Flipping Radiologic Anatomy – An Assessment of Effectiveness in a Condensed Medical Gross Anatomy and Embryology Course

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Journey to the Flipped Side

Reform - Curriculum - Course - Content

Create - Sessions - Study Design

Assess - Performance - Perception
Curriculum and Course Reform

2015
24-month Pre-clinical curriculum
19-week course
~137 contact hours
93 hours Lab
42 hours Lecture
2 hours Flipped classroom

2016 - 2017

2018
17-month Pre-clinical curriculum
16-week course
~116 contact hours
79.5 hours Lab
25 hours Lecture
12 hours Flipped classroom
Radiology Reform

Passive Learning
Large Group Delivery
Teacher-Centered
(2016)

Active Learning
Small Group Delivery
Learner-Centered
(2017-present)
Preparatory materials

❖ Available on Blackboard
❖ Average 60 min prep time
❖ Materials include:
  • Handout with labeled radiographs
  • Online modules
  • Videos
Session details

Primary: Clinician Educator

Supportive: Basic Science Teaching Faculty

Small groups of 8-10 students

60-90 minute sessions

• Part 1 - Introduction (5 min)
• Part 2 – Individual Radiologic Anatomy Activity (12 min)
• Part 3 - Whole group discussion (10 min)
• Part 4 - Small-group Clinical Application Activity (12 min)
• Part 5 - Whole group discussion (10 min)

Whole group discussions provide formative feedback
Study Design

**Question:**
Is flipping radiology effective in improving learning and creating a more engaging, active learning experience when compared to lecture?

**Aims:**
1. Assess student performance on radiology questions in a first-year medical gross anatomy course from 2016-2018
   - Compare computer MCQ and laboratory images (identification only)
   - Unpaired t-Test (p<0.05)
2. Assess student perception of radiology flipped classroom sessions
   - Voluntary survey data (2017: n=87; 2018: n=83)

**Study Groups and Interventions:**
- 2016 – Received seven traditional radiology lectures (n=87)
- 2017 & 2018 – Received one intro radiology lecture and six flipped classroom sessions (2017: n=91; 2018: n=88)
  - Exam 1 – Intro; Spine; Upper limb
  - Exam 2 – Head & Neck
  - Exam 3 – Thorax; Abdomen
  - Exam 4 – Pelvis & Lower limb
Computer Assessment Performance – Radiology Questions

- Back & Upper Limb: 61.43%
- Head & Neck: 68.9%
- Thorax & Abdomen: 78.8%
- Pelvis & Lower Limb: 92.18%

Legend:
- Lecture: Purple Bar
- Flipped: Orange Bar

* p<0.05  # p<0.01
Laboratory Practical Performance – Radiology Questions

<table>
<thead>
<tr>
<th>Category</th>
<th>Lecture</th>
<th>Flipped</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back &amp; Upper Limb</td>
<td>77.08</td>
<td>88.21</td>
<td>11.13</td>
</tr>
<tr>
<td>Head &amp; Neck</td>
<td>91.62</td>
<td>86.79</td>
<td>-4.83</td>
</tr>
<tr>
<td>Thorax &amp; Abdomen</td>
<td>90.12</td>
<td>90.05</td>
<td>0.07</td>
</tr>
<tr>
<td>Pelvis &amp; Lower Limb</td>
<td>87.65</td>
<td>91.64</td>
<td>4.09</td>
</tr>
</tbody>
</table>

* p<0.05  # p<0.01
Student Perceptions of Radiology Flipped Classroom Sessions
Survey Data

- Engaging
- Clear objectives
- Promoted active learning
- Clinical instructors were knowledgable
- Enhanced understanding of gross anatomy
- Enhanced understanding of clinical anatomy
- Improved performance Back & Upper Limb
- Improved performance Head & Neck
- Improved performance Thorax & Abdomen
- Improved performance Pelvis & Lower Limb

% Agree/Strongly Agree

- 2017
- 2018

[Graph showing data comparison between 2017 and 2018 for each of the above categories]
Student Preferred Instructional Strategies for Learning Radiological Anatomy

Survey Data

2017

2018
Qualitative survey feedback

**Strengths**

helpful, learning, clinical, material, sessions, information

**Weaknesses**

radiology, hard, clinical, images, rushed, difficult
From the fingertips of learners

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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<tr>
<td>Promoted <strong>problem solving and critical thinking</strong> to analyze clinical cases</td>
<td>Labeling images was difficult when the <strong>images</strong> would print poorly.</td>
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<td>I think the flipped classroom setting was the <strong>best way to learn radiology rather than lectures</strong>. The group work followed by an explanation really brought everything together</td>
<td>There was <strong>not enough time</strong> to think through the clinical cases or for the physician to explain them.</td>
</tr>
<tr>
<td>The combination of <strong>basic scientist and clinician approach</strong> made these sessions very complete and well-rounded.</td>
<td>Having <strong>smaller groups</strong> would be very useful and <strong>more engaging</strong>, as well as promote more of an atmosphere to have your specific questions answered about the material.</td>
</tr>
<tr>
<td>Accountability session, engaging, get to leave with a study guide</td>
<td>[Labeling activities] could be done outside of the classroom. Our sessions would be better spent going over <strong>more clinical examples</strong>.</td>
</tr>
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Is flipping radiology “better” than lecture?

• Data suggests:
  1. Greatest impact across both assessments occurs during the first exam block
  2. Flipping radiology creates an engaging, active learning experience that enhances both gross and radiological anatomy understanding
  3. Preferred instructional strategies may affect level of preparation and overall perceived effectiveness of flipped classroom

• Limitations:
  1. No survey data for 2016 (lecture only) cohort
  2. No control for previous radiology exposure/education
Future Directions

• Pair and evaluate student performance and survey data
  • Is there a correlation between preferred instructional strategies, self-reported preparedness and perceived effectiveness of flipped classroom on learning and performance?

• Transition to online, interactive content

• Track knowledge retention longitudinally (M3 radiology course)

• Continue to engage clinicians to be involved in pre-clinical curriculum

• Reassess how to best use allotted time to improve session effectiveness
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Class of 2020

Class of 2021

Class of 2022
Importance of lateral view and AP view in X-ray.