

Editorial-educational**Computer Assisted Learning: A Trend in Undergraduate Pathology Curriculum**

Raja Alyusuf, MBBS, FRCPath*

Computer Assisted Learning (CAL) includes all forms of electronically supported learning and teaching. It is a trend, which has assumed its place in medical undergraduate curriculum with varying degrees of commitment and enthusiasm. This account highlights some of its importance with special emphasis on undergraduate pathology curriculum. It discusses its advantages, disadvantages, challenges for its implementation, suggested guidelines for its adoption and integration in undergraduate medical curriculum and possible future trends.

The exponential advances of computers, software and online technologies have led to significant enhancement of medical education. The following account was based on literature search pertaining to computer assisted and online learning utilizing PubMed. Search was performed of undergraduate medical education with special emphasis on pathology education.

The study of medicine depends on analysis and synthesis of vast amount of information that includes visual and complex data. This is particularly true for a field like pathology, where it is highly dependent on interpretation of complex visual images. This lends itself rather easily to computer technology as an attractive method for learning pathology^{1,2}.

Pathology represents a fundamental link between basic sciences and clinical medicine and between normal and abnormal. It is, therefore, central to the study of medicine. To ensure that students have an adequate ground in this subject, it is necessary to invest properly in its teaching as it will have far reaching implication for the future doctor in whatever specialty he or she chooses^{1,3}.

Computer assisted learning (CAL) in the field of medicine started to gain popularity following the publication in 1993 of "Tomorrow's Doctors" by the General Medical Council (GMC) of the United Kingdom. A booklet set out ways in which medical education should be improved³⁻⁵. In Pathology, however, self-study materials, including microscopic images of tissue sections became incorporated with computerized teaching sets as far back as the 1980s¹.

*Chairperson

Pathology Department

Salmaniya Medical Complex

Kingdom of Bahrain

E-mail: ryousif@health.gov.bh

The aim of this is to evaluate the CAL trends in medical education, its importance, weaknesses and how to implement and to overcome any possible barriers.

What is Computer Assisted Learning?

Computer assisted learning is simply learning via computers. It ranges from the simple basic text with images to highly complex web based interactive menu-driven method with built in systematic feedbacks that include hypertext links and simulations⁶.

CAL programs include online technologies (internet and World Wide Web), CD-ROMs, video laser disks, multimedia workstations, virtual reality and simulation testing⁷. It covers a wide range of learning methods from didactic to interactive and a variety of technical complexity ranging from low to highly technical, cost and skills required. It is implemented either as an aid to or as a replacement for traditional formats in a variety of ways^{6,8}.

The past two decades have seen an ever-increasing number of CAL programs incorporated into health science curricula⁸. In a retrospective analysis of studies on CAL in the medical literature between 1988 and 2000, Letterie have found that CAL was identified in all medical and surgical specialties with preponderance in internal medicine, surgery, radiology, obstetrics and gynecology, pediatrics and pathology⁷.

Factors that Led to the Introduction of Computer Assisted Learning in Undergraduate Pathology Curriculum

National bodies in the USA and UK have made recommendations aimed at reducing the amount of factual learning in medicine, integrating teaching and learning across specialties and limiting the curriculum to what undergraduates need to know at qualification. GMC have recommended that modern educational methods should be used wherever appropriate. Self-directed and problem-based learning approaches are encouraged but these can be expensive in terms of staff time. One alternative delivery method for self-directed, problem-based teaching is the use of multimedia teaching packages^{1,3,5,8,9}. Several factors put medical schools under pressure to embrace CAL: reduced funding, rising student numbers, geographical dispersal and increased competition in a complex global market^{2,6}.

In pathology, the introduction of CAL was particularly influenced by the considerable strain on physical space for museum pots, microscopes and autopsy demonstrations. This led to the adoption of alternative digital means. In addition, stimulating effective discussion and interaction is often cumbersome if students are struggling to relate what they see down their own microscope to the interactions between peers and tutor¹⁰. Moreover, students seem to have a general negative attitude towards microscopy^{1,9,10}. Autopsy rates are also declining in many countries and the retention of organs from autopsies for teaching purposes is likely to become difficult, particularly in UK. Consequently, learning via virtual autopsy is likely to be the answer^{1,5}. Pathology departments nowadays are increasingly cost conscious, continuously looking for alternatives that contribute to long-term saving plans such as virtual pathology^{1,9}.

