It only took a pandemic: Engaging online students with active learning strategies

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Disclosures

• None
Cluster of pneumonia cases reported in Wuhan

December 2019

January 2020

US declares a public health emergency

February

March

Stay-at-Home Orders, School Closures

Second Wave

July

December

Third Wave

January 2021

Vaccine rollout to the public

May

Cases are falling in the US

Number of Daily COVID-19 Cases in the US

US Centers for Disease Control COVID-19 Case Surveillance Public Use Data
Challenges of Online Learning

**Technical Challenges**
- Computer access
- Internet connectivity
- Computer literacy

**Lack of Structure**
- Organization
- Self-discipline
- Time management

**Social Limitations**
- Feelings of Isolation
- Lack of interaction
- Reduced motivation
Future employment

Academic success in an online environment

Increased workloads

Internet connectivity

Computer accessibility

Future employment

Loss of social life during college

Isolation

Loneliness

Family conflicts at home

Economic hardships

Vulnerability of family members to Covid-19 infection

Stress

Depression

Anxiety

Substance Abuse

Eating Disorders

Fear

Suicide

The Online Environment

- Reduced focus
- Home environment
- Distractions
- Zoom fatigue
- Few interactions
- Passive learning
The Online Environment

• Online learning is more tiring on concentration

• We cannot transfer online the same approaches used in face to face learning
<table>
<thead>
<tr>
<th>Traditional Learning</th>
<th>Active Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive, lecture-heavy, one-way transmission of information</td>
<td>Student actively participates in the learning process</td>
</tr>
<tr>
<td>Instructor talks and students listen with few interruptions</td>
<td>Instructor talks with regular breaks for structured activities</td>
</tr>
<tr>
<td>Student concentration drops after 10 minutes</td>
<td>When student concentration begins to wane, a short in-class activity is assigned</td>
</tr>
<tr>
<td>The instructor is unaware of student comprehension during the lecture</td>
<td>Student comprehension is assessed directly during the lecture</td>
</tr>
</tbody>
</table>
Benefits of Active Learning

**Activities** promote high-order thinking skills, improving understanding and learning

**Interaction** improves human connection, engagement, motivation, and participation

**Collaboration** forces students to actively contextualize meaning among a group

**Community** supports collaborative learning and helps students feel comfortable and valued
Course Description

3-Credit Graduate Course
Fall semester

Two 75-minute lectures per week (Tues/Thurs)

Radiation Biology

Incoming Medical Physics Graduate Students

Course size Range: 4 - 14 students
How to Do It

Prepare Students for Success
1. Define measurable student learning objectives
2. Align educational content and assessments to meet them
3. Use a Learning Management System

Motivate students with Active Learning Strategies
4. Humanize course with interactions
5. Create engaging lectures & interactive activities
6. Promote a strong collaborative learning community
## Define Learning Objectives
### Prepare Content & Assessments

<table>
<thead>
<tr>
<th>Topic</th>
<th>Student Learning Objectives</th>
<th>Bloom's Learning Level</th>
<th>Assessments</th>
<th>Activities</th>
<th>Text Readings</th>
<th>PowerPoint Slides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation -induced damage to cells</td>
<td>1. Identify the 5 major types of radiation-induced chromosome aberrations</td>
<td>Remembering</td>
<td>Short answer</td>
<td>Teamwork in Jamboard</td>
<td>Radiation damage to DNA and Chromosomes</td>
<td>Radiation biology for the radiologist Chapters 1-3</td>
</tr>
<tr>
<td></td>
<td>2. Differentiate the 3 techniques for identifying DNA damage, quantifying chromosomal aberrations, and graphing cell survival curves</td>
<td>Analyzing</td>
<td>Essay</td>
<td>Padlet activity</td>
<td>Creating</td>
<td>Cell survival curves</td>
</tr>
<tr>
<td></td>
<td>3. Calculate cell survival fractions given an irradiation scenario</td>
<td>Applying</td>
<td>Solve</td>
<td>Homework</td>
<td>Creating</td>
<td>Cell survival curves</td>
</tr>
<tr>
<td></td>
<td>4. Predict how modifying radiation type, dose rate, or oxygen concentration will affect cell killing to normal cells and tumor cells</td>
<td>Evaluating</td>
<td>Short answer</td>
<td>Discussion in breakout room</td>
<td>Creating</td>
<td>Factors that affect cell survival</td>
</tr>
<tr>
<td></td>
<td>5. Recommend an irradiation treatment plan for a specific type of tumor</td>
<td>Creating</td>
<td>Discussion</td>
<td>Discussion board in Canvas</td>
<td>Creating</td>
<td>Factors that affect cell survival</td>
</tr>
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</table>
Create a Structured Course in Canvas

• Each lecture had its own:
  • **Linked page**
  • **Instructional materials**
  • **Activities & Assignments**

• Frequently sent students messages, reminders, feedback

• Synchronous lectures in Zoom
• Recorded for review
How I taught a 75-minute Course

2019: In-Person

- **Some Planning**: 30 min Lecture
- **Example Problem**: 10 min
- **Social Break**: 5 min
- **Lecture**: 30 min

2020: Online

- **More Planning**: 5 min Social Activity
- **Lecture**: 10 min
- **Interactive Activity**: 10 min
- **Example Problem**: 10 min
- **Lecture**: 10 min
- **Group Activity**: 10 min
- **Lecture**: 10 min

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Humanize the Course

• Introductions, ice breakers, virtual backgrounds, show & tell, games

• Opportunities to discuss class material
  • Join class early or stay late
  • Provide a space outside class

• Scheduled social hours outside of class

• Instructor presence, enthusiasm, humor

• Campus announcements and resources
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Create Engaging Lectures & Interactive Activities

• Spark *intrinsic motivation* to drive learning
  • Real-word problems & clinical scenarios

• Formative feedback
  • Low-stakes quizzes, games, extra credit
Answer questions for candy
Quiz - Lecture 4

Which contains greater energy deposition?

