

Visualizing Interaction: Pilot investigation of a discourse analytics tool for online discussion

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Abstract— Discussion boards are perhaps the most commonly used collaboration tool in online courses. However, native discussion tools in learning management systems are limited in their ability to show interaction patterns among learners. Tools that provide more robust visual representations of discussions can improve instructors' understanding of how students are interacting and, as a result, their ability to intervene when identifying suboptimal interaction patterns. This paper presents an exploratory investigation of one such tool, Social Networks Adapting Pedagogical Practice (SNAPP), examining its potential to help faculty understand and react to discussion patterns. Emerging learning analytics tools such as SNAPP can enhance the ability of course designers and facilitators of online discussions to make adjustments to their pedagogical approaches.

Index Terms— Computer-supported collaborative learning, learning analytics, online course design, online discussion

I. STATEMENT OF PROBLEM

Asynchronous online discussion plays a key role in computer supported collaborative learning in higher education. Instructors frequently use discussion to support collaborative knowledge-building and higher-order thinking, an important component of online learning [4]. Recent research has proposed theories and frameworks to guide the design and facilitation of online discussion [6, 12]. Design features providing structure such as protocols and criteria to scaffold discussions can be particularly critical to the achievement of high-level discourse [1, 7, 9, 10, 13]. However, educators often find the design of discussions challenging, while monitoring and getting a clear sense of the gestalt of discussion interactions can be difficult and time-consuming [11].

Discourse learning analytics tools have the potential to improve both design and facilitation of online discussion. By parsing text-based information into useful visual and numerical displays, these tools give educators real-time data, which can be used to improve discussion-based learning activities. Social Networks Adapting Pedagogical Practice (SNAPP) is a free browser plug-in that works with a range of open source and commercial learning management systems and that generates real-time visuals showing discussion interaction patterns. Figure 1 shows a comparison of visuals generated from Blackboard 9.1 and SNAPP.

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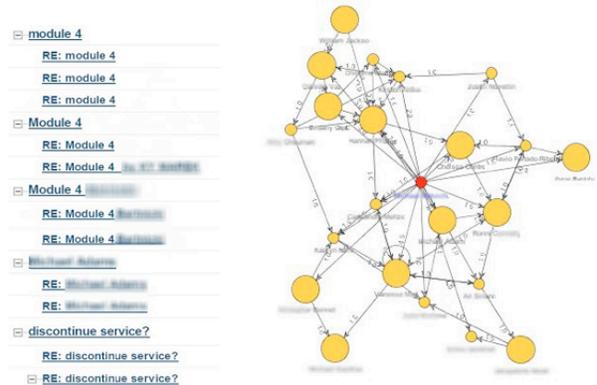


Fig. 1 Comparison of Blackboard 9.1 "tree view" vs. SNAPP-generated social network diagram.

Social network diagrams generated by SNAPP currently show only patterns and levels of interaction among discussion members; they do not include information related to the content of discussions. Therefore, one cannot discern the overall quality of discussions with the use of the SNAPP tool alone. However, SNAPP diagrams and metrics can illustrate certain characteristics of interaction, which can assist in design of interventions to improve discussions. For example, instructors can quickly determine students who are not actively involved and can identify poorly-developing discussion communities (Figure 2). Instructors can also see students who are centrally-located in discussions and correspond with many of their classmates. Early notification of this might lead an instructor to use such information to form more effective groups for later project work. Perhaps most importantly, the diagrams can prompt instructors to adjust design characteristics such as the question prompt or protocols, which can greatly improve resulting discussion quality.

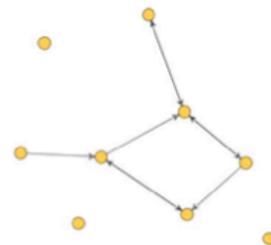


Fig. 2 Diagram showing poorly developing learning community, with students disconnected from the discussion.

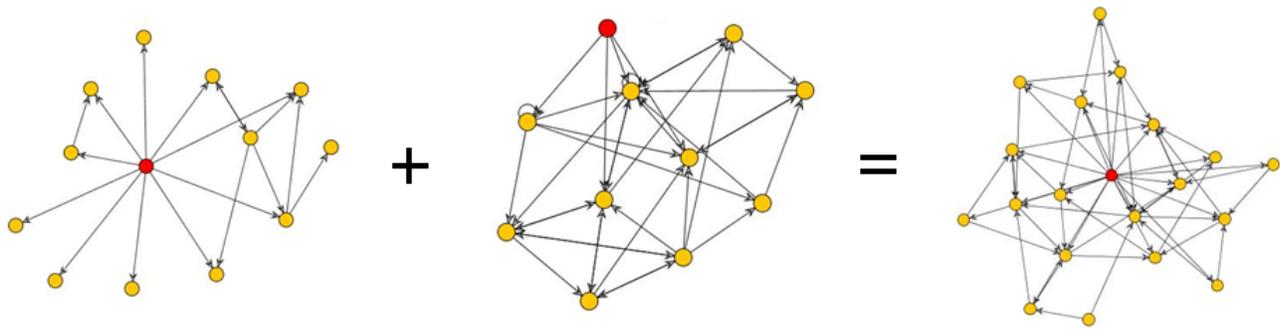


Fig. 3 Combining Instructor-Led (left) and Learning Community (middle) patterns yields Learning Community with Strong Instructor Presence pattern (right).

