Lens To Learning
Class-wide video analysis of Peer Instruction discussions
Laura Tucker, Todd Zickler, Ruonan Li, Rachel Scherr, and Eric Mazur
In Peer Instruction, students discuss conceptual questions

**Instructor**
- question (ConcepTest)

**Students**
- vote
- discuss
- re-vote
- explain

1. Participation
We have fine-grained analysis of some conversations, but students are selected for conversation analysis

Knight & Wise, http://blog.sciencegeekgirl.com/2013/04/05/understanding-clicker-discussions/, 2013

1. Participation
We have student clicker responses, but that doesn’t reflect whether they discuss

1. Participation

2. New measurement

3. Vision analysis
Current techniques miss students who don’t participate

1. Participation
Current techniques don’t allow us to track a single student’s behavior over time.
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1. Participation
If we identify under-participators and investigate causes, we can do more to encourage participation (for at least some)
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Measuring participation is important.
We can do more than identify under-participation:

How much are students talking during each ConcepTest?
We can do more than identify under-participation:

How much are students talking during each ConcepTest?

To whom are students talking (and how does grouping affect participation)?
We can do more than identify under-participation:

How much are students talking during each ConcepTest?

To whom are students talking (and how does grouping affect participation)?

How much are students talking on-topic vs. off-topic?
We can do more than identify under-participation:

How much are students talking during each ConceptTest?

To whom are students talking (and how does grouping affect participation)?

How much are students talking on-topic vs. off-topic?

Need new measurement technique
We need video that can show many students

1. Participation
2. New measurement
We need video that can show many students and “zoomed-in audio” to determine conversation content

1. Participation
2. New measurement
We implemented a discrete, comprehensive recording system

1. Participation plus...
2. New measurement
3. Vision analysis

6 miniature cameras
We implemented a discrete, comprehensive recording system.

1. Participation plus...
2. New measurement
3. Vision analysis

48 miniature microphones
We call this recording system Lens To Learning

1. Participation plus...
2. New measurement
3. Vision analysis
Our vision: automate analysis with computer vision
Our vision: automate analysis with computer vision

1. Participation
2. New measurement
3. Vision
Our vision: automate analysis with computer vision

1. Participation
2. New measurement
3. Vision
Computer vision systems have to be “trained” with human-labeled video.

Alice  Blake  Emily  Grant  Nourhan

Not pictured: Lizzy, Sean, and Thomas

Coders mark for **each student** at each time:

<table>
<thead>
<tr>
<th>Time</th>
<th>Interaction type</th>
<th>ON/OFF-topic</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:01:00</td>
<td>NONE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:01:05</td>
<td>NONE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:01:10</td>
<td>NONE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:01:15</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:01:20</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:01:25</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:01:30</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:01:35</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:01:40</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:01:45</td>
<td>INSTRUCTOR</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:01:50</td>
<td>INSTRUCTOR</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:01:55</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:02:00</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:02:05</td>
<td>PEER</td>
<td>OFF</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:02:10</td>
<td>PEER</td>
<td>OFF</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:02:15</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:02:20</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
</tr>
<tr>
<td>0:02:25</td>
<td>NONE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:02:30</td>
<td>NONE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Participation  
2. New measurement  
3. Vision
Outcome: Discussion profile for multiple questions

1. Participation plus...
2. New measurement
3. Vision analysis

% students

<table>
<thead>
<tr>
<th>time (minutes)</th>
<th>ON-topic</th>
<th>OFF-topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Outcome: Discussion profile for multiple questions

1. Participation
2. New measurement
3. Vision
What we’ve learned so far

1. Very little time off-topic (<10%)
What we’ve learned so far

1. Very little time off-topic (<10%)

2. Different questions have different profiles
What we’ve learned so far

1. Very little time off-topic (<10%)

2. Different questions have different profiles

Applications
* Success measure for ConcepTests
* Determining best practices over range of courses
Future applications

* Find students who under-participate

* See how student groupings change participation
We tell what’s happening without sound

1. Participation plus...
2. New measurement
3. Vision analysis
We tell what’s happening without sound

1. Participation
2. New measurement
3. Vision
We tell what’s happening without sound

1. Participation
2. New measurement
3. Vision
We tell what’s happening without sound

In tutorial data, no loss of accuracy in coding without sound.

1. Participation
2. New measurement
3. Vision
10 A initially flows through a light bulb. How much current flows through the bulb when a wire is connected across the bulb as shown?
<table>
<thead>
<tr>
<th>Tammy</th>
<th>0</th>
<th>So if you think that all the current will flow through the wire, the current that flows through the bulb would be zero.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharon</td>
<td>10</td>
<td>OK, my thing is that he just showed us when you put two things in parallel the current can still flow through both of them, so ...</td>
</tr>
</tbody>
</table>
### Discovery conversations

<table>
<thead>
<tr>
<th>Tammy</th>
<th>0</th>
<th>But here you’re fixing the current that flows in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharon</td>
<td>10</td>
<td>Oh, you’re right. I can actually go with that</td>
</tr>
</tbody>
</table>

1. Participation  
2. New measurement  
3. Vision
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