Advantages of CAL

A) Information Technology (IT)

Textbooks are very limited in the number of illustrations and remain unaltered between printings, while websites and CDs can be constantly altered and updated^{1,2,11}. In addition, CAL can provide immediate feedback in the form of self-assessment packages^{1,10}. It allows easy movement laterally to areas of related interest and vertically to cover a topic in greater or lesser depth, images can be easily downloaded for presentations and complete presentations can be uploaded onto the Web^{1,12}. CAL puts the control into the hands of the users and allows them to work as active participants rather than passive recipients of information^{1,13}. It also paves the way for personalized learning; where each learner can progress at his or her preferred pace, having particular advantages for weaker students^{1,6,7,10-12}. In addition, off the shelf templates that allow someone with no specific training to produce materials of professional quality are increasingly available⁶. CAL could also deliver learning material to all students, adding consistency to a highly diverse educational experience. This is especially true for practice-based learning¹⁴. Web-based CAL has the additional advantage of being technology independent and will usually function and have a similar appearance regardless of the local computer configuration^{11,12}. It renders global access to information, providing more equity between large well-funded institutions and schools with limited resources².

B) Institution

Courses supported by CAL applications may require fewer face-to-face seminars and place fewer geographical and temporal constraints on staff and students. This is particularly beneficial to students at peripheral hospitals^{2,6,14}. It also serves as a discriminatory point for potential applicants who are likely to be attracted to the institutions providing the best electronic learning media⁶.

C) Students' Attitude

Feedback from students has been almost universally favorable and such learning integrated well into clinical aspects of their study^{1,5,15-19}. In a study conducted by Reid et al to determine students' attitudes towards CAL, students indicated that CAL packages were well integrated into other parts of the course, helped them prepare for other parts of the course and explained some difficult concepts. They also reported that the most useful aspects of CAL were the questions and answers, summaries at the end, pictures, learning at one's own pace and practice in doing questions, especially MCQs¹⁵. In another evaluation of students' attitudes towards web-based CAL, Wong et al have found that students identified participating in structured, tutor-supported online discussions as contributing significantly to their active learning^{19,20}.

D) Students' Performance

Objective evaluations of the use of IT, showed improved performance in internal and national examinations^{1,21}.

E) Cost

Fully equipped multimedia computers are available at low cost and most learning centers have suites for such computers¹³. Once an application has been set up, the incremental cost of offering it to additional students is relatively small as materials can be maintained and updated relatively easily and by more junior members of staff, hence reducing cost at the long run^{1,6}.

F) Specialty Related

Computer presentation is particularly suited to subjects that are visually intensive and detail oriented such as microscopic images. As standard textbooks do not include many images due to size and cost constraints, electronic presentation of images is an attractive alternative, where the user has the freedom according to interest to browse through as many images as needed^{1,2,12}. In addition, virtual slides may reduce the need to use human tissue in learning, the normal and abnormal can be illustrated alongside each other and specific features could be marked rather than leaving the student to guess (e.g. from a glass slide)^{1,6,10}. CAL also solves logistic problems associated with glass slides such as replacing broken slides and cutting multiple sections of the same lesion, which will inevitably exhibit section-to-section variability. Virtual slides also eliminate the skill barrier that exists for many students attempting to come to grips with microscopy¹⁰.

G) Pedagogy

In Letterie's analysis of 126 retrospective studies about CAL, he found that 96% of the articles described a favorable impact in medical education⁷. It achieves the ultimate goal of higher education. The goal is to link people into learning communities. This is most efficiently achieved by the internet, where chat rooms and discussion forums heighten the social aspects of learning on the Web^{14,22}. It also expands pedagogical horizons since the most controversial argument for using CAL is the alleged ability of the virtual campus to alter the relationship between people and knowledge. In addition, the few randomized control trials about CAL in medical education, seem to be generally positive and suggest that efficacy of high quality programs in medical education is reasonably well established⁶. Moreover, CAL provides a rich environment for active learning in which the learner actively builds rather than passively consumes knowledge^{6,8,13,19,22}.

It has the potential of filling the gaps and improving consistency in students' clinical exposures, as well as to stimulate clinical reasoning and information gathering in a structured exercise, particularly if used with simulations¹⁴. Clinical clerkships could also be used efficiently if students were to learn more factual knowledge from CAL, accordingly the instructors could focus on face-to-face time with students on teaching complex skills, such as clinical reasoning and developing rapport with patients¹⁴.

Disadvantages of CAL

Despite the numerous advantages of CAL, fundamental questions about suitability, acceptability, efficacy, student performance, defined outcomes for learners and quality assurance remain to be answered^{1,9,20,23}. Some CAL packages might feature excessive detail, leaving students feeling

overburdened and uncertain about the depth of knowledge necessary¹⁵. Striving to embrace the growing wealth of technologic capabilities with continuous updates might prove somewhat more expensive and time-consuming to medical schools than originally planned^{12,14}. Besides, information can be difficult to locate, download times can be considerable and some students simply stated that they do not like it¹. It can also be overwhelmingly difficult for students with poor online capabilities⁶. Senior pathology staff who enjoys traditional teaching may find themselves regarded as a luxury¹.

