

Indian Journal of Medical Informatics, Vol 3, No 1 (2008)[HOME](#) [ABOUT](#) [LOG IN](#) [REGISTER](#) [SEARCH](#) [CURRENT](#) [ARCHIVES](#) [IAMI](#)[Home](#) > [Vol 3, No 1 \(2008\)](#) > [Sarbadhikari](#)

Indian Journal of Medical Informatics. 2008; 3(1): 3

<http://ijmi.org>**Review Article****How to design an effective e-learning course for medical education****Suptendra Nath Sarbadhikari****Department of Biomedical Informatics,****PSG Institute of Medical Sciences and Research,****Coimbatore 641 004, India.****Email: supten@gmail.com****Abstract:**

Medical Education has been conventionally taught and learnt in an inductive way and has been considered as difficult to both impart and imbibe. Information and Communication Technology (ICT), mostly as e-learning, has made the process of education much easier to comprehend. However, the application of medical informatics tools to medical education has been quite delayed and inadequate, especially in India. The paper discusses the pros and cons of e-learning and tries to provide a step-by-step primer for setting up effective e-learning courses for medical education.

Keywords:

e-learning; medical education; guidelines; curriculum design

1. Introduction

Medical Education has been known as perhaps the most difficult to both impart and imbibe. Traditionally it has been taught and learnt in an inductive way. The rigmarole has been nicely captured by Erich Segal in Doctors [1].

Information and Communication Technology (ICT), manifested as e-learning, nonetheless, has made tremendous progress in imparting education to almost all disciplines. However, the application of medical informatics tools to medical education has been quite delayed and inadequate, especially in India [2,3].

Three excellent treatises on the (phased) design [4], uses [5] and impact [6] of e-learning on medical education are available online. Two of these articles [5,6] provide lists of websites from where further assistance can be obtained in setting up medical education course modules. This brief review will not try to repeat those technical details, rather it is meant to be a simple guide for someone trying to initiate the development of e-learning modules that can effectively help in medical education. Further, the live links available in this Open Access article can be accessed by readers who are connected to the Internet.

Ruiz et al [6] reminds us that creating e-learning material involves several components: once the content is developed, it must be managed, delivered, and standardized. In other words, simply developing the content is not the end of the story.

On the other hand, Badge et al [7] report the widespread use of a virtual learning environment (VLE) with poor pedagogic development. That in turn leads primarily to an electronic document repository rather than an online learning tool which makes full use of the potential of the full suite of available tools.

To stress upon the diversity of implementing conditions, Paisian and Woodill [8] compile 22 case studies from various educators implementing e-learning courses successfully. The key points for success, as identified by them, include: proper project management processes; appropriate evaluation tools; good relationships management; training and awareness generation for both faculty and students; well managed communications and information flow; proper risk management, especially for relationships; adequate change management; and treating e-learning project management as a learning experience in itself.

For the readers interested in further details, Naidu [9] has written an excellent guidebook to clarify, simplify and demystify e-learning. Additionally, a useful blog to understand e-learning, online learning, and distance learning is maintained by Gray Harriman [10].

Nevertheless, to the uninitiated medical educator, going through the array of ICT jargon can be a formidable challenge for trying to implement an e-learning course. Therefore, I shall first state the pros and cons of e-learning for medical education, followed by mentioning the essential requirements for setting up effective e-learning courses. Next, I shall try to give a step-by-step description of how to go ahead, discuss a few issues on content development, and more importantly, elaborate on the role of mentoring for making the e-course effective. Finally I shall glance upon the main barriers for implementation and a few likely developments in near future.

2. Advantages and Disadvantages

Some of the advantages [11,12] of e-courses are as follows.

- No time is spent commuting to class and the courses can be availed from physically remote locations, provided Internet connectivity is present.
- No travel costs are involved.
- One can have a job or pursue some other interests while one attends such courses.
- One can learn when one needs it (Just-In-Time or "synchronous", as well as "asynchronous" -

where the students interact with the other students or faculty at different times).

- One can learn at one's own pace.
- Instructions can be more customized and flexible.
- Can increase student to student interactions, i.e., peer group learning and higher comfort level.
- Can lower costs for both learning providers and organizations that need training
- Can offer lower costs for students than in traditional programs
- Additional benefits include learning new technologies and technical skills

In a nutshell, it may be termed as "right knowledge at the right time in the right way".

