Interaction Processes in Collaborative Learning Networks: A Social Interdependence Perspective

Research-in-Progress

Christian Sorgenfrei
University of Hagen & EBS Business School
58084 Hagen, Germany
christian.sorgenfrei@fernuni-hagen.de

Stefan Smolnik
University of Hagen
58084 Hagen, Germany
stefan.smolnik@fernuni-hagen.de

Abstract

Information systems and communication tools such as online discussions forums are increasingly replacing traditional instructor-led learning methods with collaborative learning networks. Collaborative learning networks emphasize the distributed nature of learning and community-based sharing of knowledge, where people connect and collectively contribute knowledge to a learning community. However, the value realized through collaborative learning depends on social interaction processes that take place among members of a learning network. The aim of this paper is to present our ongoing research on social interaction processes, their determinants, and their effects on individual and group learning performance. We investigate the role of different social interaction processes in collaborative learning networks, where students' learning is derived from (instead of with) the learning community. As a result, we aim to offer theoretical insights into how collaborative learning networks enhance the learning outcomes of both the individual and group.

Keywords: Collaborative learning, learning networks, social interdependence, social interaction, organizational training

Introduction

The continuing digitalization of today's knowledge has increased the need for organizations to enable learning and knowledge sharing among their employees in order to retain a competitive advantage and to increase their revenues (Mehra et al. 2014; Zheng et al. 2010). As a result, organizations are starting to adopt learning technologies that support collaboration and knowledge sharing within learning networks (Saba Inc. and HCM Advisory Group 2013; American Society for Training & Development 2013). Collaborative learning networks involve groups of learners who use information technologies to "communicate and collaborate in order to build and share knowledge" (Hiltz and Turoff 2002, p. 56). Such learning networks emphasize the distributed nature of learning and community-based sharing of knowledge, where people connect and collectively contribute knowledge to a learning community (Siemens 2005; Downes 2010). Learning networks thus allow access to distributed knowledge that is no longer held by one individual, but "stored" in a network of people (Siemens 2005). By pooling their cognitive efforts through diversity in opinions and solutions and "concerted thinking" (Wechsler 1971, p. 904), individual learners are able to extent their own ressources and achieve learning goals which they would not have been able to achieve on their own. For example, collaborative learning supports the accomplishment of academic and work-related learning tasks in small groups (Gupta and Bostrom 2012; Alavi 1994; Lou et al. 2001) as well as in large-scale online discussion groups (Phang et al. 2009; Chen and Chen 2009; Cao et al. 2008; Arbaugh and Benbunan-Finch 2006). Yet, collaborative learning

networks are not effective per se, but often constrained by members' free-riding and off-task behavior (Salomon and Globerson 1989; Kreijns et al. 2003) as well as a lack of community response (Leidner and Fuller 1997; Zhang et al. 2013). In addition, large scale interactions in online communities like the emerging massive open online courses (MOOCs) can result in information overload (Jones et al. 2004) that may lead to group learning losses (Alavi 1994). Consequently, research on (IT supported) collaborative learning has found mixed results regarding outcomes (Dillenbourg et al. 2009; Bernard et al. 2009).

Recent research has found evidence that a group's learning performance is correlated with the social sensitivity within the group as well as with the distribution of learning conversations among the group members (Woolley et al. 2010). Learning outcomes in collaborative learning networks therefore depend on the nature of social interaction processes that take place between individual members. It is through connecting learners and fostering interaction processes that learning networks facilitate the "pooling of memory [...], the sharing of knowledge, the synergy of [...] resources and skills, and mutual encouragement" (Lévy 1997, p. 250). Effective social interaction processes, however, rely on individual participation in learning groups and requires members' "active and sustained effort" towards the groups' goals (Johnson and Johnson 2005, p. 297). Our study therefore seeks to investigate the role of social interaction processes in collaborative learning networks, and how these facilitate knowledge creation and learning in a group. More specifically, this study addresses the following two questions:

(RQ1) Under which conditions do effective interaction processes occur in collaborative learning networks?

(RQ2) What is the effect of different interaction process on individual and group learning outcomes?

Our research endeavor thus aims at characterizing effective interaction processes in collaborative learning networks that lead to the distribution of cognitive resources and effective learning outcomes. The overall objective of this paper is to present our ongoing research by theoretically deriving hypotheses and developing a conceptual model based on the social interdependence literature (Johnson and Johnson 2009) that addresses our research questions. Furthermore, we describe the methodology and the respective survey instrument that we plan to use to empirically validate our conceptual model in the context of corporate social learning networks. The intended contribution of our research is twofold: First, we conceptualize and summarize different forms of social interaction processes that are a key to effective learning in collaborative learning networks. In particular, we include both cognitive and emotional forms of interaction that may be decisive for learning performances. Second, we propose key factors and develop hypotheses of how these enable or constrain social interaction processes. We distinguish between factors that promote social interaction as well as factors that may impose barriers to social interaction to account for individual free-riding and off-task behavior that has been observed in learning and knowledge sharing communities (Leidner and Fuller 1997; Cabrera and Cabrera 2002; Kreijns et al. 2003; Jones et al. 2004).

Theoretical Background and Hypotheses

Co-operative or collaborative learning [1] is based on the mutual engagement of learners towards accomplishing shared learning tasks (Dillenbourg et al. 2009; Johnson and Johnson 2005). Compared to individual learning efforts, collaborative learning is distinguished by the personal interactions that take place among learners (Webb 1982; Slavin 1996). Building on the constructivist model of learning, collaborative learning occurs through the sharing of resources, the exchange of knowledge, and the development of a shared understanding (Leidner and Jarvenpaa 1995). Social interaction forces learners to evaluate their individual beliefs, to review inconsistencies and conflicts in their thinking, and to challenge their initial understanding (Glaser and Bassok 1989). According to this view, communicative activities such as discussing and elaborating on problems are a driver for learning achievements (Slavin 1996). While these theoretical foundations have been primarily developed and applied in traditional classroom settings, the principle of distributed cognition emphasizes the sharing of cognitive resources and information in digital social networks (Hollan et al. 2000; Rogers and Ellis 1994). In collaborative

[1] While sometimes cooperation (sharing of work) is distinguished from collaboration (mutual engagement of participants to solve tasks together), most researchers (e.g. Leidner and Jarvenpaa (1995); Slavin (1996)) use both forms synonymously.

learning networks, learning emerges from the synergy of knowledge and skills and the "pooling of memory and cognitive resources" (Lévy 1997 p. 250). Collaborative learning thus enables collective learning outcomes that exceed those achieved individually (Siemens 2005; Downes 2010).

