Conceptual Framework for Knowledge Building Analytics

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Outline

- Understanding KB analytics
- Analyzing KB as a multi-level emergent system
- Examples of KB analytics in levels

Learning vs. Knowledge Building Analytics

- Learning/knowledge building analytics is the measurement, collection, analysis and reporting of data about learners/ knowledge builders and their learning/knowledge building processes in contexts, for purposes of understanding and optimizing learning/knowledge building and the environments in which it occurs.

- Difference btw. Learning and KB
  - Learning is an internal process that results in changes of beliefs, attitudes, or skills.
  - Knowledge building is a process of creating and advancing public/community knowledge: knowledge outside the mind

(SoLAR, 2011)

Theory-Guided Analysis

- Vast data, diverse analysis tools
- Avoid “garbage in, garbage out,”
- We need conceptual frameworks to guide:
  - what data to input,
  - to output what patterns,
  - for what purpose/meaning.

From Knowledge-based to Choice-based Assessment

- “At the end of the day, whether a student has “good knowledge” will be crucial only to the degree that knowledge leads to good choices, so why not measure choices directly in educational assessments? “

Measuring What Matters Most (Shwartz & Arena)

Knowledge Building as a Multilevel Emergent System

- Social emergence: The emergence of KB collaboratives from members' interactions
  - from individuals to emergent groups (social knots), community-wide interaction (across groups), inter-community networks
- Epistemic emergence: The emergence of "big ideas" (core conceptualizations and frameworks of thinking) from micro idea interactions
  - Idea contributions→ insights from an idea thread→ advances from idea thread clusters→ "big ideas" across clusters/areas

(Sawyer, 2005; Stahl, 2013; Hong et al., 2010; Zhang, 2012; Zhang et al., 2009).

Essential to Both Social and Epistemic Emergence…

- Temporal dynamics:
  - The current roots in the past and seeds the future
  - Levels of timescales from micro (e.g. one episode, lesson) to macro (whole initiative, longer trajectories of work)

- Micro-macro links:
  - Existing/ongoing micro interactions give emergence to macro collective social and conceptual structures
  - Macro collective structures have downward impact on micro interactions
  - Macro structures are often not visible to the participants
  - View each level in the context of the higher and lower levels (Lemke, 2000)

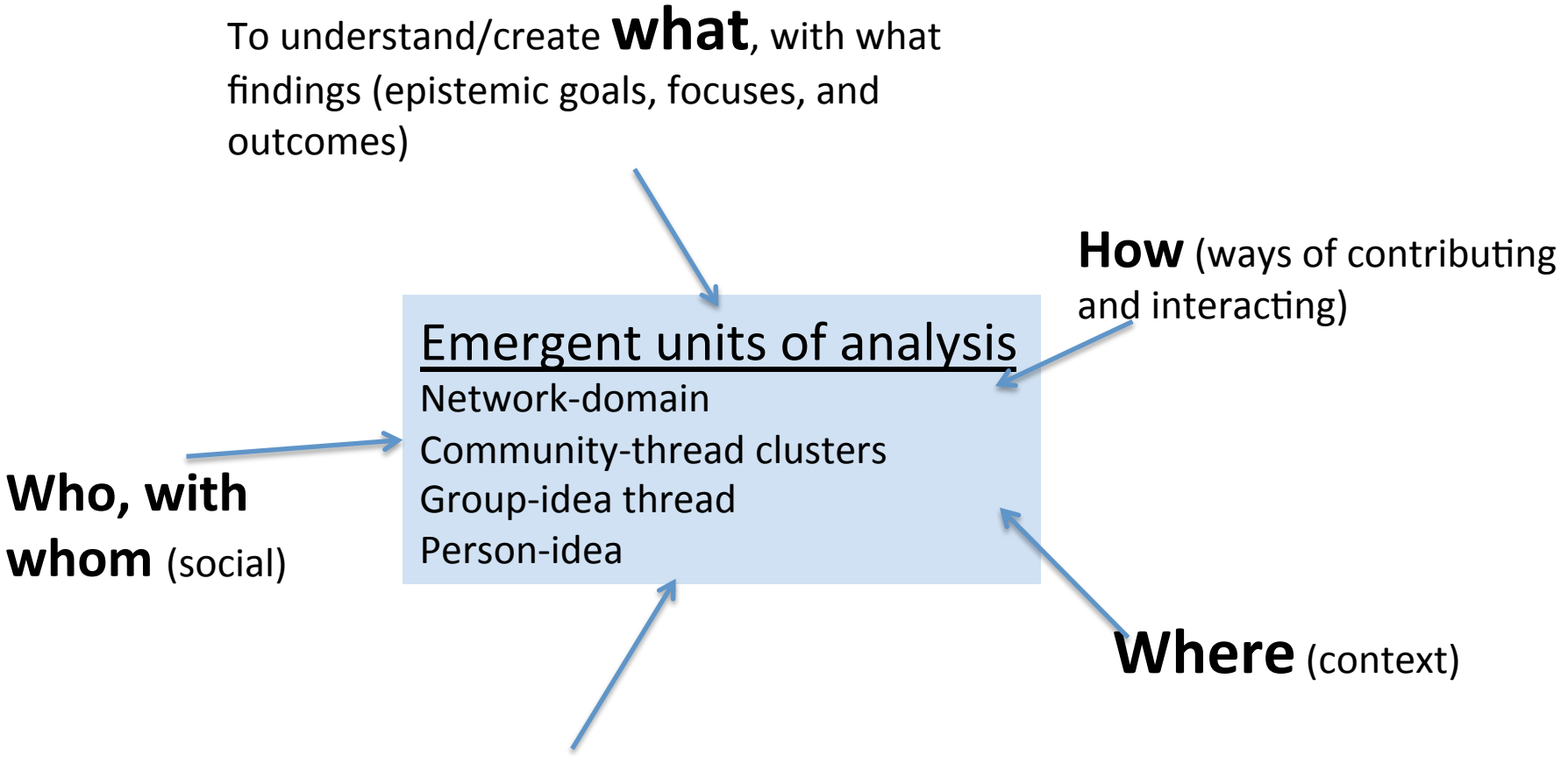
Theory-Guided Data Sampling/Sorting

- We need **time-marked socio-epistemic data** about KB
- Organized based on **multiple units/levels** of the KB system
  - Individual idea/posting contributed by a member
  - A build-on tree contributed by several immediately connected peers
  - An idea thread (line of inquiry) by an opportunistic group sharing the same interest
  - A cluster of idea threads by several overlapping groups
  - A whole initiative with multiple clusters of idea threads of a community
  - Interrelated initiatives in an area of multiple communities

