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Synopsis

Education

This section of the Yearbook contains five articles about the use of computers in medical education.

While the use of computer tools grows in educational areas, such as training and continuing education for students and health professionals, the articles consider the implementation of systems, programs, simulators, and other technologies that aim at several concurrent goals:

- Exchanging experiences
- Making knowledge of new techniques more available
- Training the ability to react before risky situations arise
- Improving understanding of complex biologic systems

A common theme is that today technology allows visualizing situations that anticipate possible real world scenarios.

It is not always possible to achieve a good balance between the complexities of the systems and devices used and the expected results. In case of the development of the Computerized Realistic Simulation [1], for example, the cost of a fairly complex system may not correlate well with the results of its application to real situations. It is difficult to measure the actual effectiveness of such computer programs, which while they may improve professional training for emergency situations, are complex to replicate. It is worth pointing out, however, that as long as technology advances, the cost-benefit ratio will allow the growth of these developments into multiple areas of professional training.

Along similar lines, but with lower cost implications, we have the development of multimedia interactive systems, which makes it easier for students to understand functional processes in a deeper way.

The paper of Scholten and Russell, "Learning about the Dynamic Swallowing Process Using an Interactive Multimedia Program" [2], allows a clear display of swallowing dysfunctions, improving the diagnostic abilities of the students. Interactivity allows them to test their diagnostic decisions which improves improving their capacity for decision making. Computer animation, video, X-ray images, sound, are the multimedia tools contributing to a better understanding of these processes. The management of dysphagia is the largest recognized subspecialty in the field of speech-language. Practicing speech-language pathologists require a comprehensive theoretical and functional knowledge base to safely and effectively manage people with dysphagia. To overcome the limitations of currently available teaching resources in this area, The Dynamic Swallow was developed as an interactive multimedia CD-ROM. A teaching resource to enhance a student's understanding of the links between the outward signs of swallowing dysfunctions seen during clinical assessment. The program gives students an understanding of what constitutes a critical condition by allowing the simulation of effects not possible on real patients. Access to images showing disordered processes contributes to the development of more expert diagnostic skills. This should lead to more targeted and effective interventions.

One of the features of the program is that the form of presentation (animation) matches the content of the material (dynamic biomechanical swallowing process), thereby enhancing learning. Students are able to determine their learning focus by selecting the sequence of activities and which features of the simulation to alter. The Dynamic Swallow is a multimedia program that includes diagrams, animations, and videos of the efficiency and safety of a swallow. The interactivity promotes active rather than passive involvement of the learner. Also, it facilitates decision making, problem solving, and reflection by allowing the students to access the information in the way that best suits their learning style. Finally, the program features a cross-platform CD-ROM playable on either Windows or Macintosh computers. The animated swallows help to link the outwards signs of swallowing dysfunctions seen during clinical assessment to real-time X-ray images of the factors at play inside the swallowing mechanism. This program deals with the oropharyngeal stages of the swallow because this is the focus of the speech-language pathologist's assessment of dysphagia. Students can

access five main menu selections from any part of the program: a) a brief introductory voice-over and video montage of people eating and drinking; b) the swallow section, which employs liquid and solid food with actual X-ray videos to highlight characteristics of the normal swallow and its variations; c) oral cavity and pharynx which contain simple colored diagrams that can be fully annotated or interactive; d) a glossary that includes an alphabetical listing of definitions.

The Dynamic Swallow could be a valuable international tool for teaching about dysphagia with potential applications in medicine and nursing. However, systematical investigation of the impact of the program on students' knowledge about the normal swallowing process would be essential.

Research in this area of multimedia development allows a standardization of this generation of models by applying the concepts of virtual reality.

The paper "Augmented Reality Simulator for Training in Two-Dimensional Echocardiography" (Weidenbach et al., [3]) continues this trend and describes processes and functions which traditionally would have been viewed as two-dimensional images at a realistic level. Students can approach the complex processes of the cardiovascular system with a high degree of understanding by interacting with the program. For example, echocardiograms can be analyzed by using a real scenario as a reference.

The objective of Weidenbach et al. was to present an echocardiography training system in which sonographers are required to synthesize two dimensional ultrasound images into a mental three -dimensional model of the heart using the technique of augmented reality (AR). The paper describes an AR application used to train sonographers in two-dimensional echocardiography.

The importance of computer-based techniques in medical education and its advantages over traditional methods of teaching is mainly based on their multimedia capabilities.

Virtual Reality (VR) immerses the user in a non-real environment. Augmented Reality (AR) is a variation of VR. It is defined as a system which [4]:

- Combines the real with the virtual
- Is interactive in real time
- Registers in 3D.

