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Mutual development in mass collaboration: Identifying interaction patterns in customer-initiated software product development

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ABSTRACT

In this paper we investigate computer-supported collaborative learning (CSCL) and innovation in a large-scale distributed setting. Get Satisfaction (GS), a social media platform for involving customers in product development activities, is our case study. In order to identify how end users contribute to product development, we researched the interactions between end users, champions, and professional developers in this online community as they jointly constructed a shared artifact (a web application). We collected publicly available platform interaction data over a six-month period (N = 229 users). The methods we employed are social network analysis (SNA) and interaction analysis (IA), which we combined in a mixed-methods design. At the network level, we identified key actors according to centrality measures. At the interaction level, we zoomed in on specific interactions. We propose a model of mass collaboration in terms of four interaction patterns: 1) *gatekeeping*, control of excessive information sharing, 2) *bridge building*, spreading information across groups in the network, 3) *general development*, allowing professional developers to create new software functionality and update existing software, and 4) *user-user collaboration*, facilitating non-centrally organized development activities, ranging from feature requests to local development. We discuss our findings and compare them with related research.

1. Introduction

With the rise of web 2.0 technologies and social media there has been a turn toward users becoming content creators, and web platforms are now largely user-driven. There are many implications to this; for education, the internet is now a platform for collaborating, sharing and connecting people rather than just a source of information. This shift has enabled ordinary people to become active contributors by interacting in distributed settings and in multiple configurations, contributing a range of different skills and expertise. This "bottom-up" approach to knowledge production has challenged the "top-down" approach prevalent in other areas (e.g. Encyclopedia Britannica vs. Wikipedia; predefined curriculum vs. self-driven learning) and is characterized by collective and open-ended production where an anonymous mass constitutes an important stakeholder. A common term for this is *mass collaboration* (Cress, 2013; Tapscott & Williams, 2008).

The essence of mass collaboration resides not only in new technologies and enhanced connectivity but also in the interaction and collaboration of a large number of participants from different places and time zones (Halatchliyski, Moskaliuk, Kimmerle, & Cress, 2014) and in the creation of shared artifacts (Moen, Mørch, & Paavola, 2012; Paavola, Lipponen, & Hakkarainen, 2004). New opportunities for collaboration have become possible through social media, where users can contribute to knowledge building in the large, such as on Wikipedia (Cress, 2013). A consequence of this for education is that small group collaboration needs to be understood within the framework of mass collaboration. However, the majority of studies in the field of computer-supported collaborative learning (CSCL) investigate collaboration and knowledge building in small groups and classrooms (Scardamalia & Bereiter, 2006; Stahl, Koschmann, & Suthers, 2006). In the present study, we used empirical data from the Get Satisfaction (GS) online community to investigate interaction between end users, champions, and professional developers in their joint effort to improve a software product. According to Heiskanen, Hyysalo, Kotro and Repo (2010), there is a need for improved research methods for investigating product development collaboration between professional developers and end users, as previous studies have glossed over moment-to-moment interactions and knowledge sharing in user-

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developer relations. Our approach is unique in that it combines two traditions: CSCL and innovation studies. To accomplish this, we used two levels of data: fine grained empirical data of social interactions and a global view of the network and its social structures. We analyzed these two levels in conjunction through a mixed-methods framework to propose interaction patterns of user-developer collaborations.

The research question guiding our inquiry is *"What are the patterns of interaction between end users and professional developers in a mass collaboration community, as seen from a mutual development perspective?"* The first part of the question addresses the network level (information paths and powerful actors), and the second part incorporates what the participants discuss and what roles they perform. We wanted to investigate both the interaction patterns of the online GS community and focus on some specific social practices in the community during mutual product development in order to extend prior research. In our previous work (Andersen & Mørch, 2009; Mørch & Andersen, 2010), five sub-processes of user-developer interactions were identified at the small-group level, leading to the formulation of the term "mutual development." Here, we take this one step further by scaling up from small-group collaboration to mass collaboration and integrating SNA and IA.