Overall, these findings support the notion that cognitive resources and learning outcomes of individuals can be extended through collaboration and interaction within a group. Although individuals may act for their own goals, collaboration has the potential to lead to a higher learning performance that is the result of group efforts rather than individual efforts alone (Woolley et al. 2010). A more refined view suggests that the effectiveness of collaborative learning depends on the "extent to which groups actually engage in productive interactions" (Dillenbourg et al. 2009. p. 6), and that the nature of interaction among students is a key to effective collaborative learning in technology-supported environments (Bernard et al. 2004; Bernard et al. 2009; Cao et al. 2008).

Although the importance of interaction processes is recognized, we lack a holistic view of the role of (different) interaction patterns for learning outcomes of individual and groups (Dillenbourg et al. 2009). In this paper, we propose that the way individual learners interact in a collaborative environment determines subsequent learning outcomes for both individuals and groups. Specifically, we distinguish between different types of interaction and knowledge exchange to reflect the various ways in which collaboration can increase learning outcomes. We thus investigate a special form of learning processes (Gupta and Bostrom 2009) that are required to solve the learning tasks at hand.

Promotive Interaction Processes in Collaborative Learning Networks

Learning communities are characterized by different forms of interaction processes that take place between individuals within a group. Our view on interaction processes draws from earlier observations of student interaction in classrooms (Webb 1982; Salomon and Globerson 1989; Johnson and Johnson 2009): They are social in nature and occur via different cognitive and emotional channels.

Cognitive interaction involves the sharing of knowledge and cognitive resources. Contributing or sharing knowledge to a community is essential for the creation of shared meanings and for assisting others in their learning efforts by providing answers and explanations (Webb 1982). Previous research has assessed knowledge contribution to shared electronic message boards (Kankanhalli et al. 2005b; Jian and Jeffres 2006), online communities (Wasko and Faraj 2005; Chiu et al. 2006; Ma and Agarwal 2007), and students' discussion forums (Phang et al. 2009; Chen and Chen 2009). By sharing, adding and combining existing knowledge, individuals can co-create new knowledge in online communities (Faraj et al. 2011).

Complementary to knowledge contribution, help seeking composes an important part of the demand side of knowledge exchange. Help seeking refers to an individual's active request for information from online communities (Phang et al. 2009) or from knowledge repositories (Kankanhalli et al. 2005a; Bock et al. 2006). Together with knowledge contribution, help seeking is an important part of vibrant collaboration and knowledge creation in social networks, which in turn determines learning outcomes (Gray and Meister 2004). Furthermore, cognitive interaction is characterized by providing feedback on others' task- and teamwork (Johnson and Johnson 2009). In a continuous interaction process, feedback on one's own performance is essential to understand how one's own actions have contributed to the group's goals (Bock et al. 2005). Importantly, the effectiveness of feedback for learning performance depends on whether feedback includes explanations in addition to the solution itself (Webb 1982).

In addition to cognitive interaction, emotional support facilitates learning by reducing learning anxiety and increasing learning self-efficacy (Webb 1982; Kreijns et al. 2003). If learners are well embedded in a social network through social relationships, a positive emotional climate is created that enhances learning satisfaction and performance (Baldwin et al. 1997). For instance, anxiety decreases and self-efficacy increases as the learners uncertainty with the learning content, process, and technological system is reduced through social support and encouragement (Chu and Chu 2010; Campion et al. 1993). Interaction processes in learning communities should therefore not be restricted to cognitive exchange, but need to include the emotional dimension which is essential in learning communities (Kreijns et al. 2003).

These interaction processes, referred to as promotive interaction (Johnson and Johnson 2009) (see Table 1), support each other's learning processes and facilitate individual and group performance. However, individuals in a group have an incentive to free-ride on others knowledge contribution that may result in "cooperation dilemmas" (Cabrera and Cabrera 2002). Although free-riding or withdrawal from a

community may save on individual learning efforts (Kreijns et al. 2003), it threatens social interactions and participation of other members, thus decreasing individual and group learning performance (Fung 2004). Moreover, help seeking alone is ineffective and discouraging if questions are left unanswered (Ridings and Wasko 2010). Thus, the absence of promotive interaction (referred to as oppositional or no interaction, Johnson and Johnson 2009) obstructs individual and group learning efforts.

Table 1. Promotive Interaction Processes in Collaborative Learning Networks

Construct	Definition	Sources and related processes in IS research
Knowledge contribution	Sharing knowledge and providing effective help and assistance to group members (Johnson and Johnson 2009), also referred to as giving help or group helping (Webb 1982)	Knowledge contribution to shared databases (Kankanhalli et al. 2005b; Jian and Jeffres 2006; Wasko and Faraj 2005) and to online communities (Phang et al. 2009; Chen and Chen 2009; Ma and Agarwal 2007; Chiu et al. 2006); Also referred to more broadly as knowledge collaboration (Faraj et al. 2011)
Help seeking	Actively seeking for help and assistance from a learning community (Webb 1982)	Knowledge seeking from online communities (Phang et al. 2009) and shared databases (Bock et al. 2006; Kankanhalli et al. 2005a; Fulk et al. 2004; He and Wei 2009); Also referred to as knowledge sourcing (Gray and Meister 2004; Gray and Durcikova 2005)
Providing feedback	Providing feedback on task- and teamwork to support group members' reasoning and learning (Johnson and Johnson 2009)	Knowledge sourcing/feedback (Gray and Meister 2004); Feedback on shared knowledge/sense of self-worth (Bock et al. 2005)
Providing emotional support	Socio-emotional support and encouragement, influencing each other to achieve the group goals (Webb 1982)	Social/personal/emotional discussions in online communities (Ridings and Wasko 2010); Peer support (Chu and Chu 2010)

In summary, promotive interaction processes that are characterized by mutual seeking and sharing of knowledge as well as by perceived feedback and emotional support among the group members are likely to result in higher learning performance. In contrast, learning groups in which members free-ride on others' knowledge contribution, withhold emotional support, or engage in other non-related tasks – in short non-collaborative groups – lead to reduced learning outcomes for both the individual and the group (Kreijns et al. 2003; Johnson and Johnson 2009). Eventually, interactions processes mediate the effect of individual learning beliefs on learning outcomes (Webb 1982; Johnson and Johnson 2005). Table 1 provides an overview of the different types of interaction processes that can occur in collaborative learning networks. Thus, we present our first hypotheses as follows:

H1: The presence of promotive interaction processes will lead to higher individual learning performance compared to negative or non-interaction.

