A Turn to the Social: Design Research to Build Understanding, Tools and Practices for the Social Nature of Online Learning

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Abstract

This case report of the Context-aware Activity Notification System (CANS) http://cansaware.com/ describes an ongoing design research project to both explore and impact the social nature of online learning. Appreciation and new software features have been developed over five periods of design and research towards salience and meaningfulness of social information by customization, adding value toward user goals, and improving our definition of context awareness.

Keywords: design research, context-awareness, online learning and social ability

Design Research for the Social Nature of Online Learning

Appreciation for the social nature of learning follows from the work of Vygotsky and Dewey among others, and has led to pedagogies that emphasize collaborative and cooperative frameworks for learning. Even the simplest teacher-student interaction is a complex social exchange dependent on roles, shared understandings, coordination of behavior, and cooperation in carrying out tasks, as well as the enactment of social capital, sociability and social identity.

As we move further into the application of online learning (learning fully mediated by online technologies) we need to be guided by the recognition that all forms of educational practice are social and that mediated education may require new tools, forms and practices to support the social nature of learning online. The need to understand as well as shape the social nature of online learning is especially important and challenging in the face of the rapid adoption of distance and online technologies for education and given that course management systems (CMS), such as Blackboard and Sakai which serve as the core tools of these adoptions, are very limited in how they provide social information and cues (Laffey & Amelung, 2007) that normally help motivate and tacitly shape face-to-face learning as well as support teachers and students as they try to be effective in social interaction.

The Context-aware Activity Notification System (CANS) project is an effort to supplement the ways that CMS provide social information. CANS has followed a design research approach to progressively improve both our understanding of how social information can be used to support social ability in online learning and the tools for providing the social information. Bereiter (2002) states that design research is defined by its purpose, "sustained innovative development," and by attributes of the communities of practice in which it is situated. The enabling attributes are innovativeness, responsiveness to evidence, connectivity to basic science, and dedication to continual improvement. The key aspects of our design research approach are (1) the coupling of a conceptual framework for how to understand and support the social nature of online learning with a design process to enact that framework in a software system for context-aware activity notification, (2) iterations that successively improve both the theory and the software (so as to achieve its purpose), and (3) a systematic approach to using data to drive the iterations and improvements. Key to this work is to use (1) data from traditional

research approaches such as comparative studies to achieve global findings, (2) data from traditional study approaches of design work, such as usability studies, to achieve "local" understanding of how the design choices impact user behavior, and (3) data from hybrids of these traditional approaches which look at usage in situ to build new insights about how the theory is manifest in the usage of our innovative technology.

The CANS System

The CANS System provides communication and database services for activity notification, and is licensed under the Educational Community License (1.0) version of the open-source license. CANS supports capturing activity information by establishing a vocabulary of tools and action events, maintaining a history of activity, making notifications available based on the context of use, and allowing users to configure their notification preferences. CANS works by observing and logging activity in the CMS, such as when a member logs in, reads a discussion board item, uploads a document, or enters a chat message. The records of all these observations are stored and matched with profiles for access to awareness information set by the members. Matches lead CANS to send information to members who want the information in a form they have selected. For example, a student in a group may want to know when the instructor has posted an assignment and have that information immediately emailed or delivered via a desktop widget (a small application that can always be visible on one's desktop). The student may want to see who has posted new messages or read existing messages, but only want that information when they enter the course website. An instructor may want the same information but want it organized in a table to see who has contributed and how much to a discussion. Thus the awareness information is a resource for instructors and students in knowing when and how to act, and also a tool for an instructor to quickly make sense of what is going on

in the course, how to assess what is going on, and identify appropriate next steps for the class or individual students. Given space limitations for this report and the continuous work undertaken on CANS since 2005 we will briefly highlight 5 periods of that work.

Design Research Periods

Period 1

Our interest in the social nature of online learning and efforts to design and develop CANS began almost serendipitously. In the late 90's a project team at MU developed an intranet system for schools called Shadow netWorkspace™ (SNS) intended to help poor and rural schools use network services such as file sharing, discussion boards, email, and do so within a secure environment. As SNS became operative we started to use it in our own teaching and project work. We complained amongst ourselves that it took too long to go into a course and look around to see if students had posted in the discussion board or uploaded documents, etc., so we decided to build a monitor that would show what had been recently done. Fortuitously we created the Activity Monitor (see figure 1) with links to the objects they referenced. In our own behavior and in those we observed in usage studies we saw users not only reviewing the monitor, but also using it as a menu for linking to the objects. In short the Activity Monitor transformed the interface from one based on system structures to one based on user activity.

