CSCL@Work:
Making Learning Visible in Unexpected Online Places Across Established Boundaries

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ABSTRACT

The authors introduce Computer-Supported Collaborative Learning (CSCL) at the workplace (CSCL@Work) as a conceptual framework for bridging the knowledge of researchers in the field of CSCL to work-based learning. In contemporary firms, shepherding the creation of new knowledge is of equal importance, and is driven by two primary research questions. First, how do organizations create new knowledge when the answer to a particular problem is not available within the firm? Second, what cultures of learning must and do exist to support solving problems when the answer is not known within an organization? Contemporary answers to these questions must recognize that learning is an implicit, often invisible component of work, and explicitly decouple the construct of learning from its main western institutionalization, the school. To advance thinking in this area, the authors undertook a meta analysis of 8 CSCL@Work cases and developed 3 design theses: 1) Learning occurs in unexpected and unusual online learning places, especially through Social Media. 2) Learning activities incorporate feedback from diverse people, who are not available within traditional organizational boundaries; 3) learning must be made visible across established boundaries. Designing explicit construction of new knowledge needs to be integrated into workplace practices today through pedagogical and technological design.

Keywords: *Collaboration, Computer Support, Learning, Making Learning Visible, Work-Based Learning*

INTRODUCTION

Computer-Supported Collaborative Learning at Work – CSCL@Work – bridges the knowledge of CSCL researchers, who are focused on learning, to the domain of workplace learning. CSCL@Work research, as proposed in this article, aims to understand how organizations create the knowledge they require when that knowledge is not already known within the organization. With this article we propose a framework for research focused on knowledge sharing by looking closely at the process of knowledge sharing, and defining CSCL@Work as a mechanism for making learning practices visible, and centering research on the collaborative creation of new knowledge. In other words, CSCL@Work frames a new area of inquiry,

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focused on making collaborative learning in the workplace explicit through social media and other collaborative technologies integrated into workplaces.

Creating a culture of learning within the organization was the focus of Organizational Learning, beginning with Argyris and Schoen (1978) and continuing through its development by Brown and Duguid (1991, 2000) and others. Historically, knowledge management solutions focus on the capture, cataloguing and retrieval of information and work processes to promote the identification of known information within an organization.

But what do firms do when the answer is not known, the problem is not yet framed, or there are no existing solutions? For example, traditional book and newspaper publishers lose customers and authors in the Social Media age. Some publishers have adapted by adopting social media and blogging strategies, but these solutions did not emerge from knowledge management systems, which are insufficient for acquiring new knowledge (Sylvie et al., 2010; Goggins, 2009).

When an industry goes through these types of fundamental changes, entire workforces need to learn new methods and approaches for performing their work. To accelerate this process, CSCL@Work asks, how can *collaborative learning* be supported explicitly in the workplace? "Learning from the past is not enough to help stakeholders accomplish their tasks and practices" (dePaula & Fischer, 2005, p. 30). In this new world, "knowledge is not a commodity to be consumed but is *collaboratively* designed and constructed in the *doing of work*" (p. 30). What sounds simple is often implicitly done instead of *designing solutions for collaborative knowledge construction as an explicit way of learning*. Some firms even avoid the term "learning". A few large technology firms built and use interactive learning environments but a greater number of firms do not focus on fostering *collaborative* learning in the workplace (Gorman & Fischer, 2009). We argue that learning is not made into a visible, integrated part of work practices.

Technology solutions are one component of supporting workplace learning. While there are new technologies making collaboration through Social Media outside of work more common (e.g., social networking systems, Blogs), there is little evidence that organizations do not yet focus clearly on using technologies like these to foster learning in general or collaborative learning, specifically. New kinds of knowledge management systems – reframed as CSCL@Work systems – might contribute to this.

The basic questions for industrial and information-society firms include, a) are they able to create new knowledge when the answer to a problem is not available, and, b) what concepts of collaborative learning exist and are they supported? Reframing work as an active learning activity is a significant challenge for firms that need to adapt quickly in a dynamic world (Easterby-Smith et al., 2009). We argue that new concepts of learning, supported by new technologies at the workplace and a new understanding of work are required to foster a work-based learning culture. Fostering such a culture is essential for creative thinking, creative actions and innovations (Easterby-Smith & Prieto, 2008). To make progress toward these important goals, we propose a CSCL@Work research agenda at the boundary between research on knowledge management, CSCW and CSCL.

From a meta analysis of 8 cases, we frame inquiry into CSCL@Work. Additionally, the lens of our combined 36 years of experience designing and implementing collaborative solutions for work and learning in industry inspired our questions. The analysis of the cases suggests that a future work-based learning approach – where employees need new knowledge on problems where the answers are not known – requires new conditions for learning.

The paper is organized as follows. We introduce the conceptual framework of CSCL@Work starting with framing emerging problems followed by a case study and finally, implications for conceptualizing CSCL@Work will be illustrated.

