Technology Supported Collaborative and Discussion Based Learning at Scale

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Students learn 1.24 s.d. more when working with a partner and automated support than students working alone (Kumar et al., 2007)
Analysis

Facilitating Effect On Teachers

Automated Support For Students

Design
Teacher: OK, does anyone want to respond to that? Who wants to respond and can prove that they listened to Marcel’s explanation and can, kind of respond with their own ideas or can add another idea to it? Frank, go ahead.

Frank: I um I agree with what you said because this for example like if you put-- if you had big um, can- like if you got a big cup of water and you put a-- an eraser in there, like a- a ah, like the eraser over there, if you put something like that in a big cup of water, the water level would rise a lot, and, if you put in a copper cube, and it’s not even gonna- it’s not going to rise that much even though that copper cube will weigh more than a eraser.

Teacher: Ahh ok, anyone agree with Frank’s idea? I like that he kind of, talked about another object and he chose an object that we know has a different volume than the eraser to compare. So, can someone explain or repeat for us what Frank thought would happen if I put an object this big, in water? James, what he think would happen if I put an object, this big, into a cup of water?

James: He said that if you-- if you like a big- bur--like a big bottle of like water

Teacher: Uh huh

James: and you put the eraser in it, then it would probably like, rise a lot. Then--

Teacher: Woah, woah, rephrase that – it has a what?

James: a different vol-- a different volume...

Teacher: And which has a greater volume?

James: The eraser.

Teacher: The eraser. Which means it takes up more space. So if I were to put this into, a container of water for example, if I were to put it into my little pitcher here, if I had this filled up and I dropped this guy in, well, which direction would my water have to go?
Empirical Support for Accountable Talk

• When teachers of math, science, and reading use structured teacher-lead discussion methods...

  • steep changes in student **achievement** (Bill, Leer, Reams & Resnick, 1992; Chapin & O’Connor, 2004)

  • **Retention** for up to 3 years (Adey & Shayer, 1993, 2001; Shayer, 1999; Topping & Trickey, 2007a, 2007b)

  • **Transfer** across domains for up to 3 years (Bill, Leer, Reams & Resnick, 1992; Adey & Shayer, 1993, 2001; Shayer, 1999; Chapin & O’Connor, 2004)

  • Students perform better on **non-verbal reasoning** tests e.g. Ravens (Mercer, Wegerif & Dawes, 1999)

  • **Reasoning** itself improves (Kuhn & Zillmer, in press; Lin et al 2012)
Agents as Support for Group Learning

Employing Accountable Talk Practices

Part of a professional development effort for 9th grade biology in an urban school district
Positive Effect on Student Learning

- **Study 1:** Year 1, Diffusion Lab
  - Students learn more on explanation questions in supported conditions ($F(1,46) = 4.3, p < .05$, effect size 1 s.d.)
  - Students in supported conditions more active in whole group discussion ($F(2,26) = 4.2, p < .05$, effect size .75 s.d.)

- **Study 2:** Year 2, Diffusion Lab
  - Students learn more on immediate post test in Revoicing Agent condition ($F(1,74) = 4.3, p < .05$, effect size .51 s.d.)

- **Study 3:** Year 2, Punnett Square Lab
  - Students learned marginally more ($p < .1$) on delayed post-test in Revoicing Agent condition
Data, Analytics and Learning

An introduction to the logic and methods of analysis of data to improve teaching and learning.
Individual learning followed by collaborative reflection supported by a virtual agent

Students engage in a significantly higher concentration of expressed reasoning in the chats than in the discussion forums or twitter.
Positive Impact of Chat Participation

- Assess impact of chat participation on dropout along the way using a survival analysis
  - **Unit of analysis:** each 2 day period
  - **Dependent variable:** Drop = 1 on the last active time period (0 otherwise)
  - **Control variables:** Number of clicks on videos and number of clicks on discussion forums
  - **Independent variables:**
    - Number of attempts to be matched for a chat (numeric)
    - Successful match (binary)
    - Interaction between Attempts and Match

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Hazard Ratio</th>
<th>P Value</th>
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</thead>
<tbody>
<tr>
<td>Video Clicks</td>
<td>2.38</td>
<td>P &lt; .0001</td>
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<tr>
<td>Forum Clicks</td>
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<td>Match Attempts</td>
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<td><strong>Match Success</strong></td>
<td><strong>.44</strong></td>
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<tr>
<td>Interaction between Attempts and Match</td>
<td>.76</td>
<td>P &lt; .05</td>
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Deliberation-based Team Formation

- Maintain community connection and team connection simultaneously
- Form teams later, after community engagement has started
- Use community engagement as evidence of who would work well together

**Big result:** Discourse Analytics enables effective team assignment
- Transactivity automatically detected between pairs of students in threaded discussion
- Max cost flow optimization to maximize averaged observed pairwise transactivity in assigned groups
- Transactivity based teams perform **3 standard deviations better** on team task than randomly assigned teams
DANCE: Discussion Affordances for Natural Collaborative Exchange

About DANCE

Drawing from two decades of research in Computer Supported Collaborative Learning, we are working to design an extension of the edX platform to enhance instructionally beneficial discussion opportunities available to students. With this working group, we want to bring together people from academia and industry to build a common vision regarding what kinds of research would be valuable to the community once such a platform extension was in place to support it. Our work is initially focusing on the edX platform in particular, but in the long run we seek to provide these capabilities to Massive Open Online Courses and other online learning platforms more generally. In particular, this working group is partnering with edX as a satellite collaborative, seeking to involve researchers and developers from multiple universities, foundations, and industrial organizations.

Our foundational work is beginning with specific interventions designed to offer synchronous collaboration activities supported by intelligent conversational agents and enhancements to threaded discussions to support more intensive help exchange by leveraging social recommendation technology. However, our goals are much broader than this, seeking to leverage insights and methodologies from the field of Human-Computer Interaction and encompassing both synchronous and asynchronous communication very broadly. Our vision includes text, speech, and video based interactions, instrumented with all sorts of intelligent support powered by state-of-the-art analytics and leveraging language technologies and artificial intelligence more broadly in order to offer contextually appropriate support. We will coordinate this effort with regular online meetings and occasional in-person workshops.

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Looking to the future: What do we want to enable?

• Project and Problem based learning
• Collaborative reflection and Collaborative Problem Solving
• Community building and social support
  – Reducing attrition in MOOCsGateways to enduring communities of practice
  – Bridging learning and practice
Thank You!

Questions?