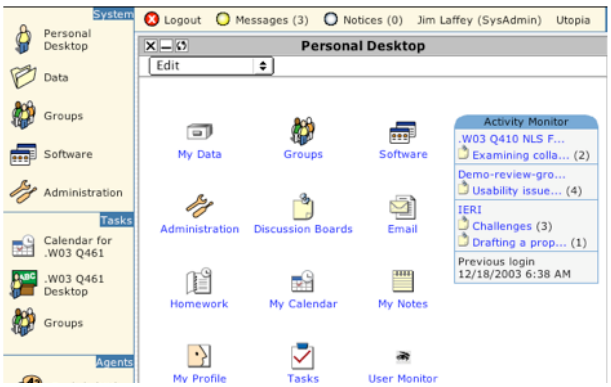


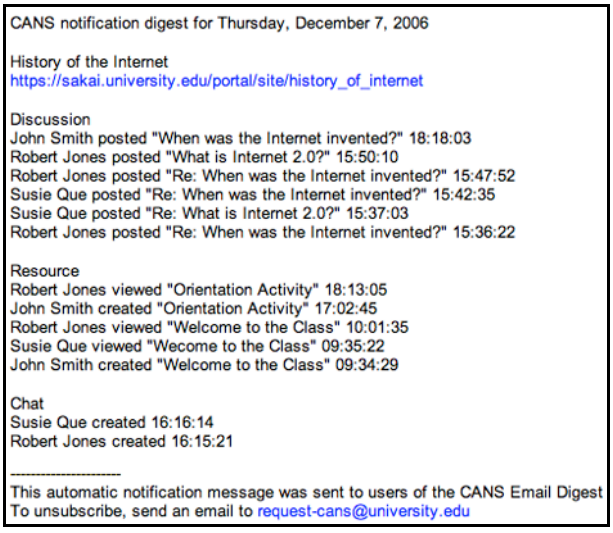
figure 1. Illustration of how the Activity Monitor was integrated into the personal desktop of SNS.

These insights led us to focus on the social nature of the online learning experience and develop a construct and instrumentation for assessing social ability in online learning (Laffey, Lin, & Lin; 2006: Yang, Tsai, Kim, Cho, & Laffey: 2006: Tsai, Kim, Liu, Kumalasari, Goggins, & Laffey; 2008: Laffey, Amelung & Goggins: 2009: Laffey, & Amelung; 2010). By social ability we mean the person's capacity to associate with fellows and to use the members, resources and tools of the social context to achieve something of value. The instrument (a work in progress) measures 5 key constructs of online social ability: social presence with instructor, social presence with peers, social navigation, communication competency, and concerns for privacy. Our work in exploring and explicating social ability has included comparisons of social ability across task and course structures, comparisons across conditions of CANS use, social network analysis, and qualitative studies with observation and interviews to further explicate our understanding of social ability and the social nature of learning online.

Period 2

When the project moved from SNS to Sakai in the Fall of 2006 we lost our ability to embed awareness information within the CMS application. Of course we appreciated that

embedding awareness information in the CMS was important and remained a key objective for the project, but given the complexity of adding new code to the core Sakai environment and the needs to work across a broad community of partners to do so, we began our efforts by considering awareness information on the "periphery." In what ways could awareness information be provided to participants outside the Sakai environment and how would this information impact the social nature of teaching and learning? We developed two ways of implementing peripheral awareness: digests and widgets. A digest summarizes activity over a period of time and provides a list (or other representation) of the actions. Figure 2 shows an example of a daily email digest listing activity in the discussion board, resources (file sharing) and chat room.


