Tools for Concurrent, Embedded, and Transformative Assessment of Knowledge Building Processes and Progress

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Abstract: In this paper we introduce a suite of analytic tools to enable users of Knowledge Forum to monitor various participation and collaboration patterns, with almost instantaneous feedback to ongoing processes. Tools for semantic analysis of content similarly provide just-in-time assessment (e.g., vocabulary overlap for different documents or Knowledge Forum database segments). Early results suggest a number of ways in which concurrent and embedded assessment enhances knowledge building in classrooms.

Background

Knowledge building systems, with formative assessment, can be conceptualized as a cybernetic system with feedback loops serving to drive the system in new directions (Roos & Hamilton, 2005). To optimize performance feedback must be relevant and timely. Analysis of discourse from computer-supported collaborative learning environments is common but, as Lee, Chan & van Aalst (2006) note, relatively little attention has been paid to the "formative, embedded, and transformative aspects of assessment in collaborative inquiry". In this paper we introduce a suite of tools that are embedded in Knowledge Forum® version 4.6 as a series of Java applets. Results can be made available to any user (teacher, student, manager, at the teacher/manager discretion). Designs also aim to empower users rather than engage them in competitive analysis, with much of the focus on community dynamics and knowledge advancement. With appropriate safeguards and attention to issues of security, data can be read directly from the Knowledge Forum database, and integrated back into it, thereby transforming the dynamics of knowledge building (Scardamalia, 2002).

Participation and Collaboration Tools

A previous Analytic Tool Kit for Knowledge Forum (Burtis, 1998) included participation and collaboration tools. The Contribution Tool (Figure 1) provides information about the number and nature of artifacts created by participants at the individual and group level. The tool provides measures of the number of notes created, the number of views in which participants worked, and other measures of individual and group performance, but it does not provide information about the relationships between individuals. That is the realm of the Social Network Analysis Tool (Figure 2), which displays the social relationships among participants based on patterns of behavior recorded in Knowledge Forum (e.g., who read/referenced/built on whose note).

Writing Analysis Tools

One of the advantages of CSCL environments is that they provide access to digitized records of the contributions of the participants. Thus, all utterances are recorded and are available for analysis. Various studies now indicate that advances in textual and graphical literacy are important by-products of work in knowledge building environments (Sun et al., 2006; Gan, 2006). In an effort to better identify such growth we have developed several writing analysis tools. These tools parse and quantify the contributions of participants in terms of vocabulary growth (Figure 3) and basic writing measures (e.g. total and unique words, mean sentence length).

Semantic Analysis Tools

The Participation, Collaboration and Writing Analysis tools focus on surface features of contributions. The Semantic Analysis Tools deal with the meaning of the discourse. The Semantic Overlap Tool extracts key words or phrases from a user-selected subset of the discourse and reports the extent to which that subset overlaps with another user-selected subset of the discourse. One application of this tool is to examine the overlap between a participant's

discourse and discourse generated by experts in a discipline or in curriculum guidelines. Other applications include the examination of overlap between two or more participants. The Semantic Field Visualization Tool (Figure 4) provides graphical displays of the overlap of the semantic fields of subsets of the discourse by employing techniques from Latent Semantic Analysis (Deerwester et al., 1990; Landauer et al. 1998).

Transformative Assessment to Support Knowledge Building

In the past, teachers using Knowledge Forum software assessed student performance through observation of classroom interactions and reading students' notes. While detailed information was available from the Analytic Tool Kit, the tools were used by researchers, not users, and for summative evaluation rather than input to ongoing practice. The just-in-time nature of the new tools is changing that.

The teacher can use the Contribution Tool during or immediately after each session to determine how productive each student has been.(e.g, how many notes were read, created or modified). Such information helps the teacher direct attention to students who may need more support or instruction, and helps them identify barriers preventing students from participating fully in the knowledge building community.

The Social Network Analysis Tool can help teachers to better understand who the central participants are in the knowledge building discourse and to see if existing social relationships are limiting or impacting positively on the community's work. The tool draws the teacher's attention to children who are on the periphery and makes it more likely that these children will receive the direct support they may need to be more integral to the work of the class.

Looking at the growth of vocabulary relative to outside measures or benchmarks gives the teacher a good indication of whether the students are learning and using concepts in the discipline, at or above grade level. Information about the complexity and quality of children's notes can also give the teacher clear direction as to the type of guidance or instruction the class may need. All of the tools support the teacher in planning in a way that is responsive to the students' evolving needs.

The various dimensions of the analytic tools identified here, and additional aspects of their use can be seen through the work of a teacher demonstrating how these tools are used to engage all students more productively in knowledge building (http://ikit.org/video/assessment/).

Future Work

Because the use of the assessment tools is tracked in the same database in which the participant-generated discourse is stored it is possible to examine the changes in discourse patterns that result from the use of the tools. We are currently designing a series of experiments that will track the nature of changes to the discourse that occur as a result of the use of the assessment tools. For example, does knowledge about participation patterns enable teachers to engage all students? Does information about semantic overlap with discourse generated by experts support knowledge advancement?

References

Burtis, J. (1998). Analytic Toolkit for Knowledge Forum. Centre for Applied Cognitive Science, The Ontario Institute for Studies in Education/University of Toronto.

Deerwester, S., Dumais, S. T., Furnas, G. W., Landauer, T. K., & Harshman, R. (1990). Indexing By Latent Semantic Analysis. *Journal of the American Society For Information Science, 41,* 391-407.

