Socio-Semantic Network Analysis of Knowledge Building Discourse: The Current State and Future Directions

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Abstract: In knowledge building discourse, learners engage in improving their ideas by utilizing conceptual artifacts through collaborative discourse. Although qualitative analysis provides fine-grained pictures of knowledge building practices, the quantitative approach needs to be developed for handling extensive data and conducting more powerful analyses in the mixed-methods. In this study, we discuss the current state of the quantitative analysis of kb discourse and possible future directions with the development of algorithms and technologies.

Research background and research purpose

Scardamalia and Bereiter (2014) explain the nature of knowledge-building by referring to knowledge as an object to continuously improve. Researchers assume that the knowledge we build is collective, and the community of people shares and discusses their ideas through collaborative discourse. Individual contribution to the community is considered as the collective cognitive responsibility to engage in the knowledge-building discourse. Through knowledge-building discourse, learners engage in the interaction between two modes of learning: the belief mode and the design mode. In the belief mode, learners develop knowledge as to what they ought to believe in creating collaborative ideas to problems they hold. Learners look for knowledge objects they can use as resources to create new ideas or conceptual artifacts by which they can create their ideas.

On the contrary, in the design mode, learners consider the developmental potential of ideas comprised of their knowledge pieces. They need to examine if their ideas are good enough to solve the problems to be addressed and how they should contribute to improving those ideas. Thus, knowledge-building is a social and dynamic movement between the two modes of learning. Learners use the belief mode of learning to investigate the current level of their community knowledge and highlighting any problems further discussed. They work in the design mode of learning to create ideas by using their available knowledge to solve problems.

Ideas and conceptual artifacts are interrelated to each other in knowledge-building discourse. For improving their ideas, learners use a variety of conceptual artifacts to examine the ideas. When psychologists use statistics to test their hypotheses, the hypotheses themselves are ideas to improve, while the statistics are a conceptual artifact for examining their ideas, hypotheses. Most psychologists (except for psychometricians) learn statistics in their belief mode of learning. For psychometricians, on the other hand, statistical techniques themselves are ideas for them to improve through their knowledge-building discourse. Thus, we need to develop analytics to capture what ideas learners share and discuss (content-oriented) and how they handle their ideas (epistemic practice-oriented) for evaluating knowledge-building discourse.

The current state of the socio-semantic network analysis of knowledge building discourse

As we discussed in the previous section, we need to conduct an analysis of knowledge building discourse from the two perspectives: what ideas students share and discuss, and how they handle them through their collaborative discourse. The perspectives are interrelated but require different approaches to the same discourse data. Researchers agree that in-depth discourse analysis would be the one for examining the perspectives, but they also recognize that we need new analytics to handle more data in an objective way. The quantitative analyses of knowledge building discourse have been recently discussed are Knowledge-Building Discourse Explorer (KBDeX) (Oshima, Oshima, & Matsuzawa, 2012) and the Epistemic Network Analysis (ENA) (Shaffer, 2017). KBDeX is an application of socio-semantic network analysis (SSNA) of discourse in which networks of participants, the conversation turns, and vocabularies are visualized. The network graph and others showing temporal changes in centrality measures provide researchers with insight into what ideas students share and discuss in their knowledge-building discourse. ENA represents another perspective. It shows researchers how a set of epistemic codes are interrelated in a two-dimensional semantic space. Configurations of the epistemic codes on the space reveal what epistemic practices learners engage in their knowledge-building discourse.

Few studies have used both analyses for the same discourse data. Oshima, Oshima, Ohsaki, and Splichal (2019) analyzed high-school students' knowledge building discourse around a complex scientific concept in their small group activities, the human immune system with the use of the two socio-semantic network analyses. Results unveiled not only how students made the advancement of their ideas of the vaccination mechanism (i.e.,

the idea improvement), but also what epistemic actions they engaged in improving their ideas (i.e., the use of conceptual artifacts). An advantage of the quantitative analyses would be the direct comparison among groups. Based on their final learning outcomes, the study identified patterns of discourse toward high or low learning outcomes.