RELATED RESEARCH AND CONTRIBUTIONS FROM CSCL AND CSCW

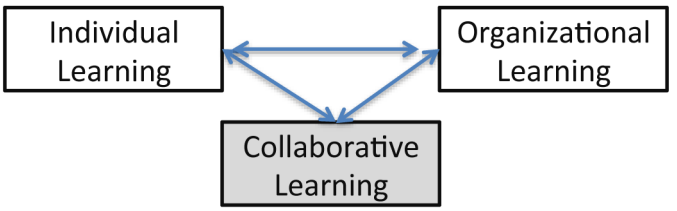
Empirical research on cooperative work practices (Lave & Wenger, 1991; Davenport, 2005), the sharing of information at work (Brown & Duguid, 2000), and the development of communities of practice in workplace settings (Wenger, 1998) show how knowledge can be shared in communities of practice when that knowledge is already known inside of an organizational context. But problems related to the *distribution* of *knowledge holders* and their knowledge (dePaula & Fischer, 2005) remain unsolved. The slogan "if Siemens only knew what Siemens knows" illustrates this problem. Prior, well-known findings like these rely on the premise that knowledge within an organization's walls can be actively diffused across the organization (Gibson & Cohen, 2003); then proceed to describe various models explaining how that occurs. Those knowledge management approaches are premised on a certain degree of *environmental stability inside a company.* The notion that you can "store knowledge" implies it is likely to be useful for some period of time sufficient to justify the effort of capturing it.

Consider the example of the organization that manages the Wikipedia website as an example of an organization oriented to knowledge-building. Recent studies of the Wikipedia virtual organization demonstrate that even highly distributed, heavily technologically mediated organizations build knowledge within them by actively soliciting knowledge from a wider community (Kittur & Kraut, 2008; Kittur, Lee, & Kraut, 2009). Despite the fact that Wikipedia is not a typical company like Hewlett Packard or other traditional organization, it provides an example of how knowledge diffusion occurs, and can occur across organizational boundaries in highly dynamic and virtual organizations. Viegas et al. (2007) look at organizational boundaries in Wikipedia and the emergence of formal structures like moderators, who contribute content, and have the authority to delete articles. The examples illustrate that collaborative learning at the workplace is enabled by new technologies, drives the creation of new kinds of organizations and faces challenges not considered in traditional knowledge management research. Research on Wikipedia illustrates the movement of informal, socially constructed practices into formal, institutionalized practices over time (e.g., Jahnke, 2010).

Rogers (2003) "diffusion of innovation" work helps to explain how new knowledge in firms is created and accepted over time. He illustrates different stages of decision-making and the people involved in creating and moving new information, through different communication channels, within a social system. Through empirical studies, he developed a frame of five adopter categories – from innovators to early adopters, early and late majority and, finally, laggards. These categories characterize the range of adoption patterns that naturally occur in organizations where new knowledge is created. The introduction of social media since the publication of Rogers original work suggests that information may now diffuse through increasingly diffuse networks not easily contained by institutional or organizational boundaries. Faster and easier communication with an increasingly more diverse audience fundamentally alters the breadth of what can be and is diffused (Jahnke & Koch, 2009).

In addition to Rogers approach, the conceptual challenge of CSCL@Work is to frame collaborative learning that combines existing knowledge and the co-construction of new knowledge in group interactions, as a part of work, integrated into working processes, and not a separate activity (Mørch & Skaanes, 2010). This is what we call collaborative work-based learning, which is a specialized form of workplace learning that develops on a daily basis at work when employees acquire new skills to solve current problems (Mumford, 2011). Formal schooling normally does not focus to such learning. Instead, learning needs to be designed across a human's life since the concept of a divided lifetime – "education followed by work" – is no longer the dominant

Figure 1. CSCL@Work focuses on collaborative learning



reality (Fischer, 2011). Knowledge-intensive workplaces are no longer separate from learning.

Finally, organizations face the challenge of creating work-based learning cultures that include informal structures to support the explicit design of learning. In such a culture, knowledge sharing is expressed as collaborative learning, with a focus on the co-construction of knowledge by social actors situated in roles within a social system (Jahnke, 2010).

Collaborative learning is distinguished from organizational learning and individual learning by the knowledge that developed through the interactions within groups supported by Social Media. Collaborative learning is distinct from traditional individual workplace learning, where the focus is on how one person learns and organizational learning, where the focus on how the entire firm learns. The three concepts in overview are:

- Individual learning. Focus on how one person learns, e.g., traditional workplace learning, trainings in workshops usually separate from work.
- Collaborative learning. Focus on the co-construction of knowledge among social actors situated in roles within groups of a firm, e.g., computer-mediated group interactions within a firm; spanning communication within and outside the firm.
- Organizational learning. Focus on how the entire firm learns, e.g., knowledge management systems and process management for the whole business company.