H2: The presence of promotive interaction processes will lead to higher group learning performance compared to negative or non-interaction.

Social Interdependence in Collaborative Learning Networks

On an individual level, previous research has identified a large and increasing set of personal benefit factors that predict knowledge exchange and interaction in virtual communities (e.g. Kankanhalli et al. 2005b; Fulk et al. 2004; Wasko and Faraj 2005; Jian and Jeffres 2006). Within a community, however, interactions are characterized by social exchange (Faraj and Johnson 2011) and interdependence of team members, where the "individual's cognitive processes affect and become affected by the ones of the other team members" (Salomon and Globerson 1989, p. 93). Social interdependence theory emerged as an

approach to structure collaborative learning in groups "that are made interdependent through common goals" (Johnson and Johnson 2009, p. 366). A key aspect in social interdependence theory is the connection between perceived interdependence of group members and promotive interaction processes (Johnson and Johnson 2009, 2005). We view social interdependence as a force that motivates interaction within collaborative learning groups and focus on three factors that represent interdependence: shared goals, task interdependence, and group cohesion (Johnson and Johnson 2009).

Shared goals refer to the degree to which members of a community share the same vision and a set of collective targets (Tsai and Ghoshal 1998; Campion et al. 1993). This situation creates interdependence among the group members as supporting others to achieve their goals also supports individual goal achievement. Shared goals support group actions and facilitate trusting bonds among members from which the whole group can benefit (Tsai and Ghoshal 1998). As are result, group members who share common goals are more likely to exchange resources. Studies on online communities have shown that shared goals (or similar constructs such as shared vision or group norms) increase the quality of knowledge sharing in such settings (Chiu et al. 2006), enhance attitudes towards knowledge sharing (Chow and Chan 2008), and facilitate group intentions (Bagozzi and Dholakia 2002). With common goals, the importance of promotive interaction and of mutual achievement rises. In contrast, if members of a group perceive that others follow different goals or purposes than their own, they are likely to withhold collaborative effort. We thus hypothesize the following:

H3a: The degree of shared goals within a group is positively related to promotive interaction.

Task interdependence results from a (perceived) dependence on others for completing a task (Campion et al. 1993). Members of a collaborative learning network who require others' knowledge to accomplish their tasks and depend on others' sharing of information are more motivated to engage in knowledge seeking and interaction (Kankanhalli et al. 2005a). Task interdependence creates a reciprocal relationship where the learning tasks of individuals are intertwined and who are therefore induced to assist each other in the assigned task (Johnson and Johnson 2009). Similarly, interdependence among work tasks has been found to increase motivation for sharing information via collaborative technologies (Jarvenpaa and Staples 2001) as well as knowledge sharing among consultant-client pairs in IT development projects (Pee et al. 2010). In collaborative learning groups, task interdependence emerges from the interrelation between learning tasks and the degree to which learners depend on others to solve a given task. Following these arguments, we hypothesize that learners who depend on or who share their tasks with others are more willing to engage in promotive interaction compared to those whose tasks are separate from others:

H3b: The degree of task interdependence within a group is positively related to promotive interaction.

Group cohesion refers to the social identity within a group or to the degree to which a group is perceived as a coherent entity (Lickel et al. 2000). In such circumstances, group members feel attracted to a group, develop bonds, and interact since they "care about one another and want one another to succeed" (Slavin 1996, p. 46). Group cohesion reflects a group's identity that comprises feelings of belongingness in terms of group membership, affiliation, emotional involvement, and attachment to a group (Bagozzi and Dholakia 2002; Bock et al. 2005; Chiu et al. 2006; Lu et al. 2011). In a virtual community, a group's boundary arises from feelings of membership and feelings that group members matter to one another as well as from feelings of influence and status within the group. These factors determine a groups sense of community and perceived social interdependence (Blanchard and Markus 2004; Rovai 2002). When individuals define themselves in terms of their group membership, they are less willing to exploit common resources and are more inclined to share their personal knowledge and participate in group activities (Cabrera and Cabrera 2002). Furthermore, groups that are characterized by social cohesion make individuals more comfortable to communicate in a technology-mediated environment (Phang et al. 2009). Similarly, feelings of trust towards other members increases the willingness to contribute information (Jian and Jeffres 2006). Group cohesion therefore acts as a control for debilitating behavior, and helps to sustain collaboration and promotive interaction. The stronger a group is perceived as a unified whole, the stronger is also the interdependence between the group members. To summarize:

H3c: The degree of social cohesion within a group is positively related to promotive interaction.

Barriers to Promotive Interaction in Collaborative Learning Networks

Thus far, we have hypothesized factors for individual engagement in promotive interaction based on perceived social interdependence with other group members. However, learning communities often fail to sustain effective interactions and are affected by members' free-riding or complete withdrawal (Salomon and Globerson 1989). This raises the question whether additional barriers exist that prevent individuals from collaborating. Costs for engaging in collaborative interaction arise when the required learning time competes with alternative tasks (Kankanhalli et al. 2005b). Time constraints – limited available time for learning activities – hinders regular knowledge seeking in organizational information repositories (Bock et al. 2006). Similarly, lack of time has been reported as a major reason for learners not participating in collaborative online learning (Fung 2004; Muilenburg and Berge 2005). In the context of our study, time constraints are connected to the number and urgency of work tasks that compete with the available learning time. In organizational training, the time spent with collaborative learning (and, thus, the required effort) is likely to be reduced if learners are involved in a large number of work tasks, especially of these tasks are urgent or important. Cumulating time constraints therefore build up time pressure and increase the costs for engaging in collaborative learning activities (Gray and Durcikova 2005). We thus hypothesize that time constraints impose a significant barrier for participating in collaborative learning:

H4a: Time constraints are negatively related to an individual's engagement in promotive interaction.