CANS notification digest for Thursday, December 7, 2006

History of the Internet
https://sakai.university.edu/portal/site/history_of_internet

Discussion
John Smith posted "When was the Internet invented?" 18:18:03
Robert Jones posted "What is Internet 2.0?" 15:50:10
Robert Jones posted "Re: When was the Internet invented?" 15:47:52
Susie Que posted "Re: When was the Internet invented?" 15:42:35
Susie Que posted "Re: What is Internet 2.0?" 15:37:03
Robert Jones posted "Re: When was the Internet invented?" 15:36:22

Resource
Robert Jones viewed "Orientation Activity" 18:13:05
John Smith created "Orientation Activity" 17:02:45
Robert Jones viewed "Welcome to the Class" 10:01:35
Susie Que viewed "Wecome to the Class" 09:35:22
John Smith created "Welcome to the Class" 09:34:29

Chat
Susie Que created 16:16:14
Robert Jones created 16:15:21

This automatic notification message was sent to users of the CANS Email Digest
To unsubscribe, send an email to request-cans@university.edu

figure 2. A sample daily email digest.

The other form of peripheral awareness was a widget. Figure 3 shows an implementation of a course activity widget. This widget is a small application that can sit on the user's desktop and routinely queries the CANS server for new notification information based on the user's notification preferences. This widget has been configured to notify Susie of new course

announcements, assignments, resources, discussion posts and chat messages. When a new notification appears (indicated as green text), the user could view a short summary of the activity by clicking on the triangle below the number. If the activity notification elicited an action, the user could navigate directly to the CMS class by clicking the course title in the Widget.

figure 3. A sample widget.

We planned a usability study comparing social ability and the social nature of online activity with and without the peripheral awareness tools. We used the guide provided by Carroll et al (2003) to operationalize awareness in learning activity. They examined how middle and high school science students used the tools of the Virtual School online environment to collaborate on a variety of group projects and science experiments, and identified three different types of awareness information for productive synchronous and asynchronous collaboration: social awareness ("who is around"), action awareness ("what is happening to objects"), and activity awareness ("how are things going on"). Four subjects were recruited from a Science methods course, and an online simulated experimental course "Teaching Science" was designed and implemented in Sakai to serve as the experimental context. We did not give written scenarios to the participants, but we asked them to imagine that they were distance learners taking the Teaching Science course and to participate in this course just as they might in a real online

course. Each subject carried out a series of simulated course related activities in Sakai within a two-week period. The course activities included: 1) an orientation activity to explore various tools in Sakai, 2) a "get to know you" activity to meet classmates and find a buddy for peer review of the lesson planning assignment, and 3) a lesson planning assignment which required proposing a lesson plan idea and to then provide feedback on their buddy's idea. These assignments were posted to the course site as appropriate for each of the 4 sessions. The sessions varied in length from 11 minutes to 53 minutes depending on the activity of the subjects. The two subjects worked primarily asynchronously with the exception of one synchronous session when the participants logged into the course site at the same time in separate rooms.

When we compared the work of students with and without widgets we found the following differences. Without widgets students spent their first few minutes in a Sakai session navigating menus and looking for what was new or salient. Students with the widgets used the widgets to navigate to what was new and usually did not spend as much time exploring. So the widget seemed to make the students both more efficient in their work and more narrow in their sense of what was important. To the extent that the widgets provided notification about all the important activity of an assignment this seems like a plus for the teaching learning process. However if there are aspects of work not included in the notification scheme then the student will be blind to them as they rely upon the widget for guidance. Interestingly, our students in the usability testing really like and came to depend on the widgets, yet the widgets were not often used by students in the context of real courses. The more collaborative and intense the assignments were the more the students valued the widget in real practice, but for most of the work of a course for most students keeping a channel open to course activity did not fit the way students wanted to work. Essentially they set aside time for their coursework and do not want to

be bothered with it otherwise. This changes as due dates become imminent and dependencies are set up among students.

Period 3

In winter 2007 a grant was awarded by the Fund for Improving Post Secondary Education (# P116B06-0045) of the US Department of Education to advance the development of CANS and study the impact of its use on teaching and learning. A series of design activities were undertaken to identify ways to improve the notification services and potentially extend them in new ways. One of the key activities was a semester long case study of a small group of students using the daily digest within an online course (Goggins, Laffey & Tsai, 2007)

