Health Sciences E-Education: Teaching Virtual Anatomy Labs

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Abstract

West Virginia University (WVU), located in a rural mountainous state in the USA, extends health education to students, laymen, and health providers. Our department teaches anatomy and provides lab access to nursing, dental hygiene, pharmacy, medical and dental students, physical and occupational therapy, emergency medicine, orthopedics, and other clinical departments.

Because of growth in the university, the traditional classroom and lab have become large with less opportunity for students to have a laboratory experience designed specifically for them. To address this problem, we are developing Virtual Anatomy Lab courses targeted for specific groups of students. Our first asynchronously delivered Virtual Anatomy Lab: Limbs and Back is designed for athletic trainers, physical and occupational therapy.

These resources are shared with institutions like the newly formed International Medical School (WWW.ximeds.org), a world-wide virtual medical school. West Virginia University has a great interest in participating in programs where open technology-mediated learning can overcome poverty and build a more stable and prosperous world. Our plan is that WVU anatomy courses and virtual labs will be part of universal medical and health education.

Online Introductory Human Anatomy Course. In 2001 a general human anatomy course was designed and produced for delivery on the internet. Because undergraduate anatomy courses from the Department of Neurobiology and Anatomy at West Virginia University are reserved for students enrolled in the Health Sciences Center professional schools and allied health programs, each year the Department of Neurobiology and Anatomy turned away 100+ students seeking an undergraduate level human anatomy course but not enrolled in these schools.

A committee was formed that included faculty and technical staff from the Department of Neurobiology and Anatomy to work on the four instructional modules: 1) organization of the body, 2) respiratory and cardiovascular systems, 3) digestive, urinary and reproductive systems, and 4) the nervous system. A good textbook is critical for the success of an online course so we worked closely with publisher Benjamin Cummings and customized their textbook Essentials of Human Anatomy and Physiology, by Elaine Mariëb, to contain the content that the students would be responsible for. In addition to the textbook Benjamin and Cummings packaged a CD-ROM that goes along with the textbook and made available online resources including study modules and practice quizzes. The course was successfully offered beginning in 2002. The course has been well received by non-traditional students, and WVU students taking the course in summer session at their homes. Out of state and international students needing a general anatomy prerequisite for more advanced study also take the course.

Virtual Anatomy Lab. At our growing university, the traditional classroom has become large. Our anatomy department teaches anatomy to nursing, dental hygiene, pharmacy, medical and dental students. Physical and occupational therapy and residents from clinical departments also use the anatomy labs. All registered anatomy students have access to a general anatomy lab, but there is less opportunity for students to have a laboratory experience designed specifically for them. Virtual anatomy lab courses targeted for specific groups of health science students are now under development to fill this need.

Our first asynchronously delivered two credit Virtual Anatomy Lab is designed for physical and occupational therapy, athletic trainers and pre-medical students. Emphasis of this course is limbs and back (Figure 3). The laboratory text and workbook authored by Dr. Julia Guy at Ohio State University is titled Learning Human Anatomy and is available from Prentice Hall Health (3rd ed., ISBN 0-13-143320-2). Because Dr. Guy’s undergraduate anatomy classes at Ohio State are very large, she also developed a companion CD-ROM entitled The Anatomy Lab. This workbook and CD-ROM enable the student to work independently in learning anatomy before they come to the gross anatomy lab.

This course has web notes, active learning exercises, online testing, and virtual visits to the anatomy lab in addition to the workbook and CD-ROM assignments. Faculty and the instructional designer employed a modified instructional design process using formative and summative feedback with feedback from students and other faculty. Active learning techniques were used extensively to increase student interest and participation (Dick W, Carey L., The systematic design of instruction, 3rd ed. Harper Collins Publishing, 1990)

The Virtual Anatomy Lab: Head and Neck will be the next course designed for pre-dental students and other dental disciplines. The combination of the general anatomy course and the Virtual Lab in their area of interest will provide sufficient information to the student or serve as a preparation for higher level anatomy courses i.e. medical, dental, and graduate courses in anatomy.

