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Preparing Students for Practical Exams: The Dreaded Anatomy Bell Ringer

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**Summary**
Undergraduate students in the health sciences typically perform poorly on practical exams. For example, the bell ringer is a stressful part of anatomy courses. This poor performance may be due to the fact that students often struggle with ‘transferring’ content from lecture (i.e., classroom) to a clinical setting (i.e., lab; Bolander et al., 2008). Although students are provided with weekly lab periods to interact with anatomical models, this learning is typically quite passive. As no assessments occur before the bell ringer, students have no early opportunities to test their knowledge. Course teaching assistants (TAs) are uniquely positioned to prepare students for the exam and to ensure they are meeting required learning outcomes. Workshop participants will explore facilitation strategies to actively involve students in the lab, thus aiding students to deepen their understanding of human anatomy and motivating reflection on these lessons. Moreover, this workshop will highlight the importance and utility of practical exams in anatomy courses and will also help increase participants’ confidence in helping students apply and evaluate their lecture-based knowledge in lab.

**Keywords**
practical exam, bell ringer, anatomy, interactive

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Preparing Students for Practical Exams: The Dreaded Anatomy Bell Ringer
Leigh Vanderloo, Western University

SUMMARY
Undergraduate students in the health sciences typically perform poorly on practical exams. For example, the bell ringer is a stressful part of anatomy courses. This poor performance may be due to the fact that students often struggle with ‘transferring’ content from lecture (i.e., classroom) to a clinical setting (i.e., lab; Bolander et al., 2008). Although students are provided with weekly lab periods to interact with anatomical models, this learning is typically quite passive. As no assessments occur before the bell ringer, students have no early opportunities to test their knowledge. Course teaching assistants (TAs) are uniquely positioned to prepare students for the exam and to ensure they are meeting required learning outcomes. Workshop participants will explore facilitation strategies to actively involve students in the lab, thus aiding students to deepen their understanding of human anatomy and motivating reflection on these lessons. Moreover, this workshop will highlight the importance and utility of practical exams in anatomy courses and will also help increase participants’ confidence in helping students apply and evaluate their lecture-based knowledge in lab.

KEYWORDS: practical exam, bell ringer, anatomy, interactive

LEARNING OUTCOMES
By the end of this workshop, participants will be able to:
• identify and explain the importance of practical exams within the lab setting;
• evaluate personal teaching approaches and formulate strategies for addressing the problem of ‘transfer’ within anatomy courses; and
• explore and appraise various active learning activities aimed at increasing students’ confidence and familiarity with practical-based subject material.

REFERENCE SUMMARIES

Clinical instructors have long complained that by the time students arrive at the clinical portion of their medical training, they have somehow forgotten the knowledge they learned in anatomy courses (i.e., at the “pre-clinical” level). Consequently, this qualitative study seeks to examine whether ‘knowledge transfer’ was identified by anatomy and surgery teaching staff as a problem, as well as to explore strategies to overcome this issue. Results from semi-structured interviews with teaching staff revealed that knowledge transfer was a problem; however, no formal strategies on how to overcome this issue were presented/suggested by participants. The authors suggest that additional steps are warranted by teaching staff (both at the clinical and pre-clinical level) in medical schools to better assist students in retaining learned anatomy-related knowledge prior to entering into clinical training. This article serves as the foundation to the workshop as it identifies and discusses a specific challenge in the health sciences discipline. Facilitators should use this paper as a way of setting the tone for the workshop as well as prepping participants to reflect on their own approaches to teaching/evaluating anatomy in a clinical setting.

This paper explores the usefulness of using in-class demonstrations to complement anatomy lectures and introduces two engaging teaching techniques. First, the author wore an apron with movable pieces, which were used to describe the movement and rotation of the stomach during embryonic growth and development. Second, the author cut a hole in the middle of a large piece of fabric, through which he placed his head. Using his entire body, this example was used to visually depict the female reproductive organs. According to end-of-term class assessments, the author determined that these simple in-class demonstrations were well received by students and proved useful in their learning and understanding of presented material. Facilitators can use this paper to highlight the importance of moving beyond lectures to include more interactive and hands-on approaches to learning anatomy (see active demonstrations #1 and #3). This paper also provides some simple examples from which the facilitator and workshop participants can brainstorm additional activity ideas.