Our case study of a group working on a collaborative project within a class showed some of the challenges of being an active member of a social learning unit when computers mediate it. Two core themes came from the analysis of how the group worked. One theme was an emphasis on managing social identity so as to maintain a cordial environment and not risk social capital. Members stated that they did not disagree with people online because it is too easy to have things misunderstood or result in bad feelings and after all they had to work with these people over an extended period of time and activities. The available tools of current CMS did not provide sufficient mechanisms and structure for argumentation and failed to provide the context cues for managing those types of exchanges. In fact “thin communication” such as we try to achieve with activity awareness may be viewed suspiciously by participants. By thin communication we mean the abstracting of certain attributes of an activity (such as it happened) and providing that in a list or other decontextualized form. What makes it somewhat problematic is instead of a person making the observation that someone just looked at their report. They may wonder “why” someone looked at their report. In our theoretical world of social navigation we might predict

that seeing someone look at a report might cause others to look at a report. However, in the real world it might create suspicions of copying ideas, feelings that others were checking up on you, etc. The other theme is one of multitasking. Students are doing their coursework as a part of their other activities. For example, "I've actually been driving down (the highway), talking to my husband and posting to my team", and "sometimes I get distracted when my boyfriend shows something up in Gears of War while I'm chatting with my team online."

Awareness as a support for participants in an environment where they are likely to be multitasking and with many possible distractions from the online learning tasks became an important attribute of the users design personas. As we considered our design in the context of multi-tasking learners, one approach was to consider how to focus attention on the learning tasks and mitigate distractions. Further analysis drew us to the belief that we needed to embrace the idea that students were multitasking and support how they managed the learning tasks within their multitasking context. They were multitasking across course tasks and across course and outside course tasks. For some students the multitasking is a natural way to work and learn, for some it is necessary given timelines and responsibilities and for others the stimulation of multiple activities or distractions seems to be an alternative to falling asleep at the keyboard.

To address the issue of multitasking we conceptualized 2 dimensions that seem to be in play for awareness information in multitasking situations. One dimension is salience. Awareness reports may be too meek to draw attention given other factors being considered, such as in the examples mentioned above of driving and observing a game being played. The opposite end of the salience spectrum may be overbearing intrusions that, especially in a multitasking situation, could lead to awareness overload. A second dimension is meaningfulness. How will users make sense of the new information? If the information is too

disconnected from the users' mental models it will be interpreted as noise and disregarded. If the information is tightly coupled to a specific event or process it may be represented in a way that is inefficient. For example, if a user is developing a response to a discussion board message it may be helpful to know that the author is currently online and working in the discussion board tool, but overwhelming to also know details about the new thread the author is in and activity surrounding that thread. This nuance seems similar to the construct of social translucence (Erickson & Kellogg, 2003). Social translucence refers to the goal of providing appropriate information and representations so that HCI can be gracefully undertaken. A physical example is when two people approach a door and one may open the door into the face of the other. Having a glass door allows for seeing the other, but the needed action does not actually require knowing who the other person is or distinct attributes abut them. Thus the door can have a filmed glass so that all that is known is that another person is approaching. Another aspect of social translucence is accountability. It may be excusable to open a door into someone's face if it was impossible to know the other person was on the other side of the door, but once cues are available for "knowing" then you are accountable for your actions. This objective of providing awareness information as needed and in appropriate representations seems a good fit for helping members derive meaning in a multitasking situation and creating online learning environments where users are more accountable for their actions.

Period 4

To achieve greater salience and meaningfulness we set out to develop a way for instructors and students to customize their own notifications. The idea of setting preferences had always been an aspect of the architecture of CANS, but there was no interface to provide the function to instructors or students. The idea of creating and managing notifiers (originally called

reporters) who could then provide you with reports was envisioned as a way to provide this interface. Notifiers are defined CANS notification subscriptions for users, implemented to organize and present information in a more context-relevant manner. In essence it is a way for a user to specify the context for which they would like awareness, and how and when it will be delivered. The design team built a set of requirements and through scenarios and mockups developed an approach for how notifiers could be implemented as an activity monitor application within Sakai. The application included a report viewer, a notifier list for managing notifiers, and functions for adding new notifiers. Managing notifiers included making them active or inactive, determining delivery methods and schedules, as well as identifying who to watch and who should receive the reports. The team developed a set of notifier templates and a mockup for soliciting feedback from prospective users. Figure 4 shows the editor for creating notifications in the current version of the Activity Monitor.

