

E-Learning in Medical Education in India

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E-learning, or learning and teaching facilitated and supported through the application of technology, is presently being used widely in all fields of education, and also being utilized extensively in medical education. This narrative review aims to introduce the concept of e-learning, and discuss its need and scope in medical education in India. Experience shows that students and faculty are mostly in favor of adopting e-learning side-by-side with traditional learning, and the advantages far outweigh the likely discomfort associated with adoption of this new method.

Keywords: *Blended learning, Computer-assisted learning, Online learning, Web-based learning.*

Interaction and repetitions are the cornerstones for learning any skill. Traditional learning has more human involvement; thus opportunity for repetition is curtailed so as to respect patient autonomy and prevent psychological stress to the patient as well as the student. E-learning involves technology and simulation, which can be repeated any number of times, exactly the same way or in changed scenario to improve the levels of learning. Innovations in technology and devices have brought a revolution in learning. The field of medical education cannot remain immune to the effects of this aptly called E-revolution. In the era of computers and hand-held devices, teaching and learning have gone far beyond the textbooks, venturing into various components of the digital world. The United Nations and WHO have acknowledged e-learning as a useful tool in addressing educational needs in healthcare workers, especially in developing countries [1,2]. We herein review the various features of e-learning in the context of its adoption in the medical education scenario in India and other similar countries.

DEFINITION

According to Ellaway & Masters [3], “e-learning encompasses a pedagogical approach that typically aspires to be flexible, engaging and learner-centered; one that encourages interaction (staff-staff, staff-student, student-student), and collaboration and communication, often asynchronously (though not exclusively so).” The common denominator is the use of technology and electronic devices to enhance learning [1-4]. It may also be defined as an approach to teaching and learning,

representing all or part of the educational model applied, that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction, and that facilitates the adoption of new ways of understanding and developing learning [1]. Web-based learning, Online learning, Distributed learning, Computer-assisted instruction, or Internet-based learning are also used synonymously and interchangeably for this type of learning [4].

CHARACTERISTICS OF E-LEARNING

The three primary characteristics of e-learning are the nature of the learning experience, synchronicity of participation, and presence or absence of face-to-face instruction [3]. Depending upon the nature, the learning experience is termed ‘didactic’ when the learning material is literally handed over to the student and they cannot change it, and ‘active’ when the student has control over the learning process. In the Interactive type, the learning content evolves as the course progresses and co-learners interact; the instructors act as facilitators and help in the evolution of learning.

The learning is termed Synchronous when the instructions are provided on the spot, as in face-to-face teaching, and Asynchronous when there may be a time gap between the instructions provided and response of the learners. In synchronous learning, participants interact with instructor in real time. There is interaction between the participants using the available audio-visual aids like chat, virtual classrooms, and audio- and video-conferencing.

E-learning is divided into Complete or full learning, and Blended or mixed-learning, depending upon the use of the method as either replacement or augmentation of the face-to-face learning. There is no physical contact of any sort in complete e-learning, whereas some contact remains in the blended type of learning. In the blended type, both the methods are used at some point of time during the whole course.

Learning management administration has a major role in success of e-learning. They have to provide technological support and keep the system functional for maximum benefits. Teachers must undergo faculty development to learn the technology. Students also learn about the tools and technology. Institute must develop a separate IT department to look after this technology.

Learning management system (LMS) is a single window software application for the teachers, students and the parents that delivers and manages instructional content, identifies and assesses individual and organizational learning or training goals, tracks the progress towards meeting those goals, and collects and presents data for supervising the learning process of the organization as a whole [5]. The teachers create and deliver content, monitor student activity, and assess students' performance; the student can access content directly on devices, can take the tests and quiz, and submit online using the internet. The student can also assess their performance. Parents can access course curriculum, attendance and performance analyses. Learning management system has in-built responsibilities, which are as follows: Registration (Enrol and administer learners online for web-based, instructor-led, and all other learning activities); Scheduling (schedule courses and define curricula to address individual and organizational learning needs); Delivery (deliver online courses and assessments or schedule instructor-led courses); Tracking (track the progress of the learners and create reports);

Communication (communicate by chat, discussion forum, mail, screen sharing and e-seminars); and Testing (test and assess competency, learning styles and student commitment). The LMSs are presently used in AIIMS, New Delhi for teaching in the Anatomy Department. These are also being used by The International Pediatric Association, World Association of Medical Editors, Committee on Immunization - The Indian Academy of Pediatrics, and Asian Pacific Pediatric Association to name a few [6]. There are many on-line LMS software available like Modular Object-Oriented Dynamic Learning Environment (MOODLE).