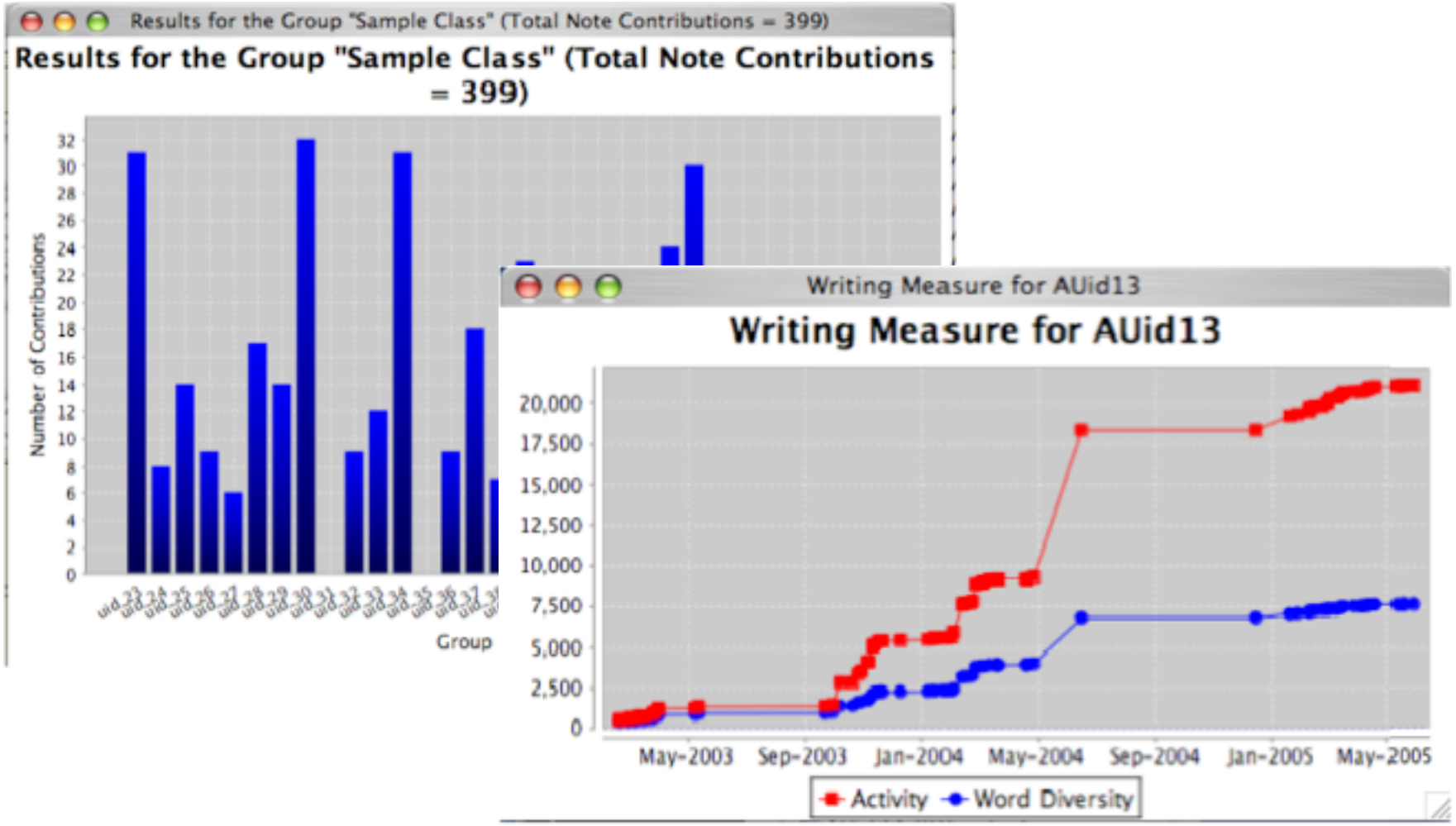
Theory-Informed Patterns as the Output of Analysis

- **<u>Patterns nested in different socio-epistemic levels (units)</u>**
  - "Person-idea": What's my focus of choice? How have I been contributing?
    - Ways of contribution, such as problematizing, theorizing, elaborating, referencing, evidence use, synthesizing…
  - "Sub-Group-idea thread": What are our shared focus of choice? How are we advancing ideas in a focal line of work?
    - Focal topics and associated contributions and contributors, progressive chain of problems and ideas, interactivity, conceptual change, idea summarization
  - "Community-thread cluster": How are we building knowledge as a community in a whole initiative?
    - Idea thread mapping, topic/concept networks (clouds), social networks, inter-thread connection, diffusion/transfer of core conceptions
  - "Network-domain/field": How has a network of communities been advancing ideas in a shared domain/field?
    - Cross-community topic/concept mapping, idea thread matching, idea and practice bridging/borrowing

