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Synopsis

Educational technology as a scientific discipline

Teaching and learning are integral parts of all clinical activity. Yet medical education is only slowly finding its place among other scientific medical specialities. Why is this? And why is computer-based learning software putting conscious pedagogy on the agenda?

Doctors have been teaching and learning at least since Aristotle. However, it is still unusual for many physicians to consider education a scientific discipline. How can we conduct double blinded, placebo controlled educational trials? And if we can't, how can we justify any change in approach towards education? The question may, however, be reversed: How can we justify status quo with no other evidence than the existence of present day doctors and patients with present day status of knowledge and skills? In other words: How do we know if what we do is the best? Educational research has progressed dramatically over the past 100 years (see a timeline at http://www.ittheory.com/timelin2.htm, refer to (1) and (2) for recent perspectives from the medical domain). Still, implementation of research from the area of education seems to be lagging behind. The situation resembles that faced by Archibald L. Cochrane (http://www.cochrane.org/cochrane/archieco.htm) in the 1960's and 70's. Available evidence from clinical trials did not induce changes in clinical practice. Patients who could have been cured with new evidence-based treatments may have lost their lives. Considering the importance of well educated physicians and patients, ineffective education may be equally fatal.

The need to increase the efficiency of education worldwide is urgent. Lecturing, tutoring and traditional classroom teaching is time consuming and expensive, and there is a limit to its spread. As more knowledge must be disseminated to an increasing number of patients suffering from the major non-communicable diseases, educational technology will no longer be optional. In spite of improvements in the health care systems of most countries, we have not seen successes in limiting the number of patients with these conditions. On the contrary, failure of effective primary prophylaxis has shifted the focus of much research towards limiting complications and the impact on living conditions. Important results of such research are waiting to be incorporated in clinical praxis around the world. Changing practice, however, is also about changing culture. In some areas, this can be done rapidly, but progress is slow in others. Decision makers in medical faculties and hospitals are often recruited from the basic scientific community and good scientific evidence from well-conducted studies is particularly important for pushing a cultural shift in medical education. The outstanding papers presented in the following section may well serve not only their own purposes. Rather, promotion of well-conducted educational research serves as evidence that educational research also works without placebo control and double blinding and that this field of research is both possible and necessary.

The learning patient

In the first years of computer-assisted learning, much focus was placed on educating medical students, less on patients and doctors. This may be a logical consequence of a more formal approach towards teaching medical students. The primary goal of medical students is learning. Also, they may take structured teaching from professional teachers for granted. Postgraduate students and patients must emphasize other important activities. Learning takes place when time can be found, and often with little or no instruction. Here computer-based materials come in handy.

Patients as learners, especially those suffering from chronic diseases, have some benefits compared to physicians:

1) Motivation: The chronic disease provides the learning patient with constant motivation. Any new relevant knowledge may be immediately put to use.
2) Time: Disease, to some extent, prevents normal working activities, but leaves the patient with more time to establish networks within patient groups for self-paced learning and

in-depth study of specific areas of current importance.

3) Control: In conditions requiring tight control of medication, like diabetes and asthma, the well-educated patient may be able to obtain a better regulation when sharing part of the responsibility with medical professionals. As an example, it has recently been shown that, among specific groups of patients, self-management of oral anticoagulant therapy may be more efficient than conventional control (3). As the availability of computers and the Internet among patients increases, dissemination of clinical information and use of interactive medical learning software via the web may solve many key patient problems.

Four research papers on educational technology

The papers selected for the Computer Supported Education section of the 2002 IMIA Yearbook illustrate that medical education is a scientific discipline and that valid conclusions can be drawn from such studies.

Web-based clinical guidelines are finding increased use for many reasons. First, they can be updated easily and inexpensively. Second, users can find the materials on any computer connected to the web. Third, publishing the guidelines on the web enables easy comparison and stimulates collaboration between clinical departments. The study by Douglas Bell and colleagues from University of California, Los Angeles, compares web-based and printed guidelines for care after acute myocardial infarction. Residents were randomized to either web-based or written guides. It was concluded that learning was more efficient in the group receiving web-based study materials. Higher knowledge scores in the web group were not statistically significant, but less time was spent, and the learner satisfaction scale was significantly higher. As such, the study adds educational scientific evidence to the practical advantages mentioned above.

