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The Anatomy of Distributed Learning

Reconfiguring Medical Education in BC

First-year medical students study a slice of kidney using both microscopes and computer screens in a new high-tech laboratory at UBC. A traditional microscope view is augmented with digital versions of the tissue samples in the "virtual slide box," a UBC-developed database that is revolutionizing the study of microscopic anatomy. Via high-speed video-conferencing technology, the students and instructors maintain a live, interactive connection with their classmates and counterparts in labs at the University of Victoria and the University of Northern BC in Prince George.

Gross anatomy is wired into the universities' distributed learning circuitry as well. A complex matrix of lights, cameras, robotics and audiovisual control systems delivers precision imagery into each lab. The goal, after all, is to give students at each site an identical experience—as if they were all around the same table as the instructor opens up the cadaver and takes them on a tour inside the chest cavity.

These are just two examples of how the technology behind distributed learning is reconfiguring the anatomy of medical education in BC. Innovative solutions have been demanded from teams of medical faculty, clinicians and technicians since planning began in 2001. The results are impressive.

"In terms of medical education programs this is absolutely cutting edge," says Dan Zollmann, an engineer and project manager with AMBIT, a Vancouver-based consulting firm. Zollman acts as "inter-site technology lead" in the distributed learning program.

Already the work here at UBC has set a new standard and is making an impact at other Canadian medical schools. Delegations from the University of Western Ontario (UWO), which plans a similar partnership with the University of Windsor, and from l'Université de Sherbrooke, which is moving ahead with a program in partnership with l'Université de Moncton and l'Université du Québec à Chicoutimi, visited BC in the spring. Both are looking at adapting components of the UBC system to their programs.

"It was almost overwhelming to see the marriage of careful thought and technology," says Jim Silcox, advisor for the Schulich School of Medicine and Dentistry at UWO. "What really hit home was that the technology really worked to preserve the cohesion of the group even though the students are on three different campuses."

The distributed education program demanded specialized infrastructure—beginning with bricks and mortar, moving through to the computer network, and on to the audiovisual and information technology components.

First "There were major architectural considerations," says network strategist Stan Shaw, who, with a doctorate in molecular biochemistry as well as network industry experience, brought both scientific and technological expertise to the enterprise. "In any video-conferencing environment you have to take into consideration the acoustics and lighting in order to make it work properly—it's a production facility." The state-of-the-art interactive lecture theatres and laboratories in the Medical Sciences Building in Victoria, the Life

Sciences Building at UBC, and the Dr. Donald Rix Northern Health Sciences Centre at UNBC were the result.

Next, they had to design a network fast enough to deliver exceptionally crisp video. Image quality is essential in the context of medical education for reasons that go far beyond an attempt to look pretty. Zollmann says the guiding principal was that "we're training the students' eyes as well as their minds. One of the critical aspects of what we train and hire doctors to do is to use their eyes.… If an instructor was showing an MRI scan in a lecture, it would be meaningless if the remote learner saw a jittering, distorted image at the other end."

To get around the problem of other Internet traffic slowing down the medical school's video conferencing, explains Shaw,. "We we took a slice of the Internet on BCNET, isolated it and gave it the high est priority of any over other traffic on the system network." The result is a system built for speed: at two three megabits per second, the network transmits video five to six times faster than the industry average.

This solved the delivery problem, but each component of the program made its own particular demands. For Zollmann, the gross anatomy lab offered one of the most interesting challenges in the design of the "remote presentation technology."

Imagine three labs, one in each of Vancouver, Victoria and Prince George, where students are gathered in an operating room–type setting, cadavers on the table. At two of the sites, students watch the anatomist deliver the lecture on large LCD or plasma monitors, with clinicians on hand for consultation.

At the third site, the anatomist not only presents the lecture and proceeds with the dissection, but also controls the outgoing video imagery. The lecturer operates the switching system for cameras that are trained on him when he's speaking directly to the students and for cameras allowing both macro and micro views of the dissection. He also has to keep his eyes on a lectern where a pair of "confidence" monitors show the imagery that is seen at the remote sites, as well as the students asking questions from those sites.

