Incorporating Active Learning into Medical Physics Education

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Introduction

“Education is the kindling of a flame, not the filling of a vessel.”

- Socrates

Who Cares How We Teach?
### Teaching Kindergarten

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TED 2250 Ethical Issues in School and Society</td>
<td>3</td>
</tr>
<tr>
<td>TED 2251 Becoming a Professional Educator</td>
<td>3</td>
</tr>
<tr>
<td>PSY 3440 Child Behavior &amp; Development</td>
<td>3</td>
</tr>
<tr>
<td>EDP 5450 Child Psychology</td>
<td>3</td>
</tr>
<tr>
<td>TED 3550 Teaching and Research in Practice</td>
<td>5</td>
</tr>
<tr>
<td>TED 5790 Student Teaching and Conference</td>
<td>5</td>
</tr>
<tr>
<td>ELE 6090 Preschool Goals and Practices</td>
<td>3</td>
</tr>
<tr>
<td>TED 5790 Directed Teaching and Conference</td>
<td>8</td>
</tr>
<tr>
<td>ELE 6020 Sem. in Early Childhood Education</td>
<td>3</td>
</tr>
<tr>
<td>ELE 6040 Role of Content Areas in Childhood Ed.</td>
<td>3</td>
</tr>
<tr>
<td>ELE 6070 Family, Community, Parent Partnerships</td>
<td>3</td>
</tr>
<tr>
<td>ELE 6340 Teaching Reading in Childhood Ed.</td>
<td>3</td>
</tr>
</tbody>
</table>

### Teaching Graduate Students

**GTA Orientation**
- Orientation for new graduate teaching assistants
- Day 1: 1-5pm
- Day 2: 8:30am-6:30pm
- Day 3: 8:30am-1pm (International/non-native English speakers ONLY)

### How Can I Become a Better Lecturer?
How Did We Get Here?

“Some people talk in their sleep. Lecturers talk while other people sleep.”
- Albert Camus

The “Tyranny of Common Sense”

State-of-the-art Teaching

- Here is some information you can read while I’m talking.
- In fact, why don’t you write it down?
- This will give us the comfortable sense that we have successfully transferred some information.
How Do Students Learn?

Traditional University Education Format

- “Traditional” course format
- “Traditional” student behavior
- Prescriptive problem solving

Physics Education Reform

What do we know about how students learn?

What are we going to do about it?
How Students Learn

1) Information transfer
2) Assimilation of that information

“Flipping” the classroom

Types of Active Learning

- Peer Instruction (Harvard)
- Class Wide Discussion (PERG)
Let's Look at Some Real Data

- Halloun and Hestenes create Mechanics Diagnostic test (and later Force Concept Inventory)
- Publish data showing two major conclusions…
  1) Conventional instruction doesn’t really change core beliefs
  2) Knowledge gain is independent of instructor

Interactive Engagement vs Traditional

- Compared $\langle g \rangle$ using MD and FCI data
- N=6542 (HS, college, university)
- IE nearly 2 SD higher

'Peer Instruction' at Harvard
What Are We Going to Do About It?

- Introduce active learning into “Introductory Radiological Physics”
- Why this course?
- What changes and why?

Each Class Period

- Reading (prior to class)
- Lecture audio/video (prior to class)
- 2 minute drill
- Abbreviated lecture
- Problems / Class Discussion
- Abbreviated video (after class)

Two minute drill

- Student randomly chosen
- 2 minute overview
- Chapter relevance within context of course
- No notes
Lecture Videos

Do students prefer video over instructor?

Not Really Peer Instruction

- PI typically short presentations followed by conceptual questions
- No pre- and post-discussion polling
- Discussion questions much more complex here

More Like “Class-Wide Discussion”

- Coined by Physics Education Research Group at U Mass
- Small group discussion of concept question
- Individual or group response
- Class-wide discussion facilitated by instructor
Class Wide Discussion

Example:

You are standing 1 meter from the source of radiation. Determine whether you will live.

Class Wide Discussion

• Developing specific capabilities
  – Estimation, statistics
  – Dimensional analysis, reasonability
  – Specific conceptual topics

Course Survey

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I reviewed the course notes before class</td>
<td>4.3</td>
</tr>
<tr>
<td>I watched the video lectures before class</td>
<td>2.1</td>
</tr>
<tr>
<td>After reviewing notes and watching lecture, I felt prepared for class</td>
<td>3.3</td>
</tr>
<tr>
<td>Reviewing notes and video built a comfortable knowledge foundation for application problems</td>
<td>4.3</td>
</tr>
<tr>
<td>My curiosity was stimulated by questions asked in class</td>
<td>4.1</td>
</tr>
<tr>
<td>I reviewed lecture video after class for further clarification</td>
<td>3.6</td>
</tr>
<tr>
<td>Watching lecture videos was helpful with learning content</td>
<td>4.2</td>
</tr>
<tr>
<td>The amount of repetition in each class period cause me to get bored</td>
<td>1.4</td>
</tr>
</tbody>
</table>

1 = Not True  2 = Slightly True  3 = Moderately True  4 = Mostly True  5 = Very True
## Course Survey

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>After working on the material for a while, I was confident to pass the exam</td>
<td>3.5</td>
</tr>
<tr>
<td>Grading I received was fair compared to other students</td>
<td>4.7</td>
</tr>
<tr>
<td>The “2 minute drill” forced me to think more deeply about material and helped me get more from the class lecture</td>
<td>4.3</td>
</tr>
<tr>
<td>The addition of the “2 minute drill” helped me to learn the material</td>
<td>5.9</td>
</tr>
<tr>
<td>The application problems contributed to my understanding of the content</td>
<td>4.1</td>
</tr>
<tr>
<td>Completing the application problems gave me confidence that I had learned the content</td>
<td>3.3</td>
</tr>
<tr>
<td>I felt that the change in the use of class time was beneficial</td>
<td>4.5</td>
</tr>
</tbody>
</table>

### Discussion

![Image](image_url)

**THAT SHOULD DO THE TRICK**

### Conclusion

“Education is the kindling of a flame, not the filling of a vessel.”

- Socrates
Thanks for Your Attention