Lens To Learning
Using Video Analysis to Classify Student Discussions During Peer Instruction
Laura Tucker,
Rachel Scherr, and Eric Mazur
The Peer Instruction pedagogy centers on students individually answering then discussing conceptual questions.

Instructor: question → Students: vote → discuss → re-vote → Instructor: explain
Courses taught with Peer Instruction often have significantly higher FCI gain than traditional courses

Significant class-wide gains in correct answer choice coincide with discussion.

Consider a rectangular Gaussian surface surrounding a dipole that has 16 field lines emanating from its positively charged end.

If you move the Gaussian rectangle around (anywhere in the plane), the field line flux through the rectangle:

A. always remains zero.
B. varies between -32 and +32.
C. varies between -16 and +16.
D. is -16, zero, or 16.
E. Other.
We don’t know how student discussions work in practice
We don’t know how student discussions work in practice
We don’t know how student discussions work in practice

Do students participate?

Do they have disciplinary engagement?

Do they just talk about the weekend?
We don’t know how student discussions work in practice

Do students participate? Yes
We don’t know how student discussions work in practice

Do students participate? Yes
Do they just talk about the weekend?
We don’t know how student discussions work in practice

Do students participate? Yes
Do they just talk about the weekend?
Do they have disciplinary engagement?
Our sample was one university course, using full-class video and audio recording

- Intro E&M
- Peer Instruction expert instructor
- $N = 89$
- 97% participation rate
Using a comprehensive recording system, we have audio and video of every student over one term.
Our recording system is discreet.

6 miniature cameras
Our 48 miniature microphones collect full-class audio discreetly
For each student, we note if the student discusses during each 5-second interval, and if discussions are on-topic.

<table>
<thead>
<tr>
<th>Time</th>
<th>Interaction type</th>
<th>ON/OFF-topic</th>
<th>Partners</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:01:00</td>
<td>NONE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:01:05</td>
<td>NONE</td>
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<td>0:01:10</td>
<td>NONE</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0:01:15</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
<td>She attempts</td>
</tr>
<tr>
<td>0:01:20</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
<td>Pays</td>
</tr>
<tr>
<td>0:01:25</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
<td>Difficult to tell</td>
</tr>
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<td>ON</td>
<td>D104,D105</td>
<td></td>
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<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
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</tr>
<tr>
<td>0:01:40</td>
<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
<td></td>
</tr>
<tr>
<td>0:01:45</td>
<td>INSTRUCTOR</td>
<td>ON</td>
<td>D104,D105</td>
<td></td>
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<tr>
<td>0:01:50</td>
<td>INSTRUCTOR</td>
<td>ON</td>
<td>D104,D105</td>
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<tr>
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<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
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<tr>
<td>0:02:00</td>
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<td>ON</td>
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<tr>
<td>0:02:05</td>
<td>PEER</td>
<td>OFF</td>
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<tr>
<td>0:02:10</td>
<td>PEER</td>
<td>OFF</td>
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<td>PEER</td>
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<td>PEER</td>
<td>ON</td>
<td>D104,D105</td>
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<tr>
<td>0:02:25</td>
<td>NONE</td>
<td></td>
<td></td>
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<tr>
<td>0:02:30</td>
<td>NONE</td>
<td></td>
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</tbody>
</table>
For each student, we add up the time spent in each interaction type.

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</tr>
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<td>PEER</td>
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</tr>
<tr>
<td>0:01:50</td>
<td>INSTRUCTOR</td>
<td>ON</td>
</tr>
<tr>
<td>0:01:55</td>
<td>PEER</td>
<td>ON</td>
</tr>
<tr>
<td>0:02:00</td>
<td>PEER</td>
<td>ON</td>
</tr>
<tr>
<td>0:02:05</td>
<td>PEER</td>
<td>OFF</td>
</tr>
<tr>
<td>0:02:10</td>
<td>PEER</td>
<td>OFF</td>
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<td>ON</td>
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<tr>
<td>0:02:20</td>
<td>PEER</td>
<td>ON</td>
</tr>
<tr>
<td>0:02:25</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>0:02:30</td>
<td>NONE</td>
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</tr>
</tbody>
</table>

Peer - 60 s
None - 25 s
Instructor - 10 s
On-topic - 60 s
Off-topic - 10 s
We plot histograms for each question: percentage of students vs. percentage of time in the interaction type
Conclusion #1: Off-topic interactions are a small fraction of total discussion time allotted.
Conclusion #1: Off-topic interactions are a small fraction of total discussion time allotted.
Conclusion #1: The fraction of discussion time in off-topic conversation is minimal

Do students participate? Yes
Do they just talk about the weekend? No
Do they have disciplinary engagement?
Our coding scheme for on-topic student conversations: check-in or disciplinary engagement
In a **check-in** conversation, students exchange answers and possibly initial reasoning.

I got 10 because...

I got 15 because...
In a **disciplinary engagement** conversation, students continue talking after exchanging initial reasoning.

I got 10 because...

I got 15 because...

**on-topic conversation space**
In a disciplinary engagement conversation, students continue talking after exchanging initial reasoning.

I got 10 because...

I got 15 because...

on-topic conversation space
Conclusion #2: 25 - 50% of on-topic conversations between students are disciplinary engagement.
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Do students participate? Yes
Do they just talk about the weekend? No
Do they have disciplinary engagement? Yes
(discussion beyond initial answer exchange)
Some conversations reach productive disciplinary engagement (conceptual progress is made)

I got 10 because...

I got 15 because...

on-topic conversation space
Some conversations reach productive disciplinary engagement, and some are discovery conversations.

I got 10 because...

I got 15 because...

on-topic conversation space

conceptual progress

correct answer
Conclusion #1: The fraction of discussion time in off-topic conversation is minimal
Conclusion #1: The fraction of discussion time in off-topic conversation is minimal.

Conclusion #2: 25 - 50% of on-topic conversations between students are disciplinary engagement.
The future: This kind of analysis can highlight similarities in successful and unsuccessful questions and delivery.
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