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Integrating a wiki into support for group cognition

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The Virtual Math Teams (VMT) project is part of an effort to investigate group cognition—the accomplishment of problem-solving and knowledge-building tasks by small groups, particularly in online, distributed contexts. The VMT environment has recently integrated a wiki component into its text chat and shared whiteboard system. The wiki component serves a number of purposes, such as summarizing synchronous small-group interactions and sharing the results among groups in a knowledge-building community.

We are exploring ways of integrating activities in the different work-space components, such as automating the posting of text from the whiteboard to a wiki page associated with the chat room, allowing collaborative browsing and editing of the wiki from the whiteboard, referencing elements of the wiki from the chat, and facilitating seamless navigation among the components. The wiki pages for chat rooms are automatically linked via categories within a 'wikipedia' for the specific domain of interest to the knowledge-building community.

The VMT system including wiki is currently being used for middle-school, high-school and junior college math students, for masters-level information science students and for research teams. Logs of VMT system usage in these authentic settings are analyzed in considerable detail; to date, about a hundred publications have resulted from research on the VMT system. This symposium contribution focuses on technological design issues stemming from the pedagogical goal of integrating knowledge building at individual, small-group and classroom levels. Detailed analysis of how technology is actually used plays a central role in VMT's design-based research approach.

Designing for Groups and Group Cognition

This paper is about how to design software to support group cognition, i.e., to open a communication space or medium for groups of people to solve problems together and to build shared knowledge. To reflect on the software design process, we build on the approach of human-computer interaction (HCI). HCI as a field has historically been oriented largely toward the relationship between the *individual* computer user and the interface of computer software. Classic HCI studies investigated the effects of different designs of desktop software upon individuals using the software. The theory of HCI was, accordingly, closely aligned with the science of individual psychology. In contrast, we look at human-*human* interaction that is mediated by computer software and by the networking of computers. Software is here seen largely as a technological communication medium which both supports and constrains interaction among groups of users. More precisely, our concern is with the small-group interaction itself, that is, the group processes, rather than the interaction of one individual as such with other individuals in the group. Conceptually and methodologically, this involves a shift from the psychology of mental processes, representations and conceptual change of individuals to the largely linguistic *interactions* of small groups.

This fundamental re-orientation entails a shift from the education of individual minds to knowledge building within groups. The issue changes from tracing effects on students of the transfer of factual knowledge from authorized sources (teachers, textbooks, drill software) to understanding how groups build and share knowledge. This new focus is sometimes termed *collaborative learning*, which includes both how groups increase knowledge and how the individuals within the groups learn concomitantly. We actually prefer the term *knowledge building* to either 'education' or 'learning'. Our preference is partially because the terms 'education' and 'learning' tend to be closely associated with traditional institutions of schooling and with psychological theories of individual minds. It is also due to the fact that one can observe the building of knowledge in products of group work, such as discourse, theory statements and documents; knowledge building can more easily be operationalized and studied. This presentation will discuss studies that we have undertaken recently to take advantage of the social networking phenomenon to promote collaborative learning of domain knowledge in a variety of math discourse settings.

Social Networking and Web 2.0

Software for collaborative learning—like that for workplace learning and community learning—is associated with significant HCI issues, that exceed the difficulties of single-user desktop-interface and web-page design. They call for new theories, assessment tools and principles. They must centrally take into account the

interactions among group participants as mediated by the software medium, and not just the interaction of an individual user to an interface. The number of possible combinations of views of the software by different participants at any given time and the variety of interactions possible explodes, making traditional HCI analysis techniques inadequate. Many technical problems and many potential uses of the software are unpredictable and have to emerge from actual usage by *groups* of people under naturalistic conditions. This limits the utility of scenarios, mockups, walkthroughs, prototypes and lab studies as assessment tools—as essential as they may still be to specific phases of the design process.

Despite the difficulties facing the development of effective collaborative learning technology, the potential benefits loom larger than ever. The recent increase in Internet usage, particularly by high school and college students, bodes well for the adoption of new educational technologies. In particular, the popularity of a range of social networking sites and of so-called Web 2.0 interactive technologies has already instilled a familiarity with computer-supported collaboration, its handiness and its benefits

During the past five years, we have been investigating pedagogical, technological and methodological issues related to fostering online discourse among math students. We have developed an approach to *chat interaction analysis* that provides the evaluative component of design-based research of networked group cognition. Most recently, we have been integrating the use of a wiki into our online environment to extend synchronous math discourse by small groups to asynchronous math knowledge building by larger communities over extended time periods.

References

For a list of publications presenting findings from the VMT project—with links to the full text—see the VMT wiki page, http://mathforum.org/wiki/VMT?ProjectPapers.