FY11 Innovations in Teaching with Technology Awards: Development and Assessment of Strategies to Enhance Self-Regulated Learning of Anatomy through a Virtual Platform

FY11 Innovations in Teaching with Technology Awards

<table>
<thead>
<tr>
<th>Proposal Title:</th>
<th>Development and Assessment of Strategies to Enhance Self-Regulated Learning of Anatomy through a Virtual Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigators:</td>
<td>Darren Hoffman</td>
</tr>
<tr>
<td>Org Unit:</td>
<td>College of Medicine</td>
</tr>
<tr>
<td>Department(s):</td>
<td>Anatomy and Cell Biology</td>
</tr>
<tr>
<td>Funding Awarded:</td>
<td>$18,565</td>
</tr>
</tbody>
</table>

Teaching & Learning Challenges

Gross anatomy is a foundational course in nearly all professional biomedical programs taught at the UI including Nursing, Dentistry, and Medicine among others. Students in these courses learn and apply complex 3-dimensional (3-D) anatomical relationships. Teachers meet this challenge differently in each course based on each program’s unique demands and appropriate pedagogical considerations though typically instructional activities are a blend of lecture and laboratory instruction. Common to all students in anatomy is a large amount of self-regulated study. Self-regulated approaches vary widely between students and, importantly, vary widely in effectiveness. One potential complication is that students do most of their studying from flat images in textbooks or lecture notes and may fail to translate from 2-D images to 3-D structures. In our efforts to shore up student difficulties in learning gross anatomy, a partnership has been developed between Dr. Hoffmann and other departmental faculty and an Iowa City-based company called Cyber-Anatomy, Inc. From this partnership a new 3-D, fully dissectible virtual cadaver (i.e., a simulation of the human body) software program was developed. This software, called Cyber-Anatomy (CA) is rapidly gaining traction as a valuable learning tool in the teaching of anatomy, having been purchased by several medical schools including the University of Iowa and Harvard Medical Schools. A short video demo of the PI using CA in a classroom environment is available at the Youtube link below (1).

Despite these positive developments, we have conducted several pilot experiments in which students who used CA for self-regulated study reported uncertainty about how to best learn from the program. This difficulty may come as no surprise when one
considers that the virtual cadaver in CA is fully dissectable with nearly 10,000 moveable objects. Novice students likely experience some level of cognitive overload when interacting with this environment (2). Our pilot work also suggests that CA can be improved if a pedagogically-informed, supportive structure is developed to guide students through the anatomy in a way that helps them focus on key anatomical relationships and concepts (3). As in cadaver-based courses, students are not simply presented with a cadaver and told to learn from it. Instead, students are given clear, educationally-based instructions for how to inspect and dissect the cadaver, one region or system at a time.

Enhancing Student Learning Through Technology

The goal of this study is to determine how to best support and enhance self-regulated learning of anatomy through the virtual CA platform. Phase I of the project will be the development of learning modules which will help direct students as they explore the virtual cadaver. These modules will be designed to test two pedagogic variables: Sequence of Exploration and Level of User Control (detailed below).

In Phase II, we will implement CA learning modules into all of our gross anatomy courses. Students in gross anatomy courses will be given access to CA learning modules for 9 body regions. Multiple learning outcomes will be measured in these courses to determine the effect of the modules and the specific pedagogic variables (detailed below).

**Timeline**

Fall 2010–Spring 2011
- Faculty investigators design 3 learning modules, each with variable support systems
- IRB ethics approval for use of student subjects will be obtained

Summer 2011
- Pilot testing with first set of 3 modules
- Student Teaching Assistants design 6 modules

Summer 2011–Fall 2012
- Use learning modules in gross anatomy courses, assess learning outcomes

**References**

1) [http://www.youtube.com/watch?v=j_o1fOU3fC8](http://www.youtube.com/watch?v=j_o1fOU3fC8)

Study Objectives
- Develop a battery of CA learning modules relevant to a broad community of anatomy students.
- Determine how to best support and enhance students self-regulated learning of anatomy.
- Improve student learning outcomes in gross anatomy:
- Visualization of key anatomical relationships and pathways.
- Clinical problem solving using anatomical principles.

Module Development
- During the 2010-2011 academic year, our research team will develop modules focused on the following three topics: 1) Pelvic Floor and perineum, 2) Foot, and 3) Cranial Nerve Pathways in the Skull. These topics are broadly applicable in many anatomy courses and represent areas that are particularly difficult to understand in 3D. The second group of six learning modules will be developed by three 2nd year Medical Students employed as TAs.

- The learning modules will be designed to teach students how to manipulate the virtual models, how to discover important clinical information through visual searching, and how to consider the structure of the body through a constructive process. To determine the best theoretical design approach, each module will be designed to reflect two pedagogical principles: Sequence of Exploration and Level of User Control.

Sequence of Exploration:
- A typical approach for presenting anatomy information in the lecture hall is to start with the bony framework of a region, add muscular elements, and then add the neurovasculature and viscera once structural context has been established. This can be described as a constructive approach. An approach typical of cadaveric dissection is to start from the intact state and break it down to individual details. This could be described as a deconstructive approach. A third approach is a hybrid, in which students start with an intact region, learn the overall context by manipulating it, then focus on deconstructing and rebuilding one structure and system at a time. Learning modules will be designed to utilize each of these approaches.

Level of User Control:
- Modules will be designed with three levels of user control: 1) Full user control the student is presented with a list of structures that they can import and view in their own desired sequence, 2) Partial user control students are presented with a list of structures in a prescribed sequence with explicit instructions for how to manipulate the model, 3) Minimal user control students are presented with pre-designed...
animations which can be paused and manipulated, but always returned to the pre-designed animation sequence. The appropriate level of user control is highly dependent on the expertise level of the user (2), so it will be important to study this variable in a diverse set of student populations. Thus students in each gross anatomy course from 2011-2012 will be eligible to participate.