International Health Sciences E-Education. West Virginia University has a great interest in exploring how open and distance learning and technology-mediated learning can improve the delivery of medical and health education. The university has formal institutional linkages with 68 international institutions and academic groups worldwide. The WVU School of Medicine collaborates with medical schools in
Dr. Elizabeth Walker has gained international teaching experience as a Fulbright scholar at Addis Ababa University Faculty of Medicine, Ethiopia; as a Rotary scholar at a new medical school in Mozambique; and as a visiting professor at a new medical school in Oman. These experiences served as a clear reminder that traditional medical schools serve only a few students. However, e-education could serve many qualified students and enable them to complete their desired academic program. Our plan is that WVU anatomy courses and virtual labs will become part of universal medical and health education.

Health Sciences E-Education in Oman. There has been debate about whether it is possible to transplant a complete medical curriculum to new schools such as the Oman Medical College (OMC). Six years ago West Virginia University Health Sciences Center agreed to assist with development and start-up operation of this private college at Sohar in the Sultanate of Oman. It was created with government encouragement to increase output of Omani physicians. WVU is involved in planning and implementing some of the Medical School's first preclinical experiences. Our course, Human Structure and Neurobiology is taught the first semester of medical school.

The initial intention was to “export” our WVU preclinical curriculum, intact, to provide Omani students with a “Western” medical education. Pre-medical students with three years of intensive English and science courses began medical school in the 2004-05 academic year (Figure 4). We have now concluded our second year of supplying visiting faculty (1-2 month terms) while permanent faculty are recruited and trained.

One key to curricular “transplantation” was transfer of our in-house IT delivery system (SOLE) to Oman, where students with (required) laptops and wireless access can use appropriate curricular materials generated for our WVU courses (or modified any time from any place!). OMC is well equipped for lectures and small group activities and has good IT support but is deficient in lab facilities. Restructuring gross anatomy lab instruction with much reduced hands-on lab work has been a major challenge. That work has been going on for three years.

The center will coordinate preparation of medical education courses/ workshops/ tutorials and other web-based materials using WebCT, or similar course management software. Students and professionals will be able to receive their education at the six campuses and sixteen (16) rural clinics/outreach centers set up at Catholic Missions/ Schools located along the main travel corridor between Beira and Zimbabwe.

Two upcoming projects support distance education outreach centers.

• Underway - Rebuild/ improving rural clinics in central and northern Mozambique - There is real concern because most rural clinics do not have a doctor, properly trained nurses or other medical support staff. Furthermore, the clinics do not have adequate facilities, medical equipment, supplies, and medicines necessary for successful delivery of health care. This ambitious project would address many of these needs. It is hoped that project funding grows to a level that will support the rebuilding/ improving of about ten (10+) rural clinics each year over a period of ten years. UCM-educated doctors could be assigned to each of these newly renovated clinics.

• Future - Distance health education - This First Phase project involves setting up a distance health education studio/ electronic classroom/ technology resource center. The center will deliver long distance courses over the Internet using course management software such as WebCT or equivalent. Courses will cover HIV/AIDS education, and a variety of continuing education courses/ workshops/ tutorials for doctors and health workers. With support from the project, students will be able to receive their long distance education at community outreach centers established at 10+ rural clinics. Each center will be equipped with direct Internet connection and five to ten computers.

Summary of Long Range Distance Education Plan at UCM. The UCM Faculty of Medicine in Beira proposes the establishment of long distance medical education/ continuing medical education for physicians, nurses and other health workers in northern and central regions of the country (Figure 8). The backbone of the medical education center needs to be the faculty of Medicine including studio/ electronic classroom, medical education laboratory, and full-time connection to the Internet. The center will coordinate preparation of medical education courses, short-courses, workshops, tutorials and other web-based materials using WebCT, or similar course management software. Students and professionals will be able to receive their education at the six campuses and sixteen (16) rural clinics/outreach centers set up at Catholic Missions/ Schools located along the main travel corridor between Beira and Zimbabwe.

These experiences served as a clear reminder that traditional medical schools serve only a few students. However, e-education could serve many qualified students and enable them to complete their desired academic program. Our plan is that WVU anatomy courses and virtual labs will become part of universal medical and health education.
• Future - Interactive distance health education - This Second Phase project adds a "live-interactive" capability so that long distance students at their computer connected to the Internet can see both video and multimedia course materials. Using an Interactive Distance Learning (IDL) system, students can see and hear the professor, see teaching materials, and even ask questions. The entire class session can be recorded for later replay by streaming video. Additional funding would make it possible for similar facilities to be created at the other five UCM campuses located around central and northern Mozambique.

