FY16 Innovations in Teaching with Technology Awards: A Virtual Laboratory and Game-based Testing Application to Facilitate Self-directed Learning in Histology and Histopathology

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<th>A Virtual Laboratory and Game-based Testing Application to Facilitate Self-directed Learning in Histology and Histopathology</th>
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<td>Funding Awarded:</td>
<td>$40,000</td>
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Background

Histology is the microscopic study of cells and tissues. It is a basic science, foundational for understanding normal body function (physiology) and disease (histopathology). It is traditionally studied in a lab where students develop skills in ‘reading’ tissue sections and relating structure to function.

In 2001 traditional histology labs were augmented by the introduction of Virtual Microscopy (VM). VM was pioneered at Iowa thanks to internal grants and has revolutionized the way biological tissue is viewed in classrooms, clinics and research labs. The funding developed the tools necessary for VM:

- digitized slides

- software that allows slides to be viewed via a client-based viewer (e.g. Google Earth at a microscopic level)

Challenges

The power of VM lies in its potential for flexible learning. Since its introduction, traditional labs have given way to VM sessions that students elect to do in their own time. This revealed a number of deficiencies that make self-directed study using VM an inefficient way of learning histology:
- simply giving students access to the tools of VM does not allow them to learn effectively

- number of digitized images is limited which promotes memorization over development of the analytical skills that are acquired only by comparing many similar specimens

To maximize quality and efficiency of learning histology in the virtual environment, the tools of VM must be complemented with expert guidance and more opportunity to hone tissue analysis skills. In attempts to address these challenges but retain flexibility afforded by VM we were forced to implement:

- On-slide annotations provide low level text-based guidance to studying images in VM

- In-class pre-labs orient students to VM slides and highlight concepts essential for independent study (1 hr/lab)

- In-class reviews make up for limited exposure to tissues by testing identification skills using a large image bank (2hrs /unit)

Project

The project will allow VM and flexible learning in histology to reach their full potential by providing students with a complete, self-directed learning experience through the development of two complementary applications:

1. A Virtual Laboratory

An interactive, guided histology lab that integrates the tools of VM. It will consist of 15 module-based apps accessible on smart devices and desktop computers. Each module will contain a “virtual expert” to guide students through activities that require exploration of VM.

We hypothesize that this will:

- eliminate need for in-class pre-labs

- improve quality of self-directed learning

- increase accessibility of virtual histology to other science courses here at Iowa.

2. A Game-based Testing App

A stand-alone app for smart devices that complements the Virtual Laboratory. It will be modeled on in-class reviews. The app will provide users with stats, progress information, feedback on answers, ‘leveling-up’ in competency and will award collectable trophies for reaching preset goals.
We hypothesize that this will:

- motivate students to practice tissue analysis techniques using a wide range of tissues
- promote better tissue identification skills
- improve the way students monitor progress in their learning

Timeline

Year 1: Development

- Develop a Basic Tissues Learning Unit comprising 4/15 Virtual Lab modules & Testing App counterparts and ensure:
  - design is a template for producing all other modules
  - template is user friendly so that course directors can build/revise content

Fall 2016: Beta testing

- Kathleen Andersen will:
  - test the Basic Tissues Learning Unit in her undergrad course (ACB 3110 Principles of Human Anatomy; 150 students)
  - gather survey/statistical data on app use and data on student exam performance

Spring 2017: Development v2.0

- Data from beta testing used to improve apps and v2.0 released to Spring courses:
  - ACB 8110 General Histology for Dental Students (80 students)
  - ACB 5210: General Histology Online (10-20 students)

Year 2: Completion

- Use templates to build remaining content to produce all 15 modules/testing
- Transition all histology labs to virtual labs

By developing software that will enhance the current VM experience we expect to achieve a number of student learning outcomes:

1. Students won’t just view they’ll do
Current limitations in VM means students rely on in-class pre-labs and post-lab review sessions to bolster learning in histology. This is because VM provides limited guidance on how to examine/evaluate digitized slides. Enhancing the VM experience by guiding students through a Virtual Lab and setting focused challenges that require interaction with VM puts students in the position of active investigator rather than passive viewer. In doing so we hope to promote deep learning and improve acquisition of tissue recognition skills.

2. Increase flexibility of student learning

Current VM viewer software restricts use to desk/laptops. Having Virtual Labs accessible to smart devices increases flexibility of study. Placing guided content and testing in the virtual environment enables students to engage in histology learning at their convenience allowing them to better manage time and other learning commitments more effectively.

3. Empower students to learn in a self-directed manner

By promoting learning through guided investigation, students can more effectively engage with content independently at their own pace. The testing app will also provide real-time feedback on learning progress via performance stats that allow students to monitor their learning and re-focus on deficient areas.

4. Increase accessibility to histology and VM

Despite histology being an undergraduate level science its reach is stifled by a need for students to attend a microscopy lab. Lack of equipment, faculty experts and in-class time means it is underserved in basic science courses, particularly undergraduate courses. Virtual Labs would increase accessibility of histology to science courses here at Iowa because it would be easy for course directors to select specific Virtual Lab modules to adopt in their courses. We would encourage undergrad biology/health science courses to do this.

