Encyclopedia of E-Collaboration

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E-Collaborative Knowledge Construction

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INTRODUCTION

Knowledge has become an important factor in the success of organizations. Several authors reflect this in their use of terms such as *knowledge society* (e.g., Nonaka, 1994) or *knowledge age* (e.g., Bereiter, 2002). The role of knowledge has changed fundamentally with the development of a knowledge society. Knowledge is still an indispensable resource for the individual as well as for an organization, but the emphasis lies on the creation of new knowledge (see Nonaka, 1994). This change also has consequences for the individual acquisition of knowledge and, in turn, for learning. In traditional learning scenarios, knowledge was seen as a commodity that could be transferred directly from one brain to another. This resulted in an interaction between teacher and learner, in which the teacher had an active role and presented parts of his knowledge to the learners, who passively received and memorized them (see Ertl, Winkler, & Mandl, 2007). However, studies have shown that whilst learning by such presentations of explicit knowledge enabled learners to reproduce it in tests, they failed to transfer it to new situations and often failed to apply it in the creation of new knowledge—the knowledge learners acquired remained inert (Renkl, Mandl, & Gruber, 1996).

BACKGROUND

Innovative approaches to teaching and learning no longer only focus on the transfer of explicit knowledge, but pay more attention to tacit knowledge (Nonaka, 1994). Tacit knowledge is often not conscious and therefore almost impossible to teach explicitly. It may comprise of situational, conceptual, procedural and strategic skills (see De Jong & Fergusson-Hessler, 1996; Nonaka, 1995). It is an important key for the application of existing knowledge and the creation of new knowledge. Constructivist approaches postulate that each learner has to construct new knowledge actively to appreciate the applicability of knowledge. Approaches such as the *cognitive apprenticeship* (Collins, Brown, & Newman, 1989) or *situated learning* (Lave & Wenger, 1991) place learners in a collaborative scenario that enables them to construct knowledge actively in collaboration with learning partners. Four different processes can be seen as particularly beneficial for collaborative knowledge construction (see Fischer, Bruhn, Gräsel, & Mandl, 2002): Learners' *externalization* and *elicitation* of knowledge, their *conflict-oriented negotiation,* and their *consensus-oriented integration*. Learners' externalization requires them to elaborate knowledge comprehensibly to their learning partners. This challenges them to actively use their knowledge. Elicitation describes a request for new knowledge to the learning partners. Learning partners are required to externalize their knowledge and the learner himself has the chance to fill gaps in his knowledge based on these externalizations. Conflict-oriented negotiation describes learners' discussion of divergent perspectives on the content, whereby consensus-oriented integration comprises of learners' efforts to find a synthesis of their different viewpoints. Consequently, the processes of externalization and elicitation primarily facilitate the acquisition and application of knowledge while negotiation and integration focus more on the creation of new knowledge. To sum up, collaborative knowledge construction is attributed with many benefits for learners (see, e.g., Cohen & Lotan, 1995; Ertl, Fischer & Mandl, 2006; Lou, Abrami & d'Apollonia, 2001; Roschelle & Teasley, 1995).

E-collaborative knowledge construction shifts these processes to scenarios of computer mediated communication. However, the term "e-collaboration" is associated with several different meanings or styles of collaboration and it is necessary to distinguish between them for conceptual clarity (see Dillenbourg, 1999; Gräsel, Fußangel & Pröbstel, 2006). One facet of e-collaboration can be described as the *exchange* of information and working material (see Gräsel et al., 2006). This style of collaboration takes place in a more casual manner and has mutual benefit from the material of the respective collaboration partners as its main goal. Another aspect concerns a professional division of work.

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Dillenbourg (1999) also calls this quality *cooperation*. Collaboration partners share a goal and have a joint plan for reaching it. In order to do this, they split the work into different steps and work individually within each step. Collaborating partners' interaction relates in this case to the planning and division of work rather than to collaboration on the content. However, e-collaborative knowledge construction requires *collaboration* in a style in which collaboration partners interact frequently with *content-specific* activities. This means that they work together at the same (virtual) place to construct one joint product or mental artifact (see Bereiter, 2002). Such collaboration does not necessarily have to happen synchronously—however, the collaboration partners' timing and their commitment has to be solid enough for the processes of collaborative knowledge construction to take place.

ENVIRONMENTS FOR E-COLLABORATIVE KNOWLEDGE CONSTRUCTION

Environments for e-collaborative knowledge construction rely on the computer, which features collaboration partners' communication; for example, by the provision of newsgroups, chats, or audio-visual communication. Furthermore, the computer screen has to provide the instructional design, e.g. instructional elements and learning material for the learners (see Kirschner, Sweller & Clark, 2006). Learners *share* this computer screen—even if located in different places. They may share the same interface structure and contents but not necessarily see the same picture simultaneously when accessing the learning environment (see Weinberger, 2003). However, in some situations they may also share one application and work simultaneously (*application sharing*). In such cases, they can see the moves of their collaboration partners during collaboration (see Dillenbourg & Traum, 2006; Ertl et al., 2006; Pata, Sarapuu, & Lehtinen, 2005). Environments for e-collaborative knowledge construction do not necessarily require fully synchronous communication, yet they require collaboration partners to be simultaneously on task. In the following, we will show two different environments for e-collaborative knowledge construction: One learning environment using discussion boards and a videoconferencing one.

