Technology in a Context: Enabling students to collaboratively participate at the interface of computation and social science

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Abstract: This paper explores the use of *reflective collaborative technology* to organize the collaboration within a class so as to produce computer science students who learn to develop technology within a critical framework. A case study is presented that shows how technology can be used to produce objects of reflection and analysis for the multi-disciplinary theoretical analysis of online activity.

Introduction

For a number of years the first author has been teaching a suite of courses in a Computer Science department that try to put computation, and technology in general, in a context. The culture of Computer Science tends to be antithetical to any kind of critical stance towards the analysis, design, engineering, and deployment of technology. In Computer Science, theory is equated to formalization and practice to technique. The context of computation, the actors and their various concerns, the interface of technology, social science, and the humanities, is mostly ignored or trivialized. Students trained in this tradition are not easily coaxed into exploring the interface of technology with disciplines outside the sciences, nor do they as a group appreciate the rigor of non-formal theoretical work. The standard model of teaching in Computer Science is to douse students with a fire hose of technology and information. Students learn to organize and retain information despite very high baud rates of information. This approach to education is not conducive to either a critical stance or reflection, both of which are requisite for learning at the interface of technology and social science. A different pace of action – with opportunities to pause and reflect, be discursive and thoughtful – is required for an educational practice that invites reflection.

Students outside of computer science would also benefit from a more reflective approach to learning about technology in a context. Examples of the set of tasks, topics, and fields that compose this second population are informatics, library research and the digital library, computer supported cooperative work, the internet, graphic design, scientific visualization and animation, education, and economics and business. These students require a basic understanding of computation/internet as an important form of mediation, how computation functions in a context, but they also need to be able to use the technology to mediate their work and to understand the context of the technology. For these students, there exists a very interesting relation between the object of study (technology) and the means of study (technology): it is reflective.

This paper will focus on the use of collaborative groupware technology to explore the interface between technology and social science. The use of *reflective collaborative technology* helps students to practice with alternate disciplinary frameworks, developing multi-disciplinary ways of orienting and methods of operation. The basic idea is to have students work online, record their work into transcripts that are reviewable, and then analyze the transcripts. This serves a range of theoretical and practical functions. The reflective technology enables students to exploit the reflective relationship between what they are learning and how their learning is mediated. Other efforts on the role of technology in reflection and education have emphasized how computers can support student reflection as the students learn the course material (Collins & Brown, 1988); for example, in a knowledge-building community (Scardamalia & Bereiter, 1994) the technology supports students as they reflect and construct new knowledge relevant to the content of the course, say environmental studies. Reflective technology, of the sort that we are interested in, gives students reviewable transcripts of their online activities, and these transcripts are directly relevant to their education about technology.

All of the collaborative platforms we have developed in our lab produce transcripts of user behavior that are reviewable and replayable. The production of transcripts of online collaborative behavior serves a range of theoretical and practical functions:

1. The exercise of collecting transcripts teaches experimental design and methods.
2. The participation of the students in data collection exercises gives students first hand experiences with online collaboration.
3. The first hand experience of the students as both collectors of data and participants in online collaboration are an object of reflection.
4. The transcripts provide concrete data for exploring and evaluating a theoretical framework.
5. The transcripts are a source of design problems and also a testing ground for design innovation.
6. The transcripts provide concrete data for teaching and practicing various kinds of analysis methods.
7. The collection of transcripts is a shared repository of data for term projects.
8. The transcripts are a basis for classroom discussion.

Integrating Reflective Technology into the Classroom

This paper presents a case study of a class at Brandeis University that used collaborative technology as a foundation for course material that puts technology in an interdisciplinary context. The case study reprises the details of a course that taught multi-disciplinary theories of intersubjectivity to computer science undergraduate and graduate students. In this course, technology was used to record the student's own online collaborative activity in a representational form that was reviewable and thereby accessible as an object of analysis and reflection. The use of the collaborative technology gave students first-hand experience with the object of study, supporting student learning for the entire range of research and development activities, both theoretical and practical, from theory, to method, to evaluation. The class was composed of a mix of graduate (13) and undergraduate (15) students. The material in the course was conceptually difficult.

The first part of the semester was spent working through a demanding reading list, especially for the computer science students whose orientation is primarily technical; the topic was intersubjectivity. Making this kind of interdisciplinary theoretical material relevant to a class of students who are largely computer scientists is not a trivial task. The material is relevant to the technical development of online environments that support collaborative effort within a community. If nothing else, the theoretical material explains why many network-mediated activities or organizations think their virtual community is an impoverished form of collaboration when contrasted to communities that regularly meet face-to-face. But the theoretical material has more relevance than that. The first step towards integrating mediated forms of interaction into emerging or existing communities of practice is to understand the requirements. Only then is one in a position to design and engineer environments that best match the practice given the constraints of the technology. Other value can also be achieved by understanding what cannot be done and why not. It is also a bit of a surprise for computer science students to discover that what occurs online is a significant source of data for navigating safe passage through contentious theoretical waters.

