(Toward) Inspiring Rich Clicker Question Discussions

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What do students get out of clicker discussions?

-- Guides to clicker use recommend individual vote + group discussion – but “classroom norms” of implementation vary widely.


-- “Naïve” groups of students show improved individual performance after discussion (majors, genetics).

   ...consistent with student survey data...

-- Many (38%) student discussions are “unproductive” (nonmajors, astronomy) – based on 10 categories.

Study Goals (ongoing)

A. Reliably measure characteristics of clicker discussions, especially those that contribute to discussion “productivity” or “richness”

B. Investigate factors which may influence discussion richness
Recording Setup

flat “table” microphones
6-channel mixer
video camera & tripod
Context of study:

• Instructor: Jenny Knight, MCDB

• Class: Developmental Biology, Fall 2010, n=111

• Overall style: “dialogic”

• Setup of clicker questions
  • Initial silent vote, small group discussion, re-vote, wrap-up
  • Points for participation

• Type of clicker question
  • Conceptual questions
  • Questions which “split” the class initially
Raw data collected:

• over 9 weeks of class

• 3 groups recorded at once (4 groups total)

• 83 conversations transcribed (2-3 per period)
You have isolated three mutants that all have the same basic phenotype of excess cell survival (too few or no cell deaths). What are the normal functions of the corresponding gene(s)?

a) To promote cell death.
b) To prevent cell death.
c) Not yet enough information to decide.
Discuss:

• Which do you think is “richer”, conversation A or B?

• Which aspects of the conversations did you use to assess “richness”? 
Conversation A:

Student 1: The question asks what are normal functions of the gene. It seems that if they get apoptosis normally then they would promote cell death. So I said A.

Student 2: That’s what I said, A.

Student 3: I said C, how do you know?

Student 1: I just assumed that if normally they get apoptosis and it’s mutated then it must be promoting it somehow.

Student 3: What if they are preventing it and they are super turned on or something?

Student 4: They could do either, it’s a trick question.

Student 1: I guess it’s possible.

Student 4: I guess you don’t have enough information...

Student 1: Yeah, so I guess we don’t know for sure then. I’ve been convinced.

Time: 35 seconds
Conversation B:

Student 1: I said C
Student 2: I said C
Student 3: C? Why?
Student 2: it says...[inaudible] cell death
Student 1: Well it didn’t say that on the clicker question.
Student 2: Yeah, it did.
Student 3: The mutation causes upregulation...
Student 1: Couldn’t it? Couldn’t it mean that it needs both to be working fully in order to have the right number of cell deaths? I don’t know, either way this question is C right?
Student 3: I’ll put C I guess...
Student 1: I mean hopefully someone else can explain it better, that’s all I got.
Student 3: I don’t know why I can’t understand it.

Time: 24 seconds
Initial Turn of Speech “Coding”

• Simplified coding system for argumentation
  (reviewed in Samson and Clark, 2008)

• Codes developed collaboratively, iteratively

• Reliability between 4 raters: .74 (adequate)
Initial Turn of Speech “Coding”

General Categories:
- Setup/Background (B) – statements about question
- Claims (C) – votes
- Questions (Q)
- Extension (X) – “above and beyond” conversation

Argumentation Categories:
- Justification (J) – new idea supporting a vote
- Sense-Making (M) – any rephrased justification
- Incomplete (I) – inaudible or fragmented justification
- Recap (R) – a complete explanation combining ideas
### Group A Conversation, Coded

<table>
<thead>
<tr>
<th>Transcript</th>
<th>Code(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1: The question asks what are normal functions of the gene. It seems that if they get apoptosis normally then they would promote cell death. So I said A.</td>
<td>B, J, C</td>
</tr>
<tr>
<td>Student 2: That’s what I said, A.</td>
<td>C</td>
</tr>
<tr>
<td>Student 3: I said C, how do you know?</td>
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<tr>
<td>Student 1: I just assumed that if normally they get apoptosis and it’s mutated then it must be promoting it somehow.</td>
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<td>Student 3: What if they are preventing it and they are super turned on or something?</td>
<td>J, Q</td>
</tr>
<tr>
<td>Student 4: They could do either, it’s a trick question.</td>
<td>J</td>
</tr>
<tr>
<td>Student 1: I guess it’s possible.</td>
<td>none</td>
</tr>
<tr>
<td>Student 4: I guess you don’t have enough information...</td>
<td>C</td>
</tr>
<tr>
<td>Student 1: Yeah, so I guess we don’t know for sure then. I’ve been convinced.</td>
<td>C</td>
</tr>
</tbody>
</table>

**Totals:**
- 1 Background
- 1 Question
- 6 Claims
- 3 Justifications
- 1 Sense-Making
## Additional Measures of Discussion

- # of turns of talk
- % of turns by most frequent speaker (dominance)
- conversation structure
  - (answer-only, transmissionist, or constructivist)
- % of group voting correct initially
- % of group voting correct after discussion

### Normalized Gain for Group:

\[
\text{Normalized Gain} = \frac{\% \text{ correct after} - \% \text{ correct initially}}{100 - \% \text{ correct initially}}
\]
Usually, 2+ students offered justifications.

