

Differentiating the effect of group dynamics on technology appropriation, artifact creation, and performance

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ABSTRACT

My research highlights how group dynamics in computer supported collaborative work significantly impact performance and technology appropriation, as well as the interactive project produced. By linking specific factors of group dynamics to outcome patterns, my analysis identifies which factors play the greatest roles in achieving success – in terms of project quality, group performance, and individual satisfaction. Data was collected during three years of an augmented paper intervention for 124 students enrolled in a Design course. Preliminary results suggest that appropriation of content sharing technologies is dependent on group dynamics, as are performance and artifact creation.

Author Keywords

Group dynamics, Technology appropriation, Collaborative learning, Collaborative work, Design education.

ACM Classification Keywords

H.5.3.b Collaborative computing; K.3.1.a Collaborative Learning; K.4.3.b Computer-supported collaborative work.

INTRODUCTION

My dissertation analysis illustrates *how performance, artifact creation, and technology appropriation are impacted by group dynamics*. Improving our understanding of the links between collaboration patterns and outcomes is critical to successfully addressing appropriation and performance problems that are fundamentally social in nature.

My preliminary data analysis shows how achieving a critical mass of users is not enough to convince users to adopt a novel collaborative technology. In my research it is the relationships between the users that determines appropriation of collaborative technologies, more strongly than the number of users. Specifically, two years ago we

conducted the first longitudinal deployment of the Anoto augmented paper technology [4]. Ten of the heaviest technology users in our study stopped using the content-sharing technology after two months, and technical improvements (speed, additional features) did not convince these students to return to their prior level of usage. At the end of the quarter interviews and survey answers revealed the reasons behind their decision: the Anoto technology facilitates sharing notes across teammates, and the students that stopped using it reported having a “free rider”[3] as a teammate.

The effect of free-riders is one of the relational outcomes of group dynamics that I am interested in analyzing, alongside group cohesiveness. I categorize both free riders and group cohesiveness as relational outcomes, because they can only be measured once the collaboration is underway. My working definition of *group dynamics* encompasses both these relational outcomes and group composition factors. Group composition factors can be measured at the outset of the collaboration, and include prior relationships between the group members, individual work preferences, collaborative expertise, goals and attitudes.

I seek to uncover the relative impact of different patterns of collaboration on technology appropriation, artifact creation, and performance. Traditionally, social challenges to technology appropriation have been grouped together, identified by their catchphrases (“free-rider,” “sucker effect,” “prisoner’s dilemma”), and tangential to the subject of the analysis. In contrast, the focus in my dissertation is on the differential effects of group dynamics. My methodology and data collection strategies draw from the disciplines of CSCW, HCI, Organizational Behavior, Workplace Studies, Design Research, Social Psychology, and Education.

My research focuses on longer-term collaborations where groups engage in creative, open-ended projects. The context is Design Education: during the past three years I have collected data from 124 upperclassmen and Masters’ students that enrolled in the HCI Design Studio course [4] and volunteered to participate in the study. As part of their coursework, students collaborate during four to six weeks in groups of four to complete an interactive project, from ideation to implementation and user testing. Completed

projects ranged widely, including an interactive charm bracelet linked to a social networking website, a “green” home illumination system, and an interactive teddy bear for hospitalized children. To capture their fieldwork and prototypes students depend on the design notebook and digital cameras. Central to contemporary design teaching practice, design notebooks provide a chronological record of ideas and decisions, inspirational clips, group notes, observations, and reflections. Design notebooks have significant import: they are considered valid sources for patent disputes in the professional field, and account for approximately 30% of the students’ final grade in the design studio courses analyzed.

We instrumented these courses for the past three years with an ecology of tools that supported capture, annotation, and sharing of the students’ work [4], centered on the Anoto technology. When used with an Anoto digital notebook, the pens record a vector-graphics representation of each stroke, along with the page, date, and time. Anoto pens also act as normal ballpoint pens should the pen run out of battery power. To view the digital notes, we created the iDeas browser where students can manipulate their content, synch related images, see other students’ notebooks, and add annotations.

For my dissertation research, I consider both the group project and the design notebook as *artifacts created* by the students. Success at the project is determined by the students’ satisfaction with the collaboration, learning, and product produced, as well as the grade (determined by the course staff and a panel of independent judges). To assess the students’ design notebooks, I borrow the methodology from design education research and analyze the students’ representations in their design notebooks, whose frequency has been correlated to positive project outcomes. Digital timestamps recorded unobtrusively through the digital pens technology supplement this traditional notebook coding method, resulting in a quantitative analysis of the design notebooks.

The iDeas ecology gives us a unique window into the group dynamics during the quarter, while simultaneously its appropriation patterns expose the challenges posed by group dynamics to the successful use of collaborative technologies for innovative products. I draw upon Activity Theory (as described in [1], [2], among others) as a heuristic framework that provides a coordinated description of the use of technology at several hierarchical levels simultaneously, and recognizes technology as mediating purposeful human activity. The mixed-method approach for data collection includes class and group meeting observations, questionnaires, notebook analysis, interviews, and performance evaluation (students’ and course staff’s). Qualitative data is used as a guide and endorsement of the findings from statistical analyses.

Beyond usage statistics, I draw from Leont’ev’s definition of *appropriation* to describe the processes by which

individuals consciously take both conceptual and operational control of a technology through involvement in culturally organized activities in which the technology plays a role supporting creative endeavors within a community of practice. In addition to considering the number of pages the students wrote and synched using the Anoto system, I analyze patterns of online browsing of each other’s notes and exporting content to other applications, the students’ feedback on the system, and the likelihood of future usage.

Lastly, I consider *course performance* as a proxy for the students’ learning beyond their success at the particular project implementation: it is a measure, determined by the course staff, of the students’ success at their apprenticeship to the design process, including class participation, as well as performance on three other projects.

The contributions of my research are both practical and theoretical. By linking patterns of group dynamics to specific appropriation and performance outcomes, my research offers concrete recommendations for fostering and maintaining dynamics within groups that maximize satisfaction and performance, as well as informing the design of collaborative systems. Beyond specific features and activities to support, the lessons we are learning from these longitudinal deployments of augmented paper broaden our perspective of computer-supported collaborations. At this juncture, the advice of the Doctoral Consortia will be very helpful. After completing data collection, I am in the early stages of analysis. I am looking very much forward to the panel’s comments, from specific suggestions of areas and metrics I have not considered, guiding how I frame my dissertation, orienting me as to how to best assess the implications and limitations of this research, to choosing and better understand the analysis underway, and suggesting relevant sources.

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