The study by Emma-Jane Berridge and colleagues from London, UK, was aimed both at patients and family practitioners, since the general practitioner will always play a crucial role as a consultant for a well-educated patient. In this project, programming was preceded by a thorough analysis, including identification of objectives, design principles, domain and more. The strategy is known among computer scientists as Object Oriented Analysis and Design, usually deploying the Unified Modeling Language. It has been described, among others, by Martin Fowler in his book UML Distilled: A Brief Guide to the Standard Object Modeling Language (4). Briefly, modeling of real-world objects is conducted as a first step in developing an object-oriented design methodology. Numerous programs, which were developed without going through the modelling phases failed to reach their goal simply because the programmers' aims differed from those of users, programming strategy was not selected in the most effective way, or human factors and user perspectives were not sufficiently taken into consideration. The process is iterative, as described in Figure 1 of the paper, with special focus on the returning arrows: Should problems arise at one level, development will need to take one or more steps back to assure a sound further development. This study is not only a valuable important educational resource for patients and their doctors. The description of how the program was developed may be directly re-used as inspiration for others planning similar projects. In addition to the design principles mentioned above, the study also contains a valuable description of how various media elements were included and deployed, as well as a discussion of the pros and cons of each element.

Ross Shegog and colleagues from Houston, Texas, present another perspective to patient education in an approach directed at asthma patients aged 9-13 years. As realized by most parents and school teachers, at this age, many children want excitement and entertainment as they often find in computer games. Developing educational software for this group of patients by using principles of computer games corresponds to meeting the children on their own playground, which may probably be the only way to maintain their attention. The study showed that this was indeed possible and that learning took place in such important areas as knowledge on self-regulation, prevention and treatment.

The study by Viorel G. Popescu and co-workers from New Jersey and California, presents an orthopaedic tele-rehabilitation system, connecting the patient at home with the orthopaedic clinic via the Internet and a web-based teleconferencing system. Considering the large number of patients in need for rehabilitation, a number that may well increase as the percentage of elderly citizens increases, the possibility for in-home tele-rehabilitation opens new perspectives for more effective rehabilitation in the future. As with other new technologies, it may be that the advanced hardware and software used in the present study will be too complicated for some patients, but the study shows important and promising results upon which further progress may rest.

Success or failure with medical learning software

Not all learning software will result in learning. The road from idea to final product is paved with challenges and many projects fail to reach their goal. Unsuccessful projects may be as expensive and demanding as successful ones, but software that end up not being used may influence decision

makers negatively when new projects are judged. Several initiatives have tried to analyze and describe success criteria for learning software. I will mention a few here. In the present context, medical learning software is a subset of academic learning software, and much of what is true for academic software also applies to medical learning software.

A comprehensive study, which deals with success criteria for academic educational software, was conducted by the CUTSD, Committee for University Teaching and Staff Development in Australia (5), (executive summary can be found at http://www.iim.uts.edu.au/about/sa_pubs/cautexec.html). The study reviewed 104 projects, which received funding from the Committee for the Advancement of University Teaching (CAUT) in 1994 or 1995, and which made significant use of a range of information technologies to develop student learning materials. The study made a series of useful conclusions directly suited for consideration by others. Without going into detail here, many conclusions coincide with what was previously established by Laurillard (6): the importance of an organizational infrastructure and collaboration between a number of people or groups with responsibilities for separate segments of the software design. Other important criteria were the use of a conscious learning design strategy; the reassurance of the integration of the software in the curriculum, including its acceptance by all teachers, and its usability (7) for both teachers and students.

It is not easy to prove the impact of standards, guides and guidelines on development and use of educational software. Probably, many guidelines find little or no use, and many new projects are initiated by developers who were not familiar with available guidelines. Moreover, too rigorous use of guidelines may limit the creativity of the developers. However, guidelines raise important questions at least for those involved in the process of developing them. Important guidelines include (8) and (9) at http://www.imbi. uni-freiburg.de/medinf/gmdsqc/e.htm. The World Federation for Medical Education, a non-governmental organization (NGO) with relation to the WHO, (http://www.sund.ku.dk/wfme/) has established a standing advisory committee for developing guidelines for medical educational software with participants from the USA, UK, Russia, Germany and Scandinavia. The first version of the guidelines was published in 1998 (10). The latest version (November 2001) is available at http://www.sund.ku.dk/wfme under activities. In the guideline development process it is striking that one key factor for international spread is that software should be open for adaptation to local needs. Teachers should be able to take ownership of the teaching materials.

Considering the very high quality of all four papers in this section of the yearbook, it should be worthwhile to consider use of the software outside the areas of origin. In many cases this requires portation of the software from stand-alone computers to the Internet. In this sense, let me make my last sentence a wish for the future. Let us hope that more top-quality medical educational software will be made available via the Internet under conditions that allow teachers to adapt it to their local needs and allows patients, physicians and students to globally benefit from it for free.

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