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Abstract

Dialog plays a central role in learning processes, particularly in shared understanding and social knowledge construction. Based on the socio-cultural paradigm, the polyphonic model of dialog considers social knowledge-building as inter-animation of voices in an analogy with polyphonic music, where novelty, creativity and coherence are assured by an interplay of dissonances and consonances, evolving towards a harmonious whole. In this analogy, voices are participants' newly introduced concepts and points of view. Automated tools implementing the polyphonic model cope with the high volume and complexity of data by relying on Cohesion Network Analysis, and applying advanced Natural Language Processing techniques. Corresponding tools were successfully used for automated dialog analysis in a wide variety of educational settings, ranging from formal philosophical discussions in text-based discussion forums to informal online blog discussions. Although the presented methods are proven to reliably predict comprehension of contents and further participation in discussions, they are limited by the nature of text-based communication. Further development of the polyphonic model will be extended to gestures and body language, both in individual and group settings.

Keywords: Content analysis, Conversation/Discourse analysis, Social Learning Analytics, Polyphonic model

Extended summary

Dialog is a well-known substratum of knowledge building, therefore a central element of the analysis of learning processes. Due to data volume and complexity, automated support is particularly helpful. For text-based dialogs, several methods and tools have been recently developed in the frame of Social Learning Analytics.

A viable starting point for knowledge building analysis was found in Vygotsky's (1978) socio-cultural paradigm, centred on the interplay between thought as inner speech and spoken language. On the same ground, Bakhtin (1984) elaborated his theory of polyphonic dialogism, according to which dialog is a fundamental philosophic category and, therefore, life and social interactions are dialogic, i.e., polyphonic, as well. Building on this assumption, Trausan-Matu (2010) introduced the polyphonic model of collaborative knowledge construction, according to which dialog analysis identifies voices (in the broadest sense, as threads of ideas initiated by a utterance and echoed by other participants) with specific character, representing distinct points of view, and contributing to a coherent whole of joint

knowledge construction. The voices sometimes form dissonances that can be solved towards consonances. This process, together with rhythm, repetitions and pauses, emerge as an inter-animation phenomenon with divergent and convergent steps, which is the crux of any creative processes and, therefore, of knowledge building.

The polyphonic model is, in fact, a discourse model that applies for any type of discourse, including music and (text-based) dialog. From this perspective, collaborative knowledge construction consists of the performance of individual voices entering a polyphonic weaving and interacting with other voices. Coherence, the central discourse feature, was frequently analysed in the past linguistics research as cohesion, a characteristic that is less complex but easier to assess. Dialog cohesion, in turn, was analysed by means of Cohesion Network Analysis (Dascalu, Trausan-Matu, McNamara, & Dessus, 2015), implemented using Natural Language Processing, Latent Semantic Analysis and Latent Dirichlet Allocation. Thus, the tools PolyCAFe (Trausan-Matu, Dascalu, & Rebedea, 2014) and ReaderBench framework (Dascalu et al., 2015) have been developed and validated.

These automated dialog analysis tools were used in different settings. Dialogs from various platforms (e.g., chats, discussion forums, blogs) were crawled, converted to a unified format, and analysed.

For example, in a formal school setting, Dessus, Simon, Dascalu, and Trausan-Matu (in press) used ReaderBench to analyse a philosophical discussion of the question: "Why do we say 'it's unfair'?" The participants were grade 5 students, two of them kept the discussion minutes synthesizing the key points, and a philosopher led the discussion. The ReaderBench tool analysed participants' contribution all along the discussion, the most relevant words used, and the topic-based proximity of participants' utterances. As expected, the ReaderBench tool and the philosopher identified the same key utterances independently from each other. Surprisingly, however, ReaderBench found discrepancies in the patterns of word relevance between the actual discussion and the discussion minutes.

In an informal learning setting, Nistor, Dascalu, and Trausan-Matu (2016) analysed discussions in online knowledge communities. Examining discourse differences between communities, they identified socio-cognitive structures (i.e., central, intermediate and peripheral community members) and predicted how likely the online communities will integrate newcomers. Experimentally, they examined the influence of the established community discourse and the newcomer inquiry characteristics on the community response to the inquiry. Based on these findings, the authors further conducted a higher education seminar successfully combining formal learning in face-to-face meetings with informal learning in online blogger communities. The automated tools had been used to select the communities that were more likely to integrate students as newcomers to their discourse.

Finally, to illustrate the common nature of collaborative discourse and music, chat dialogs were sonified, i.e., converted to music on the ground of the polyphonic dialog model. A few such pieces were performed on philharmonic stage, and were well received by musicologists.

The research presented in this paper is fundamentally limited by the text-based nature of the analysed dialog. However, the polyphonic model was also used to analyse individual and group body language (gestures) in a classroom setting (Trausan-Matu, 2013). A further limitation consisted in the cross-sectional character of the analysis the tools performed so far. Upcoming research include the longitudinal analysis of online community dialog, as well as attempts to extend the analysis to spoken dialog, and to connect dialog analysis with data from other sources, such as video-recorded body language, eye-tracking data, and digital conceptual artefacts.

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