Barriers to Incorporate CAL in Undergraduate Curriculum

Implementing CAL can be fraught with difficulties. If, however, careful attention is given to implementation guidelines (see below); it can be an extremely rewarding exercise. The following are some of the barriers to proper implementation of CAL:

A) Organizational Issues

Proper implementation of CAL may be hindered by a number of factors, such as poor integration with other forms of learning, lack of resource sharing, careful planning and cultural change, as well as, perceived barriers for failure of students to engage with a new technology and cultural resistance from staff^{6,8,14,24}. Poor course design and poorly coordinated real time teaching sessions may lead to additional frustration and time wasting^{6,25,26}.

CAL particularly with online tutoring requirements present unique challenges to staffing because of the skill-mix they require. Recruiting individuals with appropriate IT, academic writing and online tutoring skills may prove difficult²⁰. In practice, poor communication between different staff members and lack of involvement by trainers may hinder the process of implementation²⁵.

B) Economical Issues

Economic issues could be significant barriers especially an evidence for strong cost/effectiveness is lacking²⁵. The cost of hardware, software, licensing and telephonenumber charges often are important barriers to accessing web based materials than the course organizers initially assume. The amount of training needed to become comfortable with specialized software packages is often underestimated^{1,6,25}.

C) Technical Issues

CAL packages, which include pictures and animation, make high demands on and tend to 'crash' the end user's system. Lack of systems that support complex technological demands may prove a barrier to implement certain complex CAL packages^{20,25}. In addition, possible transportability and incompatibility problems and dead" hypertext links may be encountered^{25,26}. Moreover, a major concern for students in certain parts of the world is inadequacy of technology e.g. computers, internet access and internet speed²⁵.

D) Pedagogical Issues

Trainers can be reluctant to adopt new systems and can be skeptical of their benefits with a number of misconceptions, including that CAL is a “passing fad”, “cannot cope with different types of learners “and” provides fragmented learning experiences”. This is compounded by lack of guidance and good practice²⁵. Significant challenges remain to evaluate the efficacy of CAL as a supplement to traditional learning. In addition, there are concerns about negative effects on patient care and interference of doctor-patient relationship^{14,25}.

Guidelines for Successful Implementation of CAL Principle

Based on the above, certain measures need to be considered for successful implementation of CAL. This includes staff training and development along with the presence of a range of ancillary skilled staff e.g. support, design and IT. Trainers and administrators should work as a multidisciplinary team with appropriate incentives to train individual staff, to create central resource base with national approach, infrastructure, guidelines, quality assurance and integrated disciplines^{6,20,25}. Financial viability should be based on evidence of cost effectiveness, cost benefits, content, pedagogy and technology^{20,25}. In addition, CAL packages should be based on principals of evidence, standards of care, academic freedom and respect for copyright rules. It should be piloted with ongoing evaluation and updating²⁵. Positive organizational culture, values and critical thinking, management styles and pedagogical paradigms should be promoted^{6,25}. CAL should also be mainstreamed into the institution. This would avoid parallel projects, ensure cost effectiveness and allow for expansion and continuation^{2,6,25}. Administrative and technical support should also be given for trainers and learners. Finally, well-designed CAL packages should be student centered, compatible with existing computers, blends teaching with traditional methods, flexible, relevant organized content, easy logical navigation, self-paced, interactive and provides for feedback and user testing^{24,25}.

Future Trends

Due to the prohibitive cost of producing high quality CAL materials in-house, a trend is emerging amongst medical schools to collaborate and share e-modules in order to survive the ever pressing finances of delivering state-of-the-art medical education^{6,5}. Agreements between universities may eventually lead to the awarding of a degree that cannot be identified with a single institution. A future medical school curriculum may offer a flexible choice of face-to-face and self-directed modules, whereby students can make their selection to meet their unique requirements⁶.

The field of pathology lends itself rather easily to information technology. Educationalists, however, now need to consider what effects computer-assisted learning might have on the learner, the differences between the images received from a microscope and from a computer screen or between text presented in a textbook and on a website. We need to know if and how these differences might affect knowledge of and attitudes to disease and how CAL influences students learning based on their individual learning styles^{1,11}.

CAL represents the most recent technology to be introduced into medical education. As educators respond to an ever-increasing amount of knowledge to be learnt and diversity of learners at diverse learning sites, CAL will assume even greater importance⁸. Several studies clearly demonstrate an improvement in medical education over traditional modalities with CAL achieving key modern pedagogical principles^{6,7}. CAL is accepted and favored by medical students and if implemented properly by taking care of possible technical, administrative and financial challenges, it becomes highly rewarding with lasting impact on the doctors of tomorrow²⁵.

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