This paper presents a pilot investigation of a design aid and process intended to assist instructors in using social network diagrams to improve discussion design and facilitation.

II. RESEARCH GOALS

This study focuses on two key challenges faculty encounter when using the SNAPP tool independently. Instructors have difficulty in interpreting social network diagrams and in designing interventions to improve the design or facilitation of discussions when suboptimal interaction patterns are identified. To investigate how to improve use of SNAPP, a process to address these two challenges was developed and piloted.

In a recent study focusing on the use of the SNAPP tool by instructors in higher education, Dawson et al [3] identified a need for professional development in the interpretation of social network diagrams, the design of interventions when problematic patterns emerge, and the redesign of collaborative learning activities. Their work also showed that instructors used the diagrams in a primarily reflective manner, looking back on discussion interaction after courses have ended, rather than using it to adjust learning activities while they were occurring.

III. DEFINING THE VISUAL TAXONOMY

A visual taxonomy of social network diagrams for online discussions should aid faculty in identifying interaction patterns through comparison of their courses' discussion patterns to a set of standard patterns. In order to define a visual taxonomy, fifteen courses were reviewed at random to determine if specific patterns could be identified. Those patterns were then compared to patterns identified by Dawson [3]. Three of the patterns were in agreement with those findings and two additional, unique patterns were identified. Several patterns were combinations of other patterns, resulting in a total of six.

There are two basic patterns that can be conceptualized as either a continuum or a combination of patterns based on a few social network metrics. First, centralization is defined as the extent to which a network revolves around a single node, or in the case of online discourse, a single discussion participant. We termed a pattern in which a facilitator is

clearly the most central person in a network, with little interaction among students *Instructor-Led*. Discussions that involve most or all participants have a relatively even distribution of participants interacting with one another, while the instructor is only peripherally involved. We termed this a *Learning Community*. When a discussion with a Learning Community pattern includes the instructor with the highest centrality of all participants, we have identified this pattern as a *Learning Community with Strong Instructor Presence*. Figure 3 shows how three patterns are related to the concept of centrality of the instructor or facilitator (instructor is in red).

A second pattern is delineated by the degree to which all participants are interacting with each other, which is manifested by the social network metric "average centrality." Lower average centrality is congruent with a more equal distribution of interaction (see Learning Community in Figure 4). In some discussions, learners are loosely connected or not connected at all to other students. For example, students who have posted but to whom others have not responded can be seen as disconnected nodes in the left-most diagram of Figure 4. The degree to which learners are interconnected can be seen as a continuum. In Figure 4, three visuals have been used to represent this continuum: *Weak Learning Community*, *Emerging Learning Community*, and *Learning Community*.

The Emerging Learning Community Pattern identified in this study (Figure 4) is supported by work in network analysis theory; Borgatti [2] originally formalized an intuitive, idealized "core-periphery" network pattern. Additional patterns identified in this study were combinations of Instructor-Led patterns and Learning Community and Emerging Learning Community patterns.

IV. PILOT RESEARCH DESIGN

Three instructors were selected for inclusion in a pilot study, and their permission was obtained to review discussion data from one or more of their courses. A visual report of patterns was also created for each discussion. For each discussion, the SNAPP diagram was juxtaposed against the associated question prompt, arguably the most important design component of a discussion. Both the visual patterns and the discussion content were also examined in detail, and several potential interventions for each instructor and course were

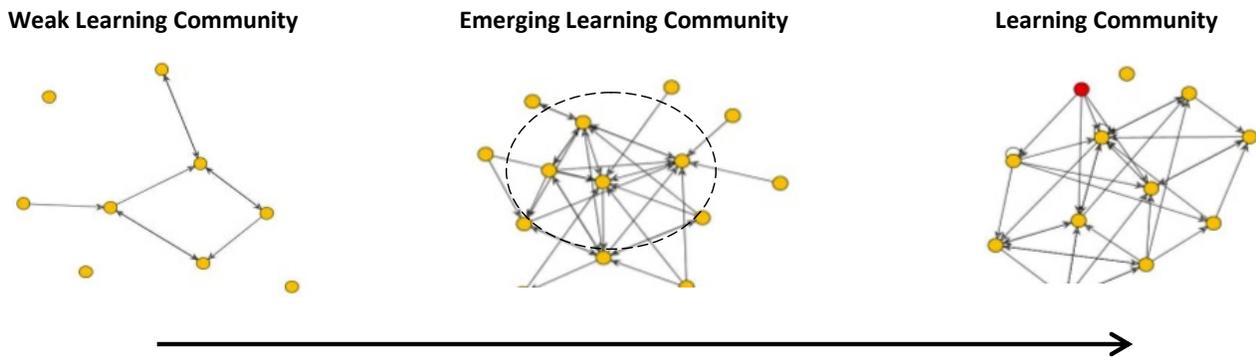


Fig. 4 Continuum showing degree to which participants are interacting.