Gan, Y. (2006). Making thinking visible: Towards the graphical literacy growth in Knowledge Forum. Paper presented at the Summer Institute of Knowledge Building, Ontario Institute for Studies in Education of the University of Toronto

Landauer, T. K., Foltz, P. W., & Laham, D. (1998). Introduction to Latent Semantic Analysis. *Discourse Processes, 25*, 259-284.

Lee, E., Chan, C., & van Aalst, J. (2006). Students assessing their own collaborative knowledge building. *International Journal of Computer-Supported Collaborative Learning, 1,* 57-87.

Roos, B. & Hamilton, D. (2005). Formative assessment: a cybernetic viewpoint. *Assessment in Education: Principles, Policy & Practice. 12(1)*, 7-20.

Scardamalia, M. (2002). Collective cognitive responsibility for the advancement of knowledge. In B. Smith (Ed.), *Liberal education in a knowledge society* (pp. 67-98). Chicago: Open Court.

Sun, Y., Zhang, J., & Scardamalia, M. (2006). Literacy as a by-product of knowledge building: An analysis of vocabulary growth. Paper presented at the Annual Meeting of American Educational Research Association, San Francisco, CA.

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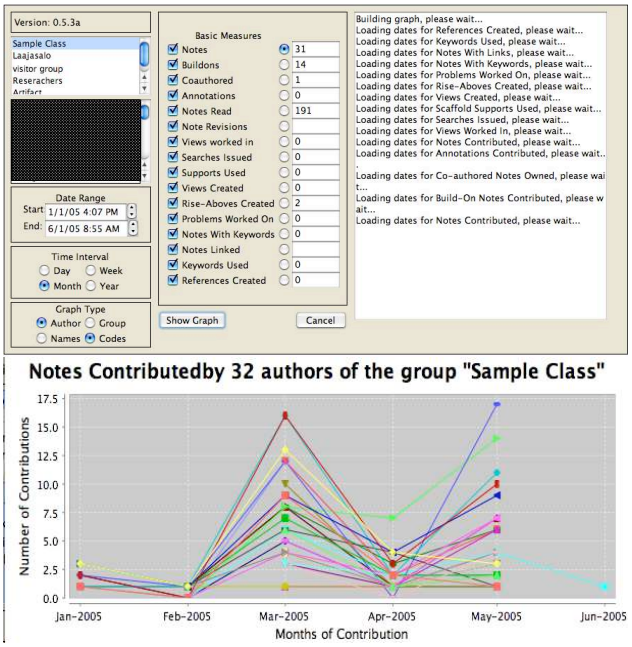

Figure 1. The Contribution Tool.

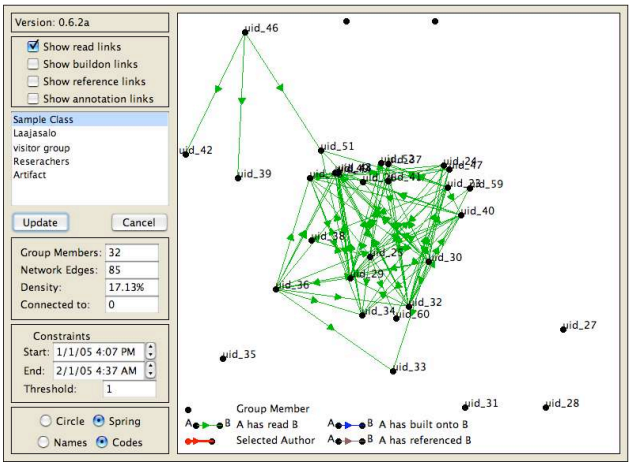

Figure 2. The Social Network Analysis Tool.

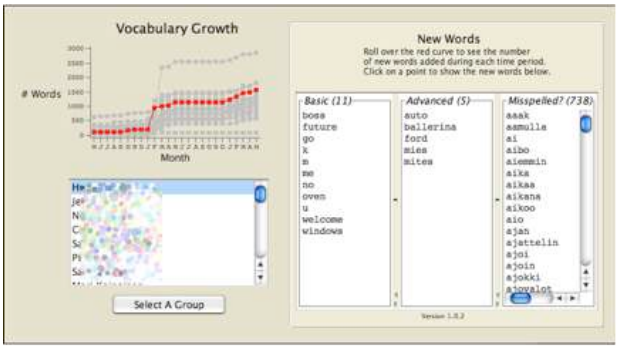

Figure 3. The Vocabulary Growth Tool.

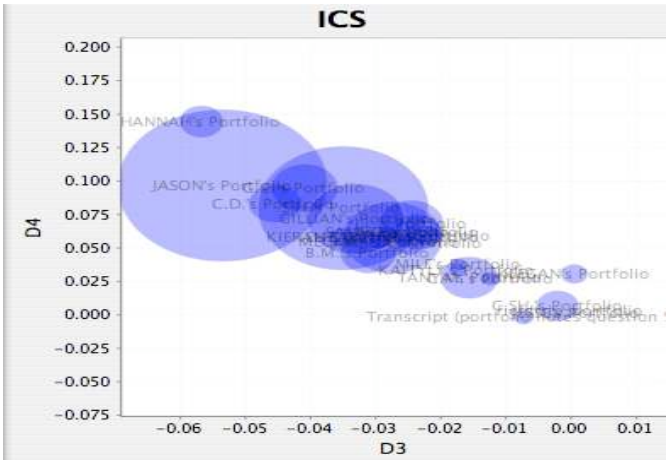

Figure 4. The Semantic Field Visualization Tool.