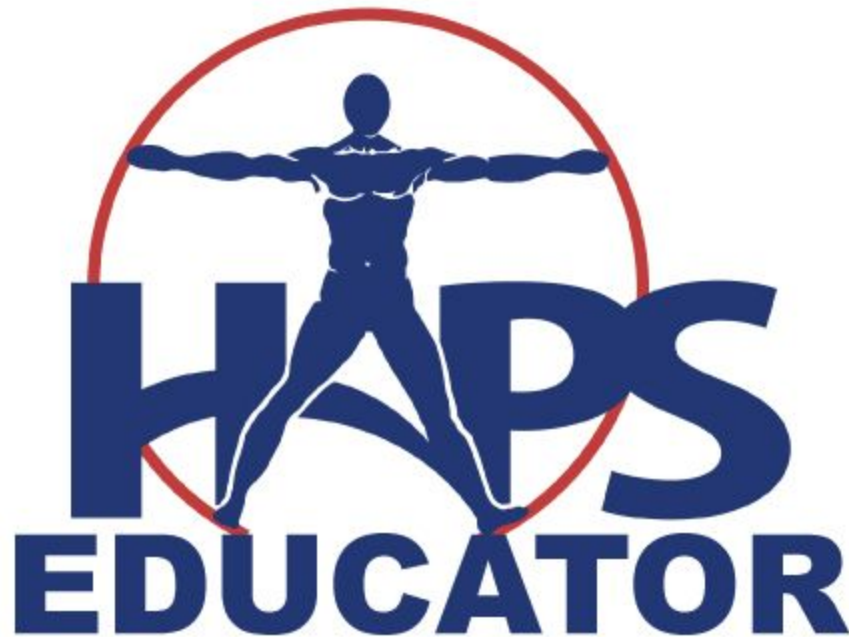**"Yes! Use your cell phones!" Active Learning with Technology in an Anatomy and Physiology Lab**

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"Yes! Use your cell phones!" Active Learning with Technology in an Anatomy and Physiology Lab.

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First article of a three-part series.

Abstract

Students struggle with the amount of information they are expected to learn in undergraduate human anatomy and physiology labs. Often, the models used in labs may look different from the figures or photos in the lab manuals purchased from publishing companies and therefore studying at home with lab manual diagrams can be an unnecessarily frustrating and time consuming experience for students. In this activity, students work together in groups of four to label models with anatomy terminology assigned to that week's lab. They take pictures of their labeled models to assemble into a PowerPoint file thus collaborating to produce a personalized student made study guide that can be used outside of lab time, to review for the lab practical. The PowerPoint files are also uploaded to the Learning Management System as the weekly group homework assignment. This activity emphasizes cooperative learning, active vocabulary application, and good conversations among students and between students and instructors. It also utilizes technology in a fun, interactive way for students, which results in no lost or late homework, no papers to store, and easier grading for instructors. doi: 10.21692/haps.2017.057

Introduction

In 2016, I began teaching human Anatomy and Physiology at my new university and, wanting to make it the best learning experience for my students, I met with my graduate teaching assistants (GTAs) before the semester to ask their opinions about what we could do to improve the lectures and labs. The three GTAs teaching the labs that semester have extensive learning and teaching experiences obtained from taking multiple Anatomy and Physiology classes, teaching undergraduate labs repeatedly, and working in biology research labs. Though reluctant when first asked for suggestions, they opened up when asked, "If you were the Anatomy and Physiology overlord, how would you change the labs to make them better?" They laughed but then expressed many concerns. For example, the lab and lecture material often did not match so students might see something in lab and then not learn about it in lecture for two more weeks. Too much time was required for students to do lab assignments that were not aligned with assessments. Time required to grade these lab assignments (up to 75 assignments per GTA, per week) was also overwhelming. Grading required so much of the GTA's time to grade that they resorted to just checking it off as "complete" or "incomplete" for students' weekly grades. Receiving a completion grade just for filling in the blanks does not provide students with feedback on whether they understood where to locate the anatomical terms. Additionally, the cost of the lab manual, that was not very useful in the first place, was too high. Moreover, anatomical terms on the list students were responsible for, "The Bible," did not always match the figures in the lab manual or in their

textbooks. The GTAs expressed frustration that students were wasting their time and money on lab manuals that were not useful as study guides for the material they were required to learn. These graduate students wanted their students to be successful but felt restricted by the set-up of the lab.

When asked how we could make the lab learning experience better the GTAs had several suggestions. To promote collaboration and peer learning, both of which are recognized in the literature as effective forms of active learning, students could work in groups of four and turn in one assignment per group (Freeman *et al*. 2014, Hughes 2011, Moyer 2016). This change in structure would help students learn from each other and would reduce GTA's workload from grading up to 144 homework assignments (two chapter units for 3 sections of 24 students) each week to grading only 18 (6 groups per section) group assignments.