AR links real with virtual data. For the augmented reality simulator, a 3D surface model of the human heart was linked with echocardiographic volume data sets.

A three-dimensional surface of the human heart was designed based on an expert's knowledge. This virtual heart model was combined with 3D echocardiographic data according to the concept of AR.

The data sets were registered (i.e. synchronized) with the heart model to establish spatial and temporal congruence.

The software was evaluated in basic echocardiography courses. One group of students was trained using diagrams, atlases and texts, while the other group used the simulator. Better results were obtained in the last group, even during short training periods. The simulator was also used during courses for pediatric echocardiography.

However, not only the new generation of software and electro-biomedical devices facilitate and improve professional training. The Internet, with its world-wide reach, allows professionals to both learn and exchange experiences. CME programs use list servers as possible professional training instruments.

The paper of Chan et al., "Problem - Based Small – Group Learning via the Internet Among Community Family Physicians: A Randomized Controlled Trial" [5] (PBSGL), describes an experiment carried out in Canada. The benefits of small interaction groups were studied using multiple choice questions before and after the experiment. Although the conclusions do not show a clear difference, it does confirm the feasibility of carrying out analysis work and topic discussions with PBSGL using the internet.

The objective of this study was to determine the feasibility and effectiveness of a problem-based small-group learning (PBSGL) conducted via the Internet in a randomized controlled trial. A group of 23 family physicians from rural Northern Ontario, and across Canada, were randomly assigned to a study group (n= 11) and a control group (n = 12) . The study group spent two months discussing the topic of depression in the elderly with the help of a facilitator and two geriatric psychiatrists. The control group was given similar educational resources via the Internet but not the benefit of the small group interaction. Outcome measures include qualitative feedback from the learners and teachers as well as a Multiple Choice Questions (MCQ) test before and after the study.

Continuing Medical Education (CME) using LISTSERV is quite popular. A good LISTSERV is characterized by an excellent composition of its members and a strong list owner (the person in charge of the list). He or she can control the quality of the discussion to some extent, and remove any disruptive members from the list. Everyone on the LISTSERV is supposed to obey "netiquette". LISTSERV is a place where one finds experts in a field from around the world. The uniqueness of this study was its attempt to apply the idea of a problem-based small- group using well -established technologies (internet, e-mail) as the means of communication among the group members.

The advantages of using LISTSERV for PBSGL include: 1) easy to enter and exit the different groups, 2) participants, facilitators and faculty members, 3) easy and timely delivery

of resource materials via e-mail attachments or WWW, 4) "threads" can be analyzed for quality control, evaluation and possible calculation of CME credits and 5) the program can be administered with minimal running costs.

The participants were a highly specialized group of family physicians. On average they had been in practice for approx. 13.5 years and reported one to three years of experience with the WWW. Almost two-thirds knew about problem-based learning and had no problem doing independent MEDLINE or other Internet searches. Although there were no statistically significant differences between the two groups in terms of key characteristics, the control group was older and had been in practice longer. It is unclear whether this method of CME is truly effective, or whether the knowledge gain assessed via MCQs is a valid and reliable outcome measure, since learners' knowledge gains using MCQs as a measure failed to demonstrate significant differences. However this study has shown that it is feasible and inexpensive to organize PBSGL using the Internet.

Because of its ease of use and availability worldwide, the Internet is a natural vehicle for providing courses at a distance. This allows students from anywhere in the world to have access to knowledge and experiences from highly specialized teaching institutes.

"An International Distance Learning Course in the U.S. and Japan" [6] describes a distance learning course offered via two way interactive video and the Internet from the University of North Carolina at Wilmington (U.S) to nursing students at Mie Prefecture College of Nursing (MCN) in Japan.

A literature review showed: a preference for face-to-face interaction by students and resistance to computer and communications technologies. Faculty needs to keep students engaged and create opportunities for student-student and student-faculty interaction. Faculty should be trained in the technology available to support instruction [7].