E-learning methods can vary from as simple as audio cassettes to as complex as multi-point video-conferencing facilities supported by online applications. **Table I** provides a list of e-learning interventions used in the medical field [1].

ROLE IN MEDICAL EDUCATION

The integration of e-learning in medical education is the need of the hour. Medical Council of India (MCI), the regulatory body of medical education in India, has recognized the importance of the technology and has included the use of electronic means in the broad competency "Lifelong learner committed to continuous improvement of skills and knowledge [7]." An Indian medical graduate must have obtained this competency at the time of graduation. The student has to continuously acquire new skills and keep himself abreast of latest development, a goal presently considered difficult to attain in the absence of technology. The use of e-learning can help them achieve the goal of continuous professional development, considering the vastness of syllabus, paucity of time, and already overburdened schedules [8]. Recognizing the importance of information technology for the doctor of today, the General Medical Council in UK also advocates that

TABLE I E-LEARNING INTERVENTIONS

<i>Intervention</i>	<i>Comments</i>
Non-networked computer-based e-learning	The learners need not to go online. They are not connected to each other and the learning occur independent of each other. Learning occurs through static methods like pen-drives or CDs.
Internet and local area network-based e-learning	The learning takes place through the Internet or a local area network. Many participants can share the content and the e-learning. Examples are LMS, Moodle, Blackboard
Psychomotor skills trainer	The development of fine motor coordination skills and techniques are attained through Technology.Example
Virtual reality environments	Real or artificial environment is generated with the help of technology and the participants get a real time feeling of doing the same thing.
Digital game-based learning	Application of game principles and mechanics in non-game contexts in solving problems. The technology helps in solving the problems as they come.

medical graduates should be able to “make effective use of computers and other information systems, including storing and retrieving information [9].”

From a simple ‘disseminator of content’, teachers are increasingly metamorphosing into ‘facilitators for learning’ [4,10], which is facilitated by e-learning tools that provide a variety of online resources [11]. E-learning technology can be used in the augmentation of all the learning domains *viz.*, cognitive, psychomotor and affective. In the cognitive domain, group teaching in classrooms could be enhanced by providing online material like pre-lecture assignments and audio-video clips during the sessions. Even students could be provided with virtual resources like audio-video clips, podcasts, animations, and web-links for self-directed learning intended to be used at home, or as part of Flipped lectures. Psychomotor skills, although best learnt with real practice, can also be augmented by technology, at least up to the ‘knows how’ level. Audio-visual demonstration of procedures, diagnostics and interventions can be provided. Students may read through the explanations and view checklists of procedural skills before actually practicing the same under supervision in clinical postings or in skill laboratories. In the affective domain, videos of scenarios depicting good and bad communication-skills, role-plays and counselling sessions, and self-recordings can be used to stimulate learning. Other modalities include online case-studies and patient logs, clinical decision support systems, virtual patients, medical video games, E-books, e-atlases, teaching databases, and digital versions of online journals.

COMMON MODALITIES FOR E-LEARNING

Flipped classroom: Flipped classroom approach means that the tasks performed by the students are flipped or reversed between the class time and self-study time. Majority of the learning is done by the students themselves – before the class and outside the classroom – by utilizing online resources like videos, recorded lectures, PowerPoint presentations, and handouts provided by the teacher. The advantage of this type of blended teaching is that instead of merely information transfer, discussion and student-centered learning and problem solving takes place. It means the shifting of the teacher from typical ‘sage-on-the-stage’ to the ‘guide-by-the-side’ [12]. Indian experience with the technique has shown good acceptance by medical students [13].

Smartphones: Smartphones have great potential for e-learning in medical education as they are handy, provide the required information at the point-of-care, and help in better decision-making. With the increasing usage of the smartphones and user-friendly apps by the medical

students, this will further gain popularity. There are various mechanisms by which e-learning can be imparted by smartphones – *e.g.*, apps like dosage calculators, growth charts, Curofy, Docplexus, SCAT; web-based features like PubMed for handheld devices; and social media apps like Facebook, WhatsApp, and YouTube [14]. These mechanisms have the potential to increase collaboration, problem-solving and networking in the medical students, allowing them to share images and data, and participate in blogs or video-conferencing.

Clinical decision support systems: These are another breakthrough in e-learning where the clinician makes a decision keeping in mind the inputs provided by the support system and interpreting them with their own understanding. Typically, data is provided to the technology-enabled systems where it is analyzed and then decision-making options are given to the treating doctors, at the point-of-care (bedside, outpatient setting, *etc.*); *e.g.*, UP TO DATE (<http://www.uptodate.com/home/product>).