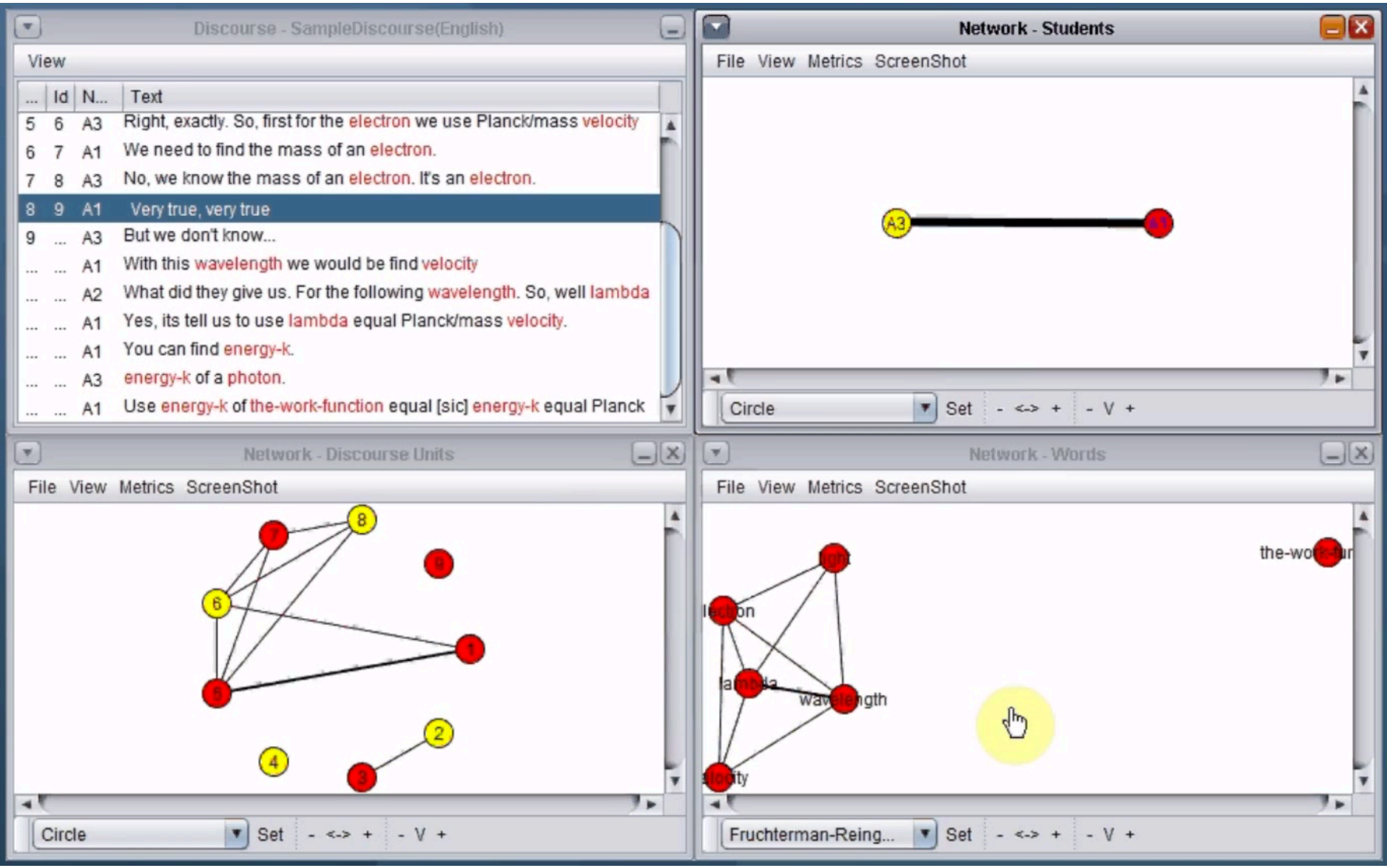
Integrating Multiple Dimensions for Each Unit/Level of Analysis



Individual “Person-idea”: How have I been contributing?



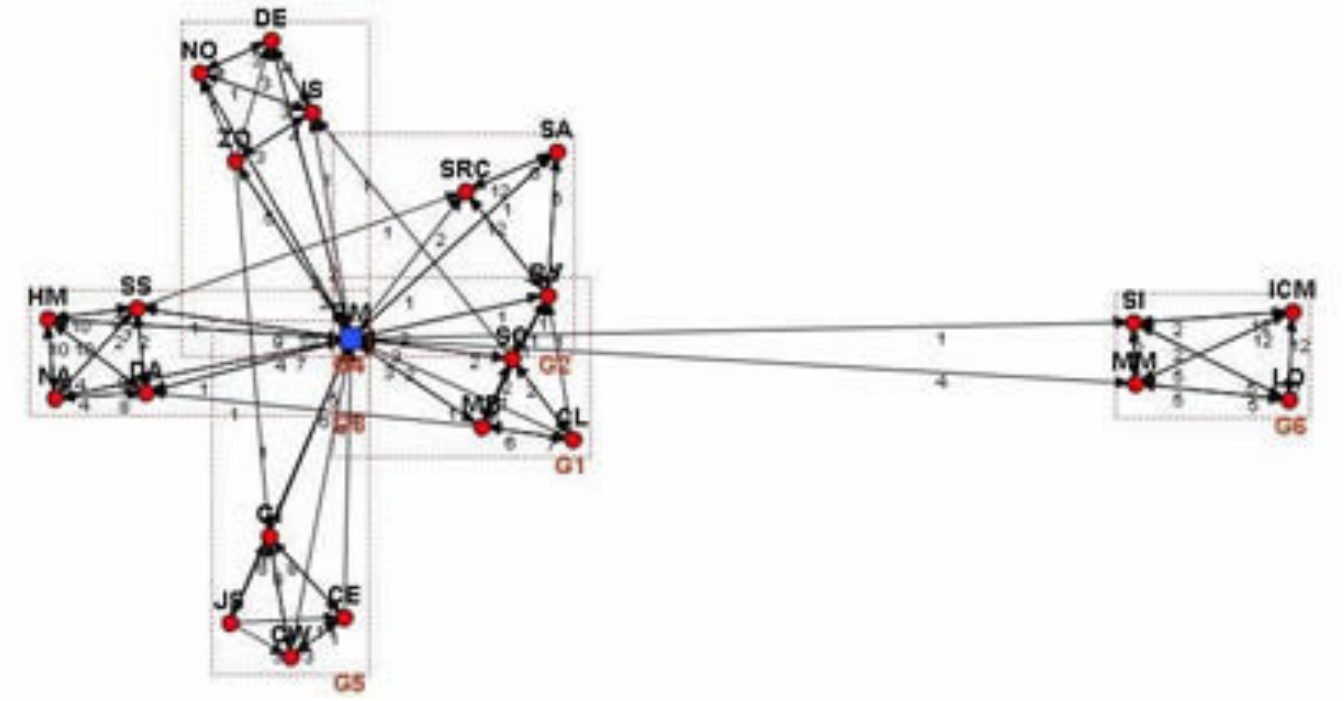
(Teplovs, Donoahue, Scardamalia, & Philip, 2007)



