages stored in websites (Friedman, 2007).

Information technology was expected to provide medical students with easier and more effective access to a wider variety and greater quantity of information. Because

information technology was expected to play an important role in primary and secondary education, it was believed that medical students' knowledge and expectation of computer use would grow consequently, and increasing demand for computer skills in medical curricula would have a great potential to influence how medicine would be taught and learned (Mooney & Bligh, 1997).

Today, multimedia technology, the World Wide Web, and the omnipresent nature of networked computers have transformed educational technologies. Medical educators now use technology more than ever to deliver learning resources, and this increased use can be seen in the growing number of publications and conference presentations related to educational technology (Aschenbrener, 2008). Accordingly, educational technologies have enhanced teaching and learning in medical education, and will continue to evolve and become further integrated into all aspects of the medical industry.

Information technology has made medical knowledge accessible for everyone. Patients not only use ICT to better understand medical issues, but they also use networking to inform each other, rate their doctors, question medical procedures, and launch malpractice suits. The Internet has made the medical knowledge accessible for everyone around the world and medical knowledge is no longer a health care provider monopoly. Health care experts and physicians must be well prepared to cope with changing patient behaviors and knowledge (Karsenti & Charlin, 2008, p. 69).

Computer technology has been impacting medical education for the past four decades. As computer technology has evolved and improved through the time, it has become more integrated with and inseparable from medical knowledge due to exponential changes happening to the medical field itself. Computer technology has affected medical education from ease of storing and retrieving data, performing statistical analysis, and individualizing the medical education, to the creation of and access to gigantic medical research engines on the Internet, distant learning and practicing, and virtual simulators. As the world becomes more globalized, having access to information, communication technologies, and information literacy, become extremely important for future physicians.

B) Studies Regarding ICT Use in Medical Education:

Because of the important role that computer technology plays in medical education in both industrialized and developing countries, medical students' computer skills have been researched for at least the past three decades (Dorup, 2004; Hollander, 1999; Lashof, Banta, Pengov, Gardner, & Pietz, 1979). These studies suggested that in both industrialized and developing countries, students realize the significant transforming impact of ICT on medical education and want to see the necessary changes being implemented to facilitate this revolutionary transformation (Karsenti&Charlin, 2008).

One issue regarding ICT in medical education is access. While industrialized countries benefit from investing in ICT, developing countries could particularly benefit from ICT-mediated education because of the lack of educational institutions and qualified medical educators, poor distribution of facilities, and poor access to the latest educational infrastructure (Maharana et al., 2009). Students in developed countries have adopted ICT if available, and actively use medical databases (Virtanen & Nieminen, 2002). However, access to technology is often an issue in developing countries.

ICT use was examined at a medical college in Burla, India, and according to Maharana et al. (2009), ICT could be a useful tool to address problems in medical education, but the lack of technology and resources was a serious limitation. Most users were deprived of access to the vast medical literature available in electronic format, and the medical college had not been able to use the services available at national and international levels (Maharana et al., 2009).

Even if access to ICT is not an issue, student skills levels may impede the use or adoption of ICT and computer skills classes or assistance is needed for the medical students (Azarmina et al., 2004; Kir, Ogur, Kilic, Tekbas, & Hasde, 2004; Link &Marz, 2006; Lotfnejadafsha, Habibi, &Ghaderipakdel, 2007). Multiple studies have been done that examined the perceptions medical students had regarding computers, computer skills, and ICT (Bin Ghouth, 2008; Dorup, 2004; Hollander, 1999; Lotfnejadafsha et al., 2007). One finding common to all of these studies was that while the students usually used computers and the Internet for personal use, few used computers or ICT in their medical education. Another commonality was that all of the participants understood the importance of ICT in medical education, and were willing to use ICT if available and training was provided (Bin Ghouth, 2008; Dorup, 2004; Hollander, 1999; Lotfnejadafsha et al., 2007).

At Uromia University of Medical Science in Iran, Lotfnejadafsha et al. (2007) found that, in general, the medical students had no formal computer training and were unaware of the medical research and education resources available. In a study conducted in Yemen, it was concluded that despite the medical students' computer and Internet knowledge being good, their use of technology for medical research was poor (Bin Ghouth, 2008). The highest levels of competence assessed were usually for e-mail, Internet use, and file management, and very few students were confident in specific applications such as office productivity software or doing a Medline search (Azarmina et al., 2004; Vittal, 2004).

In order to increase ICT use among medical students, Kommalage and Gunawardena (2008) concluded that improving IT knowledge among undergraduate students was

important because they found that entering medical students had inadequate IT knowledge, and this highlighted the importance of having an introductory IT course for medical undergraduates. At the Gulhane Military Medical School in Ankara, Turkey, it was observed that medical students used the computer and Internet essentially for nonmedical purposes, and the researchers concluded that to encourage students to use the computer and Internet for medical purposes, tutors should use the computer and Internet during their teaching activities (Kir et al., 2004). Dorup (2004) found that teaching of basic information technology still needed to be integrated into medical studies, and that this need did not seem likely to disappear in the near future.

Link and Marz (2006) conducted research in an introductory course on computer-based and web-based training where students were asked to fill out an online questionnaire covering a wide range of relevant attitudes and experiences. The study concluded that although many students would benefit from a basic introduction to computers and the computer-based resources of the university, a single computer course for all the students would not be useful nor would it be accepted due to the wide range of computer skills among students:

There is no one-size-fits-all course design available. Such a course should either be split into several tracks according to students' different levels of computer literacy, or it should be held only for students with little or no computer experience. (Link & Marz, 2006, p. 4)

However, better training opportunities do not necessarily translate into better knowledge or effective using habits; more structured training - one which would form part of the curriculum - is necessary (Bello, Arogundade, Sanusi, Abioye-Kuteyi, & Akinsola, 2004).

