Evaluating Distributed Cooperative Learning

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INTRODUCTION

Evaluating outcomes associated with computer-supported cooperative learning (CSCL) is difficult for a variety of reasons. One must consider user-interface usability issues, coordinated multi-user computer issues, learning efficacy in general, cooperative aspects of group learning specifically, and the larger context of the classroom(s) in which the previous issues are situated. Geographically displaced learning communities coordinating activities through computer networking technologies with individuals and subgroups, often working and learning different things at different times and places, present even greater challenges for researchers assessing outcomes on students, teachers, and educational organizations. Specifically, problems result because measurement is dispersed in time and across place, and as a result, the subsequent evaluation stages are more complicated because these activities occur across individuals and groups.

We have developed a general-purpose multifaceted evaluation framework to address complex, distributed activities as they relate to multi-user (groupware) computer interfaces (Neale and Carroll, 1999). In this paper, we describe the framework specifically as it relates to the CSCL context in which we developed it. We also describe some of the methodological perplexities facing researchers who combine multiple methods and data, and we describe various solutions for managing the data collection, analysis, integration, and interpretation process.

Learning in Networked Communities (LiNC)

The evaluation work described here is part of an interdisciplinary educational technology project called Learning in Networked Communities (LiNC). A single interface integrates a set of groupware tools with various collaboration and synchronous and asynchronous communication mechanisms (Isenhour, Carroll, Neale, Rosson, & Dunlap, 2000). A Java-based networked learning environment called the "Virtual School" includes a collaborative science notebook that allows personal or shared workspaces for planning, developing, organizing, shared writing, and annotation of science projects. Communication tools built into the Virtual School include structured Web-based discussion forums, e-mail, real-time chat, video conferencing, and shared whiteboards. A server coordinates and preserves content centrally across users.

BACKGROUND: REQUIREMENTS FOR DISTRIBUTED CSCL EVALUATION

Contextual Evaluation

Evaluation methodologies for single-user computer interfaces have serious deficiencies when applied to the recent development of groupware interfaces (Greenberg, 1991), and consequently, there is no

accepted mainstream approach to multi-user assessment. It is difficult to create controlled situations in the lab that reflect the social, motivational, organizational, and political dynamics so essential for groupware success found in actual work contexts (Grudin, 1990). Learning and technology integration cannot be divorced from contexts of use either. Subtleties of students' learning mediated by technology, teacher implementation of such technology constrained by real curriculum demands, and common classroom limitations (e.g., insufficient time, too many students, and not enough computers) make it imperative that CSCL technologies be implemented and subsequently evaluated in genuine classrooms.

Curriculum Evaluation

Technology cannot be designed and evaluated in isolation of designing and evaluating curriculum and pedagogy. Focusing on curriculum during evaluation has become a greater concern in the development of education technology for two reasons: 1) The number and types of technology available in the classroom have significantly increased, and 2) there have been radical shifts in fundamental beliefs surrounding the goals and strategies to education (Roblyer, Edwards, & Havriluk, 1997). Technology use in the classroom and learning inescapably emerge over time, often over weeks or months. To understand how learning unfolds in this context, evaluation must also span the learning process over time. This is especially the case when a wide range of issues is being considered in the evaluation or when evaluation has components of exploration. As a result, CSCL evaluation should be longitudinal to the extent possible. Approaching evaluation from this framework has been a natural incorporation into our entire participatory design life cycle that fully involves our teacher-collaborators (see Chin, Rosson, & Carroll, 1997).

EVALUATION FRAMEWORK FOR DISTRIBUTED MULTI-USER SYSTEMS

Synergistic Methodological Pluralism

Based on the evaluation requirements just described, we have developed a multifaceted evaluation framework that captures complex, distributed activities by combining quantitative human performance data and approaches under a qualitative research framework based on fieldwork. We have adopted a relatively new but increasingly promising pragmatist research paradigm (Tashakkori & Teddlie, 1998). This strategy uses a mixed-model research design, which fundamentally incorporates in all phases of the research process both quantitative and qualitative philosophies and approaches. Mixing methods in our research goes beyond purely methodological considerations. We have followed Brewer and Hunter's (1989) approach to including both quantitative and qualitative paradigms in all stages of the research process: problem formation, measurement, building and testing theory, data collection/analysis, sampling, and the reporting of findings.

Mixed-Model Evaluation Process

Our emphasis up to this point in our research has been on formative evaluation (Scriven, 1967)—rich descriptions of classroom practice incorporating technology used to guide refinement and redesign. Figure 1 is a visual representation of our multi-faced evaluation framework. Quantitative deductive philosophies and qualitative inductive philosophies are applied to all levels of both quantitative and qualitative methods and data. The methods include interviews, surveys, questionnaires, focus groups, direct observation and field notes, contextual inquiry, video, system logs, and student-constructed artifacts. We have had to substantially modify existing single-user