During the second part of the semester the students practiced methods of transcript analysis. The last part of the semester was a workshop where the class collectively worked at reading transcripts as they proceeded with their term projects; the class also continued to read papers. The use of collaborative technology to create objects of reflection and analysis was critical to the development of the students' practice.

The class used wiki-based technology called CEDAR throughout the semester. CEDAR enables students to collaborate same time/different place vis-à-vis a wiki. It provides students with a set of "What You See Is What I See" (WYSIWIS) components: a public chat, shared Wiki editor, shared web browser, and a document overview that displays a map of the Wiki structure that the users create and maintain. Replayable transcripts of online user activity are automatically recorded. A replay device enables students to review their online activity as if they were viewing a videotape.

CEDAR was initially introduced to the students one month into the semester. CEDAR was used to give the students some hands-on experience with online collaboration and prepare for data collection exercises. The class was divided into teams of 2 to 5 students who engaged in a collaborative task. Because CEDAR was still in beta stage, these exercises provided an opportunity for some motivated discussion of design for use. The data we collected was used for exercises in class that forced students to apply various kinds of transcript analysis methods. Analysis of the data was also featured on the exam that assessed their skill at applying the transcript reading techniques they had been taught, and provided a basis for term project proposals.

During class, the initial set of data was replayed to apply theoretical concepts to concrete data and teach the students the transcript reading techniques. The initial replay device was very slow, so it was rebuilt. Some of the students created additional tools for analyzing the transcripts: shell scripts extracted and displayed the chat among the users in chronological order; they also produced logs of the users' activities at the level of "He is chatting" or "He downloaded a file".

Students were encouraged to bring their laptops to class so they could break out into smaller groups and practice transcript analysis. The initial set of data was also used as a basis for their term project proposal. Each proposal was required to include at least one segment of transcript to illustrate their idea. Examples of topics include: visualizing awareness between participants, division of labor, interruptions, and leadership within groups.

The class engaged in a redesign task. The plan was to redesign CEDAR for a second set of data collection exercises. Time constraints limited the changes that could be made to CEDAR. As a result of class discussion, two additional features were implemented. The data collection exercise was modified so it would provide a more interesting set of data. The goal here was to prevent the employment of a "divide-and-conquer" strategy among the team. This would encourage more interaction and joint sensemaking among the users. These uses of the technology helped the students to develop the scientific practice of experimental design. They also enabled the students to produce data that would improve their project results.

The class collected a second set of data using the new task and the modified version of CEDAR. This exercise provided the students with a more carefully engineered set of data that better supported their term project work. It also completed the redesign cycle by presenting the class with the opportunity to critically reflect on the tasks of interface design and experimental design.

Some analysis was done of the effect of integrating the production of objects of reflection and analysis into the framework for the course. The range, scope, and quality of the term projects provided significant evidence that using collaborative technology to support reflection enabled students to participate at the interface of computation and social science. With but a few exceptions, the term projects uniformly demonstrated significant progress at understanding the theoretical topics discussed in class. The projects showed that the students were able to take abstract theoretical ideas and apply them to the close analysis of detailed transcripts of online activity. Without the in-class participation and practice at reading and analyzing transcripts, showing the relevance of theory to the dynamics and concreteness of online activity, it would have been much more difficult for students to make the leap – much of the class would have been lost.

At the end of the semester we handed out a survey to the students asking theoretical and practical questions about the course topics and structure and the value of the CEDAR technology. 93% of the students said that the CEDAR technology is useful for studying and applying the theoretical topics covered in the class. 82% of the students stated that having access to replayable transcripts made the theoretical papers read in class more comprehensible. 79% thought the availability of transcripts was helpful in choosing a topic for their term project. 82% believed that the second set of data was more relevant to their term projects. 75% believed that transcripts helped to focus the interface redesign task.

The survey also yielded the following representative comments from the students: "It helps you understand the task better to do it yourself. It gives more insight into how groups collaborate, how joint sense is achieved. It is easier to look at data from a task you are familiar with." "When we see the transcripts, the examples correlate with the theoretical stuff we read about. We can relate examples we see to the theory and challenge the theory." "Some of the papers were clarified or made concrete by examples from our transcripts."

References

Collins A. & Brown, J.S. (1988) The Computer as a Tool for Learning through Reflection. In Mandl H. & Lesgold A. (Eds.) Learning Issues for Intelligent Tutoring Systems, 1-18.

Scardamalia, M. and Bereiter, M. (1994) Computer Support for Knowledge-Building Communities. *Journal of the Learning Sciences*, 3(3), 265-283.

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