This article reviews the usefulness of utilizing various instruction strategies of teaching anatomy to medical students. Specifically, the following strategies are examined: computer assisted learning, didactic models, pro-section, dissection, radiology, and the use of living people. The rank-ordering of the teaching methods from most to least effective, as indicated by students and professors, was as follows: pro-section and dissection, radiology and living people, computer assisted learning, and didactic models. In summary, while the utility and challenges of using the different strategies were discussed, authors suggest that a multi-modal approach (i.e., beyond simply lecturing) to teaching anatomy would prove to be the most effective. This paper supports the overarching premise of the workshop as it emphasizes the need for course instructors/TAs to incorporate various teaching strategies to convey course content. This paper helps set the stage for discussion regarding how best to move away from the typical practice of students passively interacting with models in lab to prepare for practical exams.


This brief cross-sectional study explores the bell ringer exam scores of American undergraduate students who received anatomy instruction via: 1. 2D images, 2. 3D images, and 3. hands-on models and prosected specimens. Results revealed that no one instructional method was found to be more supportive of student learning/success over another, and alludes to the fact that students may benefit from a mix of various teaching methods/strategies. Facilitators can use this paper to demonstrate how various modes of instructions and/or activities can be used in anatomy labs to better prepare students for the bell ringer exam.


A phenomenographic analysis was undertaken to explore senior medical students’ and clinical teachers’ experience in learning/teaching anatomy. Students were interviewed in order to gain information on how best they organize and study anatomy-related material. It was found that students approach...
anatomy learning in various ways, namely: memorizing, experiencing, and/or contextualizing. As a means of helping students understand and connect to the presented material, authors suggest that anatomy curricula should be modified in a way that utilizes various learning and contextualization strategies. Facilitators can use this paper to help inform the final group activity of the workshop (i.e., the creation of a handout to help students prepare for the bell ringer exam).

**CONTENT AND ORGANIZATION**

<table>
<thead>
<tr>
<th>Duration (min)</th>
<th>Subject</th>
<th>Activity</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Welcome / introductions</td>
<td>Mini lecture and brief ice-breaker activity</td>
<td>Welcome participants and introduce himself/herself as workshop facilitator.</td>
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<tr>
<td></td>
<td></td>
<td>The facilitator may choose to use a brief icebreaker activity to assist with introductions and to set the tone for the workshop (i.e., to help create a comfortable environment).</td>
<td>Introduce the purpose of the workshop.</td>
</tr>
<tr>
<td>12</td>
<td>Introduction to the Bell Ringer Exam</td>
<td>Mini lecture</td>
<td>Discuss practical exams in anatomy labs (i.e., the bell ringer), current trends among students taking these exams, as well as the challenge of addressing knowledge transfer.</td>
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<tr>
<td></td>
<td></td>
<td>The facilitator introduces the topic of practical exams in an anatomy lab and participants will have the opportunity to briefly comment on (based on the readings by Bolander et al., 2008, Kerby et al., 2011, and Wilhelmsson et al., 2010):</td>
<td>Provide participants with the opportunity to reflect on and share their approaches to teaching anatomy in the lab.</td>
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<tr>
<td></td>
<td></td>
<td>- What is the bell ringer?</td>
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<td></td>
<td></td>
<td>- The usefulness of practical exams</td>
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<td></td>
<td></td>
<td>- Trends among students (i.e., how well do students typically fare on these exams in anatomy)</td>
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<td></td>
<td></td>
<td>- The issue of ‘transfer’ in anatomy (lecture vs. lab setting) – why is this problem and how can we overcome it?</td>
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<td></td>
<td>Participants will be given 8 minutes to complete the “Reflection Activity” sheet (Appendix A). Then, through a guided group discussion, the facilitator should ask some of the participants to briefly share their points with the entire group.</td>
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<tr>
<td></td>
<td></td>
<td>- What approaches do you take in class to teach anatomy? Activities?</td>
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<td>- Do you circulate the lab and ask/answer questions?</td>
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<td></td>
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<td>- What types of questions do you typically receive from students in lab regarding course content?</td>
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</tbody>
</table>
| 60 | Preparing Students for the Bell Ringer Exam (20 minutes) | Active demonstration #1 – [online] quizzes | Experience completing and creating quiz questions that would test the students’ anatomical knowledge, thus providing immediate feedback on their progress in the course.  

With the remaining time, participants will work together in small groups to write 3-5 anatomy questions and solutions. Questions should be appropriate for an online format (i.e., true/false, multiple choice, fill in the blanks).  

The facilitator should collect each group’s completed questions to compile a list that can be distributed to all attendees (to be sent via email post-workshop).  