(Oshima, Oshima, & Matsuzawa, 2012)

The framework suggests that these analyses can be embedded in high levels and integrate multiple dimensions: contributions and promising ideas in which area/line of work, about what content, from whom, when…

Emergent Group-Idea Thread

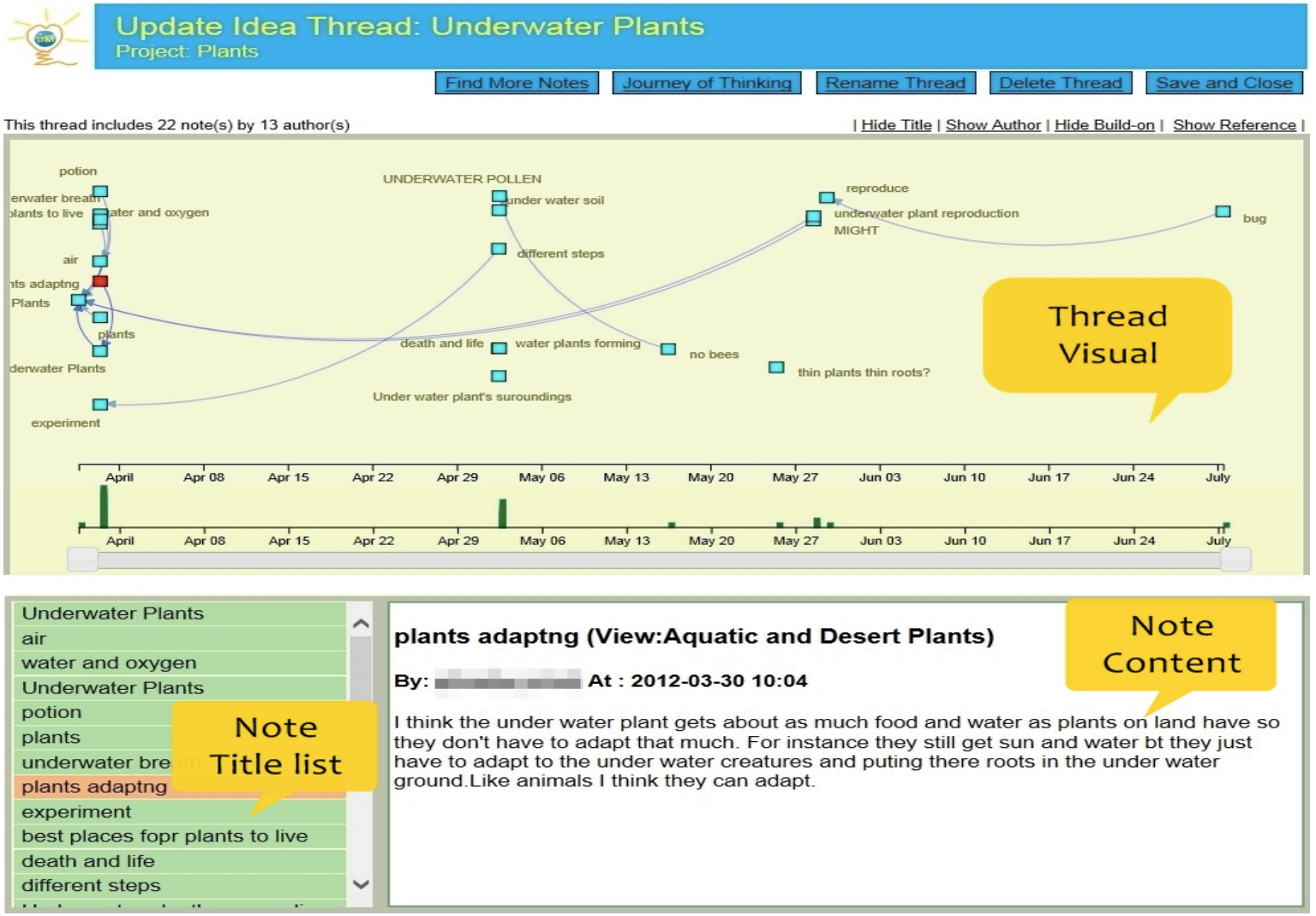


Analyze sub-networks (cliques and clusters) in SNA

Zhang et al., 2009

Future efforts to connect social cliques with other dimensions such as what, when…