However, the disadvantages [11,12] are no less and listed below. Some of these can act as potential drawbacks for implementing e-courses.

- Instructors need to learn to be effective online instructors and to convert face-to-face contents online. Confidence and attitude are likely to develop over time and training.
- Need for suboptimal Time management (by both students and faculty).
- Internet Connectivity and / or Access problems.
- More time consuming for instructors to provide individualized feedback (because more learners are often actively involved).
- Equipment needs of students and learning providers, involving the cost and adaptability to new technology, as well as, overcoming mundane problems like virus, spam and phishing attacks.
- Need for Ongoing technical training and support of learners and instructors.
- Academic honesty of online students is difficult to monitor.
- Need for various types and effectiveness of assessments.
- Lack of face to face interaction.
- Equity of access to learners of all backgrounds and parts of society.
- Requires new skills and responsibilities from learners.
- Does not provide many social aspects of a true campus or traditional classroom.
- Waning enthusiasm and ignorance.

Contrarily, the age old adage states that where there is will there is a way. Therefore, most of the disadvantages stated here can be overcome if there is strong enough motivation from the providers and users.

3. Tools and Applications

Now that we are aware of the pros and cons, it is time to know about the requirements for designing and developing e-courses for medical education.

The technological infrastructure [13] will depend on the budget and intent of the academic management. However, minimal requirements for offering a full-fledged course would be something similar to those listed below.

I. Hardware:

Web Server: A Computer that can run a computer program that is responsible for accepting HTTP (Hypertext transfer protocol) requests from web clients known as web browsers, and serving them HTTP responses along with optional data contents, which usually are web pages such as HTML (Hypertext markup language) documents and linked objects like images.

At the student end, apart from standard Internet browsers, multimedia appliances like headset, web cam may be optionally required.

II. Software:

a) A solution stack of software, usually free and open source software (FOSS), used to run dynamic Web sites or servers. A common example is the LAMP Architecture, where:

Linux - Operating System

Apache - Apache Web Server

MySQL - Database Management System (Database Server)

PHP - Hypertext Preprocessor (Scripting Language)

b) Learning Management System: Commonly used free ones are: Moodle (<http://moodle.org>) and ATutor (<http://atutor.ca/>).

c) Free lesson construction software to build a teaching website: like Hot Potatoes: (<http://hotpot.uvic.ca/>) Incidentally, Moodle allows Hot Potatoes quizzes to be used with it.

Optionally:

d) Blog Publishing System: A commonly used free one is WordPress (<http://wordpress.org/>) is a blog publishing system written in PHP. All data is stored in a MySQL database.

e) Wiki software: A commonly used free one is MediaWiki (<http://www.mediawiki.org/wiki/MediaWiki>), which is a web-based wiki software application used by all projects of the Wikimedia Foundation, and many other wikis, including Wikipedia and Citizendium.

f) Videoconferencing (Desktop): Instead of cost intensive (branded) dedicated videoconferencing systems (including both hardware and software), a PC or laptop can be used for videoconferencing using the freeware Skype (<http://www.hl7.com.au/Skype-Video-Conferencing.htm>).

III. Human Resources:

a) Content Developers: Subject or Domain Experts - also known as SMEs (Subject Matter Experts) - they would decide on the actual content (text, slideshows, audios, still images, videos - of lectures or of procedures, blogs, wikis, podcasts, mailing lists or even videoconferencing units). For more advanced medical Institutes, the course may be connected with the Hospital Information System, PACS (Picture archiving and communication system) and EMR (Electronic medical records).

b) Web administrators: To design, develop and maintain (update) the site. They should be ably supported by the Network administrators of the Institute.

c) Instructors / Tutors / Mentors: To monitor and assist the day to day progress of the students - they may or may not themselves be content developers

4. Steps for initiating e-learning course(s)

Once the hardware, software, network and personnel requirements spelt out in the previous section are decided and procured, the actual work of designing the course begins.

The exact steps [14] may vary among individuals and organizations. However, a brief but practical outline is presented here.

(i) Initiate Faculty to the pros and cons - as elaborated in section 2 - perhaps with the help of more illuminated faculty members from the Institute or outside.

(ii) Encourage regular interchange of ideas, discuss and demonstrate how to overcome practical difficulties. This may be done with face-to-face (F2F) meetings and / or e-group discussions. A Pilot study (for content development, keeping in mind the issues discussed in the next section) may be first undertaken by a core (motivated) group of faculty members.