**Note.** During the term, quizzes will be completed online to ensure all students across different course sections will be administered similar questions (i.e., a selection of questions of various levels of difficulty from a question bank) and to facilitate grading. |

| Preparing Students for the Bell Ringer Exam (40 minutes) | Active demonstration #2 – case studies | Create anatomically-related case studies that will encourage students to apply their knowledge and reasoning in order to solve a problem. A solid understanding of anatomical features and systems will be required to successfully work through these problems.  

The purpose of this type of exercise is to provide students with the opportunity to transfer and apply their knowledge on a much deeper level. This is known as **backward-** |

Participants will be given the opportunity to complete a mini five-question quiz focusing on the hand and wrist (paper version; see Appendix A – active demonstration #1). The answer key will be provided.  

With the remaining time, participants will work together in small groups to write 3-5 anatomy questions and solutions. Questions should be appropriate for an online format (i.e., true/false, multiple choice, fill in the blanks).  

The facilitator should collect each group’s completed questions to compile a list that can be distributed to all attendees (to be sent via email post-workshop).  

Participants will then be given the opportunity to write a case study of their own. Participants will be asked to draw on class material to help create an anatomically-related case as well as a ‘simple’ solution.  

The facilitator should collect each group’s completed cases to compile a list that can be distributed to all attendees (to be sent via email post-workshop). |
reaching transfer as students are being asked to use previously acquired knowledge and reasoning to solve a complex problem (i.e., the case study; Bolander et al., 2008).

| 15 | Group Discussion | The facilitator leads a discussion and evaluation of the various strategies to preparing students for the bell ringer exam.  
- What are some of the pros and cons of each of the strategies we reviewed today?  
  - Is the onus on the TAs to create all these activities?  
  - How do we ensure consistency across labs?  
  - Time commitment?  
- Do any of these strategies present challenges for learners?  
  - What if students have not been reviewing the material from class and therefore cannot fully participate in these activities?  
- Can you think of a way that we could improve and/or modify these strategies to better support student learning and knowledge transfer?  
- Could you see yourself implementing any of these strategies in your labs – why or why not? | Discuss the pros and cons of each newly introduced strategy. Ways to modify/improve the activities and/or overcome challenges (i.e., class constraints) may be discussed as well.  
Participants will also be given time to brainstorm other potential lab assignments that may prove useful in helping students engage interactively in the lab to help enhance learning.  
- Can you think of any other activities that might prove useful in helping students apply what they learn in lecture to the lab setting?  
  - Actively engaging with models?  
  - Asking students to label diagrams (including bones, muscles, innervations, and associated and/or supporting
15

<table>
<thead>
<tr>
<th>Group Activity – Preparing Students Handouts</th>
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<tbody>
<tr>
<td>Think-Pair-Share</td>
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<tr>
<td>In pairs or small groups, participants will discuss and write down what they believe should be included in a handout for students pre-exam (Appendix A – group activity). Key points may include:</td>
</tr>
<tr>
<td>• A description of the bell ringer format (‘de-mystifying the bell ringer’)</td>
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<tr>
<td>• Tips for preparing for a practical exam in anatomy</td>
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<tr>
<td>• Sample questions</td>
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<tr>
<td>Next, the small groups will be asked to rejoin the larger group to share their ideas. The facilitator should collect each group’s completed form and compile the list of key points discussed and distribute to all attendees (to be sent via email post-workshop).</td>
</tr>
</tbody>
</table>

Discuss key material that should/could be included in a handout to help students prepare for the bell ringer exam (draw on Wilhelmsson et al., 2010 reading).

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<table>
<thead>
<tr>
<th>Summary / Wrap-up / Question Period</th>
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<tbody>
<tr>
<td>Facilitator provides a brief overview of the workshop’s content. Time should be provided to participants to reflect on the presented content and ask questions.</td>
</tr>
<tr>
<td>The overview of key points will help solidify participants’ newly gained knowledge regarding preparing undergraduate students for the anatomy bell ringer.</td>
</tr>
</tbody>
</table>

To provide participants with an opportunity to ask any final questions.

**Total Time: 120 minutes**

**PRESENTATION STRATEGIES**

This workshop will commence with an introduction to practical exams, their utility, and the issue of ‘transfer’ (Bolander et al., 2008) among undergraduate health sciences students in anatomy. Next, active demonstrations will be incorporated into this workshop to not only ensure participants have a chance to ‘experience’ each of the learning activities, but to allow for iterative reflection as well (e.g., how could I make this work in my lab?, what could I change/modify/add?, etc.). Lastly, participants will be given the opportunity to draft a handout for their students which explains the bell ringer exam, its purpose, and how best to prepare for this type of exam. The rationale for this final activity is two-fold: 1. it will allow participants the opportunity to discuss and refine a usable document for their students, and 2. it will serve as an indirect method of solidifying and reinforcing key points of the workshop.