devised. In addition, all design and facilitation features of all discussions were noted. Because question prompts were identified as the most important design feature, each was coded with one of the six levels of Bloom's cognitive levels to aid in potential intervention suggestions. Research has shown that question prompts at higher cognitive levels correlate with higher levels of discourse [8]. In a study examining the relationships among question types and students' subsequent interactions, Ertmer et al [5] used a similar approach to coding discussion prompts.

Instructors were then sent the visual key of patterns and the report showing patterns from each of their discussion boards juxtaposed with each respective question prompt. In discussions with each instructor, the SNAPP visual key of diagram patterns was explained in terms of what information from diagrams might reveal about learner interactions, and how such information could be used to improve discussion design. A brief set of questions that focused on instructors' goals, satisfaction levels, and challenges were used as a guide to the discussions. Finally, potential interventions for redesign of discussion activities were discussed. Intervention suggestions ranged from very simple organizational changes in discussion structure to more significant adjustments in discussion design or facilitation.

V. RESULTS

The three instructors described below had extensive experience teaching online. Their names have been fictionalized and modified to protect identities.

Instructor Matson: Undergraduate business: Her discussions were focused on mini-scenarios at Bloom's cognitive level of application. Her facilitation consisted of brief postings including agreeing or disagreeing with students, redirecting, giving confirmation, and asking questions. Students rarely followed up on her queries. There was little to no feedback at the end of each discussion. Her postings comprised 25-30% of total number of posts. Course discussions were very consistent in terms of interaction pattern (Learning Community with Strong Instructor Presence) and numbers of posts by students and the instructor. The instructor noted the consistency of her social network diagrams and

seemed pleased with this result, as well as the overall interaction pattern illustrating consistent involvement by all students. The key intervention suggestion centered on shifting to a less involved facilitation strategy during discussions and a more involved strategy after them (via a summary feedback announcement). We thought this would yield a benefit of reducing her workload while maintaining or even increasing student engagement. We also suggested increasing the level of difficulty of the scenarios, which might improve cognitive engagement with course concepts.

Instructor Hinson: Graduate education: His discussions covered a broad range of questions types, but most were on the lower cognitive level of Bloom's taxonomy. Student participation varied widely, depending upon the question type and topic. There was very low level of participation by the instructor, perhaps fitting with the facilitation philosophy of an instructor with a background in education. Feedback was primarily given after discussion completion. Discussion visual patterns also varied broadly. The instructor felt the SNAPP tool had great promise for helping with identification of participation patterns. He quickly determined that diagrams showing high levels of interaction did not necessarily indicate high-quality interaction. Nevertheless, he showed a strong interest in using the tool immediately for potential interventions. The diagrams showing weaker patterns particularly caught his interest and initiated a discussion that included ideas around alternative tools for some current discussion design features.

Instructor Paulson: Undergraduate business: His question prompts were at higher levels of Bloom's cognitive domain, and student participation was quite robust. Because his discussion activities were focused on simulations of negotiations (essentially role plays), followed by reflective discussions taking the form of self and peer assessment of those simulations, the format of the discussions was very clear and focused. The instructor's participation was minimal and occurred only in the reflective discussions, while feedback was primarily given after discussions. Discussion diagrams were primarily Learning Community patterns. The instructor felt that SNAPP could be particularly useful for identifying disengaged learners and students playing the role of Information broker early in the course. Given that his course

used discussions for pair and group work, this function of SNAPP seems important for this course.

VI. CONCLUSION

This paper intended to show how a learning analytics tool can be used to improve discussion design and facilitation with the use of visual aids and an interview/discussion process. Two of the three instructors committed to using SNAPP in future teaching. For these instructors, the visual aids seemed to impact their view of the effectiveness of their discussions. However, instructor Matson seemed unlikely to adjust her design or facilitation. Her pedagogical philosophy was supported by the (instructor-centered) interaction patterns, which could prevent adjustments that may enhance her discussions. Future plans for use of visual aids described in this study include using them as part of a “post-facilitation” review process, which is an existing course design step that follows an instructor’s first facilitation of a new online course. The purpose of this process is to review the design and facilitation of a course to determine how the course might be improved. The use of visuals at this juncture may prove the most potentially impactful point at which to focus attention on discussion design and facilitation.

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