An Environment Using Discussion Boards

Environments that use discussion boards, forums or newsgroups are quite common in the domain of virtual seminars in higher education (see Koschman, Suthers, & Chan, 2005; Schnurer, 2005; Weinberger, 2003). This communication is asynchronous, which means that there is no immediate reply to a contribution and collaboration partners have enough time for thoughtful replies to colearners' contributions (see Schnurer, 2005; Weinberger, 2003). Furthermore, many systems allow learners to edit and improve contributions (see Clark & Brennan, 1991; Dennis & Valacich, 1999). However, when applying discussion boards for e-collaborative knowledge construction, the instructional design of the learning environment has to ensure that they have *similar paces* (see Fischer & Waibel, 2002)—their activities have to be synchronized to a certain degree.

Weinberger (2003) describes an example of such an environment. He chose the asynchronous environment because the instructional design of his study focused on elaborate individual case analyses, which develop during the ongoing collaboration. In this environment, three learners deepened their understanding regarding an educational theory. They worked collaboratively on a problem-solving task based on three learning cases. For the collaborative case solutions, the environment provided three discussion boards, one for each case. In collaboration with their teammates and referring to individual resources, learners negotiated to find a suitable solution for each case. They wrote messages about case diagnoses and commented on each other's contributions. This negotiation requested them to externalize and apply their content-specific knowledge as well as case-solving strategies. At the end, one learner prepared synthesis of their perspectives as a final solution for each case. In this scenario, the asynchronous learning platform enabled learners to communicate and to reply to each other's comments with a temporal delay, yet because of the fixed timeframe provided for working in the learning environment, they could correspond timely enough to collaborate in knowledge construction and come to a joint case solution.

An Environment Using Videoconferencing

In videoconferencing, learners communicate in spoken words through an audio and a video channel (see Ertl et al., 2006). The audio channel transmits spoken discourse and the video channel usually provides an image of the head and the chest of the learning partners. To support e-collaborative knowledge construction in videoconferencing, learners find a shared application on their screen in such scenarios. This functions as a tool for making contents of the spoken communication permanent.

Ertl, Reiserer, and Mandl (2005) describe a study, in which two learners were negotiating on collaborative theory learning. The instructional design requested a synchronous communication to support learners' dialogue and an immersive interaction of elicitations and externalizations. The audio communication facilitated the learners' elaborations by the natural flow of language, while the video was not essential to the task. However, it increased the awareness of the communication partners and made learners feel more comfortable. In this learning environment, each learner had knowledge about one particular theory of educational psychology and the goal of the scenario was that both learners should understand both theories. This scenario required the learners to each teach their respective theory to their partner. Therefore, they had to externalize their theory knowledge. Furthermore, they had to understand their partner's theory and to elicit knowledge from their partners. Both learners used the shared application for taking notes, making visualizations and providing a collaborative summary of both theories.

Outcomes of Both Environments

Both studies found beneficial effects for the collaborative work on the task and individual learning outcomes with respect to each learning environment (Ertl et al., 2005; Weinberger, 2003). These results are in line with several other studies using similar learning environments (see, e.g., Bromme, Hesse, & Spada, 2005; Koschmann et al., 2005). Learners improved their knowledge about the particular learning material during their activity in the learning environment (see Ertl et al., 2005; Weinberger, 2003). Furthermore, they also acquired several skills which could be seen as tacit knowledge in this scenario: Weinberger (2003) emphasized that learners acquired beneficial collaboration strategies, and Ertl et al. (2005) stress that learners get skilled in discriminating between conceptual aspects and evidence for theories.

MEDIA AFFORDANCES FOR E-COLLABORATIVE KNOWLEDGE CONSTRUCTION

Considering that the environments described are quite different with respect to the communication scenario, one might wonder if one particular communication scenario could be superior to others. There are a number of theories and taxonomies about media choice (see Daft & Lengel, 1984; Dennis & Valacich, 1999; McGrath & Hollingshead, 1994) and some empirical studies comparing different media with respect to learners' performance on different tasks, which may help in answering this question (see Anderson et al., 1997; Fischer, Bruhn, Gräsel & Mandl, 2000; Pächter, 2003; Piontkowski, Böing-Messing, Hartmann, Keil & Laus, 2003; Weinberger, Ertl, Fischer, & Mandl, 2005). In general, the theories and taxonomies are somewhat lacking in evidence and the studies report heterogeneous results. The explanation for these blurry answers lies in the fact that researchers used different tasks and conceptualizations and measures for the outcome of e-collaborative knowledge construction. To resolve this heterogeneity and to make clear predictions, researchers sometimes tried to investigate which medium is best suited to a particular task and with respect to defined goals (see, e.g., Anderson et al., 1997). However, this kind of issue raises the question as to the goal of such studies. Might it be valuable to know which communication is best for one particular context or might it be more sensible to think about how to realize elements required by the instructional design of an environment for collaborative knowledge construction using different tools. This was already Clark's (1994) argumentation, in which he states that the type of instruction influences the learning much more than the medium.