The quantitative studies of knowledge building discourse like Oshima et al. (2019) is increased and presented at ISLS-based conferences or other related meetings such as International Conference of the Quantitative Ethnography (ICQE), and scientific journals such as ijCSCL (e.g., Csanadi et al., 2018) and Journal of Learning Analytics (Lee & Tan, 2017; Oshima et al., 2018).

The future directions of the SSNA of knowledge building discourse

While the SSNA is a promising approach to analyzing the knowledge-building discourse, the following future directions of research would be further explored. First, the *unit of analysis* should be explored more rigorously. The co-occurrences of attributes such as words and codes within a range of discourse segments are calculated to create a network graph. Identifying the appropriate size of an analysis unit is crucial. In ENA, for instance, the concept of the stanza window size has been proposed as a meaningful sequence of conversation turns (Shaffer, 2017). A sentence or a single conversation turn is proposed as the unit of analysis in KBDeX (Oshima et al., 2012).

Second, the temporality of SSNA has not been sufficiently examined yet. Ideas discussed, as well as conceptual artifacts used in the knowledge-building discourse, may change over time. Csanadi et al. (2018) demonstrated that the ENA could successfully include the temporal nature of discourse compared with the ordinary categorize-and-count approach. Ohsaki and Oshima (2019) examined the life length of the link in the network of vocabulary in KBDeX and demonstrated that the life length of the network link made it possible for researchers to detect more sensitive changes in the improvement of ideas in the knowledge-building discourse.

In this poster presentation, the authors will demonstrate the new types of SSNA with a real discourse dataset and further cultivate new ideas of the socio-semantic network analysis of knowledge-building discourse with the audience.

References

Csanadi, A., Eagan, B., Kollar, I., Shaffer, D. W., & Fischer, F. (2018). When coding-and-counting is not enough: using epistemic network analysis (ENA) to analyze verbal data in CSCL research. *International Journal of Computer-Supported Collaborative Learning*, *13*, 419–438.

Lee, A. V. Y., & Tan, S. C. (2017). Promising ideas for collective advancement of communal knowledge using temporal analytics and cluster analysis. *Journal of Learning Analytics*, *4*(3), 76–101.

Ohsaki A., & Oshima J. (2019). A Socio-Semantic Network Analysis of Discourse Using the Network Lifetime and the Moving Stanza Window Method. In: Eagan B., Misfeldt M., Siebert-Evenstone A. (Eds.), *Advances in Quantitative Ethnography*. ICQE 2019. Communications in Computer and Information Science, vol. 1112. Springer, Cham.

Oshima, J., Oshima, R., & Fujita, W. (2018). A mixed-methods approach to analyze shared epistemic agency in jigsaw instruction at multiple scales of temporality. *Journal of Learning Analytics*, *5*(1), 10–24.

Oshima, J., Oshima, R., & Matsuzawa, Y. (2012). Knowledge building discourse explorer: A social network analysis application for knowledge building discourse. *Educational Technology Research & Development*, *60*, 903–921.

Oshima, J., Oshima, R., Ohsaki, A., & Splichal, J. M. (2019). Collective Knowledge Advancement through Shared Epistemic Agency: Socio-Semantic Network Analyses. In Lund, K., Niccolai, G., Lavoué, E., Hmelo-Silver, C., Gweon, G., and Baker, M. (Eds.), *A Wide Lens: Combining Embodied, Enactive, Extended, and Embedded Learning in Collaborative Settings, 13th International Conference on Computer Supported Collaborative Learning (CSCL) 2019, Volume 1* (pp. 57–64). Lyon, France: International Society of the Learning Sciences.

Shaffer, D. W. (2017). *Quantitative ethnography*. Madison, WI: Cathcart Press.

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