CyberSurgeon

Internet broadens surgical education environment

by Karen Sandrick, Chicago, IL

A virtual reality anatomy lecture with interactive, three-dimensional organs that can be drilled down to examine individual tissues and organelles, cellular and even anatomic structures. A holographic mannequin suffused with electromagnetic waves that can be touched and sliced into layers. Artificial intelligence that creates personal educational profiles that adapt the instructional environment to match a surgeon's style of learning and level of expertise.

"Surgeons will be sitting around in a room with a hologram in the middle of it, and they will be able to interact in different ways, taking a model of the uterus and blowing it up to the size of the room so, literally, in single file, they will be able to walk through the organ, look at the anatomy, and discuss where to make incisions. Surgeons will be moving beyond the educational environment of today to achieve what I term smart learning, which uses artificial intelligence to assess their learning styles, create a teaching environment that personalizes information, and changes the degree of difficulty to maximize their learning potential," says Jeffrey Levy, MD, assistant professor of obstetrics and gynecology, Jefferson Medical College, Philadelphia, PA.

Educational enhancements

These aspects of Internet-based surgical education will be commonplace in the next three to 10 years, Dr. Levy believes. "The Internet will give us a whole new realm of possibilities, possibilities of enhanced communication and education to level the playing field in the ways we teach our students and physicians. It's a key to interactive, flexible, and adaptive learning environments," he notes.

Dr. Levy is chief executive officer, chairman of the board, and chief education officer for MedCases, Inc., a Philadelphia-based electronic medical education company that teaches physicians by telecasting actual patient presentations over the Internet. A sample surgical case, for example, describes a 65-year-old woman with a history of diverticulosis who presents to the emergency department with constant, dull pain in the left lower quadrant, a low-grade elevated temperature, and anorexia for the last two days. It then guides the reader through an initial workup, differential diagnosis, laboratory and imaging tests, final diagnosis, and a treatment plan. The exercise is totally interactive and fluctuates according to the path the reader chooses. By including a built-in mentoring system, the MedCases system generates feedback to the reader throughout the discovery and decision-making process.

Currently, MedCases provides case presentations in five specialties: obstetrics and gynecology, pediatrics, family practice, internal medicine, and general surgery. In the coming months, the company will add case presentations for pulmonology and cardiology and will expand to cover 30 specialties in the next three years. MedCases offers subscription products to medical schools or clinical departments for students, interns, and residents as well as individual subscriptions for practicing surgeons that award 48 continuing medical education credit hours for completing four cases a month. The company also has produced prototypes for medical journals, textbook publishers, and specialty societies that simulate a patient encounter based on a review article, meta-analysis, chapter, or grouping of specialized cases.

MedCases' approach to teaching is not a new concept. "Problem-based learning has been around for over 30 years, and it's been experimented with or used in practically every medical school in North America at some point or another," Dr. Levy acknowledges.

What's different about MedCases is the interactive capability. "We're taking a new technology to enhance the process and create an environment where students can have self-directed learning, get as much as 80 pages of background material about a case from the literature, go into in-depth

mentoring, and obtain 50 or more pictures or video elements, all in one place," Dr. Levy explains.

Simulated surgery via computers

In the next three to five years, when the Internet drastically expands past current bandwidth constraints, it will bring virtual reality problem-based instruction to life. "Instead of just confirming for a surgeon that, 'yes, you chose the right procedure for this patient case,' the surgeon will be able to perform the procedure on a simulated patient over the Internet in a virtual reality experience. The patient will look real. There will be tactile and force feedback, so the patient will feel real. The surgeon will be using instruments that give the look and feel of an actual procedure. And the patient's outcome will be affected by how well the surgeon performs. So, if a patient has a bad result, the surgeon will have to deal with the complications," Dr. Levy adds.

Holographic education, an offshoot of virtual reality that is still in early development, will become one of the new frontiers for surgical education, Dr. Levy says. "When we put an image in 3D in the middle of a room and surgeons can interact with it, they essentially will be able to pull out components of a virtual cadaver, like the lungs, and look at them more closely, moving down the trachea to the bronchioles and finally to the alveoli. Surgeons will be able to immediately understand 3D anatomical structures and images by rotating them in different directions and zooming in and out," he observes.

A.I. to track ability

Artificial intelligence (A.I.), which is about 10 years in the future according to Dr. Levy, will individualize every component of surgical education by directing instruction according to a surgeon's learning strengths and weaknesses as comprehension improves and knowledge grows. "We're closer to getting artificial intelligence that can learn from what we do and that can potentially learn from our mistakes," Dr. Levy adds.

As an example, Dr. Levy poses the prospect of a run-of-the-mill written test. If an instructor gives a surgeon a 1,000-question test, he or she would have to check the answer to every question to decide how well the surgeon grasped the subject matter. With artificial intelligence, however, the instructor could track a surgeon's understanding through branching logic. The answer to each question would lead down a different branch to sets of questions that feed off one another and provide a picture not only of the surgeon's store of knowledge but his or her reasoning ability.

The same is true for teaching. "Artificial intelligence agents in the future will be able to determine a surgeon's level of learning and thought processing. It will learn from what surgeons do and take them down different branching points of teaching to make education more effective. It will figure out what type of educational experience works for a surgeon and change the teaching environment to bring it more in tune with how the surgeon gains intelligence," Dr. Levy says.

Artificial intelligence also will adapt instruction to a student's experience, tailoring information at different levels for first-year medical students and surgeons who have been in practice for 10 or 15 years and changing the degree of difficulty of educational programs to maximize the learning potential for every surgeon, he explains.

The Internet will provide the opportunity for telementoring so surgeons in their hospitals, homes, or offices can have an expert at their elbows to guide them through simulated procedures every step of the way. "The way to do this economically is to have a centralized mentor who can reach hundreds or thousands of physicians simultaneously throughout the world," Dr. Levy says.

When unlimited bandwidth frees the power of the Internet, surgeons will be able to access virtual reality and artificial intelligence anywhere. "Anything we can do on the most powerful computers in the world," Dr. Levy says, "we will be able to do at home." Ω

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