In addition to time barriers, learners in an virtual environment face a high degree of autonomy that may challenge instructional clarity (Ardichvili et al. 2003; Sahay 2004). At the core of learning autonomy is a learner's freedom of choice, self-governance, and independence that relates to the learner's sense of control over the "use and effects of technology" (Sahay 2004, p. 294). Perceived learner autonomy corresponds to the extent learners believe to have instructional control over their learning process and is a critical condition for effective learning choices and performance (Kraiger and Jerden 2007; Sun and Hsu 2013; Cao et al. 2008). The impact of learning autonomy for learning outcomes has been a major research issue for some time without conclusive evidence in one or the other direction (Kraiger and Jerden 2007; Williams 1996). Proponents of learner control suggest that flexible instruction offers employees the opportunity to learn outside of predetermined hours of work, thus reducing the tension between learning and work time (Fulton et al. 2013). A high degree of autonomy, however, may not increase motivation of learners unambiguously. Conjoined with feelings of isolation during the learning process, learning autonomy has been related to frustration and anxiety (Chou and Liu 2005; Scheiter and Gerjets 2007), providing caution against the proposition that all learners are the best judge of their instructional strategy (Piccoli et al. 2001). Notwithstanding potential positive effects of learning autonomy, we suggest that learning autonomy in collaborative learning networks loosens the bonds to the course, deregulates the learning process and lowers enforcement of collaboration. We thus hypothesize:

H4b: The level of perceived learning autonomy is negatively related to an individual's engagement in promotive interaction.

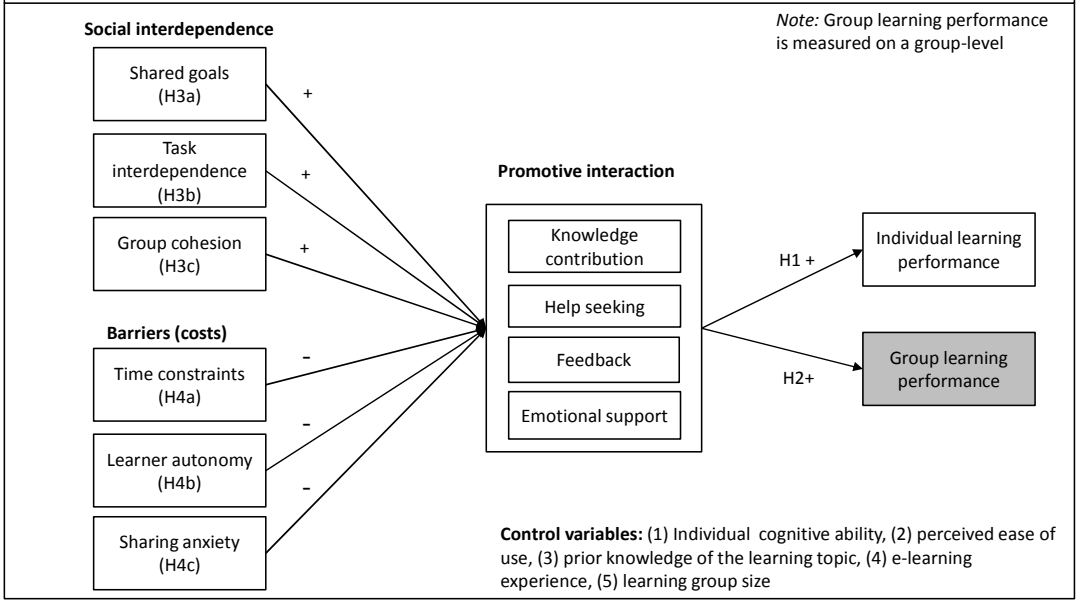
Even if learners have positive attitudes towards a learning community, active participation may be prevented due to anxiety towards knowledge sharing and interaction in a community. In knowledge-sharing communities, anxiety is related to fear of disapproval or criticism for sharing false or irrelevant content that act as barrier for knowledge sharing (Ardichvili et al. 2003; Leidner and Fuller 1997). In contrast to individual learning, collaborative learning poses a risk for exposing gaps in one's knowledge. Individuals are less likely to contribute knowledge when they feel to have little expertise or show little confidence in their expertise, or when they conceive that their knowledge would not contribute to the existing knowledge level (Wasko and Faraj 2000; Kankanhalli et al. 2005b). As a result, the more anxious somebody is to pass on knowledge, the less likely she or he is to collaborate with other group members. This is consistent with findings that a high level of knowledge sharing self-efficacy (people believing that their knowledge can support others) is positively related to knowledge contribution and performance (Chen and Chen 2009; Kankanhalli et al. 2005b). In line with the above arguments, we thus hypothesize:

H4c: Sharing anxiety is negatively related to an individual's engagement in promotive interaction.

In summary, we have proposed promotive interaction patterns in collaborative learning networks that (1) determine individual and group learning outcomes, (2) are facilitated by perceived social interdependence

within the learning group, and (3) are impeded by learning and collaboration barriers. The research hypotheses are summarized in the conceptual model presented in Figure 1.

Figure 1. Research Model



Research Design and Method

To evaluate our conceptual model, we intend to adopt a survey approach to allow for a better generalizability of our results (Boudreau et al. 2001). The hypotheses are tested through structured questionnaires, which afford a quantitative analysis of our model based on a positivist research paradigm. In our investigation, we focus on individual and group level outcomes of interaction processes. While we are primarily interested in an individual's willingness to engage in different interaction processes, we include both individual- as well as group-level learning outcomes as dependent variables.

To evaluate our conceptual model, we will proceed in three stages in line with accepted research paradigms for conducting survey-based field studies (Churchill Jr 1979; Moore and Benbasat 1991). In stage 1 (which is currently in progress), we specify the domain for each construct and generate an initial pool of questionnaire items that fit to the constructs' definitions (Haynes et al. 1995). Where possible, measures are adapted from existing studies where they have been tested and proven to be reliable. For the remaining constructs, we use established measurement development guidelines (Bagozzi 2011). Table 2 summarizes the constructs and their sources used in our model. In line with the original sources, all constructs except group performance are measured on the individual level of analysis.