Online education sites: Online sites such as Stanford Medicine 25 (<https://stanfordmedicine25.stanford.edu>) teach the art of bedside clinical examination – an art that is swiftly disappearing from the curricula of the medical students, owing to the over-importance of the theoretical concepts. Here e-learning can come in handy as the skills can be imbibed after watching the online content, revised when needed, and are a major assistance for self-directed learning – even during professional life.

Skill laboratories: These are the places where the upcoming physician can practice and hone the relevant skill in a controlled environment before practicing them on real patients. The simulation-based method has become a part of curriculum of all medical specialties. Not only the beginners but the experts have also shown to be benefitted by these laboratories [15]. Basic clinical skills to complex surgical skills can be practiced using these labs [16,17]. The experience can be gained by working on manikins or with standardized patients in controlled ‘mistake-forgiving’ training environment. The skill laboratories have also been shown to be following the modified version of Peyton’s Approach [18]. They use structured format, and depending upon the performance of the students, graded challenges and exposures to a variety of clinical skills that can be provided. Assessment and feedback can also be provided by this modality. Airway management, resuscitation, arrhythmia management, cardiac monitoring, scrubbing, and placing an intravenous catheter are few examples of the procedures which could be learnt and practiced in skill laboratories.

TEACHERS' AND STUDENTS' PERCEPTION

Students have reported that they attain more knowledge by understanding the subject better, acquire better skills, feel more satisfied due to easy accessibility, flexibility, and increased interactivity with co-participants [19]. Lack of interaction with the teacher [20] and in-depth group discussion for clarification of concepts for complex topics has also been reported [21]. Various studies report that students prefer e-learning as a supplemental tool rather than replacement one [23,24].

Teachers perceive that e-learning saves time in editing and updating of content [24], setting-up laboratory equipment, and repeating the experiments [25], which could be utilized for face-to-face classes [26]. They also do not have to worry about variation in content delivery [27]. The less tech-savvy generation of teachers consider imposition of e-learning as an additional burden because they think it is less worthy, have time-constraints in developing the content, and have lack of confidence in meeting the technical demands [28].

Advantage of e-learning are described in **Box I**.

INDIAN EXPERIENCE

Presently e-learning in medical education in India is

growing at a good pace. Computers, smartphones and internet have carved a niche for themselves in the life of medical students. Currently, most of the e-learning activity done by the residents in the medical colleges is limited to data search for their thesis and research work. The use of technology in medical education in other areas is in a nascent stage. Supporting this fact, 89% of the participants in a recent study used computer-based literature searches at least once per month to either prepare presentations (90.2%), carry out research [65%], or to research patient-related problems (60.3%) [36].

Frehywot, *et al.* [37], in a systematic review on e-learning in medical education in resource-constrained settings, reported the major reasons of using e-learning to be a faculty shortage, to cast the net wider, and to maximize the use of resources by the students.

St. John's Hospital, Bangalore and Christian Medical College, Vellore have utilized TUSK platform developed by Tuft's University for all their e-learning activities, especially to build support for their undergraduates to work in rural and underserved areas of India through strengthening distant learning efforts. The TUSK software contains full-text syllabi, slides, lecture recordings (audio and video), class schedules, course evaluations, dissection

Box 1 ADVANTAGES OF E-LEARNING

- *Flexibility and ease of access:* E-learning is not fixed or time bound to a particular schedule and is very easily accessible, so learners can choose a place and time of their own liking [29]. Teachers can also update and edit the learning material at their own convenience [24]. The accessibility of the content *via* small size of the gadgets, mostly hand-held, also complements this feature [30].
- *Cosmopolitan nature:* E-learning is sans frontiers, and this has been found to be useful in remote and rural areas as well [31]. The participants may actually belong to any part of the globe [32]. Rare cases and diseases peculiar to a particular geographical area can also be studied globally.
- *Time-saving:* More number of students can be taken up at same time, thereby reducing the time needed for total lectures. The content once made is eternal, and can be revisited any number of times. The saved time in preparing lectures can be used by the teachers to hone their higher level of cognitive e-learning [25,26].
- *Stop-gap arrangement:* E-learning can be used to hone the skills before actually encountering the real patient. This decreases the probability of error and also saves time. This allows repetition, and thereby improvement in the desired skills [33,34].
- *Adult learning principles:* E-learning helps in deeper learning, increases self-motivation, and fulfils the adult learning principles [4,34]. It also allows the participants to set their own pace as per their learning styles and can be used as best suited tool for personalized and interactive e-learning experience. It is tailored to student's needs and is learner-centered, thus helping in self-directed learning [1,11].
- *Uniformity:* Since identical information is posted to all the participants, the curricula uniformity is maintained across the learners. The students posted in off-site campuses also receive identical inputs. This helps in the uniform attainment of learning objectives because of equal availability of quality and quantity of information dispersed [1,35].

guides, a quiz and case maker, grade book, and other resources made available by the faculty [38].