(iii) Take the students into confidence (end-user validation of proposed course modules). Also a "Needs Assessment" of the targeted students may be carried out with an online survey with the free SurveyMonkey (<http://www.surveymonkey.com/>). This step is also very important for ensuring successful participation (and likelihood of knowledge transfer) among the students. Further, students participating seriously in an online survey are likely to be serious in completing e-learning courses.

(iv) Concerned faculty members may have to spend a significant amount of time in planning. Just as "practice makes perfect", the first attempt may not necessarily be the best one.

(v) The Learning objectives should be clearly stated and appropriate assessment should be carried out with the results counting towards the final grades (e.g., for the Internal Assessment marks).

Of course, it has to be ascertained (and perhaps ensured) that the students have sufficient computer and Internet access.

5. Issues for Content Development

Choules [5] and Ruiz et al [6] provide details of the content development practices and exemplary websites for those. Elaborate details are also available at [15,16]. The key points from these references are:

- Teaching strategies should be creatively blended, using methods like instructional units, case studies, simulations, video units and other Web based resources to encourage learners. These courses should enable learners to see the relevance of the material, respect the expertise learners bring to the course, allow learners to control their own learning paths through meaningful exercise and activities and, last but not the least, emphasize clearly and continually the connections between what is being learnt and the real world applications.

- At first the scope, guidelines and workflow for the course have to be defined. The scope should cover the extent and depth of content coverage. The guidelines should include the strategies, look and feel, and the level of interactivity.

- The study material should have an introductory paragraph, one or more explanatory paragraphs, and a summary paragraph. The structure and the navigation through the course modules must be predefined.

- Quizzes or other interactive activities - like exercises or assignments, problem-solving situations, or short simulations should be integrated into the body of the module.

- Any module should not contain more than one or two main ideas or concepts.

- To meet the course duration and to provide adequate content to the students, content has to be categorized and segregated into predefined parts, main content and additional content. Main content should be covered in detail in the course. Additional content may be placed in the Reference section of the course. It may be included as optional reading at appropriate places.

- Only the most important "must-know" (essential or need) details should be emphasized, while the "nice-to-know" (desirable or want) ones may be added to the additional reading materials. This can help to maintain the prescribed course duration without resulting in content overload.

- Wherever possible, the text content should be supplemented with audio and/or video clips containing relevant information, such as background information, "how to" instructions, or examples that further clarify key learning concepts.

- The content format should ideally be compliant to the standards like XHTML (Extensible hypertext markup language) of W3C (World Wide Web Consortium) and Sharable Content Object Reference Model (SCORM) [17] that is a collection of standards and specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility and reusability of Web-based learning content.

- Testing for validation [18] and careful packaging (keeping in mind download limits of the end-users) have to be undergone before the final launch.

Summing up, to make certain that e-learning is effective, the study materials have to be validated for construct, content and pedagogy [18]. Further they must be:

a) Easily accessible.

b) Easy to download.

c) Easy to understand (written in a language suited to the level of the students).

d) Learning objectives should be clear and the course designed to meet those objectives (good planning is a must).

e) Sufficient hands-on exercises / assignments / quizzes should be supplemented to the "static" reading (text/image), viewing (video) and listening (audio) study materials and "dynamic" (interactive) contents, if possible.

Another important aspect is that of "effective designing" [19,20] that stresses more on "usability".

Examples of online learning materials are abundant in [21]. Some of these include repositories known for pioneering work like:

http://www.gutenberg.org/wiki/Main_Page

http://www.nlm.nih.gov/research/visible/visible_human.html

<http://www.eskeletons.org/>

Also, there are some sites that offer help in developing such content like the following.

The International Virtual Medical School - [IVIMEDS](http://www.ivimeds.org/) (<http://www.ivimeds.org/>)

[MedEdPORTAL](http://services.aamc.org/jsp/mededportal/goLinkPage.do?link=home) (<http://services.aamc.org/jsp/mededportal/goLinkPage.do?link=home>)

6. Role of Mentoring

As delineated in the previous section, high-quality course material should be attractive and motivating to the targeted students. On the other hand, designing an "effective" e-learning course cannot end there. It must be reinforced by "mentoring".

The e-mentoring sessions are stronger pillars for the success of any e-course. However well written the course material may be, peer-group and student-mentor discussions on specific practical problems help in understanding difficult concepts and real-life dilemmas far better.