The measurement scales for constructs related to perceived social interdependence (group cohesion, shared goals, and task interdependence) are adapted from measures proposed in the literature to fit the context of our study. For example, items for measuring task interdependence are collected from studies on work-task-interdependence and adapted to a learning context (Campion et al. 1993; Jarvenpaa and Staples 2001). Measures for perceived barriers to interaction are, however, less established and often lack a broader empirical validation. The definition for learning autonomy is based on a previous literature review (Sorgenfrei et al. 2013) and items are based on the perceived choice scale which has been used in an educational context (Vallerand et al. 1997). Sharing anxiety is developed based on work on knowledge sharing barriers (Ardichvili et al. 2003) as well as on the related measure for knowledge self-efficacy (Kankanhalli et al. 2005b). Individual learning performance is assessed as perception about one's learning progress and experience that is due to the course. Previous research has shown that perceived learning is a reliable predictor of actual learning outcomes (Alavi 1994; Alavi et al. 2002; Cao et al. 2008). In addition, we use group learning performance (measured as an individual's assessment of group

learning performance) to investigate whether collaboration leads to specific group outcomes that are independent from individual outcomes (Baldwin et al. 1997; Sparrowe et al. 2001). By adopting a group perspective of outcomes, we recognize that an individual's engagement in promotive interaction can have impacts on other members of a learning group beyond individual outcomes, thus leading to the emergence of collective phenomena (Morgeson and Hofmann 1999).

Table 2. Construct Overview and Definitions

Construct	Definition	Literature sources
Group cohesion	Degree to which individuals feel attracted to the group and identify themselves with the group.	Adapted from Blanchard and Markus 2004; Chiu et al. 2006; Lu et al. 2011
Shared goals	Degree to which individuals perceive to share the same vision and a set of collective goals.	Adapted from Chow and Chan 2008; Chiu et al. 2006
Task interdependence	Degree to which individuals perceive to depend on other group members to accomplish their learning tasks.	Adapted from Jarvenpaa and Staples 2001
Time constraints	Degree to which learning time competes with work tasks (leading to time pressure).	Self-developed, based on Bock et al. 2006; Gray and Durcikova 2005
Sharing anxiety	Fear of disapproval or criticism for exchanging false or irrelevant knowledge	Self-developed, based on Ardichvili et al. 2003
Learner autonomy	Degree to which users of learning systems perceive instructional autonomy over their learning process.	Self-developed, based on Fulton et al. 2013; Vallerand et al. 1997
Individual learning performance	Individual's perceived learning performance in terms of learning experience and satisfaction, and improved understanding of the material	Adapted from Cao et al. 2008; Alavi 1994; Arbaugh and Benbunan-Finch 2006
Group learning performance	Individual assessment of group learning performance (group level construct)	Adapted from Choi et al. 2010; Sparrowe et al. 2001

Note: Please see Table 1 for the definitions and sources for interaction constructs.

In order to control for exogenous factors that potentially affect the interaction processes and learning outcomes, we also include five control variables. To account for potential technological difficulties, we include perceived ease of use as a control variable (Davis 1989). Ease of use is a critical factor that affects how users integrate any IT system into their daily routines (Gray and Durcikova 2005). We also control for an individual's overall virtual learning experience as well as for cognitive ability (measured by the educational level) to account for differences in learning outcomes (Baldwin et al. 1997). In addition, we intend to control for self-rated expertise of the learning topic as well as for the learning group size as sustaining virtual interaction tends to be more difficult for larger groups (Ridings and Wasko 2010).

In the next step of our research process (stage 2), we will refine our item pool and develop a measurement scale. To initially validate and refine the measurement instrument developed from the literature, we will conduct semi-structured interviews with experts from organizational training departments and human capital consultancies (Bock et al. 2005). The experts will be asked to go through the initial questionnaire and to provide feedback on clarity, completeness, and whether the construct definitions capture the essence of the respective phenomena. Subsequently, the final measurement scale is intended to be developed using established card-sorting and item-ranking procedures in order to reword and/or remove unclear items and to ensure content validity (Anderson and Gerbing 1991; Moore and Benbasat 1991). Towards this end, the measurement scale will be pre-tested with a selected sample of users of collaborative learning networks to ensure construct validity (Straub et al. 2004).

In stage 3, the final survey instrument will be eventually field-tested with surveys distributed to individuals using collaborative learning tools in selected organizations. The paths in our structural model

will be explored by applying partial least squares evaluation techniques (for the analysis at the individual level) as well as hierarchical level modeling (for analysis of group performance impact) (Hofmann 1997). We aim for testing our model in the context of (virtual) collaborative training in Germany-based, multinational organizations that have launched social learning technologies (such as discussion forums, internal blogs, and social networking tools) to complement traditional learning management systems.

Contributions and Outlook

The aim of this paper is to present our ongoing research on social interaction processes, their determinants, and their effects on individual and group learning performance in collaborative learning networks. While earlier research has investigated interaction between a learner and a learning system or (virtual) instructor (Cao et al. 2008; Bernard et al. 2009), the focus is gradually moving to social interaction between learners (Dillenbourg et al. 2009). In our conceptual model, the different interaction processes are derived from earlier research on classroom-based collaborative learning (Webb 1982; Salomon and Globerson 1989) as well as from more recent research on knowledge exchange in virtual communities (see Table 1). From the literature, we find that knowledge contribution and seeking have received a fair amount of research. However, feedback and emotional support have so far received only very limited attention.

Our theoretical contribution lies in the conceptualization of a theoretical model as well as an initial instrument for measuring the role of interaction processes in collaborative learning networks. Although the importance of interaction for collaborative learning in education has been recognized (Webb 1982), the majority of research on collaborative learning focuses on comparing the outcomes of individual versus group learning (e.g. Gupta and Bostrom 2012; Arbaugh and Benbunan-Finch 2006; Lou et al. 2001), thereby neglecting the importance of social exchange. In our research, we address the role of social interaction processes that hold a key to explain differences in collaborative learning performances (Dillenbourg et al. 2009). In particular, drawing on and extending prior research on knowledge sharing, we conceptualize different types of promotive interaction processes that include both cognitive and emotional forms of interaction, which are held to determine learning performance in collaborative learning networks (see Table 1). In addition, we propose specific conditions under which promotive interaction processes occur. While most studies on knowledge exchange focus on individual motivational factors (e.g. intrinsic and extrinsic rewards, Kankanhalli et al. 2005b, or beliefs on a systems' usability and interaction support e.g. Phang et al. 2009; Lu et al. 2011), we introduce social interdependence and perceived barriers as two countervailing forces that facilitate or prevent social interaction. On the one hand, factors that enhance the level of perceived social interdependence act as forces that promote knowledge exchange, feedback, and emotional support in online learning networks. On the other hand, we propose different barriers in order to account for individual free-riding and off-task behavior in collaborative learning. We thereby intend to clarify the mixed results found in the literature regarding the outcomes of IT-supported collaborative learning (Dillenbourg et al. 2009).