The course involved a combination of two-way interactive video with Powerpoint screens and on-line classes. Powerpoint allows the video transmission of text, charts, photos, film clips, etc, while simultaneous interpreters at MCN translated the entire lectures. The Internet classes used a combination of web pages, electronic mail and discussion forums. Students were required to read the weekly lecture notes posted on the Web, as well as read articles recommended by the instructor. Students were also asked to submit their written homework via e-mail and to present the results of the interviews and surveys in English. A detailed syllabus including a list of articles from the US and Japan, and weekly lecture notes were provided. All the Internet technology tools included: instructional design standardization; student technology support and instructional delivery 24 hours a day and seven days a week; a threaded discussion forum designed for distance learning environments; student authorization and authentication via user-id and passwords to the course homepage, and seamless integration of multiple educational learning paradigms. Students could check the course syllabus and view the class lecture notes by date, by major unit or by topic. This method allows students with different learning styles to see the course materials from multiple perspectives. The course homepage also included a videotaped introduction (in RealVideo format) of the instructor, so that students could hear and see their instructor, providing a "human component" to the on-line materials. In addition to using web pages and e-mail, guest speakers and videos were also used to stimulate student learning. The students were able to contact the instructor through the course homepage. Because all lecture notes were posted on a web page, students did not have to take notes during classes.

Generally the students showed positive responses and stated that the course challenged and stimulated them intellectually. The major goals were related to increasing knowledge about nursing education, practices and issues between the US and Japan. The second major goal was to improve the Japanese nurses' written and spoken English.

The course provided the necessary structure for nursing students to evaluate the strengths and weaknesses of nursing in Japan versus the USA. Participating students showed a very high interest in the contents of the lecture provided every week. This shows that, despite the fact that the authors do not believe that distance education is the best teaching method, the implementation of the course was successful and it provides an effective and affordable means of education.

The teaching strategies should meet the needs of other students- not only those of Japanese students - in an international setting, Because nursing is a universal profession challenged by global issues [8], nurses in the United States need to collaborate and network with nurses from other countries to develop strategies that affect health and nursing care [9]**.** Nurses in the US can also learn from their counterparts in other countries.

Sound, movement, interactivity, virtual reality, real images, and diagrams, are a part of the pedagogical resources that improve the performance of future professionals.

The paper "Computerized Realistic Simulation: A teaching Module for Crisis Management in Radiology" (Sica et al., [1]) describes the effectiveness of a simulation program similar to that used by anesthesiology departments, but developed to teach radiologists the principles of crisis management.

Realistic simulation is used to teach crisis management skills to a variety of professionals such as pilots, military personnel, firefighters and nuclear power plant workers. Within the field of medicine realistic simulation is successfully used to train residents to administer anesthesia. Computerized mannequin simulators enable the simulation or re-creation of the environment in which a real crisis occurs. The effectiveness of this training tool has been proven.

A patient simulator was fitted to resemble a patient in a CT scanner radiology suite. The mannequin was capable of exhibiting real-life physiologic responses and generated human breathing and heart sounds, as well as voice. These attributes were under semi-automated remote control and responded dynamically. Participants were instructed to approach the mannequin as they would a live patient. The control console was located in a separate room. The operator had both direct and televised visualization of the room but could not be seen by the participants. Two scenarios were designed and developed to be sufficiently complex to include a variety of potential crises that a radiologist might encounter. The outcome of the scenario was the resolution of the patient's symptoms, his stabilization and transfer to another unit, or the patient's death. Both a radiology nurse and technologist were present or available to simulate a hospital environment.

The 24 participants were divided in six groups, each of which attended one half-day session at the center. The course was conducted for three consecutive days and the two scenarios ran during each session. Their order was reversed after each session so that each scenario occurred with equal frequency, so as to eliminate or average out performance variability that may have been related to the degree of difficulty of a scenario. All scenarios were videotaped for review.

To the author's knowledge this report is the first in radiological literature that describes the use of realistic simulation to train of radiologists in crisis management and suggest improved performance results during one training session. Fully evaluating a new teaching technique such as this one, particularly its impact on performance, is difficult. Although the subjective ratings are an important measure of participant acceptance, these ratings do not correlate with the effectiveness of the program. Their approach was to have two independent observers randomly review and score each videotaped session. The observers were not involved with the course. The results of their evaluation indicate that a program which combines the hands-on experience of realistic simulation with teaching the principles of crisis management can be effective.

Simulation training is expensive and can be labor intensive. The costs increase with the degree of fidelity desired. Simulation centers are not widely available. Trainees could travel to attend a course at such a center, just as they would for other courses at scientific meetings. However, concerns inherent in such studies are: Will the performance improvements during the course translate into better real-life decisions? If so, how long will this effect last? Despite such concerns, the study has shown that realistic simulation technology can be an effective teaching tool for radiology trainees in the principles of crisis management.

In conclusion, although distance education is not necessarily a better method than the present one, there is no doubt that it provides many students from all over the world the possibility of accessing pedagogical and training resources that otherwise would be impossible for them to reach. Student training and ongoing education of professionals have access to increasingly better tools for easier information access. These technological resources must be studied and assessed in order to take advantage of their benefits, and to carefully analyze their weaknesses.

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