We will exemplarily illustrate this claim using the aspect of the synchronicity of communication, which is one of the categories in Dennis and Valacich (1999). In synchronous scenarios, the communication happens immersively. Learners talk or "chat" with each other during e-collaborative knowledge construction.

They can react to their partners' statements quickly. In contrast, communication partners have to wait until a statement has arrived in asynchronous scenarios and thereby the communication flow is not immersive (see Weinberger et al., 2005). This means that synchronous communication features frequent interaction and coordination while asynchronous communication evokes more thoughtful and comprehensive replies. Consequently, tasks requiring highly frequent interaction—for example collaborative teaching—may be solved better in synchronous scenarios and thoughtful case analyses may in turn require asynchronous communication (see also McGrath & Hollingshead, 1994; Pächter, 2003). Nevertheless, the instructional design of the scenario may reduce such effects: for example when introducing individual phases in synchronous communication scenarios. Designing a videoconferencing task using a sequence of collaborative and individual phases may give learners the chance for exchange as well as for individual reflection (see Ertl et al., 2005; Rummel & Spada, 2005). In contrast, instructional design could give learners in an asynchronous learning environment a strict timeframe for their activities (see Weinberger, 2003). This could synchronize learners' activities when they are working with discussion boards and improve the exchange of the learning partners (see Fischer & Waibel, 2002).

Conclusion

The focus of this article was on e-collaborative knowledge construction. In contrast to the broad concept of learning, e-collaborative knowledge construction relates to an interactive process of collaborative knowledge acquisition or the collaborative creation of new knowledge. This article has shown two examples of environments for collaborative knowledge construction in different communication scenarios. These environments were not restricted to the transfer of explicit knowledge—learners also had the opportunity to socialize tacit knowledge. To reach this goal both environments provided different elements of instructional design to overcome limitations of the media: The asynchronous environment of Weinberger (2003) provided learners with a strict timeframe to facilitate tight collaboration and timely contributions of the collaboration partners which are a prerequisite for successful collaborative knowledge construction. In contrast, instructional design of the videoconferencing environment provided learners with the task of creating a collaborative summary of their respective theories in the shared application. This enabled them to work on their shared mental artifact. To sum up, the design of the environment for e-collaborative knowledge construction may compensate for the differences in the various communication scenarios.

E-collaborative knowledge construction is of major significance for e-collaboration. This significance applies mainly to situations that require e-collaboration in interdisciplinary teams, in which different experts are collaborating to find the best solution for a problem (see Rummel & Spada, 2005). To do this, each of them has to bring in his/her particular expertise, yet they also have to construct a shared problem space together (see Fischer et al., 2000). They then have to learn about the perspectives of their e-collaboration partners and to construct a team knowledge about the problem, e-collaboratively.

E-collaboration and e-collaborative knowledge construction is no trivial task. Collaboration partners must learn to work together (see Rummel & Spada, 2005). Therefore, e-collaboration partners require facilitation to improve the results of their collaboration (see Mandl, Ertl, & Kopp, 2006) and to avoid undesired group effects (see, e.g., Salomon & Globerson, 1989). It is important that tools and workspaces comprise of several scaffolds for e-collaboration in future.

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KEY TERMS

Application Sharing: Mechanism that allows e-collaboration partners to work with the same application on the same document simultaneously.

Collaborative Teaching: Method of education in which a group of learners acquire knowledge by alternately assuming the role of teachers.

E-Collaborative Knowledge Construction: Synchronized e-collaboration with the goal to acquire or create new knowledge.

Environment for E-Collaboration: Working place of an e-collaborator. The environment provides all the tools and resources applied during e-collaboration.

Explicit Knowledge: Knowledge that can be intentionally expressed and quantified. Examples of this kind of knowledge include facts and descriptions.

Learning Case: Description of a real-world scenario, which helps learners to apply their knowledge.

Mental Artifact: Immaterial product, which e-collaboration partners construct during the process of e-collaboration.

Mutual Dependency: Requirement for successful e-collaboration. Mutual dependency ensures that both partners can benefit from e-collaboration and it may reduce undesired group effects.

Shared Problem Space: The shared knowledge of e-collaboration partners which is necessary to solve a problem collaboratively.

Tacit Knowledge: Knowledge, which is acquired rather unconsciously by socialization or practice. It may be seen as complementary to explicit knowledge.