Group Cognition in Chat: Methods of Interaction / Methodologies of Analysis

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Nordic Network for Analysis of Interaction and Learning

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Research Agenda

- How do small groups of students construct their shared experience of collaborating online?
- Group interactions have structure and elements of their own that call for analytic approaches at the small-group unit of analysis.
The VMT Project

- How do teams of middle school students (age 13-15) discuss math in a chat room?
- The Virtual Math Teams project at mathforum.org provides chat rooms for groups of 3-6 students to
  - Problem-solve a challenging algebra or geometry problem for about an hour
  - Explore an open-ended math world
  - Chat about their own math concerns
Project Questions

- How to form groups of students?
- Technologies to support collaboration?
- Math pedagogy and curriculum?
- Mentoring, training, feedback, scaffolds?
- Scalability & sustainability of a service?
- Building a user community?
- Online social practices?
- Analysis of interaction?
Conversation Analysis (CA)

- **Except:**
  - Data: chat logs (no transcription)
  - Typed, not spoken, text
  - Not F2F, no gaze, no physical engagement
  - Message production not visible
  - Mediated by chat environment
  - Messages designed for reading
  - Persistence of messages
  - Simultaneous, overlapping production
  - Math content, not informal conversation
  - Educational context, not socializing

- **Better:** Interaction Analysis
Preliminary Findings

- Methods of collaborative sense making
- Expository vs. exploratory narrative
- Individual & group knowledge intertwined
- Typical math proposal/response pairs
- Referencing math objects
- Sequentiality and flow of group consciousness
Methods

– To adapt to institutional settings
– To socialize, have fun, flirt
– To get to know each other better
– To establish interpersonal relations or roles
– To form themselves into groups
– To define a problem to work on
– To start working on a problem
– To agree on how to proceed
– To bring in math resources
– To agree on solutions
– To stop problem solving
Research Methodology

- Data sessions among researchers
  - Shared cultural basis
- Accountability as theoretical basis from ethnomethodology
  - How are texts designed to show their meaning?
- Design-based research
  - Using CA for analysis of usage
### Expository & Exploratory Discourse

<table>
<thead>
<tr>
<th></th>
<th>Expository narrative</th>
<th>Exploratory inquiry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problems seen in advance</td>
<td>X X X</td>
<td>X</td>
</tr>
<tr>
<td>Problems seen simultaneously</td>
<td>X</td>
<td>X X X</td>
</tr>
</tbody>
</table>
The Group of Individuals

Three years ago, men made up two out of every three internet users in America. Today the ratio of male to female users is about 1 to 1. In that time the number of American females using the internet has grown by 30,000,000, while the number of males who use the internet has grown by 100%. By how much has the total internet-user population increased in America in the past three years?