The wider use of modern computer and Internet technology would result in more effective medical education, particularly in developing countries (Mansoor, 2002). The increased competition in a complex global market puts medical schools under pressure to embrace computer assisted learning; however, without support and training for staff and students, new technology could prove an expensive disaster. Expansion of computer assisted learning requires cultural change as well as careful strategic planning, resource sharing, staff incentives, active promotion of multidisciplinary working, and effective quality control (Mansoor, 2002).

This section has overviewed some of the prior studies related to ICT and its integration into medical education in different countries, and highlights some of the most common findings among them. These studies generally show that lack of technology and access, inadequate IT education for entering medical students, no formal computer training in medical curricula are mostly observed in medical schools located in developing countries. Studies reveal that the highest levels of competence among the medical students are for e-mail, general Internet use, and file management rather than specific applications such as Medline search. Improving IT knowledge among the students, improving IT facilities, and training faculty would be beneficial to medical schools and medical students around the world.

It's worth mentioning that in most of the studies reviewed, paper-and-pencil surveys were used to assess the students' computer skills which may not be an accurate method due to the students' incorrect perceptions and understanding of the term computer literacy, the faculty and institution's inaccurate perception of computer literacy, lack of precise definition, and social desirability or possible bias in responding (Lahore, 2008).

C) The Role of Leadership in Medical Education With Regard to ICT:

Computer technology is being integrated into medical education as an effective tool for teaching, learning, plus allowing access to a wider variety and greater quantity of ever increasing information and research. However, educational leaders play an essential role in incorporating this new technology into medical education in order to maximize the efficacy of this integration and improve the quality of medical education as well as training informed and efficient physicians for twenty-first century. This leadership, with regards to integration of ICT into medical education, differs in industrialized countries and developing countries. In order to integrate ICT into medical education in a developing country such as Iran, the educational leadership needs more fundamental changes, i.e., moving the centralized decision making process to a more decentralized system where the schools are given the authority to implement changes with regards to their needs and possibilities.

Industrialized Countries vs. Developing Countries, and a call for leadership:

ICT usage in medical education is different between industrialized and developing countries. While developed countries have invested heavily in ICT integration in medical education and made it possible for medical students to have access to the latest updates in the medical fields, developing countries are lacking behind due to number of economic, social, and infrastructural limitations (Kommalage & Gunawardena, 2008).

IT knowledge and computer skills among medical undergraduates and healthcare workers are higher in developed countries compared with developing countries, mainly due to facility limitations such as the availability of computers and Internet connections. For instance, in Sri Lanka, IT based components are not included in medical curricula in most medical schools, and experiences with IT-based activities in

medical schools is limited. The case is the same for most developing countries, and publications on this topic from those countries are limited (Kommalage & Gunawardena, 2008).

Historical View:

Computer technology was not being used to its full potential due to poor development approaches in 1990s. Designing and developing innovative approaches for effective implementation of technology seemed essential particularly in medical education. One of the first steps toward successful implementation of technology in the medical field was believed to raise computer literacy among students. The need for computer literacy was becoming increasingly important across the world and specifically in developing countries. Formal computer courses and more computer facilities seemed inevitable in medical curricula and medical schools. Ostensibly, it was believed that the earlier medical students become computer literate, the more they could use technology to its full potential and be prepared for the future (Shortliffe, 1999).

Incorporating effective computer literacy courses into medical education curricula-specifically in developing countries-and facilitating its usage for academic purposes seemed necessary. Educational leaders must design, develop, and implement such a change in their capacities specifically in the medical field, and medical schools were expected to develop or recruit expertise in academic computing and tie those people in closely with curriculum planners and reformers (Shortliffe, 1999, p. 3).

At this time of rapid change in our health care system, and hence in medical education, recognition of the strategic role of informatics education is dependent on visionary leadership and institutional commitment; those institutions making the greatest strides in this area have made broad commitments to integrated information technologies. (Shortliffe, 1999, p. 3).

Recent View:

Almost a decade later, Skochelak (2010) recommended leaders of medical schools in the United States and Canada to actively advocate changes in medical education and to create a positive learning environment and organizational culture, and to use developing technology to support new methods for learning, promote efficient health care delivery, improve health care quality, and integrate teaching about electronic health records and other support tools into clinical education.

Educational Leadership in Iran:

The leadership in medical education in a country like Iran is faced with more challenges compared to Western countries because of the role of the government in leading and managing universities and the centralized management system in Iran. Bikmorady (2009) named some of the barriers to effective academic leadership in medical schools in Iran such as politicization, instability, paradoxical management, lack of meritocracy, centralization, bureaucracy, a tendency toward governmental management, and inefficacy of governmental academic leadership.

According to Bikmoradi (2009), for changes in medical education to be systematic, efficient, and innovative, medical schools' leadership needs to be changed from centralized to more of a departmental decision making process, where the departments are given the autonomy to decide their own future.

Summary

This paper overviewed the role of ICT in medical education through a historical perspective from 1979 to 2010, the studies regarding ICT use in medical education both in developed and developing countries, and the role of educational leadership in medical education.

ICT's impact on medical education has evolved a great deal as both medical science and computer technology have gone under profound enhancement. While developed countries could harvest their investments in ICT, medical schools in developing countries are still struggling with designing, implementing, and delivering ICT required changes in medical education. Educational leaders in developing countries should be aware of this existing technological gap, and start to bring fundamental changes in their institutions with regard to ICT.

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