

Exploring the Potential Impact of the Electronic Revolution on Pharmacy Education

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Tremendous advances in computer technology have served pharmacy well in providing efficient dispensing record systems, quick and accurate information retrieval, and software applications for intervention documentation, pharmacokinetic analyses, and research applications (1-4). The present electronic revolution, however, will take the applicability of computer technology to new levels and may very well revolutionize pharmacy school curricula.

Heretofore, pharmacy school curricula have been dominated by didactic learning housed in a university setting integrated with clinical rotations. Increasingly, pharmacy educators have incorporated more case-based learning and problem-solving skills in their didactic courses. Advances in the electronic revolution, specifically Internet applications, may and should change how the curriculum is handled.

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Historically, higher education institutions existed to: 1. create knowledge and evaluate its validity, 2. preserve information, and 3. transmit information to others (5). How we transmit information to others can be done more effectively, efficiently, and independent of geographic borders with the advent of the electronic revolution. Virtual courses and virtual universities are not the substance of science fiction any longer. The governors of the western states are considering a joint venture whereby they mutually fund a regional virtual university. Fourteen states (e.g., Alaska, Colorado, Utah) and one territory (Guam) presently comprise the Western Governors University (<http://www.westgov.org>). Professors at the 60,000-student Houston Community College system bid for time off to develop courseware in the College's New Media Center as they establish a virtual campus. Students at the Kansas State University (KSU) use BioMOO as the medium for their virtual course from Mr. St. Amand, a researcher for the U.S. Department of Agriculture who is on faculty at KSU.* These live exchanges make for a dynamic course. Professors at several colleges, including the University of Texas at Austin and University of Pennsylvania, conduct courses in MOOS as supplements to their face-to-face courses (6). The University of Texas Department of Geography offers a virtual introductory geography course funded by the National Science Foundation. More than 50 classes at the University of Connecticut at Storrs have "virtual classrooms" on the Web (7). Students access readings online, hand in their papers electronically, and review exhibits and other materials via their computers (7). In short, the electronic revolution is already affecting education.

Using the Web allows the instructors to integrate charts, photographs, sound, and video without the memory limitations of a typical personal computer. Imagine delivering a lecture on pneumonia, accessing the Web, walking students through a physical examination, allowing them to hear breath sounds, view a lung x-ray, and conduct a literature search as you explore therapy options. No longer will a pharmacy students arrive on the first day of rounds not

*BioMOO is an on-line meeting place for biologists using MOOS or Multi-user, Object-Oriented domains which are textually based immersion environments.

knowing what "white out" is on a lung x-ray of a patient with pneumonia. Students will also have access to all these resources and will help them engage in active learning processes outside of the classroom.

Medical education has a substantial presence on the Internet with interactive patient cases. Students equipped with multimedia computers can assess heart sounds and breath sounds as they advance through a virtual physical examination. The Interactive Patient (Marshall University) (<http://medicus.marshall.edu/medicus.htm>), Pittsburgh Case Index by Patient History (University of Pittsburgh Medical Center) (<http://www.pathology.pitt.edu/cases/dxindex.html>), and Patient Simulations at the Virtual Hospital (University of Iowa) (<http://indy.radiology.uiowa.edu/VirtualHospital.html>) are but a few of the dynamic case-based instructional sites available on the Internet. Many pharmacy practitioners have begun to place their interactive cases on the Internet as well (<http://www.sci.libuci.edu/~martindale/Pharmacy.html>). Savvy pharmacy students will access these resources as they proceed through their curriculum to enhance their own understanding of subject material. Where this progress in educational technology will lead us is limited only by our imagination and willingness to expend energy for this endeavor.

Multimedia computer-assisted learning in self-paced fashion incorporating patient cases and problem-solving scenarios will serve our students well. Not all students respond well to didactic-based learning. Self-paced learning accommodates individual students' own circadian rhythms, allowing them to access the information in the early hours of the morning and/or midafternoon, and integrates their weaknesses and strengths, allowing them to spend more time on areas of weakness and breeze through (but reinforce) their areas of strength). Active learning can be better incorporated into the curriculum. The half-life of medical information is very short; for this reason, it is imperative that students learn how to learn. Faculty can guide and expect their students to access information resources, come to class better prepared, and be able to cover more content in the course. The faculty's job will be to teach the student how to think, how to apply the information to the patient case, and how to solve problems rather than only delivering lecture material in a time-circumscribed format.

With this type of medium comes the recognition that students can learn from a major scholar regardless of where the faculty member or the student is physically located. Course discussions can take place in conjunction with or independent of a specified lecture period. This technology lends itself to distance learning. Those institutions already heavily involved with distance learning who incorporate this technology will be at a decided advantage in integrating multimedia applications for "in-house" curricula. This also calls into question the need for physical proximity of pharmacy scholars at universities: will we need—and will society support—70 to 80 colleges of pharmacy in the not-so-distant future?

In the past, the advantages of electronic forums may have been exaggerated, but few today can dispel the argument that computer technology will have a profound impact on pharmacy education. In fact, it has been suggested that it would be politically naïve to ignore the impact of the Internet on education (8). Successful organizations who embrace the technology will establish a virtual electronic presence. Faculty will need to be recognized within the promotion and tenure process for their efforts in developing electronic media and instructional methods. The Internet will be recognized as a venue for publication reflective of a national presence; indeed, the exposure afforded within the Internet itself will provide a platform for a national presence. With equally rigorous peer review, this medium will become a viable alternative to traditional publication.

There are several issues pharmacy educators need to address and the discussion should begin now. Listed below are a template of suggested discussion issues/questions realizing that as we delve into this issue more questions will arise.

1. How can we assure every individual faculty member has Internet access?
2. Should every pharmacy student have Internet access? How can this be best accomplished? Should students be required to have their own personal multimedia computer upon admission into a college of pharmacy or should students have Internet access through university-based computer clusters?
3. How should faculty be supported in development of Web publishing capabilities? How should Internet publishing software

- be made available to pharmacy faculty? How should time be allotted to develop these skills? How can faculty access trained personnel to assist in learning these skills?
4. How should the promotion and tenure process recognize teaching innovations and contributions made in the electronic media?
 5. How can we establish and recognize peer-reviewed electronic publications?
 6. How can we help administrators recognize the need for and finance ongoing computer maintenance and upgrade costs with incorporation of these needs as an ongoing annual budget item?
 7. How can we promote the understanding that a presence on the Internet will be integral in maintaining national stature as a quality program?

Computer technology has the power to change the foundation of pharmacy curricula. Those who harness its power effectively will be better positioned to be one of the colleges of pharmacy of the twenty-first century. Students who graduate from those programs will be better prepared to assimilate into a society which has experienced the electronic revolution.

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