(A) 50,000,000 (B) 60,000,000 (C) 80,000,000 (D) 100,000,000 (E) 200,000,000
<table>
<thead>
<tr>
<th>Line</th>
<th>Time</th>
<th>Name</th>
<th>Message</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>350</td>
<td>4:31:55</td>
<td>Mic</td>
<td>how do we do this..</td>
<td></td>
</tr>
<tr>
<td>351</td>
<td>4:31:59</td>
<td>Mic</td>
<td>without knowing the total number</td>
<td>0:00:04</td>
</tr>
<tr>
<td>352</td>
<td>4:32:01</td>
<td>Mic</td>
<td>of internet users?</td>
<td>0:00:02</td>
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<tr>
<td>357</td>
<td>4:32:23</td>
<td>Dan</td>
<td>it all comes from the 30000000</td>
<td></td>
</tr>
<tr>
<td>358</td>
<td>4:32:23</td>
<td>Mic</td>
<td>did u get something for 10?</td>
<td>0:00:00</td>
</tr>
<tr>
<td>359</td>
<td>4:32:26</td>
<td>Dan</td>
<td>we already know</td>
<td>0:00:03</td>
</tr>
<tr>
<td>360</td>
<td>4:32:44</td>
<td>Mic</td>
<td>30000000 is the number of increase in american females</td>
<td>0:00:18</td>
</tr>
<tr>
<td>361</td>
<td>4:33:00</td>
<td>Mic</td>
<td>and since the ratio of male to female</td>
<td>0:00:16</td>
</tr>
<tr>
<td>362</td>
<td>4:33:02</td>
<td>Mic</td>
<td>is 1 to 1</td>
<td>0:00:02</td>
</tr>
<tr>
<td>363</td>
<td>4:33:09</td>
<td>Mic</td>
<td>thats all i got to give. someone finish it</td>
<td>0:00:07</td>
</tr>
<tr>
<td>364</td>
<td>4:33:10</td>
<td>Mic</td>
<td>haha</td>
<td>0:00:01</td>
</tr>
<tr>
<td>365</td>
<td>4:33:18</td>
<td>Cosi</td>
<td>hahaha</td>
<td>0:00:08</td>
</tr>
<tr>
<td>366</td>
<td>4:33:20</td>
<td>Mic</td>
<td>hahaha</td>
<td>0:00:02</td>
</tr>
<tr>
<td>367</td>
<td>4:33:21</td>
<td>Dan</td>
<td>hahaha</td>
<td>0:00:01</td>
</tr>
<tr>
<td>368</td>
<td>4:33:26</td>
<td>Mic</td>
<td>u all thought i was gonna figure it out didn't</td>
<td>0:00:05</td>
</tr>
<tr>
<td>369</td>
<td>4:33:27</td>
<td>Mic</td>
<td>u</td>
<td>0:00:01</td>
</tr>
<tr>
<td>370</td>
<td>4:33:28</td>
<td>Mic</td>
<td>huh?</td>
<td>0:00:01</td>
</tr>
<tr>
<td>371</td>
<td>4:33:28</td>
<td>Hal</td>
<td>it would be 60,000,000</td>
<td>0:00:00</td>
</tr>
<tr>
<td>372</td>
<td>4:33:30</td>
<td>Mic</td>
<td>hal</td>
<td>0:00:02</td>
</tr>
<tr>
<td>373</td>
<td>4:33:31</td>
<td>Mic</td>
<td>its all u</td>
<td>0:00:01</td>
</tr>
<tr>
<td>374</td>
<td>4:33:33</td>
<td>Mic</td>
<td>see</td>
<td>0:00:02</td>
</tr>
<tr>
<td>375</td>
<td>4:33:34</td>
<td>Mic</td>
<td>i helped</td>
<td>0:00:01</td>
</tr>
<tr>
<td>376</td>
<td>4:33:54</td>
<td>Cosi</td>
<td>ok, so what’s 11 – just guess on 10</td>
<td>0:00:20</td>
</tr>
<tr>
<td>386</td>
<td>4:34:45</td>
<td>Mic</td>
<td>lets get back to 5</td>
<td></td>
</tr>
<tr>
<td>387</td>
<td>4:34:47</td>
<td>Cosi</td>
<td>i think it's more than 60,000000</td>
<td>0:00:02</td>
</tr>
<tr>
<td>388</td>
<td>4:34:57</td>
<td>Mic</td>
<td>way to complicate things</td>
<td>0:00:10</td>
</tr>
<tr>
<td>389</td>
<td>4:35:03</td>
<td>Cosi</td>
<td>haha sorry</td>
<td>0:00:06</td>
</tr>
<tr>
<td>390</td>
<td>4:35:05</td>
<td>Mic</td>
<td>life was good until you said that</td>
<td>0:00:02</td>
</tr>
<tr>
<td>391</td>
<td>4:35:07</td>
<td>Mic</td>
<td>;(</td>
<td>0:00:02</td>
</tr>
<tr>
<td>392</td>
<td>4:35:18</td>
<td>Cosi</td>
<td>they cant get higher equally and even out to a 1 to 1 ratio</td>
<td>0:00:11</td>
</tr>
<tr>
<td>393</td>
<td>4:35:27</td>
<td>Cosi</td>
<td>oh, no wait, less than that</td>
<td>0:00:09</td>
</tr>
<tr>
<td>394</td>
<td>4:35:32</td>
<td>Cosi</td>
<td>50000000</td>
<td>0:00:05</td>
</tr>
<tr>
<td>395</td>
<td>4:35:34</td>
<td>Cosi</td>
<td>yeah, it's that</td>
<td>0:00:02</td>
</tr>
<tr>
<td>396</td>
<td>4:35:36</td>
<td>Cosi</td>
<td>im pretty sure</td>
<td>0:00:02</td>
</tr>
<tr>
<td>397</td>
<td>4:35:37</td>
<td>Mic</td>
<td>haha</td>
<td>0:00:01</td>
</tr>
<tr>
<td>398</td>
<td>4:35:38</td>
<td>Mic</td>
<td>how?</td>
<td>0:00:01</td>
</tr>
<tr>
<td>399</td>
<td>4:35:57</td>
<td>Cosi</td>
<td>because the women pop had to grow more than the men in order to even out</td>
<td>0:00:19</td>
</tr>
<tr>
<td>400</td>
<td>4:36:07</td>
<td>Cosi</td>
<td>so the men cant be equal (30)</td>
<td>0:00:10</td>
</tr>
<tr>
<td>401</td>
<td>4:36:11</td>
<td>Mic</td>
<td>oh wow...</td>
<td>0:00:04</td>
</tr>
<tr>
<td>402</td>
<td>4:36:16</td>
<td>Mic</td>
<td>i totally skipped the first sentenced</td>
<td>0:00:05</td>
</tr>
<tr>
<td>403</td>
<td>4:36:16</td>
<td>Cosi</td>
<td>therefore, the 50,000,000 is the only workable answer</td>
<td>0:00:00</td>
</tr>
<tr>
<td>404</td>
<td>4:36:19</td>
<td>Dan</td>
<td>very smart</td>
<td>0:00:03</td>
</tr>
<tr>
<td>405</td>
<td>4:36:21</td>
<td>Cosi</td>
<td>Damn im good</td>
<td>0:00:02</td>
</tr>
</tbody>
</table>
How can I figure out the increase in users without knowing the total number of internet users? <Mic>