Preliminary unpublished data. Please contact Sarah Wise at sarah.wise@colorado.edu if you are interested in sharing/reporting these data.
More “productive” than nonmajors’ class

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Results: impressions of groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Nickname</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>“under the radar”</td>
</tr>
<tr>
<td>B</td>
<td>“loudmouths”</td>
</tr>
<tr>
<td>C</td>
<td>“genial overachievers”</td>
</tr>
<tr>
<td>D</td>
<td>“last in, first out”</td>
</tr>
</tbody>
</table>
Groups: variable, few sig. differences

Mean # Turns of Speech

% of turns by dominant speaker

Error bars = standard deviation
Kruskal-Wallis 1-way ANOVA, p<.01

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Justification patterns mirror performance

Mean # of Justifications

% constructivist

Mean Normalized Gain

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Error bars = standard deviation

* = Krustal Wallis one-way ANOVA, p<.01
A. Reliably measure characteristics of clicker discussions, especially those that contribute to discussion “productivity” or “richness”

-- coding reliably captures productivity, style
-- groups surprisingly similar
-- multiple styles can be “productive”
-- looking forward to adding more “layers” of coding
A. Reliably measure characteristics of clicker discussions, especially those that contribute to discussion “productivity” or “richness”
   -- coding captures productivity and style
   -- groups surprisingly similar
   -- multiple styles can be “productive”
   -- looking forward to adding more “layers” of coding

B. Investigate factors which may influence discussion richness
Which *factors* influence the “richness” of clicker discussion?

**Question factors**
(difficulty, clarity, interest)

**Classroom norms**
(setup, wrap-up, grading)

**Social dynamics**
(personalities, collaborative skills)
We hypothesized...

Instructor behaviors can influence discussion richness, when they repeat to form a “classroom norm” Turpen and Finkelstein (2009) PhysRevST-PER 5: 020101

-- are answers or justifications emphasized in the setup?
-- is the histogram revealed before the discussion?
-- does the instructor interact with groups during discussion?
-- are student ideas solicited?
Can Instructor Style Influence Discussion?

Jenny alternated two styles in Developmental Biology, weekly:

<table>
<thead>
<tr>
<th>“Answer-oriented” style</th>
<th>“Justification-oriented” style</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Voting histogram revealed, after individual vote.</td>
<td>• “Your votes are split between 3 choices. Go ahead and discuss, and focus on the reasons for your answers.</td>
</tr>
<tr>
<td>• “Discuss with your table and revote, and after that I’ll explain it.”</td>
<td>• Tables asked to give reasons for choice.</td>
</tr>
<tr>
<td>• Tables not asked to speak after revote.</td>
<td>• Histogram revealed after discussion ends.</td>
</tr>
</tbody>
</table>
### Reasoning Differed Slightly with Instruction

<table>
<thead>
<tr>
<th>Measure</th>
<th>Answer-oriented (n=34)</th>
<th>Justification-oriented (n=49)</th>
<th>Stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>% constructivist</td>
<td>68%</td>
<td>90%</td>
<td></td>
</tr>
<tr>
<td># turns of speech</td>
<td>18 (8.7)</td>
<td>23 (13.4)</td>
<td></td>
</tr>
<tr>
<td>Mean # justifications</td>
<td>4.8 (3.1)</td>
<td>6.0 (3.3)</td>
<td>p=.08</td>
</tr>
<tr>
<td>Mean # rephrased</td>
<td>1.2 (1.9)</td>
<td>2.9 (3.3)</td>
<td>p=.01</td>
</tr>
<tr>
<td>Mean # claims</td>
<td>5.9 (3.1)</td>
<td>5.5 (4.6)</td>
<td>p=.66</td>
</tr>
<tr>
<td>Mean normalized gain</td>
<td>51%</td>
<td>46%</td>
<td></td>
</tr>
</tbody>
</table>

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( ) = standard deviation
Interpreting Style Data...and Future Plans

• “Answer-Centered” cues *slightly* altered conversations, despite overall “Justification-Oriented” context
  
  → Statistical comparisons, by group
  
  → Would discussions differ more significantly between *sections* with different norms?

• Upper division majors may have started course with argumentation skills
  
  → How do Freshmen / Nonmajors argue (or fail to argue)?
  
  → Can Justification-oriented norms help students develop argumentation skills?
  
  → Could trained TAs help students develop argumentation skills?
Take home messages:

• Students do have productive conversations

• Classroom norms influence productivity
  – What instructors do, matters!

• In your classroom, try:
  – Reminding students to discuss reasons, not votes
  – Expressing interest in discussing wrong answers
  – Train TAs to prompt discussion and move around
  – Randomly choose groups to contribute to wrap-up
  – Save histogram for the end of wrap-up
Thank you:

- Jenny Knight
- Katie Southard
- Bre Pritchard
- Jia Shi

- Kathy Perkins and Chandra Turpen: study design advice

- Erin Furtak – School of Education: coding advice, equipment loan

- Ben Spike – Physics: equipment loan
Future measures of conversations

- Duration of conversation
- % of time “on-task”

- % of group providing justification (replaces 3 categories)
- Level of reasoning (Osborne, 2004)
  - 1 – no justifications made
  - 2 – one justification, no rebuttal
  - 3 – one justification, weak rebuttal
  - 4 – one justification, strong rebuttal
  - 5 – multiple justifications and rebuttals

- Content coding of justifications