Also undertaken were reviews of the mockups in focus groups and individually with instructors and students, and usability testing by instructors of revisions to the mockups. Instructors saw value in having activity notifiers , especially the capability of being able to ask questions of the activity dataset. For example the instructors wanted to see the activity of certain students or performance on certain assignments. Many of the points they expressed related more to non-activity than to activity. They wanted to know when students were not doing what was expected as early as possible so they could intervene.

Instructor A said: “It will help me. Especially, for some students who seldom post anything. If I can see what students are doing over there. Maybe I see that one of my students just keeps logging in with out posting anything to the discussion, submitting their assignment, or

doing anything. I can send him message about why he is logging in but not completing the assignment."

Instructor B said: "There is a lot of data that you can actually find and display in variety of ways for individual student or group activity which is great. The ability to be able to see what students are doing is a great part. I would use this when I see students not doing what they are supposed to do. I could come here and see what they are actually doing. This will help me to help them."

Additionally, instructor A emphasized that the awareness information provided by the activity notifier could help plan her future lessons or adjust teaching methods/strategies because she could observe students' behavioral patterns. Aligned with this answer was the recognition by a member of our team who is also an instructor, that when he started reviewing CANS data he recognized that a fairly substantial number of students were not reading his introductory remarks for each course assignment. He was able to redesign how assignments were introduced placing greater emphasis on the introductory remarks and improved the rate at which students read the materials.

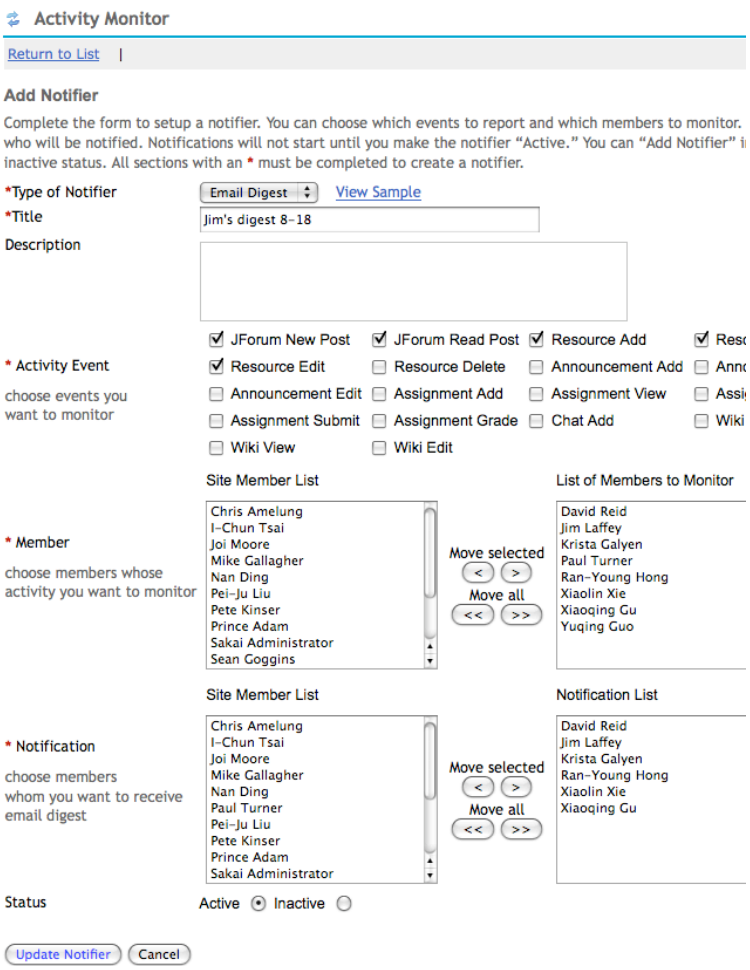


figure 4. Parameters for editing a notification

The requirements process which culminated in the usability study for the summer led us to some new insights about what we were trying to achieve with CANS. One key insight came from contrasting what we were hearing from instructors in the usability test with what we had learned from students in the small group study of the winter. The students were multitasking and concerned about the implications of their actions on others ……being very much in the moment. The instructors on the other hand were interested in reflecting on information to make future plans of action. We wonder if this is a difference between students and instructors or rather a

difference between the 2 study methods. We hypothesize that it is related to both. One of the conclusions that we draw is that the "context" in context awareness is a multifarious construct.