It seems to all come from the 30,000,000 figure. <Dan>

30,000,000 is the number of increase in American females. Since the ratio of male to female is 1 to 1, <Mic>

the total of male and female combined would be 60,000,000. <Hal>

No, I think it must be more than 60,000,000 because the male and female user populations can’t get higher at equal rates and still even out to a 1 to 1 ratio after starting uneven. No, I made a mistake, the total must be less than 60,000,000. It could be 50,000,000, which is the only multiple choice option less than 60,000,000. <Cosi>

Very smart. <Dan>
Math Proposal Adjacency Pairs

1. A bid for a proposal is made by an individual for the group to work on: “I think we should ….”

2. An acceptance, confirmation or up-take is made on behalf of the group by a second person: “Ok,” “right”

3. There is an elaboration of the proposal by members of the group. The proposed work is begun, often with a secondary proposal for the first sub-step.
1. Avr (8:21:46 PM): Okay, I think we should start with the formula for the area of a triangle
2. Sup (8:22:17 PM): ok
5. pin (8:22:35 PM): yes
6. pin (8:22:37 PM): i concue
7. pin (8:22:39 PM): concur*
8. Avr (8:22:42 PM): then find the area of each triangle
10. Sup (8:23:03 PM): the base and heigth are 9 and 12 right?
11. Avr (8:23:11 PM): no
12. Sup (8:23:16 PM): o
13. Avr (8:23:16 PM): that's two separate triangles
14. Sup (8:23:19 PM): ooo
15. Sup (8:23:20 PM): ok
17. Avr (8:23:27 PM): i think we have to figure out the height by ourselves
18. Avr (8:23:29 PM): if possible
19. pin (8:24:05 PM): i know how
20. pin (8:24:09 PM): draw the altitude'
21. Avr (8:24:09 PM): how?
22. Avr (8:24:15 PM): right
23. Sup (8:24:19 PM): proportions?
24. Avr (8:24:19 PM): this is frustrating
25. Avr (8:24:22 PM): I don't have enough paper
26. pin (8:24:43 PM): i think i got it
adjacency pair
other uptake
intersubjective small-group meaning making
co-construction of sequentiality in doing math
A Failed Proposal

- 1. No semantic or syntactic structure
- 2. Poor timing in sequence of messages
- 3. Interruption of on-going work
- 4. No elicitation of a response
- 5. No proposal of work to be done
- 6. No history of helpful contributions
Comparing Proposals

17, 18. Avr (8:23:29 PM): i think we have to figure out the height by ourselves … if possible
19. pin (8:24:05 PM): i know how
21. Avr (8:24:09 PM): how?
20. pin (8:24:09 PM): draw the altitude'
22. Avr (8:24:15 PM): right
24. Avr (8:24:19 PM): this is frustrating […]
23. Sup (8:24:19 PM): proportions?
25. Avr (8:24:22 PM): […] I don't have enough paper
References & Threading

- Importance of deictic referencing & indexicality
- VMT-Chat allows explicit, graphically represented references:
  - (a) between chat messages
  - (b) from a message to drawings
- Students often combine textual & graphical referencing
1. What is the shortest path along the grid between the two points?
2. How many possible routes are there from point A to point B?
3. What is the maximum distance from point A to B if you can only travel on each POINT once?
4. How many ways are there to get from A to B in rectangle ABCD?
5. Make a right triangle with AB as the hypotenuse. What is the area of the circumscribed circle?
6. Can you go off the edge and come back somewhere else?