Our practical contribution lies in developing an instrument with which organizations can eventually evaluate their social learning initiatives. Socially distributed learning in online learning networks holds the promise to enhance learning beyond what can be achieved by traditional training methods. By exchanging knowledge and by providing feedback and support, individual members of learning groups benefit themselves and advance the group's knowledge. While many organizations still rely on formal instructor-led training, collaborative learning networks are being increasingly introduced as learning method (American Society for Training & Development 2013). In particular, discussion forums, blogs, and virtual communities of practice are becoming a part of social learning technologies (Saba Inc. and HCM Advisory Group 2013). Our research thus aids managers who are concerned with the implementation of corporate training to understand the drivers of employees' learning performance.

So far, our research is limited in that it is solely based on the literature and theoretical development. Thus, our model requires further elaboration and validation in the upcoming research stages. In order to validate and refine our model, we intend to corroborate the conceptual model within an organizational training setting. Information technologies and communication tools such as online discussion forums have altered learning and distribution of knowledge in organizations. As organizations progress toward new collaborative learning methods, research is needed to further explore the role of social interaction processes that eventually determine learning performance and training success.

References

Alavi, M. 1994. "Computer-mediated collaborative learning: an empirical evaluation," *Management Information Systems Quarterly* (18:2), pp. 159–174.

Alavi, M., Marakas, G. M., and Yoo, Y. 2002. "A Comparative Study of Distributed Learning Environments on Learning Outcomes," *Information Systems Research* (13:4), pp. 404–415.

American Society for Training & Development 2013. *Informal Learning: The Social Evolution*, Alexandria, VA: ASTD Press.

Arbaugh, J. B., and Benbunan-Finch, R. 2006. "An Investigation of Epistemological and Social Dimensions of Teaching in Online Learning Environments," *Academy of Management Learning & Education* (5:4), pp. 435–447.

Ardichvili, A., Page, V., and Wentling, T. 2003. "Motivation and barriers to participation in virtual knowledge-sharing communities of practice," *Journal of Knowledge Management* (7:1), pp. 64–77.

Bagozzi, R. P. 2011. "Measurement and Meaning in Information Systems and Organizational Research: Methodological and Philosophical Foundations," *Management Information Systems Quarterly* (35:2), pp. 261–292.

Bagozzi, R. P., and Dholakia, U. M. 2002. "Intentional social action in virtual communities," *Journal of interactive marketing* (16:2), pp. 2–21.

Baldwin, T. T., Bedell, M. D., and Johnson, J. L. 1997. "The social fabric of a team-based MBA program: Network effects on student satisfaction and performance," *Academy of Management Journal* (40:6), pp. 1369–1397.

Bernard, R. M., Abrami, P. C., Borokhovski, E., Wade, C. A., Tamim, R. M., Surkes, M. A., and Bethel, E. C. 2009. "A meta-analysis of three types of interaction treatments in distance education," *Review of Educational Research* (79:3), pp. 1243–1289.

Bernard, R. M., Abrami, P. C., Lou, Y., Borokhovski, E., Wade, A., Wozney, L., Wallet, P. A., Fiset, M., and Huang, B. 2004. "How does distance education compare with classroom instruction? A meta-analysis of the empirical literature," *Review of Educational Research* (74:3), pp. 379–439.

Blanchard, A. L., and Markus, M. L. 2004. "The experienced sense of a virtual community: Characteristics and processes," *ACM Sigmis Database* (35:1), pp. 64–79.

Bock, G.-W., Kankanhalli, A., and Sharma, S. 2006. "Are norms enough? The role of collaborative norms in promoting organizational knowledge seeking," *European Journal of Information Systems* (15:4), pp. 357–367.

Bock, G.-W., Zmud, R. W., Kim, Y.-G., and Lee, J.-N. 2005. "Behavioral Intention Formation in Knowledge Sharing: Examining the Roles of Extrinsic Motivators, Social-Psychological Forces, and Organizational Climate," *Management Information Systems Quarterly* (29:1), pp. 87–111.

Boudreau, M.-C., Gefen, D., and Straub, D. W. 2001. "Validation in Information Systems Research: A State-of-the-Art Assessment," *Management Information Systems Quarterly* (25:1), pp. 1–16.

Cabrera, A., and Cabrera, E. F. 2002. "Knowledge-sharing dilemmas," *Organization Studies* (23:5), pp. 687–710.

Campion, M. A., Medsker, G. J., and Higgs, A. C. 1993. "Relations between work group characteristics and effectiveness: Implications for designing effective work groups," *Personnel Psychology* (46:4), pp. 823–847.

Cao, Janna, M. C., Ming, L., Judee, K. B., and Jay F. Nunamaker, JR. 2008. "An empirical investigation of virtual Interaction in supporting learning," *The DATA BASE for Advances in Information Systems* (39:3), pp. 51–68.

Chen, I. Y. L., and Chen, N.-S. 2009. "Examining the Factors Influencing Participants' Knowledge Sharing Behavior in Virtual Learning Communities," *Educational Technology & Society* (12:1), pp. 134–148.

Chiu, C.-M., Hsu, M.-H., and Wang, E. T. G. 2006. "Understanding knowledge sharing in virtual communities: an integration of social capital and social cognitive theories," *Decision Support Systems* (42:3), pp. 1872–1888.

Choi, S. Y., Lee, H., and Yoo, Y. 2010. "The Impact of Information Technology and Transactive Memory Systems on Knowledge Sharing, Application, and Team Performance: A Field Study," *Management Information Systems Quarterly* (34:4), pp. 855–870.

Chou, S.-W., and Liu, C.-H. 2005. "Learning effectiveness in a Web-based virtual learning environment: a learner control perspective," *Journal of Computer Assisted Learning* (21:1), pp. 65–76.

