

# An Innovative Social-Cognitive Engagement Network Representation

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**Abstract:** Collaborative learning stresses an intertwined relationship between social interaction and cognitive engagement. To support collaboration, emerging social network representations strive to demonstrate not only social interactional relations, but also cognitive-related information. In this poster, we proposed an innovative social-cognitive network representation to track learners' social interactions and cognitive engagements, in order to better understand the relationships between them.

## Introduction and literature review

Grounded upon socio-cognitive constructivism theories (Liu & Matthews, 2005), collaborative learning stresses an intertwined relationship between social interaction and cognitive engagement. To support learners' collaboration, e.g., building knowledge-based epistemic objects and materially-embodied prototypes, it is beneficial to provide learners with both social (e.g., who interacted with whom) and cognitive (e.g., what information is exchanged) information.

Social network analysis (SNA) is a research method and visualization approach in the computer-supported collaborative learning (CSCL) field to examine relations between learners, characteristics of the relations, and temporality of interactions during collaboration (Cohen, Manion, & Morrison, 2013). In SNA representation, a social network is represented in graphics with entities as *nodes*, and the connections between two entities as *ties*. A node is any entity in CSCL: human (e.g., instructors, students, groups) and non-human (e.g., epistemic objects, materially-embodied prototypes). A tie is the link between two entities in a network, which has its own weights and directions.

Recently, emerging innovative SNA visualizations strive to demonstrate not only social interactional relation, but also cognitive-related information. Literature review revealed three main approaches. Taking epistemic concepts or ideas as network entities, the first approach visualizes the relations between cognitive entities through network representations (e.g., Shaffer, Collier, & Ruis, 2016). This approach can be used to demonstrate co-occurrence of concepts, keywords, or ideas within given texts. The second approach demonstrates the relations between learners and cognitive-related entities, such as who contributes to what concepts, keywords, or ideas (e.g., Oshima, Oshima, & Matsuzawa, 2012). Third, both social information (e.g., peer interaction) and cognitive information (e.g., discussion topics) in a network graph to aid students' collaborative argumentation (e.g., Dado & Bodemer, 2018). Therefore, it is beneficial to demonstrate both social and cognitive information in order to facilitate collaboration by using SNA visualization tools or representations. Therefore, it is beneficial to demonstrate both social and cognitive information in order to facilitate collaboration by using SNA visualization tools or representations. In this poster, we proposed and applied an innovative social-cognitive network representation to show learners' social and cognitive engagement.

## Research methodology

This proposed social-cognitive engagement network representation demonstrated both social interactions (e.g., participatory role, network position, interaction frequency) and cognitive engagements (e.g., knowledge inquiry, knowledge construction). We defined six social participatory roles to capture interaction patterns, i.e., *leader*, *starter*, *influencer*, *mediator*, *regular*, and *peripheral*, in terms of the levels of participation (reflected by outdegree and outcloseness), influence (reflected by indegree and incloseness) and mediation (reflected by betweenness) (Marcos-García, Martínez-Monés, & Dimitriadis, 2015). We defined six cognitive engagement levels including superficial-, medium- and deep-level "knowledge inquiry" (individual cognitive inquiry), and superficial-, medium- and deep-level "knowledge construction" (group knowledge advancement) (see Ouyang & Chang, 2018 for more details). In the social-cognitive network, node size represents a student's knowledge inquiry score in the individual level; edge width between two students represents knowledge construction score during peer interactions in the group level; node color represents a student's social participatory role. We empirically applied this network representation to show students' social and cognitive engagement in three online discussions from a graduate-level online course.

## Visual representation results

The social-cognitive networks revealed students' social participatory roles, cognitive engagement levels and the relationship between them. (see Figure 1). First, active students (e.g., *leader* R) consistently played active roles throughout discussions and had medium/high cognitive engagement. Inactive students (e.g., *peripheral* P) demonstrated inactive roles and had low/medium cognitive engagement. Second, some *leader* students made no contribution to knowledge inquiry within initial comments (e.g., R and C in discussion 3), while a couple of *peripheral* students made high-level knowledge inquiry (e.g., T in discussion 3). Third, there were very few mediator students, serving as bridges between sub-groups; they made medium level contributions to knowledge inquiry and knowledge construction (see Figure 1).

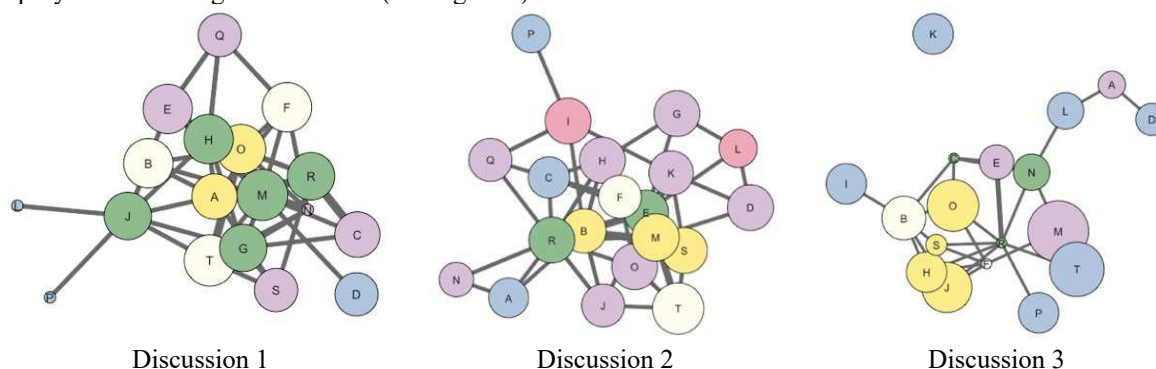


Figure 1. Social-cognitive networks.

Note. Green - leader, yellow - influencer, ivory - starter, coral - mediator, purple - regular, and blue - peripheral.

## Practical implications

To support learners' collaboration, e.g., building knowledge-based epistemic objects and materially-embodied prototypes, collaborative learning tools or representations should strive to provide both social and cognitive information. The lack of cognitive-related information may impede learner agency development. For example, some *peripheral* students did post deep-level knowledge inquiry but did not get enough peer responses to further build up knowledge construction. When these students were only provided with low-level social interaction information, their motivation for taking actions on further social-cognitive engagement may be discouraged. If students were provided with both social and cognitive information, they would develop a better self-awareness of their learning processes, which is a first step toward further knowledge construction in the groups. Therefore, it is necessary to provide students with social- and cognitive-related information through social-cognitive engagement network representations.

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