The system development required experimentation. Zollmann, the other technologists and the anatomists identified problems during demonstrations of a prototype system in early 2004: the controls were wall-mounted and out of the anatomist's reach; the touch-screen control was not sensitive to a gloved hand; the images were often in shadow because the lighting did not adjust to the camera angle and focus; and there were motion control issues.

"There were a couple of demonstrations where people were getting ill, not because of the subject matter—everyone in the room was comfortable seeing organs on display—but because the motion of the tour through the chest cavity was so erratic that people couldn't maintain orientation," Zollmann says. "It was clear we couldn't actually teach students with that particular configuration of technology."

Video and lighting systems used in hospital operating rooms proved not to be the answer as they are extremely expensive and meant to be controlled by a dedicated operator.

"What we did instead was adapt off-the-shelf camera equipment and very high-powered lights," Zollmann says. "One is a $30,000 camera, ceiling-mounted and with a robotic control that works in sync with the lights to make sure the specimens are not in shadow, and are consistently illuminated and clear. It's completely motorized, which allows for very close zoom or magnification without shaking or jittering. With a very simple joystick, the anatomists were controlling the camera like a pro in about 90 seconds."

The second camera is a $3,000 miniature camera mounted on an adjustable stem that can be angled or twisted in any direction—it looks like a flashlight on a gooseneck microphone. The anatomist can place it inside the chest cavity and focus in on details that are not captured by the ceiling-mounted camera.

"What made it exciting is that we had a group of anatomists who didn't know technology, and technologists who didn't know anatomy, and we educated each other to the point where we created something that made everyone extremely happy," Zollmann says.

The use of video technology, has gradually entered into the teaching of anatomy over the past decade. Says Zollmann, "This system expands its capability—it's an evolutionary rather than a revolutionary thing. What's happening in histology, however, is revolutionary."

The virtual slide box is an online version of the set of 200 slides students study in their first- and second-year histology courses. Each digital image is a whopping 5.9 gigabytes, which renders a perfectly sharp image on large computer screens, even when looking at a detail magnified 40x.

"The students are of a generation that has grown up with computers and they love this kind of interactivity with the computer screen," says Dr. William Ovalle, UBC's medical histology course director. "They can look at it at home; review on their own time."

The virtual slide box is one of the components of the distributed learning program that most impressed the recent delegation from the University of Western Ontario, Zollmann says. "When Dr. Ovalle and I took them through the histology multi-purpose labs and showed them the virtual slide box, their chins hit the table. They could not believe it. They all instantly recognized that what we're doing in histology will transform the way the subject is taught."

UWO's Silcox, who recalls his own struggles with the microscope as a student, agrees with Zollmann. "The histology lab demo was breathtaking," Silcox says. "The virtual slide box, in fact, almost makes the microscope obsolete."

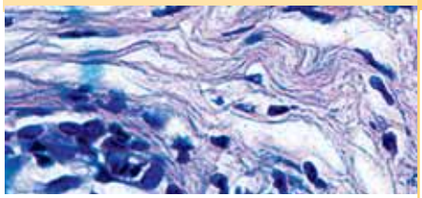
Ovalle, who has taught histology at UBC for 33 years, says it's still important for students to be skilled with both the old and the new

technology. "Some people ask, 'Doesn't this replace the microscope?' In our view, it supplements the microscope. It's important to have both."

Development of the technology used in the distributed learning program continues. For example, Zollmann says, the future is in refining the current distributed-learning technologies for greater portability—for sites even further removed from special facilities at universities or hospitals.

"What I think is going to be the next frontier for us is exploring video conferencing between potentially many sites. Traditional video conferencing maxes out at four locations. After that they stop working the way we need them to work—the ability to view people at all sites. Our next challenge is to have large numbers of sites connecting and distributing to sites with just one or two people at them. The other areas we're now starting to research and test are fully functioning laptop systems that can connect with traditional video-conferencing systems."