Online Google groups are being used extensively by the Medical Council of India to train the medical faculty under one-year fellowship in medical education at ten nodal centers across India. Listserv is being used as an e-learning platform in the FAIMER fellowship conducted at various centers in India.

India's first telemedicine center at Apollo Aragonda Hospital in the state of Andhra Pradesh was inaugurated in 2000 [39], and since then there are more than 500 telemedicine centers linked with about 50 specialist hospitals across the country. The telemedicine software system has been developed by the Centre for Development of Advanced Computing and is used to connect many medical institutes of India [40]. The postgraduates are also benefitted by the webcasts made available by professional bodies *e.g.*, Indian Academy of Pediatrics. Edusat lectures are being delivered daily for the medical undergraduates in Punjab.

Despite these efforts, e-learning has reached very few medical colleges. The usage of technology in medical education is not free of challenges and following are few of hurdles which prevent the widespread usage of e-learning:

Hardware and software issues: The technological infrastructure in form of hardware and software is compulsory to run e-learning program. The issues related to the hardware are cost, shortage of units, and lack of technical knowledge to operate them [6,41]. The software issues include the need to obtain licenses [42], and frequent up-gradation of hardware required to support them. Round-the-clock access at both home and off-campus is necessary for e-learning to have maximum impact.

Connectivity: The success of e-learning also depends upon the internet connectivity [10,43]. Adequate bandwidth would be needed at various levels to ensure proper downloading – lower speed or interruptions lead to sub-optimal use of this modality.

Financial issues: The impetus of starting these programs means financial burden for installation, running, and maintenance of the e-learning program [44-46]. It would also need developing the infrastructure and recruiting the staff. This will put additional burden on the institution's resources, and the administrators may be reluctant to invest on e-learning.

Security and safety of personal information: The privacy and security of data has to be maintained. With the

expanding cyber world, cybercrimes are exponentially increasing, and more efficient ways of providing security for identity management are needed [47]. Latest anti-virus software and operating systems are also needed. The issue of plagiarism, with respect to the online content, also needs to be taken care of.

Faculty and support staff shortage: One of the most important challenges would be to ensure the availability of faculty and support staff. The medical fraternity is already overburdened and doctors are doubling up as academic persons. There is dire need of more staff for designing, teaching, and tutoring the new students about e-curriculum and modification of the existing system to complete or blended e-learning [1,5]. The support staff is also required to maintain the ever-changing requirements of e-learning.

Technical support: Even if the infrastructure is present, the technical support to run the system, awareness about the support materials, quick solutions to the technical glitches is lacking [35,48]. The trainers are frequently not aware of the type of support required in particular programs. Many studies have concluded that awareness about computer technology and competency as well as proficiency in usage of computers at learners' level is 'a must' to adopt this technology [49].

Lack of face-to-face interaction: The bulk of the early teaching is with traditional face-to-face interaction; its non-availability in e-learning is a well-recognized challenge [34,50]. The lack of tutor support, especially in understanding the complex and 'difficult-to-understand' topics, have also been cited as a disadvantage of e-learning [51].

Psychological issues: There is resistance to need of change in both the teachers and students alike, especially when there are no guidelines [5]. The need of information or guidance for grasping the concepts of this seemingly difficult topic makes learners even more skeptical [44]. Prevailing myths about the e-learning may also discourage the learners [44,52]. The attitudinal aspect is one of the hindrances in implementation of e-learning strategies in India.

Language barriers [10]: Many studies have found that language is a barrier in implementation of e-learning [25]. Similar to the bulk of conventional learning, the instructions in e-learning are provided in English, which may make its adoption somewhat difficult for those not well-versed with the language.

THE WAY FORWARD

E-learning is a significant advance with the potential to

change the face of medical education in India in the coming years. For this to happen, Institutions and teachers need to be prepared to accept the change, and put-in the required resources — whether manpower or time or money. For successful incorporation of e-learning in the existing set-up, the following attributes are essential: motivation and self-discipline; ability to study independently or schedule study time; understanding the e-learning process; and adequate equipment and dedicated work space/support. It is up to the medical educators and administrators to incorporate these modalities, and researchers to test these in the Indian settings to inform decision-making. The students are ready and waiting.

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