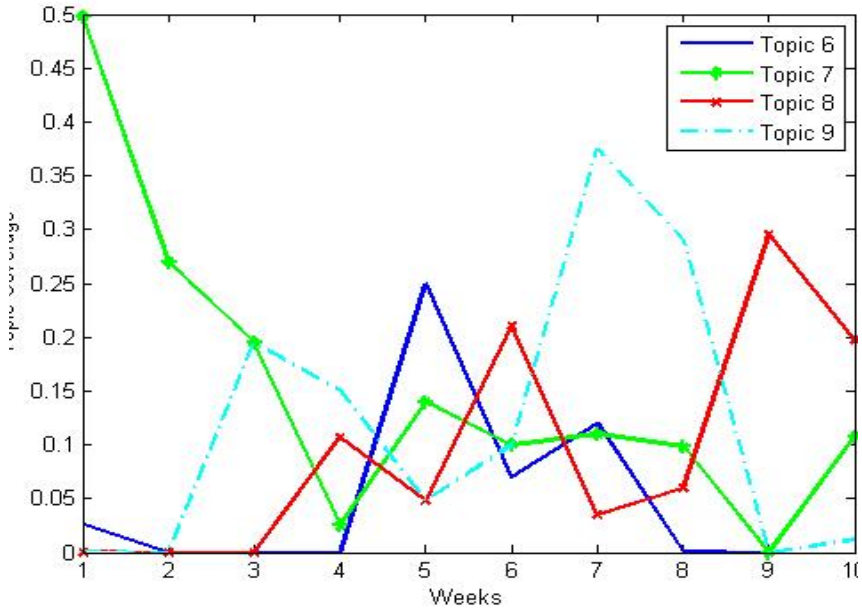
Emergent Group-Idea Thread



Chen et al., 2013

Emergent Group-Idea Thread

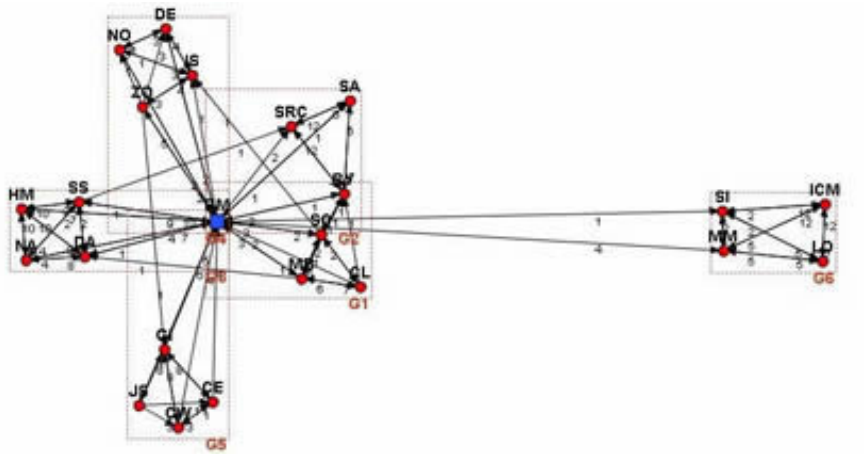
Probabilistic Topic Models (Sun et al., 2014)

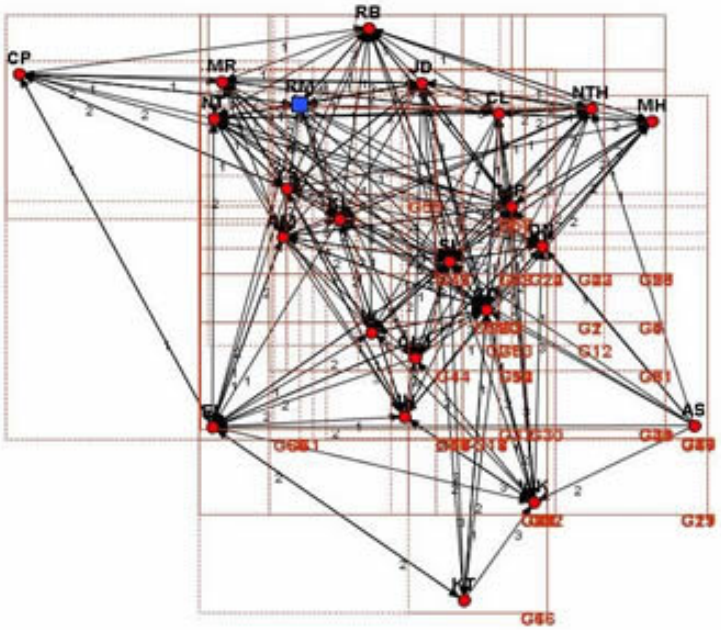


Topic 6	'sun' 'when' 'earth' 'moon' 'eclipse' 'shadow' 'other' 'world' 'around' 'line' Eclipses and seasons	Eclipses and seasons
Topic 7	'white' 'snow' 'colour' 'prism' 'black' 'melt' 'when' 'see' 'fast' 'why'	White light and snow
Topic 8	'shadow' 'object' 'made' 'opaque' 'energy' 'part' 'call' 'umbra' 'what' 'go'Shadows and light sources	Shadows and light sources
Topic 9	'through' 'go' 'can' 'reflect' 'tinfoil' 't' 'think' 'was' 'angle' 'when'	Reflective materials

Whole Community-Thread Clusters

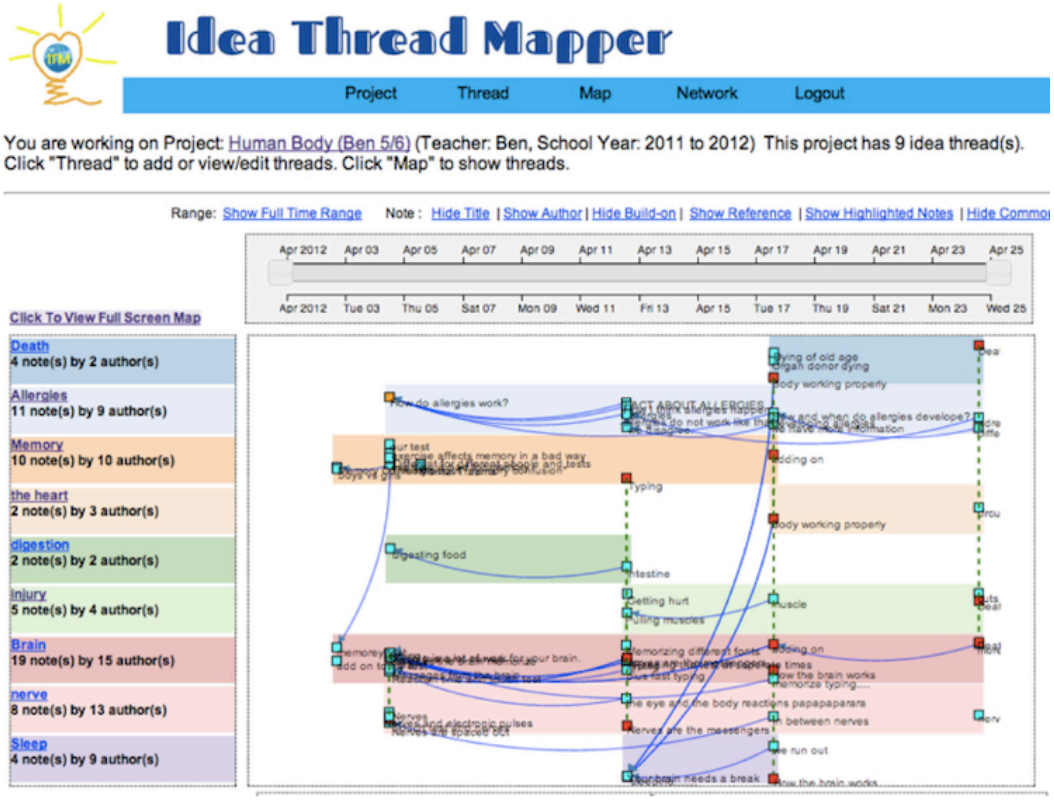
- Network Centrality, Cohesion…



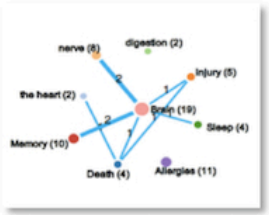


From more centralized to more distributed and coherent networks (Zhang et al., 2009)