There is more innovation on the way in the delivery of medical education, and UBC is clearly on the cutting edge.



The virtual slide box and the remote presentation technology support the delivery of the Faculty of Medicine's MD Undergraduate program on three university campuses. This "distributed" program, developed in collaboration with UNBC, UVic, the regional Health Authorities and the provincial government, is an innovative response to the alarming shortage of doctors in BC's rural communities.

The evidence suggests that training doctors in or close to the communities they come from, and/or hope to serve, helps to keep them there. "This may attract students who wouldn't otherwise consider medicine because they don't want to relocate to larger centres," says Dr. Angela Towle, associate dean, MD Undergraduate Curriculum. "The distributed program, with the technology, makes it more acceptable, more doable."

In recognition of this innovation and collaboration, the Faculty's Distributed Medical Education team, Drs. Joanna Bates, Angela Towle, Oscar Casiro, and David Snadden, were named winners in the Leadership category at the seventh annual **BC Innovation Awards in Educational Technology** this spring. For more about the awards, please go to http://www.bccampus.ca.

Technology offers solutions, but it also makes demands. The web of fibre-optic cable, circuitry and lenses that brings together three campuses requires teachers rethink their techniques.

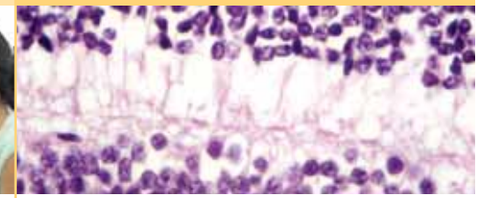
"Teaching's always been a performance for me, that's what I've always loved about it," says Dr. William Ovalle, a 33-year veteran of the classroom. Now he has to adapt his style to multiple cameras and remote audiences as well as run PowerPoint projections and direct the use of the virtual slide box. "When I first heard about the distributed program I thought, 'Oh, no, this is going to be impossibly hard work, and we'll lose the sense of personal touch.' But I found that that's not the case. We are in touch., wWe're communicating. It's incredible. We're all in the room together."

Ovalle is enthusiastic about the new technology. "I thought I would get swamped, but I find it revitalizing. We are incorporating traditional ways of teaching, but we have new methodologies as well. We have the best of both worlds."

For Niamh Kelly, UBC's foundations of medicine course director, the technological component of the distributed program will set medical students up for the technological advances and continuous learning that will be an ongoing part of their practice.

"To me, technology means better connectedness and that means better communication," she says. "Look at the work life of a medical practitioner: they qualify at age 25; on average, they have 40 years of practice. Look at the rate of change of knowledge over four decades, and it's a given that they will have to continually upgrade.

How will they get that knowledge if they could be working anywhere from an urban centre to a remote village? Technology is the answer. It's all about up-to-the-minute connectedness. It makes sense that our undergraduate students embrace technology, expect it, learn to use it and make it the forerunner of their continuous learning."



Faculty of Medicine professor Wayne Vogl has a runaway international success on his hands with **Gray's Anatomy for Students**, the textbook he co-authored with Richard Drake and Adam Mitchell. The book, which features access to an on-line online searchable text, an interactive surface anatomy component, downloads of more than 1,000 illustrations, and a test bank, is an ideal complement to the gross anatomy courses in the Faculty's distributed medical program. Among the many other medical schools using the text are Johns Hopkins, Yale and UCLA.

Student end-users were involved in every step of the book's development. Publisher Elsevier sent mock-ups of each chapter—including options for artwork—to student groups around the world. "We paid incredible attention to student feed-back feedback," Dr. Vogl says.

Professor Vogl and Richard Drake, Director director of Anatomy at Cleveland Clinic Lerner College of Medicine, each bring 25 years experience teaching in the lab to this project. Mr. Mitchell, MBBS, FRCS, FRCR, a consultant radiologist at Charing Cross Hospital, Imperial School of Medicine, London, England, provided the clinical expertise.