The brainstorming continued. What if students were required to create their own study guides that were customized to contain every term on the list that corresponded to that lab practical? How could we do that? Students love to use their cell phones. Why not encourage them to use their phones to take pictures of the models, label them, and then use those pictures as a study guide? The files could be uploaded to the University's Learning Management System (LMS), which would reduce paperwork for the GTAs to keep track of and would not require any cost to students to print their work. This assignment would also eliminate the requirement to purchase a lab manual. The textbook we use for lecture

has labeled figures similar to the models used in labs. Why should students buy a lab manual when they already have a book with detailed, labeled figures and images? As we discovered terms that did not match between the textbook and the required list, we made note of them and either used both terms, or let students know which one term they would be expected to know. What about grading and accuracy? This greatly reduced the GTAs workload and allowed them to provide more effective feedback to students because the GTAs could check student work during labs to make sure they were proceeding correctly. When homework was turned in, grading merely required looking through the PowerPoint slides provided by each group for correct labeling and completion for all terms assigned that week. The GTAs were also able to provide feedback to each group member in the comments section on the LMS allowing students to learn from any mistakes they had made. Homework grading drastically decreased.

The following description illustrates the procedure that has evolved as we used the technique of student-created study guides over the last year and a half with approximately 600 students.

Student Activity

In this activity, students work together in the same groups of three or four students throughout the semester. Each group is responsible for producing a photographic, labeled study guide. Each group works together to find each of the terms for the week and label them on the models. An example of weekly terms to learn during week five is provided in Appendix A. Larger structures, like osteons on bone tissue models, can be labeled by writing on lab tape and sticking it on the models directly. Smaller details, like canaliculi, are pointed out with the tip of a probe and the tape with the identifying label is stuck to the handle. Each group takes pictures of their labeled models with their cell phones and adds the pictures to one PowerPoint presentation to submitt to their instructor as homework using our LMS. We have noticed that students can be creative in their use of technology, using apps such as SnapChat to immediately annotate their pictures. The models they label are the models they will be tested on during the lab practical exam. The product is a student created study guide that is quick to grade, is digitally stored which reduces lost homework assignments, and answers the question, "What do we have to know for the test?" The study guide students create as homework includes everything that could be asked on the practical exam.

Teacher's guide

Target audience: High school through college level human anatomy classes, although it could be used with any lab where observation of detail and memorization of categories is the objective.

Learning outcomes
1. Identify and label the terminology assigned for that week on the models.
2. Develop communication and collaboration skills while producing a study guide for the group.

HAPS Learning Goals 1, 2, and 7
1. Develop a vocabulary of appropriate terminology to effectively communicate information related to anatomy and physiology.
2. Recognize the anatomical structures and explain the physiological functions of body systems.
7. Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system.

Prior knowledge required: How to use a cell phone to take and send pictures, how to retrieve and upload pictures to a personal computer, and how to make a PowerPoint presentation. Each anatomy lab stands alone although each practical tests students over approximately four lab periods of terminology.

Time required: One two- or three-hour lab period. Within the lab period, the entrance quiz and mini-lecture take the first 20 minutes and the exit quiz has to be started 20 minutes before the end of the lab to ensure time for every student to complete it. The remaining time is used to complete their homework (study guides) and study. Our labs are three hours long but some students finish early.

Guidelines for classroom implementation

The first week of class, students come to the lab and sit together in groups of up to four. These are the groups they work with for the whole semester. There are up to 24 students per lab section with one GTA and, when available, undergraduate teaching assistant (UTA). We emphasize collaborative learning and that future careers will also require collaboration so we are helping them prepare for that likelihood by the way lab exercises are constructed. Following a brief introduction to the lab, students break into their groups and begin describing, finding, labeling and taking pictures of the models labeled with the terms they are responsible to learn for the week. Students may divide the tasks among themselves as they please (label writer, terms finder, photo taker, PowerPoint-assembly). They generally work in pairs and then share what they learned with the other group members. An additional incentive to work together and clean up after themselves is provided by three participation points for each lab. Students have three days to complete the labeling homework and turn in one PowerPoint per group. Only PowerPoint files are accepted by the LMS, removing the possibility for students to send a file of unorganized images and maximizing ease of grading for the instructor. The assignment is worth ten points. Students have examples available of what labeling techniques are acceptable and what are unacceptable on the LMS, similar to those provided below:

Unacceptable Homework Labeling

Label spans several structures and is hindering the view of the structure indicated

Font color does not contrast enough to be easily read.

No context. The picture is so zoomed in it is difficult to tell what the structure is.
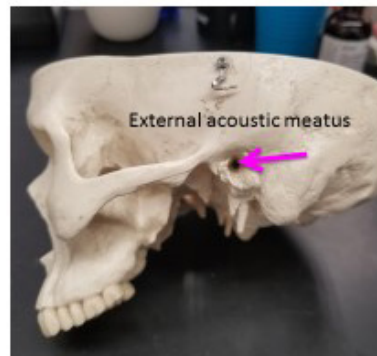

The subject is too far away to easily read the label

Acceptable Homework Labeling

The label is clear and legible. The label is on the pointer indicating the structure.