Whole Community-Thread Clusters



Example analyses: Distribution of notes in threads



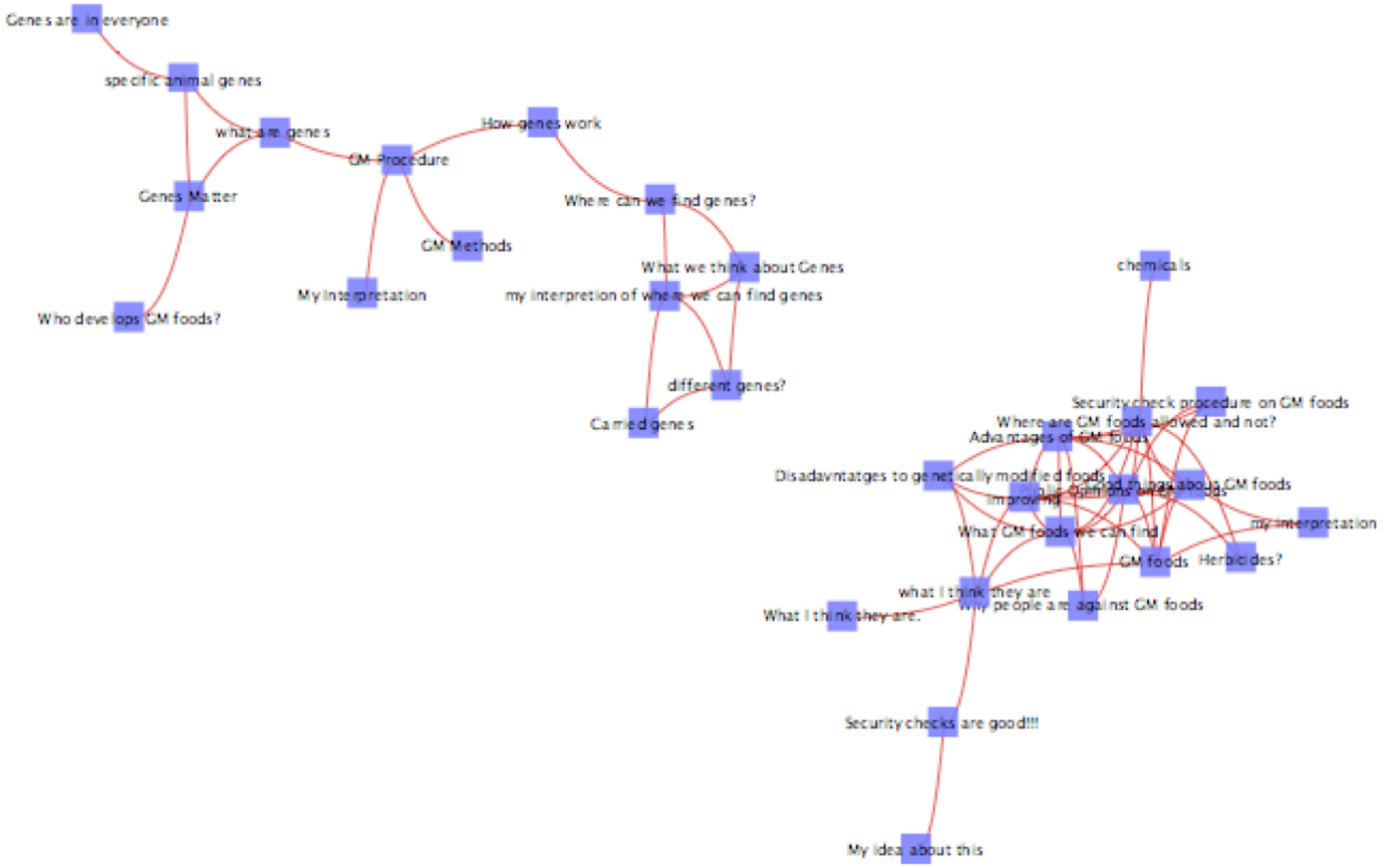
Cross-thread connection

Whole Community-Thread Clusters

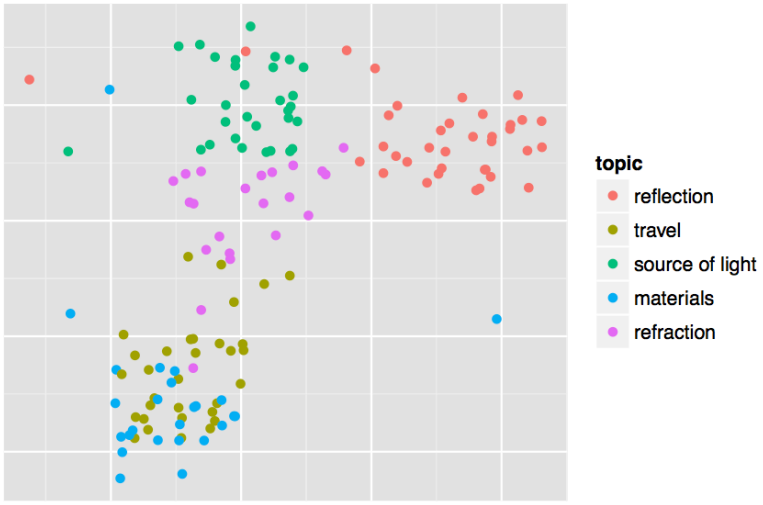
- Community knowledge represented by key-term cloud in a grade5/6 class exploring human body system (Hong & Scardamalia, 2014)