Assessment of Learning Modules
• In two years of use in gross anatomy courses, a tremendous data set will be made available to assess learning as it relates to the following study variables: Sequence of Exploration, Level of User Control, and Student Learning Level (undergraduate vs. professional).

Quantitative Data:
• During practice: Pre-test knowledge score, total practice time, total time on specific tasks, and students judgment of their learning on a scale of 0-100%.
• Post-practice: Post-test knowledge score, and post-course self-assessment quiz on the ICON classroom management system.
• We will also collect data from longer term (e.g., 1 month or more) retention-test knowledge scores and performance on later classroom assessments (e.g., standardized MCQ exams, lab practicals).

Qualitative Data:
• Measuring student benefit in terms of learning outcomes is a valuable approach yet it does not touch upon student experiences. Hence, our additional key outcome will be the students perceptions and evaluation of the learning modules (e.g., what worked and did not work, what they would have liked changed in the module).

Currently Accessible Resources
Personnel
• Our primary research team will create (directly or via supervised medical students) the learning modules required for the proposed project. Our team possesses the requisite expertise to develop the modules and subsequently, to evaluate the pedagogical effectiveness of each module. From the development perspective, Dr. Hoffmann is an anatomy instructor in numerous anatomy courses throughout the year and is the primary anatomy consultant for CA. He has unique and extensive experience with the software program and its development team. Dr. Pizzimenti is an experienced anatomy instructor who has worked with CA for several years and taught gross anatomy at all undergraduate and professional levels. To enhance the pedagogical evaluation of the modules, Dr. Brydges will contribute his expertise in the study of self-regulated learning of clinical skills in the health professions education context. Dr. Brydges also has broad experience teaching gross anatomy.

Technology resources
Students will be able to use any computer in Hardin Health Sciences Library to run the CA simulation or run the ActiveX control on their own home computers/laptops to run the simulations wherever they wish. CA software functions on any computer with basic graphics functionality.

Our intimate relationship with the CA production team is vital to the completion of this project. We will be able to interact with the graphic design and engineering teams at Cyber-Anatomy, Inc. to help facilitate integration of our learning module elements directly into the software program. Critically, the management team at Cyber-Anatomy, Inc. views our collaboration as mutually beneficial because they regard improvement in the educational design of CA as value added to their enterprise.

Instructional space

At the beginning of each course, students will need to be instructed on how to utilize the software effectively. These sessions will be conducted in the Information Commons in the Hardin Health Sciences Library which is available free of charge.

Student populations

Summer 2011 and 2012
- Gross Human Anatomy for PAs and Allied Health (45 students)
- Pre-M1 and Pre-D1 students in pre-matriculation courses (40)

Fall 2011 and 2012
- Medical Gross Anatomy (150)
- Human Anatomy for PTs (36)

Spring 2012
- Gross Human Anatomy for Dental Students (80)

*In fall and spring semesters, undergraduate pre-nursing and pre-pharmacy students in Principles of Human Anatomy could be recruited to take part in the study. (300 students)

*Dr. Brydges and his colleagues in the anatomy programs at the University of Toronto could also be recruited to join the study.

Opportunities to share study results locally

It will be important to disseminate the results of this work into other departments and colleges. Self-regulated study is a relatively understudied phenomenon, and an area of great potential for improving learning through technology. There are a host of local educational forums that would be appropriate for sharing this work on campus without cost (e.g., Medical Education Research Day, Center for Teaching seminars, etc.).
Other funding resources
- There are currently no other funding resources devoted to this project.

**Required Resources**

**Personnel Costs**
- The student TAs will need to be funded (hourly wages) during their two-month summer appointments.
- The faculty involved in the project would need to travel between the University of Iowa and University of Toronto campuses to facilitate communication between teams at each institution and to national meetings for Anatomy and Medical Education societies to present this research to interested audiences.

**Computer Equipment**
- Our research team will build the first 3 CA learning modules. To produce those modules in a format that is compatible with the CA software program, a high-performance computer capable of running the programs required to build simulation modules will be essential. This computer would also be used by the student TAs during the summer of 2011.

<table>
<thead>
<tr>
<th>Rough estimate of costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three Student Teaching Assistants: $14976.00</td>
</tr>
<tr>
<td>8 weeks @30 hours/week @$20.00/hour = $4800.00 in wages + $192.00 in benefits (4% rate) = $4992.00/student</td>
</tr>
<tr>
<td>Travel Allowance: $4800.00</td>
</tr>
<tr>
<td>Typical round-trip flight to/from Cedar Rapids and Toronto ~$600.00</td>
</tr>
<tr>
<td>Funding would cover 4 semi-annual site visits over the 2-year study period and 2 annual conference trips by Dr. Hoffmann (American Association of Anatomists and Central Group on Educational Affairs in Association of American Medical Colleges).</td>
</tr>
<tr>
<td>High Performance Computer: $2500.00</td>
</tr>
<tr>
<td>A computer dedicated for use in development of learning modules will be purchased with all appropriate high-end graphics capability and high processor speed for manipulation of large image files.</td>
</tr>
<tr>
<td>Office supplies: $300.00</td>
</tr>
<tr>
<td>Paper and photocopies will be required for generation of flyers, consent forms and documents, printed copies of learning modules and general incidental use. Electronic media storage (16 GB flash drives) will also be purchased for the primary investigative team.</td>
</tr>
</tbody>
</table>

Total Costs: $22,576.00