Period 5

The implementation currently under development seeks to address salience and meaningfulness through customization, multiple forms and representations of social information and by adding value through forms of representation of the social information. For example the widget (which appears on the course home page in Sakai) shown in figure 5 uses the top panel for social comparison data, the mid panel provides links to hot forums and resources, and the lower panel recommends forums based on student behavior.

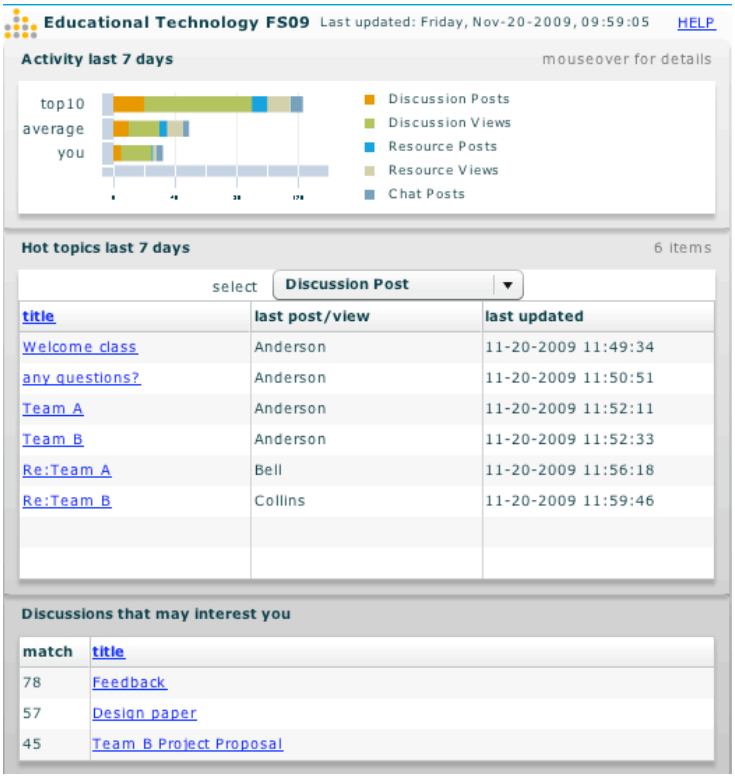


figure 5. Illustration of the social notification widget.

Similarly figure 6 shows an interactive webpage that can be accessed as an application within Sakai that allows students to see what has happened and identify active resources and discussions that they have not yet viewed.