- Future efforts need to connect word clouds to other dimensions: who, when, how (ways of contribution)…

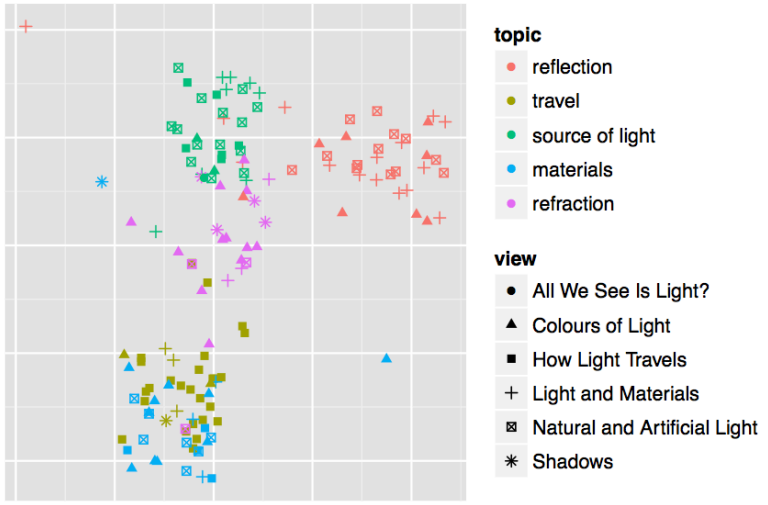
Semantic links among notes (Teplovs, 2010)



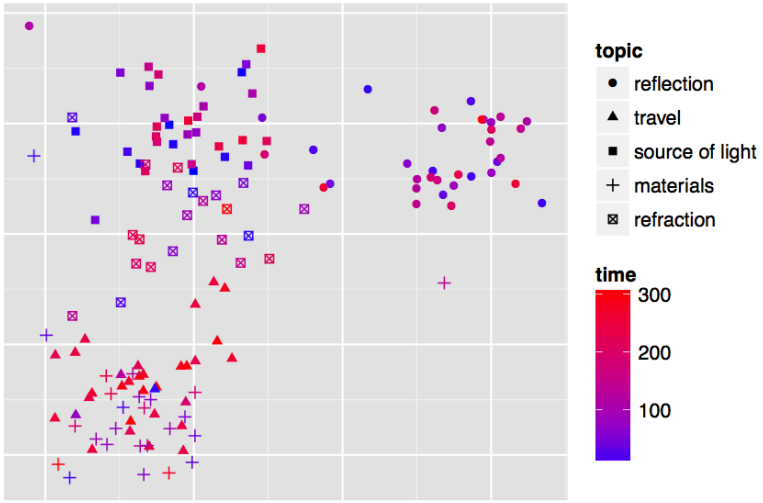
Explorations of visualizing semantic space by different variables (Chen, 2014)



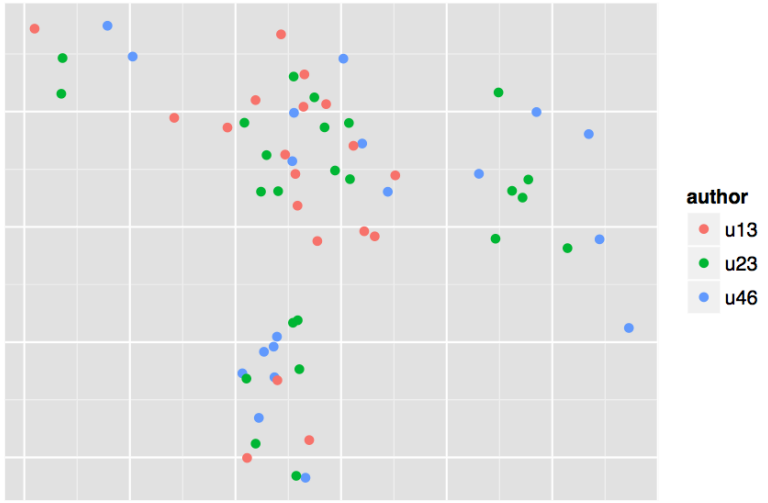
(1) By topics (top 5 topics)



(2) By topics and views



(3) By time



(4) By students (top 3)

Inter-community networks-Knowledge Domains

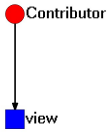
KSN as an example (Hong, Scardamalia, Zhang, 2010)

Legend

A red-circled node = a contributor

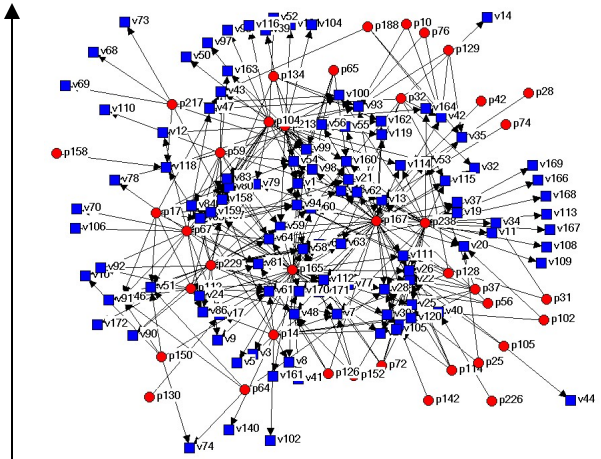
A blue-squared node = a view

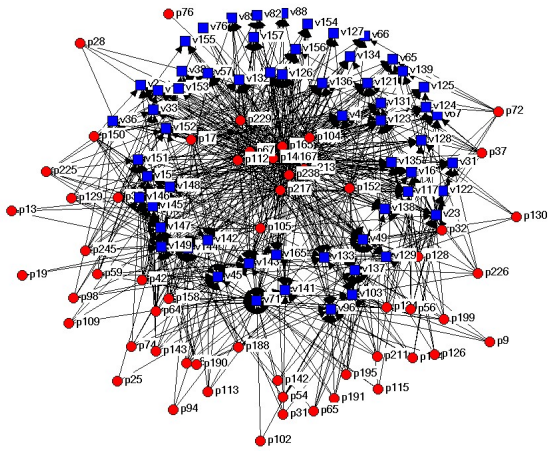
Tie= strength of knowledge-building (note contribution from a contributor to a view) as measured by the unit of analysis:

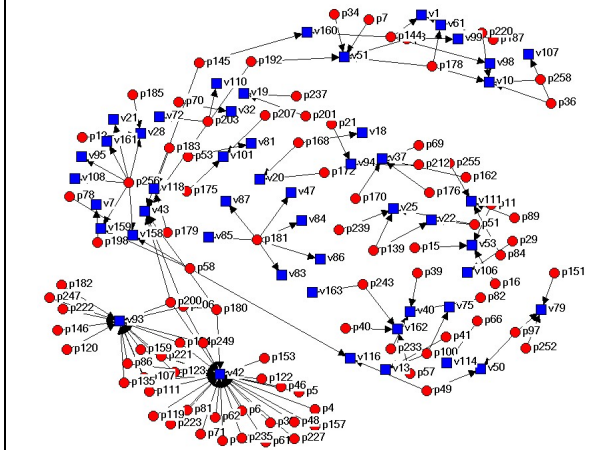


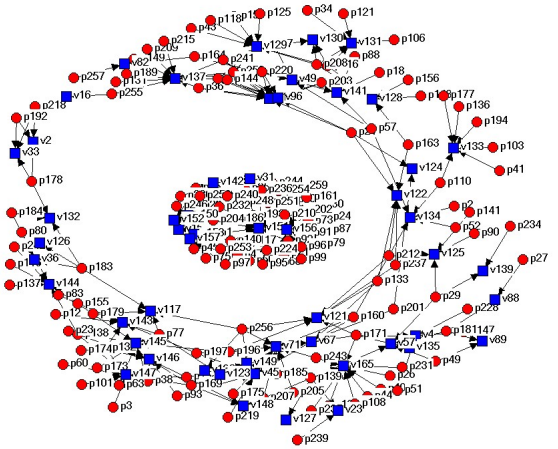
Strong Collaboration

Weak Collaboration







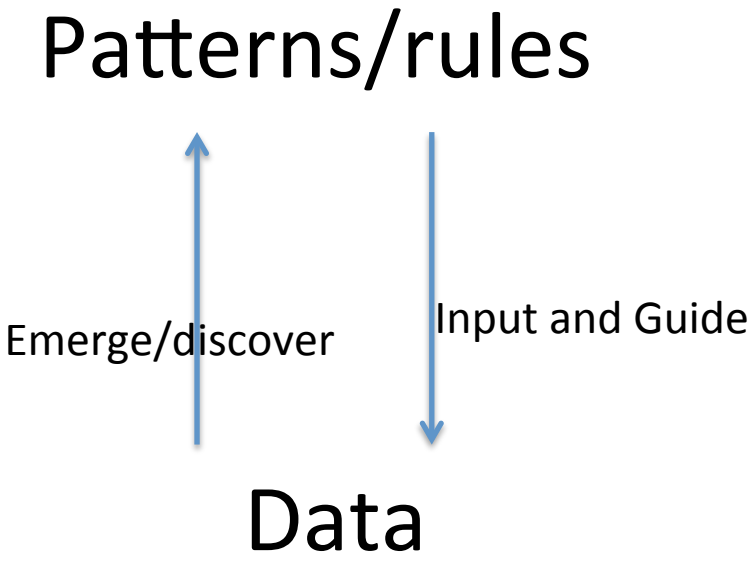


Weak Knowledge-interaction

Strong Knowledge-interaction

Future efforts: open data and make visible of which community (who) is advancing what knowledge

Integrating Bottom-Up and Top-Down Processes



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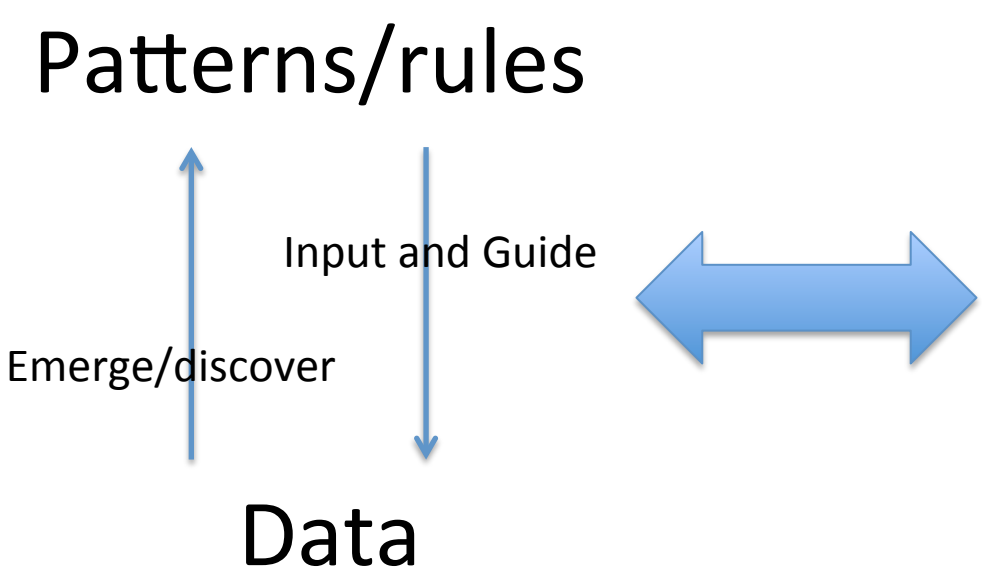

Progressive problem-solving and community knowledge advancement

General discussion

- Data is not neutral
- KBE is not neutral
- How to conceptually integrate various KB measures into more coherent higher-level KB indicators?
- How to technologically link different KB analytic tools for more sophisticated use of knowledge advancement?

Thanks!

For What Purpose/Use?

- Reflective feedback
- Formative assessment
- Summative assessment
- Emergent representation of epistemic and social structures across the different levels
  - Shared goals
  - Practice profiles (e.g. ways of contributing and interacting)
  - Collective knowledge and trajectories
  - Sub-community structures
  - Idea-person connections
  - Cross-community connections