Just like all the fingers of a hand cannot be of same size, all the tutors/instructors/faculty mentors in such e-courses will not be equally responsive. Some may be intimidating, some may be encouraging. No amount of meticulous planning or briefing for such activities will be able to overshadow individual brilliance or dullness.

Some of the effective guidelines [22,23] for selecting the mentors (especially if they are not regular faculty members of the imparting organizations) could be that they:

1. Must have regular ongoing access to the Internet (even if on move or vacation).
2. Must have good online written communications (and listening) skills and respect for Netiquette: <http://www.nlm.nih.gov/listerv/netiquette.html>
3. Must enjoy using emails and surfing the Net.
4. Must check (and respond to) emails regularly for interacting with the mentees.
5. Must be able to protect sufficient amount of time to address the questions raised by the mentees at any point of time.
6. Must be clear about the benefits for volunteering to participate and also about expected accomplishments for both self and the mentees.
7. Should be knowledgeable on the subject and willing to share the knowledge by facilitating exploration, confronting difficult issues and serving as a role model.
8. Should be able to maintain confidentiality and trust.
9. Should be interested and involved in the learning process.
10. Should be able to encourage and motivate.

7. Common barriers in implementation

Before being content with the thought that the well-developed content and motivated mentors are going to ensure the success of the e-course, it may be prudent to look back at the possible obstructions. Most of the barriers are listed as "disadvantages" in Section 2 [11,12]. However, in the Indian scenario [24], the most important ones are:

A. Usability issues (for both the faculty and the students)

- I. Access to and comfort with the Internet
- II. Proper time management

B. Design issues

- I. Giving more importance to the interface compared to the actual content.
- II. Copyright issues (where plagiarized materials are freely uploaded)
- III. Underestimating the role of SMEs (Subject Matter Experts).
- IV. Lack of well planned learning objectives
- V. Ineffective mentoring and peer-to-peer knowledge transfer.

8. Future Prospects

With advances in both informational and educational technological tools, it is time to harness their full potential. This can be done by gaining the confidence of major stakeholders and improving with constant feedback from end-users (students). Over time, both individualized (adaptive) and group (collaborative) learning will be facilitated by well designed e-learning courses for medical education.

Nearly 13 years ago I had written [25] that the medical profession is yet to embrace information technology wholeheartedly. Perhaps the time is finally changing!

An important challenge remains to resolve the paradox between information explosion (overload) for the students and the information paucity (mostly technological - among both the students and faculty). Interestingly, proficiency in information technology skills does not guarantee "information literacy" [26]. Filtering useful information from the junk and duplicate ones can command high degree of expertise.

As Finnegan [27] has said, learning online requires reading comprehension skills sufficient to master the material presented. There is a need for ongoing research to evaluate the online reading skills of typical adult learners as compared to the readability of e-learning courses. The implication of the research will influence instructional design techniques, particularly the level of language or vocabulary used, use of graphics, page layout, interactions, and other methodologies to engage the learner in a deeper level of engagement with the content. Designing e-learning with an appropriate reading level will enable "Johnny" to read and comprehend the material which will foster "Johnny's" learning. Researchers, e-learning designers and instructors must stay focused on the goal of e-learning, "Learning".

Hopefully, the readers will now be encouraged and feel confident enough to venture into navigating the vast sea of e-learning and the benefits will accrue to all who are involved with medical education.

References:

1. Segal E. *Doctors*. New York: Bantam Books, 1988
2. Sarbadhikari SN. *The State of Medical Informatics in India: A Roadmap for optimal organization*, *J. Medical Systems*. 2005; 29: 125-141.
3. Sarbadhikari SN. *Basic Medical Education must include Medical Informatics*, *Indian J Physiol. Pharamcol.*, 2004, 48(4): 395-408.
http://www.ijpp.com/vol48_4/basic_medical_395.pdf <http://openmed.nic.in/203/>
4. Albarrak AI. *Designing E-learning Systems in Medical Education: A Case Study*, <http://faculty.ksu.edu.sa/AIbarrak/Publications/E-Learning%20Design%20Papers.pdf> (Accessed July 2008)
5. Choules AP. *The use of elearning in medical education: a review of the current situation*, *Postgrad. Med. J.* 2007; 83: 212-216 <http://pmj.bmj.com/cgi/reprint/83/978/212>
6. Ruiz JG, Mintzer MJ, Leipzig RM. *The Impact of e-Learning in Medical Education*, *Acad Med*. 2006; 81: 207-212.
http://www.med.ufl.edu/oea/opfd/faculty/club_med/impact_of_e-learning_in_medical_education.pdf
7. Badge JL, Cann AJ, Scott J. *e-Learning versus e-Teaching: Seeing the Pedagogic Wood for the Technological Trees*, 2005:
<http://www.bioscience.heacademy.ac.uk/journal/vol5/beej-5-6.pdf>