• Underway - Electronic medical library/digital library - A modern library is essential to the student-centered Problem Based Learning (PBL) method utilized at the UCM Faculty of Medicine. This project will support library modernization and will establish a variety of new electronic medical resources. The size of the library will be doubled. Several classrooms on the floor directly above the current library will be renovated into library spaces, including the addition of an internal stairs, and air conditioning. Magnetic markers and bar code labels will be added to library books and new exit door sensors will provide better maintenance of the collection. A catalog of holdings will be placed on-line. A reliable full-time Internet connection will be added and also inter-connected to the rest of the UCM local campus network in Beira. Finally, UCM will establish a number of new on-line electronic medical resources. These will include a HIV/AIDS information resource center, a medical Geographic Information System (GIS) resource center, and a new drug information center. Additional funding would make it possible for similar capabilities to be added at libraries on the other five UCM campuses located around central and northern Mozambique.

• Future - Develop a new program in public health - A two-year masters level program in public health at UCM will broaden support for successful delivery of health care in central and northern Mozambique. A public health program also provides a meaningful alternative career path for students who are not able to gain admission to UCM medicine or who start in medicine and later drop out.

• Future - Develop a support system for UCM-educated doctors at rural clinics - The first UCM-educated doctors will graduate in May 2007. They are excited about and already committed to the practice of family medicine in rural areas. But harsh realities of life in rural Mozambique may be more than they and their families are prepared to handle. This project would address a need for adequate living conditions: housing, water, telephone, computer and Internet connection. This project could also provide a modest salary supplement. The overall goal is high doctor-retention rates at the rural clinics.

• Underway - HIV/AIDS, STDs, malaria and TB: a comprehensive program for research, education, prevention and treatment.

Pilot Rural Clinic. The first pilot Rural Clinic is located in Mangunde at a Catholic mission in a remote rural area, in the district of Chibabava. This is the only rural clinic in Mozambique that also treats HIV/AIDS, and it was featured in an article in SLATE magazine (www.slate.com/id/2119853/entry/2119968). Mangunde is 303 km away from the city of Beira, in a rural area around 4 ½ hours driving time over roads that are marginal in many sections. When the project was started, there were only two HIV clinics in the Beira area, both in Beira city: one run by the government and one by the Catholic lay organization.

This new rural clinic is equipped with 16 solar panels to power some equipment, but not enough to power all the medical and computer systems. So a back-up generator had to be bought and runs most of the days. Solar panels are, however, very important to save fuel during the days when there are no medical visits and when often it is not required that all the computers be on at the same time. The clinic is well-equipped with 2 LAN servers and 5 computers (one each in the exam room, pharmacy, acceptance desk, doctor's office and blood collection areas), 2 deskjet printers (laser printers consume a lot more energy) and 1 solar energy-powered refrigerator to store medications. It should be noted that the Chibabava District does not have electricity from the grid, or telephones. Funding for infrastructure improvement has not kept pace with the original plans.

Conclusion. Virtual anatomy lab courses are designed for specific groups of health science students. These labs are most beneficial as introductory courses for beginning anatomy students. Even medical students can benefit from the virtual lab as an initial experience, followed with hands-on work in the gross anatomy lab. The challenge is to provide virtual labs that would be equivalent to traditional hands-on gross anatomy labs and could be offered as distance courses.

Virtual Frog Dissection Kit â€“ From Berkeley Lab. Virtual Cat Dissection â€“ From Penn State University. Virtual Pig Dissection â€“ From Whitman College. The following anatomy and physiology laboratory simulations and educational learning exercises are available for a fee. Commercial products. Anatomy & Physiology LabPaqs â€“ Hands-on laboratory experiences. Also see the list of other Biology Labs.

Figures

Figure 1. West Virginia Rural Education Partnerships.
Health sciences education is made accessible to the entire population.

WVU extended learning department encourages faculty to provide more learning possibilities everywhere.

Figure 2. West Virginia Educational Pipeline.

Figure 3. Virtual Anatomy Lab: Limbs and Back.
Figure 4. First Class of OMC medical students - year 2004.

Figure 5. Gross anatomy lab at OMC.

Figure 6. Catholic University of Mozambique (UCM) has six campuses located in four cities across central and northern Mozambique.
Figure 7. UCM's first pre-medical class - 2000.

Figure 8. Anatomy lab at UCM medical school.

Figure 9. UCM distance education plan.
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