Extras
7. What is the shortest path along the grid between any two points $(x_1,y_1)$, $(x_2,y_2)$?
8. How many shortest paths are there from A to B and how does this vary with changes in the positioning of A relative to B?
9. Suppose the right and left edges of the grid are connected. How does that change the distances between points?
1. ImH: what is the area of this shape? [REF TO WB]
2. Jas: which shape?
3. ImH: woops
4. Imh: ahh!
5. Jas: kinda like this one? [REF TO WB]
6. Jas: the one highlighted in black and dark red?
7. ImH: between th stairs and the hypotenuse
8. Jas: oh
9. Jas: that would be a tricky problem, each little “sector” is different
10. Jas: this section [REF TO WB]
11. ImH: perimeter is 12root3
12. Jas: is smaller than this section [REF TO WB]
13. ImH: assume those lines are on the blocks
14. Jas: the staircase lines?
15. ImH: yea
16. Jas: they already are on the blocks
The Collaborative Experience

- How is the group experience structured as interpersonal interactions?
- How is the group constituted as an interactive unit?
Replies, Up-Take, Pairs, Triplets

- In CA, turn taking structures the sequentiality & social order
- In chat about math, bids & up-takes like “math proposal adjacency pairs” structure the flow of interaction
- Meaning is created by these interactions among multiple people – it is not simply transferred between individuals and agreed upon
Longer Sequences

- Adjacency pairs or bid/up-take
- Longer sequences that do some work
- Episodes of interaction
- Topics of dialog
- Online sessions
- Interruptions & returns
- Initiation & transition
- … various layers & time scales
Constructing Proofs

Problem-solving sequences of math work are analogous to proof. Proofs include:
– The problem statement/situation
– Exploratory search for a solution
– Reduction to elegant proof
– Formal proof statement
– Lived experience of following the proof (see Livingston)
Stream of Group Consciousness

- Narrative flow of group interaction: introduction, character development, problem phase, resolution, temporal sequencing
Group Cognition in Chat

- In chat, small groups construct shared meaning, solve problems, formulate proofs, conduct inquiry.
- Through interplay of interpretive perspectives, questioning, checking, etc., group cognition can exceed individual cognition.
- Small groups constitute themselves and form larger communities.
How Groups Construct their Experience

- Designers can provide environment, affordance, infrastructure, opportunities
- But the users enact their experience, establish methods of interaction, & construct shared meaning within and about their situation
How does one transform recordings of interaction into analytic accounts?

- Design-based research as tool-design, interaction usage analysis, re-design

- Member methods as analytic structures
  - Found everywhere
  - Understood by community participants
  - Facile adaptation by students
What is the relation between studies of interaction & theories of learning?

- Learning takes place through establishment of shared meaning, created in interaction (via instruction, books, guided discovery, cooperative explanation, collaborative exploration, interaction)
How does one make the analysis relevant for curricular design?

- Design opens a world of opportunities & removes barriers
- Interaction analysis shows what members can do there and what barriers remain
The VMT Team

- Principal Investigators: Gerry Stahl, Stephen Weimar, Wesley Shumar
- Math Forum staff: Stephen Weimar, Annie Fetter, Ian Underwood
- Research Assistants: Murat Cakir, Johann Sarmiento, Ramon Toledo, Nan Zhou
- Post-docs: Alan Zemel, Elizabeth Charles
- Visiting researchers: Jan-Willem Strijbos (Netherlands), Fatos Xhafa (Spain), Stefan Trausan-Matu (Romania), Martin Wessner (Germany)
- The VMT-Chat software was developed at the Fraunhofer Institute IPSI in Darmstadt, Germany, by Martin Wessner, Martin Mühlpfordt and colleagues based on their ConcertChat
- The VMT project is supported by the US National Science Foundation
“Group Cognition”
(the book)
MIT Press in the Spring
prepublication version
available now:
www.cis.drexel.edu/faculty
/gerry/mit

Journal of CSCL:
ijCSCL.org

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