As informed by the literature (Chan, 2010; Kerby et al., 2011; Newhouse, 2007; Packahel et al., 2013), multiple instructional approaches will be utilized by the workshop facilitator to maximize learning among participants (i.e., the TAs). A large proportion of this workshop will comprise of small and large
group discussions. Employing both discussion styles will promote increased participation and engagement, as well as provide opportunities to learn from and expand on fellow participants’ comments. The workshop leader should position himself/herself to facilitate open discourse, thus creating a supportive environment in which participants can interact and engage in meaningful discussions. Throughout the entire workshop, the facilitator should make himself/herself available to answer questions and assist with troubleshooting. On this note, the facilitator should also remain cognizant of the time. To guarantee all material is covered and adequate time is provided for discussion and reflection, it is crucial that the facilitator be able to direct conversations when required. This will help ensure that the workshop unfolds and flows in an organized manner.

The facilitator is encouraged to read through and familiarize himself/herself with the foundational pedagogical readings used to inform this workshop and to make every effort to help participants prepare for this workshop in advance (see Appendix B). The workshop leader should be prepared to take notes throughout the workshop and to send a summary of the key points raised during discussions (via email) to participants post-workshop.

Workshop target audience: Teaching Assistants in Anatomy
Workshop size: 15-20 participants

ADDITIONAL REFERENCES

APPENDIX A: Workshop Handouts

Reflection Activity
1. In the space below, please describe a typical day in your anatomy lab. What approaches do you take to teach and/or reinforce lecture material to students? What activities (if any) have you used?

2. Based on the readings by Bolander et al. (2008), Kerby et al. (2011), and Wilhelmsson et al. (2010), how might you approach your anatomy lab differently? Did any of the findings from these articles resonate with your experiences as an anatomy lab instructor?
Active Demonstration #1 – Sample Quiz
Take 5 minutes to complete the following quiz.

1. The thumb is an example of a:
   a. Ball and socket joint
   b. Saddle joint
   c. Condyloid joint
   d. None of the above

2. True or false: The lunate bone is located in the posterior row of the carpus articulating superiorly with the radius.

3. Which long bone primarily makes up the outer section of the forearm and is connected to the carpal bones to form the wrist?
   a. Ulna
   b. Fibia
   c. Radius
   d. Two of the above

4. Located on the posterior row of the carpus, the scaphoid articulates with the _________________ to form the wrist.

5. True or false: Synovial joints are typically bounded by a fibrous capsule whose inner membrane secretes a viscous lubricating liquid, thus allowing a limited range of motion.

Solutions: 1. b); 2. true; 3. c); 4. radius; 5. false.

Now it is your turn! Brainstorm 3-5 questions (i.e., multiple choice, true or false, fill in the blank) that would be suitable for an online quiz.
Active Demonstration #2 – Sample Case Study

Individually or in groups, try to solve the following case.

Angela is a runner. Lately she has been complaining of constant pain in the bottom of her left foot. What is likely causing her this pain? Identify (using the correct anatomical term) the area in her foot that is likely injured and/or inflamed.

**Solution:** Plantar fascia

Now it is your turn! Take some time to draft an anatomically-related case study for students at the undergraduate-level. It does not need to be long or overly complex, but should still serve as a challenge for students and will require that they utilize class material to solve the problem. Cases based on basic recall of information should be avoided. Do not forget to include the solution.
**Group Activity – Handout Activity**

In small groups, take some time to discuss which key components should be included in a handout geared towards helping undergraduate students succeed on their bell ringer exam. What do you think is important for students to know when preparing for this exam? You may wish to draw on the findings from the Wilhelmsson et al. (2010) paper. Add your notes to the blank space below and/or on the larger sheet provided. Be prepared to share your points with the larger group.
APPENDIX B: Facilitator Guidelines

Prior to the workshop, the facilitator should read through all material and be well-versed in the pedagogical references used to inform this workshop. A brief PowerPoint presentation could be prepared in advance to help direct the workshop and to ensure all learning objectives and material are covered in the allotted time.

The facilitator should prepare and bring the following material with him/her to the workshop:

- Pens and markers
- Copies of all worksheets
- Large paper for note taking during group discussions

The facilitator is also encouraged to email the following articles to attendees in advance of the workshop. These will help inform and enrich discussions.

