Thinking at the Small-Group unit of analysis

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Overview

• What I have begun to learn from my current research – year 1 of 5 and a book

• “Thinking at the group unit of analysis”
  – Not so much an ontological commitment to group mind
  – As a methodological focus on group discourse as a process of shared meaning-making that is productively analyzed at the group level

• For CSCL to promote knowledge building, it should understand & support with technology thinking at the group unit of analysis
How can we analyze collaborative learning?

- What are the students doing in a video clip?
- How should we analyze their interaction?
- What methods can we use to analyze the methods they use to interact?
- How can we understand, evaluate and re-design educational interventions – What analytic methods do we have to understand learning practices in design-based research?
How should we understand collaborative learning?

• Should we view a group as the sum of its individual members?

• Or should we view the group as an emergent phenomenon with its own ideas?

• What is the relation of the individuals to their group?
Multiple units of analysis

• The tradition in education and psychology methodologies is to focus on the *individual person* as the unit of analysis: what is the person doing, thinking, intending, learning

• The tradition in sociology and anthropology methodologies is to focus on the *social unit or culture* as the unit of analysis: what are the norms, institutions, values, rules

• CSCL work may benefit from also focusing on the *small group* as the unit of analysis: what is happening in the interaction, discourse, shared meaning-making
Distinguish perspectives

<table>
<thead>
<tr>
<th>agent</th>
<th>activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td>Interpretation</td>
</tr>
<tr>
<td>Small Group</td>
<td>Meaning-making</td>
</tr>
<tr>
<td>Community of practice</td>
<td>Social practice</td>
</tr>
<tr>
<td>Researcher</td>
<td>Analysis</td>
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<tr>
<td>Educational innovator</td>
<td>Design</td>
</tr>
</tbody>
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3 Theories of Collaborative Learning

• Vygotsky: internalization – often taken as a focus on the *individual* psychology

• Lave: participation in community practice – often taken as a focus on the *community* sociology

• Small groups as engine of knowledge building – focus on the *intermediate* unit of analysis
Groups rock!

Some research hypotheses for future empirical investigation and for a theory of small group cognition grounded in such analysis:

• The *small group* is the unit that mediates between individual learning and community learning.
• *Community* participation takes place primarily within small group activities.
• *Individual* learning is acquired through participation in these small group activities.
• Both individual identities and community practices are formed through small group activities.
Group activity theory

- Activity Theory
- Mediation of Group Cognition

**Shannon transmission theory**
- S ———— O
- S = situated, engaged self or other: dialog or discourse theory
- G = mediating group cognition: small group collaboration

**Vygotsky mediated cognition**
- S ———— S
- S = situated, engaged self or other: dialog or discourse theory
- G = mediating group cognition: small group collaboration

**Engeström activity structure**
- S ———— O
- S = situated, engaged self or other: dialog or discourse theory
- G = mediating group cognition: small group collaboration
- CoP
- Discourse Community
Group cognition

• Cognition = thought = logic = coherent sequence of meaningful units

• Rationality as sequentiality
  – Sentence, argument, proof

• Dyadic conversation as sequentiality
  – Conversation analysis: turn-taking dialog (sequencing), building common ground (group meaning)

• Small group cognition as sequentiality
  – Interpretation, negotiation, meaning-making
Voices intertwine into 1 cognitive act

In the following transcript from the SimRocket video clip:

- Utterances build sequentially
- Each is interpreted by later utterances
- Each refers to previous utterances
- They reference (index) artifacts
- They are situated in the network of their references
Individual utterances are meaning-less

- 1:22:05 Brent    This one’s different
- 1:22:06 Jamie    Yeah, but it has same no...
- 1:22:08 Chuck    Pointy nose cone
- 1:22:09 Steven   Oh, yeah
- 1:22:10 Chuck    But it’s not the same engine
- 1:22:11 Jamie    Yeah, it is,
- 1:22:12 Brent    Yes it is,
- 1:22:13 Jamie    Compare two n one
- 1:22:13 Brent    Number two
- 1:22:14 Chuck    I know.
- 1:22:15 Jamie    Are the same
- 1:22:16 Chuck    Oh
- 1:22:17 Brent    It’s the same engine.
- 1:22:18 Jamie    So if you compare two n one,
- 1:22:19 Chuck    Oh yeah, I see, I see, I see
Cognitive change by the group
Looking for a comparison to a standard (Rocket 3)

- Rocket 1 with **big bertha engine**, rounded nose cone, 3 fins and sanded body.
- Rocket 2 with **big bertha engine**, pointed nose cone, 3 fins and sanded body.
- Rocket 3 with **astro alpha engine**, rounded nose cone, 3 fins and sanded body.
- Rocket 4 with **astro alpha engine**, rounded nose cone, 4 fins and sanded body.
- Rocket 5 with **crazy quasar engine**, rounded nose cone, 3 fins and sanded body.
- Rocket 6 with **crazy quasar engine**, rounded nose cone, 3 fins and painted body.
- Rocket 7 with **giant gamma engine**, rounded nose cone, 3 fins and sanded body.
- Rocket 8 with **giant gamma engine**, pointed nose cone, 4 fins and painted body.
The group sees differently

- Rocket 1 with **big bertha engine**, rounded nose cone, 3 fins and sanded body.
- Rocket 2 with **big bertha engine**, pointed nose cone, 3 fins and sanded body.
- Rocket 3 with **astro alpha engine**, rounded nose cone, 3 fins and sanded body.
- Rocket 4 with **astro alpha engine**, rounded nose cone, 4 fins and sanded body.
- Rocket 5 with **crazy quasar engine**, rounded nose cone, 3 fins and sanded body.
- Rocket 6 with **crazy quasar engine**, rounded nose cone, 3 fins and **painted** body.
- Rocket 7 with **giant gamma engine**, rounded nose cone, 3 fins and sanded body.