A. Spur
B. Biob
C. Delta ray

4/4 students answered

25% for Spur
75% for Biob
0% for Delta ray
Jeopardy for extra credit before an exam

<table>
<thead>
<tr>
<th>General</th>
<th>Radiation Interactions</th>
<th>DNA Damage &amp; Repair</th>
<th>Chromosome Damage</th>
<th>Measurement methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 point</td>
<td>1 point</td>
<td>1 point</td>
<td>1 point</td>
<td>1 point</td>
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<tr>
<td>2 points</td>
<td>2 points</td>
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<tr>
<td>3 points</td>
<td>3 points</td>
<td>3 points</td>
<td>3 points</td>
<td>3 points</td>
</tr>
</tbody>
</table>
Promote Collaborative Learning

- Collaboration maximizes student learning

- Significant class time devoted to small group activities
  - Think-Pair-Share, “Jigsaw” Peer Teaching, Problem solving

- Exploit collaborative virtual tools
  - Chat and Discussion boards, Breakout rooms
  - Online apps like Google Doc, Padlet, Jamboard, etc
Without speaking, walk around the room and find the person holding the card that pairs with the cell on your card.
Read, discuss in groups, teach the class

**Reading Assignments**

(6 minutes)

**Group 1: Tattoos in MRI**
- Student A: https://www.livescience.com/32801-do-mri-machines-affect-tattoos.html
- Student B: https://blog.radiology.virginia.edu/mri-with-tattoos/

**Group 2: Blankets in MRI**
- Student A: https://www.prayforoah.com/mri-burn.html
- Student B: https://www.radiologytoday.net/archive/rt0310p24.shtml

**Written Summaries**

(3 minutes, 1-3 sentences per student)

**We Learned:**
Tattoos in MRI can be dangerous and cause heating due to metallic particles (iron) present in the ink. The iron can interact with the magnetic and radio waves and conduct an electric current that heats up the tattoo.

**Discuss with your group**

(3 minutes)

**We Learned:**
A boy wrapped in an anti-hypothermia blanket (containing aluminum) suffered a third-degree burn during an MRI scan. The company which makes the blankets issued an immediate recall. The punch line is that even non-ferromagnet metals are potential heat conductors.
Students read assigned sections from BEIR-VII, created summary slides, and taught the class.
Brainstorm what you think may be a possible radiation-induced health effect
Meet your partner in a breakout room and create 4 Q&A’s related to today’s lecture.
Literature review, risk calculations, presentations, discussion
## Number of Assessments Increased

<table>
<thead>
<tr>
<th></th>
<th>Fall 2019</th>
<th>Fall 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>During class</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra Credit</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Exams</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Graded Quizzes</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ungraded Socrative Quizzes</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Team work</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Peer instruction</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Outside of Class</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projects</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Homework Assignments</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Reading Assignments</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Team work</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Results

- All students demonstrated:
  - Strong participation and enthusiasm
  - Great team work and support
  - High grades (above B+)
  - Positive instructor feedback
Dr. Barreto did a great job keeping the class involved in the lecture. It’s easy to space off during zoom sessions and I feel she did a great job interacting with students.

The class breaks were a welcome relief and made the information intensive lectures easier to pay attention to.

Dr. Barreto provided good PowerPoints and created many interactive activities for us to do with our classmates.

I felt like I had an instructor who didn't expect perfection but expected 100% effort. I respect that - It makes you want to give it your all.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Response Rate</th>
<th>Instructor Mean</th>
<th>College Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>The instructor was enthusiastic about the course.</td>
<td>100%</td>
<td>5.00</td>
<td>4.51</td>
</tr>
<tr>
<td>The instructor explained material clearly and in a way that enhanced my understanding.</td>
<td>100%</td>
<td>5.00</td>
<td>4.38</td>
</tr>
<tr>
<td>The instructor maintained clear standards for response and availability.</td>
<td>100%</td>
<td>5.00</td>
<td>4.41</td>
</tr>
<tr>
<td>The instructor fostered a positive learning environment that engaged students.</td>
<td>100%</td>
<td>5.00</td>
<td>4.44</td>
</tr>
<tr>
<td>The instructor provided prompt and meaningful feedback on my performance in the course.</td>
<td>100%</td>
<td>5.00</td>
<td>4.28</td>
</tr>
<tr>
<td>The instructor was instrumental to my learning in the course.</td>
<td>100%</td>
<td>5.00</td>
<td>4.36</td>
</tr>
<tr>
<td>Course content was relevant &amp; useful.</td>
<td>100%</td>
<td>5.00</td>
<td>4.32</td>
</tr>
<tr>
<td>The course fostered regular interaction between student and instructor.</td>
<td>100%</td>
<td>5.00</td>
<td>4.01</td>
</tr>
<tr>
<td>Course activities improved my ability to analyze, solve problems, and think critically.</td>
<td>100%</td>
<td>5.00</td>
<td>4.22</td>
</tr>
<tr>
<td>Overall, this course was a valuable educational experience.</td>
<td>100%</td>
<td>5.00</td>
<td>4.37</td>
</tr>
</tbody>
</table>
Challenges of Active Learning

- It takes more class time
- Planning takes more prep work
- Instructors lack institutional support
- Large class sizes complicate implementation
- Instructors may believe students are engaged
- Students may resist new approaches
Final Thoughts

- The pandemic has opened the door to new teaching opportunities
  - Give students a role in actively participating
  - Emphasize community and collaboration
  - Use technology to enhance the learning experience
Thank you!

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