Font color contrasts against the background to be easily read. The arrow is pointing at the structure.

Instructor observations

At the beginning of the semester, students often get frustrated by this method of student directed learning. When students experience minor difficulty they expect the instructor to tell them where things are on the models as soon as they experience a little difficulty. Not all of the terms are visible on all of the models and some terms are indeed, hard to find. The instructor needs to resist immediately giving students the answers as soon as they ask. For example if a student asks, "Where is the osteocyte and lacuna? They look the same in the diagram". The instructor can break it down by explaining roots of words that are common in anatomy. For example, students may be guided to the answer by explaining "cyte" means cell, and we know cells are soft, and bone is hard. So, we cannot expect a cell to be smashed inside the bone, it needs a hole to sit in. Thinking for themselves about where a particular body part or structure might be located is encouraged. Instructors give advice; tidbits and tricks that might help students remember things. For example, "Lacuna" sounds like lake, and a lake is the bowl that the water sits in, just like the osteocyte sits in the lacuna. And then sing, "*lacuna matata*- it means no worries, for the rest of your life" (from The Lion King). Instructors monitor students' progress throughout the lab, and offer to check their labels before they complete their assignments to make sure students are not teaching themselves incorrectly.

We encourage students to use a variety of resources available in the lab including their own textbook, other textbooks, Internet image searches, and their lab partners. Students also teach each other how they remember things and they quiz each other. Both techniques are examples of peer teaching, which has been shown to increase learning for all students involved (Hughes 2011). With practice, students learn to use their resources and help each other.

It is important to note that we do not ignore student requests or refuse to answer questions. Instructors (GTAs and UTAs) and undergraduate teaching assistants are available throughout the lab to help students learn and they do help students find terms when they need help. However, when students look for the terms themselves, they begin repeating the words, and by doing so, start to internalize this new language of anatomy. Knowing where and how to look for information, whether that means asking others, using the Internet to search, or reading a manual is a valuable life skill.

In conclusion, we implemented this method in fall 2016 and have used it with approximately 600 students. We developed it to (1) stimulate conversations between students, (2) promote the development of learning communities, (3) use lab time effectively through students making a study guide based on what they will be tested on, and (4) decrease the cost of the lab for students by having them make their own electronic lab notebook specific to our lab and models, instead of buying an expensive lab manual. Part 2 of this series explains another way we use technology to help our introductory students learn Anatomy and Physiology. We will describe how GTAs worked together to make short videos for each topic covered in each lab. These videos are posted on YouTube. It is like taking a lab instructor home! It all started with a snow day.

About the Authors

Heather Rudolph is a postdoc researcher whose interests include graduate teaching, assistant professional development, and rural community sustainability through science education. She is passionate about teaching human Anatomy and Physiology and draws from both active and applied learning techniques in order to connect the formal classroom environment to real life experiences.

Anna Schwabe is a biology education doctoral candidate who researches genetic relationships in Cannabis. Her teaching expertise lies in Anatomy and Physiology labs where she has organized and developed labs to maximize student learning while fostering a teaching environment conducive to novice student instructors. She is also a certified scientific botanical illustrator.

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Appendix A

Week 5

Skull and Axial Skeletal

Be able to identify all the bones listed and know #'s where indicated.

Microscopic bone structures:

Central Canal

Lacuna

Canaliculi

Lamellae

Osteocyte

Osteon

Bone Anatomy

Compact bone

Spongy bone

Diaphysis

Epiphysis

Articular cartilage

Epiphyseal line

Yellow marrow

Red marrow

Bones of the Skull

Frontal Bone

- Frontal sinus

Parietal Bone

Temporal Bone

- Zygomatic process

- Styloid process

- External acoustic meatus

- Mastoid process

- Jugular foramen

- Carotid canal

- Internal acoustic meatus

Occipital Bone

- Foramen magnum

- Occipital condyles

Sphenoid Bone

- Sella turcica

- Sphenoidal sinus

Ethmoid Bone

- Cribriform plate

- Crista galli

- Superior nasal concha

- Middle nasal concha

- Ethmoidal sinus

Other Bones of the Skull

- Mandible

- Zygomatic

- Vomer

- Maxilla

- Lacrimal

- Palatine

- Nasal

Axial Skeleton

Hyoid

Cervical Vertebrae (7)

- Atlas

- Axis

Thoracic (12)

Lumbar (5)

Sacrum

Coccyx

Sternum

- Manubrium

- Body

- Xiphoid process

Ribs (24 total)

- True (14: 7 pairs)

- False (10: 5pairs)

  - Floating (4: 2 pairs)