See list as pairs of comparatives (Rocket 1 & 2)
SimRocket video

simrocket.avi
Mind as cognitive artifacts

- Group underwent cognitive change
- Shift in viewing “as”: list as structured
- Gave new shared meaning to list artifact
- Interactively constructed a new conceptual tool: paired configurations
- Individuals can internalize this as a “cognitive artifact” – expand their minds
Varieties of collaborative learning

• Middle school public school math classroom in South Philadelphia
• Students work independently in groups
• But in parallel – in synch
• Help each other; maintain synch
• Negotiate & share meanings
Individual $\rightarrow$ group $\rightarrow$ individual

- As in SimRocket (middle school public classroom in North Boulder),
- actions of individuals interact
- and their interpretations intertwine
- to produce shared group meanings
- Different ways of collaborating, different classroom norms, different group practices
Parallel collaboration at Sharswood  

A collaborative math class  
Sharswood Middle School  
Philadelphia School District
Making learning visible

• Participants must make their learning & understanding visible to each other in order to collaborate
• Video makes their displays visible to researchers: persistent & repeatable
• We can identify member methods of interaction, practices of enactment
• Practices can serve as analytic items
Doing ignorance

Erasure
by Prof. Wesley Shumar
Math Forum ethnographer

erasure bw.avi
Collaborating on math

• Individuals contribute proposals
• Checking of each other’s proposals
• Negotiation of agreement
  – Not just correct math
  – But also shared meaning
• Synch of bodies as roles change
Computing $\pi$ • College students at Drexel
Constructing new math

- Synch of bodies as roles change
- Defining the problem collaboratively
- Negotiation of agreement
  - Not just correct math
  - But also creating something new
  - Enjoying the interaction
    - Socially and intellectually
“Rocking taxicab geometry” – constructing new math

- College students at Drexel
Virtual Math Teams

- Students come to Math Forum and register to join an online team of students to discuss an interesting math problem from the Problem of the Week (PoW)
- They meet in a collaboration chat room (PowWow) for about an hour
- Year 1 of a 5 year research project to design problems, group formation procedures, collaboration supports, software media, research methods
Doing problem solving

- The group constructs steps of a math proof or problem solution
- The members negotiate each step
- The solution is carried out as social discourse:
  - It includes social interaction
  - Building personal identities
  - Recognition & power relationships
  - Reflection on the interaction
  - etc.
Intertwining group meaning-making & individual interpretation

• As the group builds toward a solution,
• individuals reconcile their interpretations
• and agree on each step
• or discuss until they agree
• This way, opinions are checked from multiple perspectives until tentatively accepted as shared group knowledge
• And the group knowledge (shared meaning) is incorporated in the personal understandings (individual interpretations)
Okay, I think we should start with the formula for the area of a triangle.

A = \frac{1}{2}bh

I believe.

yes

i concue

concur*

then find the area of each triangle

oh, wait

the base and height are 9 and 12 right?

no

that's two separate triangles

ooo

ok

right

i think we have to figure out the height by ourselves

if possible

i know how

draw the altitude'

how?

right

proportions?

this is frustrating

I don't have enough paper

i think i got it

its a 30/60/90 triangle

I see
A research agenda

Here are some theoretical issues investigated in part III of my book as part of a research program focused on the small group unit of analysis:

• Can we learn from traditional communication theories and technologies how to support online small groups? (chapter 14)
• Can processes of group cognition provide a basis for individual cognition and learning? (chapter 15)
• Can we identify meaning-making and knowledge-building at the group unit? (chapter 16)
• Can we understand how group meaning is shared among group members? (chapter 17)
• Can we make learning visible in group discourse, so we do not have to be confined to measuring indirect learning outcomes? (chapter 18)
• Can we say that it is possible for a group as such to think / learn / build knowledge / construct meanings that cannot be attributed to any of the group members individually? (chapter 19)
• Can we develop new conceptions of group discourse that might open up innovative approaches to fostering group cognition? (chapter 20)
Group discourse

- The group discourse is the medium in which shared meaning is constructed during collaboration
- Ask what an utterance means (what role it plays, how it is used, what work it does) in the discourse, rather than what the speaker had “in mind”
- Participants offer their interpretations from their personal perspectives
- These are intertwined and established as shared before the group can go on
Group cognition

- Group cognition emerges as shared discourse
- It provides ideas, vocabulary, artifacts & meanings for both individual participants and for their community of practice
- To study learning, knowledge-building, meaning-making, collaboration, etc. we should focus on the small group as unit of analysis and make visible the emergence of group cognition from the intertwining of individual efforts
- A focus on group cognition does not minimize the possibility of individual intelligence – rather, it shows the origin of meanings, artifacts, language, mental skills, motivations and behaviors that make individual intelligence possible as more than animal instincts.
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this presentation:
www.cis.drexel.edu/faculty/gerry/europe.html

forthcoming book:
www.cis.drexel.edu/faculty/gerry/mit

new journal:
ijCSCL.org