Several researchers acknowledge social network analysis (SNA) as a highly relevant and necessary research method for describing and understanding interaction patterns in CSCL (Cress, 2013; Halatchliyski et al., 2014). For example, Halatchliyski et al. (2014) have underscored how SNA is a unique and largely unexplored method for tackling the large-scale dimensions of mass collaboration within CSCL. De Laat, Lally, Lipponen, and Simons (2007) have used SNA in a mixed-methods approach to provide an analytical framework for understanding message exchanges among mass collaboration participants, capturing a richer, and more accurate, picture of the complexity of such conversations. Our approach differs from previous studies in two ways: 1) it combines SNA with interaction analysis (IA) and 2) it explores patterns of interaction around the development of a software artifact.

The paper is organized as follows: First, we survey related work. Then, we describe our case study and the context for the study. Next, we present and argue for our mixed-methods approach to data collection and analysis. We then present and analyze our empirical data by focusing on topical findings, presenting representative excerpts as instances of mass collaboration in customer-initiated software product development. We compare our findings with results reported in the literature we surveyed. Finally, we summarize our findings and suggest some directions for future research.

2. Literature review

2.1. Mass collaboration

Tapscott and Williams (2008) coined the term "mass collaboration" to describe how people can join forces in self-organized communities to dynamically produce new goods and services. Their work has not been without critique. For example, Elliott (2007) claimed that they failed to provide an adequate definition or criteria for discerning collaboration from other collective activities such as cooperation and coordination, making the term a buzzword and stripping it of analytical value.

Cress (2013) differentiated between formal and informal learning when she defined mass collaboration, emphasizing that formal learning involves knowledge building in smaller groups in classroom settings, whereas mass collaboration is about knowledge building "in the wild," usually outside educational institutions and often in informal or semi-formal contexts of work and leisure activities. She found that these activities induce individual learning while demonstrating collaborative knowledge creation in wiki-based systems, further developing shared knowledge artifacts (Cress, 2013).

Halatchliyski et al. (2014) have discussed the relevance of mass collaboration for CSCL, proposing collective knowledge to be constituted as substance and by participation. By studying article production in Wikipedia, their study shows how collective knowledge is manifested in the structure of artifacts and can be traced back to the collaborative activity of authors with different levels of experience and expertise (Halatchliyski et al., 2014). Wikipedia's interconnected articles represent a network and were thus analyzed using a network analysis approach. This form of mass collaboration was defined as a knowledge building activity: creating shared knowledge based on existing, openly accessible knowledge in collaboration with many other users.

Forte (2015) is critical of the use of the term "knowledge building" in conjunction with mass collaboration, arguing that the discursive processes associated with article creation in Wikipedia cannot be associated with knowledge building. Yet, despite the critique of the collaborative learning potential of Wikipedian discourses during article creation and discussion, Forte (2015) agrees there has been little attention paid to how information is selected, vetted, and verified by learners in this community. Our study differs from these studies in that we address another form of mass collaboration, mutual development, manifest in two ways: 1) there is an asymmetrical relationship between the participants, professionals (software developers) and amateurs (customers and end-user developers) and 2) the goal of their activity is to produce both concrete (software tools) and abstract (knowledge) artifacts.

2.2. SNA studies in CSCL research

De Laat et al. (2007) used social network analysis to study patterns of interaction in a networked learning community, investigating how its members share and construct knowledge. The authors used a mixed-methods approach, combining content analysis, critical event recall and SNA.

Siqin and colleagues (2015) investigated synchronous discourses between 27 Chinese undergraduate students collaborating in fixed groups during an introductory research methods course. They used a multifaceted analysis (involving social network analysis and content analysis) to assess online discourses and examine its potential relationship to individual learning throughout the course, as well as to examine different aspects of collaboration.

Martinez et al. (2006)have suggested that SNA can serve as an appropriate method for studying interaction patterns and provided examples of this in three different CSCL scenarios. They demonstrated how effective the method is for supporting the study of participatory aspects of learning at the network level.

Our study differs from previous studies in that we used a mixed-methods approach, combining SNA and IA, and applied this to discourse processes in mass collaboration. Our work builds on the notion of "collaborative knowledge creation" developed in the European KP-Lab (Moen et al., 2012; Paavola et al., 2004) and integrates CSCL with innovation studies.

2.3. User-driven innovation

User-driven innovation (UDI) refers to innovation by end users, customers, or consumer of products. Eric Von Hippel (2005) argued that integrating active users in companies' product development processes may lead to product innovation and value creation. He introduced a method for identifying sources of innovation by