Social Network Analysis for Knowledge Building: Establishment of Indicators for Collective Knowledge Advancement

Jun Oshima, Yoshiaki Matsuzawa, Ritsuko Oshima, Shizuoka Univ.,
3-5-1 Johoku Naka-ku Hamamatsu-shi JAPAN
joshima@inf.shizuoka.ac.jp, matsuzawa@inf.shizuoka.ac.jp, roshima@inf.shizuoka.ac.jp
Carol Chan, Jan van Aalst, Univ. of Hong Kong
eckchan@hkuce.hku.hk, vanaalst@hkuce.hku.hk

Abstract: This study aims at applying social network analysis (SNA) to establishing indicators for collective knowledge advancement. To do so, a SNA application, KBDeX, was developed and the effectiveness of several indicators was examined by applying them to an evaluation of students’ discourse. Results indicated that SNA with our proposed indicators might quantitatively capture the collective knowledge advancement.

Theoretical Background and Purpose

In educational research on networked learning and computer-supported collaborative learning, there have been discussions on the advantages of using SNA to investigate collective knowledge advancement and individual learners’ engagement in this advancement (e.g., De Laat, Lally, Lipponen, & Simons, 2007). A limited number of studies have used SNA, especially in the knowledge-creation metaphor (Paavola, Lipponen, & Hakkarainen, 2004). Over a period of three years, Zhang, Scardamalia, Reeve, and Messina (2009) implemented a complementary approach that used SNA to visualize and compare classroom collaboration among fourth grade elementary school students through a CSCL environment designed to support them in knowledge building. An analysis of the students’ online participatory patterns and knowledge advancement indicated that this learning process facilitated students’ knowledge advancement effectively, and that this was the case through critical changes in organizations within the classroom: from fixed small groups in the first year of the study to appropriate collaboration through dynamic formation of small teams based on emergent goals.

Oshima, Oshima, and Knowledge Forum Japan Research Group (2007) further extended the potential of SNA as a core assessment technique by describing a different type of social network. Ordinary SNA illustrates the social patterns of learners, namely, the learners’ social network. As de Laat et al. (2007) suggested, this approach is thus informative when examining developments or changes in the participatory structure of a community. However, Oshima et al. (2007) argued that existing social network models are unable to examine how collective knowledge advances through learners’ collaboration. Instead, they used a similar procedure to that in ordinary SNA, but proposed a different type of social network, one based on the words learners use in their discourse on a CSCL environment. This social network, with words selected as nodes representing learners’ knowledge or ideas during discourse on a study topic, was compared with a network of words from the discourse of a group of experts on the same topic. The results showed that there were remarkable differences in the collective knowledge of elementary school students and of experts in terms of the words centered on the networks. Oshima et al. concluded that SNA could provide a new type of representation of knowledge building by learners, enabling researchers to adopt a new complementary assessment technique for investigating knowledge building community models.

Although educational studies have proposed the application of SNA to learning analysis as a new assessment technique in the knowledge-creation metaphor, an exact methodology has to be established. Currently, researchers familiar with SNA conduct analysis with whatever software is available to them. For those interested in using SNA to analyze discourse data for examining participation patterns and collective knowledge advancement during collaborative learning, SNA software that can easily explore discourse data is needed. As a consequence, we have developed the Knowledge Building Discourse Explorer (KBDeX) software. In this paper, we introduce KBDeX and explain how three different types of discourse-based social networks are represented. Moreover, SNA conducted with KBDeX is demonstrated by using written discourse data in a CSCL environment.

Knowledge Building Discourse Explorer: An Application for SNA of Discourse in Collaborative Learning

To establish a methodology for discourse analysis in collaborative learning from the perspective of knowledge creation metaphor, we are currently developing an application called Knowledge Building Discourse Explorer (KBDeX) (Matsuzawa et al., 2010). KBDeX visualizes network structures of discourse based on a bipartite graph of words × discourse units (e.g., conversation turns, BBS postings, or sentences) (Figure 1). Using discourse data (in .csv format) and a list of target words for bipartite graph creation as its input, KBDeX can create visualizations of three different network structures: (1) learners’ network structure (top right window...
in Figure 1), (2) unit network structure (bottom left), and (3) the network structure of the target words (bottom right).

Figure 1. The Interface of KBDeX.

KBDeX automatically calculates typical measures for network structures in SNA, (1) the betweenness centrality coefficient, (2) the degree centrality coefficient, and (3) the closeness centrality coefficient. Betweenness centrality is a measure for estimating how each node mediates pairs of other nodes with the shortest path length. High betweenness centrality suggests that the node is a key mediator linking other nodes. Degree centrality is straightforward, showing the extent to which each node is linked to other nodes in the network. High degree centrality means that the node is positioned at the center of the network or a local cluster. Finally, closeness centrality is a more sophisticated measure of how close the node is to other nodes in the network, based on geodesic distances. Based on these three centralities, we demonstrate how the collective knowledge advancement could be measured by using real data sets in a published article (Chan, & Lam, 2010).

References

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