Chow, W. S., and Chan, L. S. 2008. "Social network, social trust and shared goals in organizational knowledge sharing," *Information & Management* (45:7), pp. 458–465.
Chu, R. J., and Chu, A. Z. 2010. "Multi-level analysis of peer support, Internet self-efficacy and e-learning outcomes – The contextual effects of collectivism and group potency," *Computers & Education* (55:1), pp. 145–154.
Churchill Jr, G. A. 1979. "A paradigm for developing better measures of marketing constructs," *Journal of Marketing Research (JMR)* (16:1).
Davis, F. D. 1989. "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *Management Information Systems Quarterly* (13:3), pp. 319–340.
Dillenbourg, P., Järvelä, S., and Fischer, F. 2009. "The evolution of research on computer-supported collaborative learning," in *Technology-enhanced learning*, Balacheff, N. et al. (ed.): Springer Science & Business Media B.V, pp. 3–19.
Downes, S. 2010. "New Technology Supporting Informal Learning," *Journal of Emerging Technologies in Web Intelligence* (2:1).
Faraj, S., Jarvenpaa, S. L., and Majchrzak, A. 2011. "Knowledge collaboration in online communities," *Organization Science* (22:5), pp. 1224–1239.
Faraj, S., and Johnson, S. L. 2011. "Network exchange patterns in online communities," *Organization Science* (22:6), pp. 1464–1480.
Fulk, J., Heino, R., Flanagin, A. J., Monge, P. R., and Bar, F. 2004. "A test of the individual action model for organizational information commons," *Organization Science* (15:5), pp. 569–585.
Fulton, L. V., Ivanitskaya, L. V., Bastian, N. D., Erofeev, D. A., and Mendez, F. A. 2013. "Frequent deadlines: Evaluating the effect of learner control on healthcare executives' performance in online learning," *Learning and Instruction* (23:0), pp. 24–32.
Fung, Y. Y. H. 2004. "Collaborative online learning: Interaction patterns and limiting factors," *Open Learning: The Journal of Open, Distance and e-Learning* (19:2), pp. 135–149.
Glaser, R., and Bassok, M. 1989. "Learning theory and the study of instruction," *Annual Review of Psychology* (40:1), pp. 631–666.
Gray, P. H., and Durcikova, A. 2005. "The Role of Knowledge Repositories in Technical Support Environments: Speed versus Learning in User Performance," *Journal of Management Information Systems* (22:3), pp. 159–190.
Gray, P. H., and Meister, D. B. 2004. "Knowledge sourcing effectiveness," *Management Science* (50:6), pp. 821–834.
Gupta, S., and Bostrom, R. 2009. "Technology-Mediated Learning: A Comprehensive Theoretical Model," *Journal of the Association for Information Systems* (10:9), pp. 686–714.
Gupta, S., and Bostrom, R. 2012. "An Investigation of the Appropriation of Technology-Mediated Training Methods Incorporating Enactive and Collaborative Learning," *Information Systems Research* , pp. 1–16.
Haynes, S. N., Richard, David C. S., and Kubany, E. S. 1995. "Content validity in psychological assessment: A functional approach to concepts and methods," *Psychological Assessment* (7:3), pp. 238–247.
He, W., and Wei, K.-K. 2009. "What drives continued knowledge sharing? An investigation of knowledge-contribution and-seeking beliefs," *Decision Support Systems* (46:4), pp. 826–838.
Hiltz, S. R., and Turoff, M. 2002. "What makes learning networks effective?" *Communications of the ACM* (45:4), pp. 56–59.
Hofmann, D. A. 1997. "An overview of the logic and rationale of hierarchical linear models," *Journal of Management* (23:6), pp. 723–744.
Hollan, J., Hutchins, E., and Kirsh, D. 2000. "Distributed cognition: toward a new foundation for human-computer interaction research," *ACM Transactions on Computer-Human Interaction (TOCHI)* (7:2), pp. 174–196.
Jarvenpaa, S. L., and Staples, D. S. 2001. "Exploring perceptions of organizational ownership of information and expertise," *Journal of Management Information Systems* (18:1), pp. 151–184.
Jian, G., and Jeffres, L. W. 2006. "Understanding Employees' Willingness to Contribute to Shared Electronic Databases A Three-Dimensional Framework," *Communication Research* (33:4), pp. 242–261.
Johnson, D. W., and Johnson, R. T. 2005. "New developments in social interdependence theory," *Genetic, social, and general psychology monographs* (131:4), pp. 285–358.