Undergraduate Students

Kathleen Andersen directs the following courses and, as part of this project, will adopt Virtual Labs in place of didactic histology teaching. We hope this will enhance student experience in histology, better prepare them for future science classes and provide opportunity for them to develop skills in self-directed learning and practical histology.

ACB 3133 Human Anatomy Online 35 students

ACB 3110 Principles of Human Anatomy 150 students

ACB 6000 Anatomy for Advanced Practice Nursing 12 students
Graduate/Professional Students

Dr. Swailes co-ordinates histology in the following integrated courses where Virtual Labs will have a large impact on student learning:

MED 8123 Foundations of Cellular Life 180 students
MED 8124 Mechanisms of Health and Disease I 180 students
MED 8133 Mechanisms of Health and Disease II 180 students
MED 8134 Mechanisms of Health and Disease III 180 students
MED 8223 Mechanisms of Health and Disease IV 180 students
ACB 8121 General Histology for Dental Students 80 students
ACB 5205 General Histology for Graduate Students 0-5 students

Post-Baccalaureate Masters Students

The project would also allow us to pioneer an entirely online lab-based histology course as part of a Masters in Anatomy (due to commence in Spring 2017):

ACB 5210 General Histology Online 10-20 students

5. Improve student recognition skills

Current VM is lacking extensively in its ability to test tissue recognition skills. The testing app will provide a pool of images that will allow students to practice and improve these skills in an engaging manner.

6. Free up curriculum space

Virtual labs eliminate in-class sessions freeing up physical and schedule space. In the medical program alone, elimination of prelabs (1hr x 15 labs) and review sessions (5 x 2hrs) releases students from 25hrs contact time alone. Preserving this ‘free’ time allows them to better manage busy schedules/deadlines, maximize learning in histology/other classes, decrease stress and become better self-directed learners.

Current Resources

- Tools for viewing histology
- Digitized glass slides
- Viewer software licensed through Biolucida is already available, however we will need to expand the license to accommodate additional undergraduate students, (this is noted in the estimate of costs)

- Histology content

Dr. Swailes has developed the backbone of content for 15 Virtual Laboratory modules including:

- prelab sessions (ppt)

- text based histology lab guides (pdf)

- VM annotations (online)

Dr. Swailes has established content for The Game-based testing App:

- image library from histology reviews (ppt)

- access to a huge number of glass slides (would need digitizing at additional cost)

- a prototype that illustrates the possibility of a game based app (https://www.youtube.com/watch?v=9dE5zhKSoHs or see attachment)

- Anatomy and Cell Biology Department

- Administrative support for managing project funds

- Supplementary funds from Department Chair to attend meetings to disseminate findings from this project

Needed Resources

Our needs are primarily for individuals with advanced software programming/app development skills to help advance both aspects of this project. Drs. Swailes, Dee and Andersen are content experts with many collective years of experience in teaching and creating novel teaching/learning activities to help our student learn effectively, but they are not app developers. The investigators are excited to work closely with someone who could help develop the software behind projects

- App developer: Virtual Laboratory Modules

We are looking to fund a developer to create a module template that would act as the model for future labs. The model could then be populated with Dr. Swailes’ content and the VM viewer to create all 15 histology Virtual Lab modules. These labs must:

- utilize VM
- contain guided interactive content to promote a student’s independent investigation of tissues using the VM

- be functional on a smart devices and desktop machines

- App developer: Game-based Testing App

Dr. Swailes has been testing students’ skills at identifying tissues and cells in histology using large image banks during in-class review sessions. We think that this type of image review would translate well to a game-based application where students have to apply learned identification skills (pattern recognition and analysis of stain) to identify tissues or their components. He is looking to work closely with an app developer that can create a unique testing app that:

- accesses a bank of images to test students identification skills

- has a statistic monitoring component that students can use to track their progress

- provides feedback for incorrect answers

- has a trophy earning and/or ‘leveling up’ component that encourages continued use

- secondarily, may even allow students to compete against each other in a histology league, play in ‘arcade’ mode (where you lose lives for each incorrect answer) depending on level of technicality involved

We have created a basic visual prototype that demonstrates the broad scope/potential of such an app (see attachment). We would like to work closely with an app developer with experience in developing game-based apps (but who could also rein in Dr. Swailes’ over-exuberant creativity!) to bring this much needed testing tool to histology students on their devices.

1 x Experienced App Developer 400hrs @ $60/hr = $24,000

1 x Student App Developer 400hrs @ $30/hr = $12,000

Increase Biolucida license by 200 to provide access to Kathleen Andersen’s undergraduate Anatomy students (in communication to obtain quote, $$$)

Total: $35,000 - $40,000

What is your rough estimate of costs?

Supporting document(s):

FY16-ITTA-Swailes-Prototype-for-a-HistologyGameBasedApp.docx
Article number:

104508