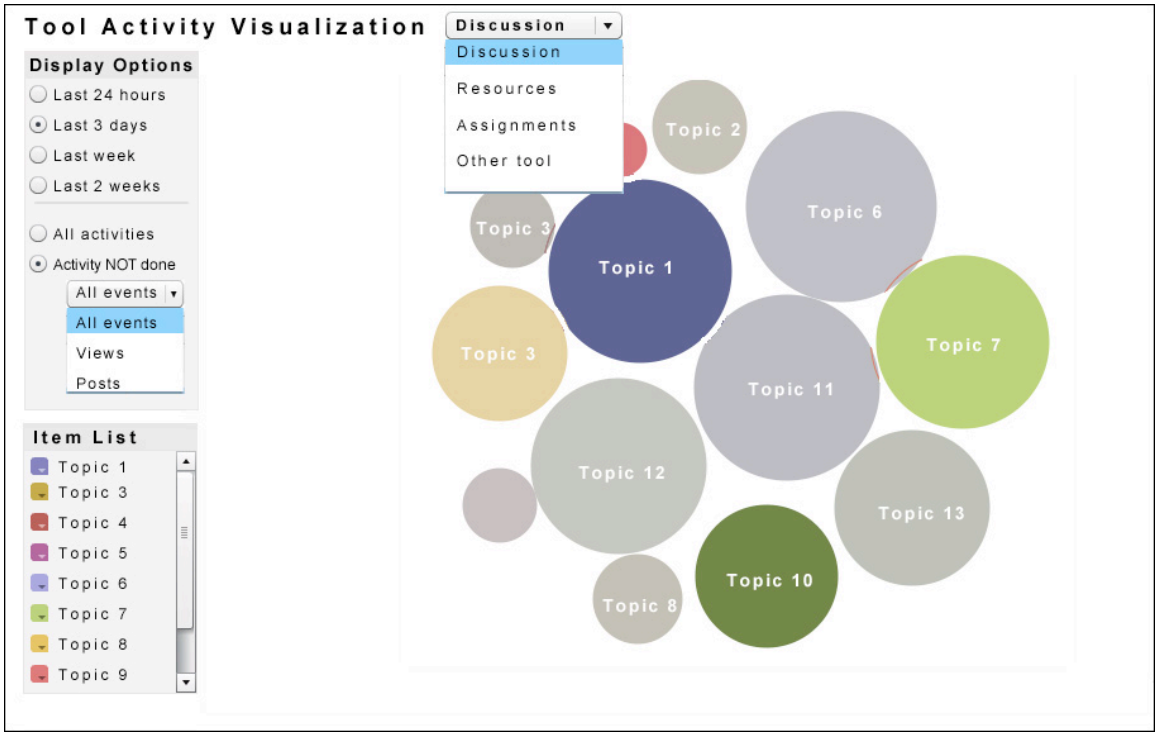


figure 6. A mockup for an interactive webpage for visualizing social activity.

Discussion

Our work has attempted to both improve the design of a specific application and to build new knowledge about the social and cognitive aspects of being social in an online course as well as new knowledge about how the computer can best mediate the social nature of online learning. In both respects we see much ground yet to cover. We anticipate that the final design will be both peripheral in the sense of email digests and widgets and central as we build designed notification artifacts into the home pages and applications of Sakai. In addition we see mechanisms for customization as essential to

accommodate the great variety we find in types of courses, the way courses are implemented and the individual members who populate them. A key transformation that occurred through the design process was a re-architecting of the CANS to accommodate the need for context to include looking back over past activity as part of planning for future activity. The notification system had been optimized for speed when context was primarily determined by location (site and application), but now users were describing aspects of historical context (e.g., who was there, where are you in a process, and what happened prior) that required knowing relationships and not just current status. This recognition caused us to revise the architecture to focus on every object in the system as an aspect of context. When actions were substantially viewed as reflexive, such as responses to when someone enters chat or when a new message is posted to the discussion board, location of activity served as sufficient context to motivate and shape action. However, more reflective action (such as should I intervene with this student or am I ready to move to the next unit) may call for more and different contextual cues, such as how does this student compare with others over a range of assignments or where in the process are other students and at what pace are they moving.

Our knowledgebase for making sense of context awareness in online learning has also expanded. Context is not solely defined by attributes of the environment or even relationships of the members to the environment. Context is influenced by levels of trust among members, by objectives of maintaining your identity within the group and by the processes that are defined by the nature of education and courses. For example, if the ability to learn from each other in a course is valued, how can context awareness be supported for processes like negotiation of meaning or argumentation?

Along with making changes the specific design of CANS and drawing inferences about the concepts and principles involved in the social nature of online learning, we have also drawn conclusions about the design process. Some of the key conclusions are:

- Design should be an iterative process. Whether it takes 3 years or 3 days the process must include the ability to learn from the work undertaken and improve the artifact.
- The iterations should be informed by feedback from real users. These users must be able to see and experience the product in their own environment or in simulations of that environment.
- Multiple forms of data can enrich understanding. Examining case studies of real practice and usability data from simulated activity provide different perspectives on user needs and expectations as well as different framings for context.
- Sensitivity to affect in the user performance both in test settings and in the work context provides a sense of what will be tolerated and how actions have multiple outcomes. In a sense attention to affect allows a "stress testing" of the HCI of the system.
- The design must map well to the language and processes of the domain. We have used examples of how courses require students to argue (in a positive sense) about the meaning of constructs as a key form of learning. When individuals argue in person they use many cues for how to make their case but to also know how to learn from the argument. These cues form a context for argument and to the extent that CANS represents these cues well it will contribute to learning.

Our work and process, of course, has been shaped by our situation, and may not apply to many instances of software design. However the methods used and lessons learned seem to fit well with in-house development that may live with products that are

evolving over a number of years. Similarly we see our experience as in tune with open source project design where good ideas are made better through a community process and can be made even better through a community using design research as a guide to product improvement and community learning.

The research reported here was partially supported by FIPSE, U.S. Department of Education, through Grant # P116B06-0045. The opinions expressed are those of the authors and do not represent views of FIPSE or the U.S. Department of Education.

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