Johnson, D. W., and Johnson, R. T. 2009. "An educational psychology success story: Social interdependence theory and cooperative learning," *Educational Researcher* (38:5), pp. 365–379.
Jones, Q., Ravid, G., and Rafaeli, S. 2004. "Information Overload and the Message Dynamics of Online Interaction Spaces: A Theoretical Model and Empirical Exploration," *Information Systems Research* (15:2), pp. 194–210.
Kankanhalli, A., Tan, B. C. Y., and Wei, K. 2005a. "Understanding seeking from electronic knowledge repositories: An empirical study," *Journal of the American Society for Information Science and Technology* (56:11), pp. 1156–1166.
Kankanhalli, A., Tan, B. C. Y., and Wei, K.-K. 2005b. "Contributing knowledge to electronic knowledge repositories: an empirical investigation," *Management Information Systems Quarterly* (19:1), pp. 113–143.
Kraiger, K., and Jerden, E. 2007. "A meta-analytic investigation of learner control: Old findings and new directions," in *Towards a Science of Distributed Learning*, M. Fiore, and E. Salas (eds.), Washington D.C.: American Psychological Association.
Kreijns, K., Kirschner, P. A., and Jochems, W. 2003. "Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: a review of the research," *Computers in Human Behavior* (19:3), pp. 335–353.
Leidner, D. E., and Fuller, M. 1997. "Improving student learning of conceptual information: GSS supported collaborative learning vs. individual constructive learning," *Decision Support Systems* (20:2), pp. 149–163.
Leidner, D. E., and Jarvenpaa, S. L. 1995. "The use of information technology to enhance management school education: A theoretical view," *Management Information Systems Quarterly* (19:3), pp. 265–291.
Lévy, P. 1997. "Education and training: New technologies and collective intelligence," *Prospects* (27:2), pp. 248–263.
Lickel, B., Hamilton, D. L., Wieczorkowska, G., Lewis, A., Sherman, S. J., and Uhles, A. N. 2000. "Varieties of groups and the perception of group entitativity," *Journal of Personality and Social Psychology* (78:2), p. 223.
Lou, Y., Abrami, P. C., and d'Apollonia, S. 2001. "Small group and individual learning with technology: A meta-analysis," *Review of Educational Research* (71:3), pp. 449–521.
Lu, X., Phang, Chee Wei, and Yu, J. 2011. "Encouraging participation in virtual communities through usability and sociability development: an empirical investigation," *The DATA BASE for Advances in Information Systems* (42:3), pp. 96–114.
Ma, M., and Agarwal, R. 2007. "Through a glass darkly: Information technology design, identity verification, and knowledge contribution in online communities," *Information Systems Research* (18:1), pp. 42–67.
Mehra, A., Langer, N., Bapna, R., and Gopal, R. D. 2014. "Estimating Returns to Training in the Knowledge Economy: A Firm Level Analysis of Small and Medium Enterprises," *Management Information Systems Quarterly* (38:3).
Moore, G. C., and Benbasat, I. 1991. "Development of an instrument to measure the perceptions of adopting an information technology innovation," *Information Systems Research* (2:3), pp. 192–222.
Morgeson, F. P., and Hofmann, D. A. 1999. "The Structure and Function of Collective Constructs: Implications for Multilevel Research and Theory Development," *The Academy of Management Review* (24:2), pp. 249–265.
Muilenburg, L. Y., and Berge, Z. L. 2005. "Student barriers to online learning: A factor analytic study," *Distance education* (26:1), pp. 29–48.
Pee, L. G., Kankanhalli, A., and Hee-Woong, K. I. 2010. "Knowledge Sharing in Information Systems Development: A Social Interdependence Perspective," *Journal of the Association for Information Systems* (11:10), pp. 550–575.
Phang, C. W., Kankanhalli, A., and Sabherwal, R. 2009. "Usability and Sociability in Online Communities: A Comparative Study of Knowledge Seeking and Contribution," *Journal of the Association for Information Systems* (10:10), pp. 721–747.
Piccoli, G., Ahmad, R., and Ives, B. 2001. "Web-Based Virtual Learning Environments: A Research Framework and a Preliminary Assessment of Effectiveness in Basic IT Skills Training," *MIS Quarterly* (25:4), pp. 401–426.

Ridings, C., and Wasko, M. M. 2010. "Online discussion group sustainability: Investigating the interplay between structural dynamics and social dynamics over time," *Journal of the Association for Information Systems* (11:2), pp. 95–121.
Rogers, Y., and Ellis, J. 1994. "Distributed cognition: an alternative framework for analysing and explaining collaborative working," *Journal of Information Technology* (9), pp. 119–128.
Rovai, A. P. 2002. "Sense of community, perceived cognitive learning, and persistence in asynchronous learning networks," *The Internet and Higher Education* (5:4), pp. 319–332.
Saba Inc., and HCM Advisory Group 2013. *State of the Industry Study: A Pulse on Social Learning*.
Sahay, S. 2004. "Beyond Utopian and Nostalgic Views of Information Technology and Education: Implications for Research and Practice," *Journal of the Association for Information Systems* (5:7), pp. 282–313.
Salomon, G., and Globerson, T. 1989. "When teams do not function the way they ought to," *International Journal of Educational Research* (13:1), pp. 89–99.
Scheiter, K., and Gerjets, P. 2007. "Learner control in hypermedia environments," *Educational Psychology Review* (19:3), pp. 285–307.
Siemens, G. 2005. "Connectivism: A learning theory for the digital age," *International Journal of Instructional Technology and Distance Learning* (2:1), pp. 3–10.
Slavin, R. E. 1996. "Research on cooperative learning and achievement: What we know, what we need to know," *Contemporary Educational Psychology* (21:1), pp. 43–69.
Sorgenfrei, C., Smolnik, S., Hertlein, M., and Borschbach, A. 2013. "The Impact of Learner Control on E-Learning Effectiveness: Towards a Theoretical Model," in *Proceedings of the 32nd International Conference on Information Systems*, R. Baskerville, and M. Chau (eds.), Milan. December 15th-18th, AIS.
Sparrowe, R. T., Liden, R. C., Wayne, S. J., and Kraimer, M. L. 2001. "Social networks and the performance of individuals and groups," *Academy of Management Journal* (44:2), pp. 316–325.
Straub, D., Boudreau, M.-C., and Gefen, D. 2004. "Validation guidelines for IS positivist research," *The Communications of the Association for Information Systems* (13:1), p. 63.
Sun, J.-n., and Hsu, Y.-c. 2013. "Effect of interactivity on learner perceptions in Web-based instruction," *Computers in Human Behavior* (29:1), pp. 171–184.
Tsai, W., and Ghoshal, S. 1998. "Social capital and value creation: The role of intrafirm networks," *Academy of Management Journal* (41:4), pp. 464–476.
Vallerand, R. J., Fortier, M. S., and Guay, F. 1997. "Self-determination and persistence in a real-life setting: Toward a motivational model of high school dropout," *Journal of Personality and Social Psychology* (72:5), pp. 1161–1176.
Wasko, M. M., and Faraj, S. 2000. ""It is what one does": why people participate and help others in electronic communities of practice," *Journal of Strategic Information Systems* (9:2), pp. 155–173.
Wasko, M. M., and Faraj, S. 2005. "Why should I share? Examining social capital and knowledge contribution in electronic networks of practice," *Management Information Systems Quarterly* (29:1), pp. 35–57.
Webb, N. M. 1982. "Student Interaction and Learning in Small Groups," *Review of Educational Research* (52:3), pp. 421–445.
Wechsler, D. 1971. "Concept of collective intelligence," *American Psychologist* (26:10), pp. 904–907.
Williams, M. D. 1996. *Learner control and instructional technologies*, New York: Simon & Schuster Macmillan.
Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., and Malone, T. W. 2010. "Evidence for a collective intelligence factor in the performance of human groups," *Science* (330:6004), pp. 686–688.
Zhang, C., Hahn, J., and De, P. 2013. "Continued Participation in Online Innovation Communities: Does Community Response Matter Equally for Everyone?" *Information Systems Research* (24:4), pp. 1112–1130.
Zheng, W., Yang, B., and McLean, G. N. 2010. "Linking organizational culture, structure, strategy, and organizational effectiveness: Mediating role of knowledge management," *Journal of Business Research* (63:7), pp. 763–771.