8. Paisian B and Woodill G, Eds, *Plan to Learn: Case Studies in eLearning Project Management*: <http://www.celea-aceel.ca/DocumentHandler.ashx?DocId=1945>
9. Naidu S, *e-Learning: A guidebook of principles, procedures and practices*, Commonwealth Educational Media Center for Asia, 2nd Ed, 2006, ISBN: 81-88770-04-3
10. Gray's E-Learning Blog: <http://www.grayharriman.com/blogger.html>
11. <http://www.nwlink.com/~donclark/hrd/elearning/proscons.html> (Accessed July 2008)
12. <http://www.elearners.com/resources/elearning-faq5.asp> (Accessed July 2008)
13. <http://www.c4lpt.co.uk/Directory/> (Accessed July 2008)
14. <http://www.e-learningcentre.co.uk/eclipse/Resources/designing.htm> (Accessed July 2008)
15. Joana, *Content Design*, <http://www.midsolutions.org/cms/course/view.php?id=9> (Accessed July 2008)
16. Australian Flexible Learning Network, *VET e-learning content development guidelines, 2008*
<http://e-standards.flexiblelearning.net.au/docs/vet-elearning-content-dev-guide-v1-0.doc> (Accessed July 2008)
17. <http://www.adlnet.gov/scorm/> (Accessed July 2008)
18. Turker A, Gorgun I, Conlan O; *The Challenge of Content Creation to facilitate Personalized eLearning Experiences*
https://www.cs.tcd.ie/Owen.Conlan/publications/turker_IJeL2006_v4.pdf (Accessed July 2008)
19. Martin S, *Effective visual communication for graphical user interfaces*:
http://web.cs.wpi.edu/~matt/courses/cs563/talks/smartin/int_design.html (Accessed July 2008)
20.
<http://www.smashingmagazine.com/2008/01/31/10-principles-of-effective-web-design/> (Accessed July 2008)
21. <http://www.merlot.org/merlot/index.htm> (Accessed July 2008)
22. <http://www.servicleader.org/old/vv/direct/> (Accessed July 2008)
23. <http://www.coyotecommunications.com/sanchezov/ready.html> (Accessed July 2008)
24. <http://e-learnindia.blogspot.com/2005/12/e-learning-deadly-traps.html> (Accessed July 2008)
25. Sarbadhikari SN, *Medical Informatics – Are the Doctors Ready? (Guest Editorial)*, *J. Indian Med. Assoc.*, 1995, 93: 165 - 166.
26. Hirsh K, Klapin M; *Savvy Web Searching*:
<http://www1.umn.edu/ohr/teachlearn/tutorials/savvy/savvy/index.html> (Accessed July 2008)
27. Finnegan DM, *E-Learning Success: Readability versus Reading Skill, 2006*:
http://www.itdl.org/Journal/Oct_06/article04.htm (Accessed July 2008)

Paper received on 06/05/2008; accepted on 18/07/2008

Correspondence:

Suptendra Nath Sarbadhikari

Department of Biomedical Informatics,

PSG Institute of Medical Sciences and Research,

Coimbatore 641 004, India.

Email: supten@gmail.com

This Open Access article is available at: <http://ijmi.org/index.php/ijmi/article/view/y08i1a13>

© 2008 Author(s); licensee Indian Journal of Medical Informatics under

[Creative Commons Attribution-No Derivative Works 3.0 License](http://creativecommons.org/licenses/by-nd/3.0/).

ijmi
Vol 3, No 1 (2008)

TABLE OF CONTENTS

Reading Tools

How to design an ...

Sarbadhikari

Abstract

Review policy

About the author

How to cite item

Indexing metadata

Print version

Look up terms

Notify colleague*

Email the author*

Add comment*

RELATED ITEMS

Author's work

Related studies

Multimedia

Book searches

Pay-per-view

Government health sites

Relevant portals

Databases

Online forums

Teaching files

Government policy

Media reports

Web search

SEARCH JOURNAL

CLOSE

* Requires [registration](#)