These distinct foci, however, influence each other, as illustrated in Figure 1. We argue that it is useful to differentiate theses concepts for the analysis and design of CSCL@Work.

Learning at work can be developed and designed in a way that is closely integrated to the daily-life of work or as a learning process that is completely separate from the work itself. But the higher the degree of integration of learning into the work processes, the better learning takes place (e.g., Herrmann et al., 2004). Traditional notions of learning do not work here because there is no clear reference for what is correct. Learning is different to 'textbooks learning' in particular when there is no clear reference point for the identified problem. Providing employees with opportunities for creative thinking and creative action is a more useful approach for targeting new knowledge construction. This needs to be considered for conceptualizing CSCL@Work.

We understand collaborative learning as "an active process of constructing rather than acquiring knowledge, and instruction as a process of supporting that construction rather than communicating knowledge" (Duffy & Cunningham, 1996). Here, instruction is not restricted to teaching but encompasses scaffolding and enabling *opportunities for learning*. Following this, collaborative learning is defined as co-construction of knowledge and competence development where different people have the opportunity for creative thinking, introducing new ideas and taking creative actions. This new perspective transforms learning from a concept focusing on knowledge transfer to one that can foster innovation. Learning outcomes are newly developed skills that learners use to solve a specific problem, to create new ideas together with other people, or to create new

actions (Anderson & Krathwohl, 2001; Barr & Tagg 1995). The result of learning is visible in the changed behavior of a learner (Collins & Halverson, 2009; Biggs & Tang, 2007).

Operationalizing this new view of collaborative work-based learning inspires a new set of questions about the behaviors, culture and infrastructure needed to support building a framework for CSCL@work (adapted from Fischer, 2010):

- What is the underlying concept of collaborative learning within organizations?
- What kinds of *opportunities* to enable collaborative learning in the workplace are available?
- Do sociotechnical designers, researchers and workplace learners need to focus on a *new balance of formal and informal learning*? To what extent?

Situating CSCL@Work: Integrating Disparate Research

Understanding, reflecting and designing computer-supported collaborative learning at work needs to integrate as well as to extend existing research in CSCL (Computer-Supported Collaborative Learning) and CSCW (Computer-Supported Cooperative Work). There are a few important distinctions between CSCL and CSCW research that frame our contribution to each community, and lead to an integrated research focus on CSCL@Work.

We wish to avoid the rhetorical danger associated with making general statements about any field, as it is especially perilous to *bridging* research. Since both CSCL and CSCW incorporate a munificent number of theories and approaches, our work must reflect and respect the diversity.

Stereotypes of how each field is commonly framed by those not centered within the field may help to illustrate differences in this case. Stereotypes do not reflect the whole truth, but perceptions that emphasize a subset of community characteristics. For the reader familiar with one of the two fields or neither of them, the following stereotypes are illustrative.

- CSCL: It is not true that CSCL is just about K-12 learning at schools. However a lot of CSCL studies are done in schools and there are few examples of workplace studies in the proceedings of the CSCL biannual conference or the International Journal of CSCL.
- CSCW: It is not true that CSCW is just about knowledge transfer within an organization but many studies presented at ACM sponsored CSCW conferences like ACM, CSCW and Group, or the European Conference on CSCW focus on knowledge management, but do not present studies of collaborative learning at the workplace.

A key distinction between the fields is their different focuses on the relationship between novice and expert. CSCL is focused on helping novices learn – mainly knowledge that already exists in the world and in specific disciplines. CSCW, in contrast, is focused on helping experts learn, sharing what others know, what is known elsewhere in the world, or what will be new knowledge in the world.

While emphasizing certain aspects of each field in a general way, these stereotypes highlight the contrast between CSCL and CSCW research. They also point to a middle-ground gap that can be filled by a bridge called CSCL@Work. In the following sections, we review the distinct contributions of each field of inquiry to CSCL@Work.

Contributions from CSCL

CSCL focuses on how learning can be improved through computer mediated collaboration. New theories of how knowledge is constructed by groups (Stahl, 2006), how teachers contribute to collaborative learning and the application of socio-technical scripts for learning (Dillenbourg & Hong, 2008) are all emerging from CSCL researchers. Most of this work, however, remains focused on K-12 institutions. Hence,

CSCL research focuses on the application of computer support for learning in the context of traditional educational institutions, like public schools, private schools, colleges and tutoring organizations. CSCL research does not address workplace learning in a substantial way, or learning in contexts where the answer is not known.

Applying technology to enable collaborative learning is the contribution of CSCL, but to date contributions to workplace settings have been limited. CSCL research investigates the application of computer support for learning in the context of traditional educational institutions, like public schools, private schools, colleges and tutoring organizations. The work of the CSCL scientific community has generated exciting new theories of how knowledge is constructed by groups ("group cognition") (Stahl, 2006), and how teachers contribute to collaborative learning (Kreijns et al., 2002; Laffey et al., 2006) and the application of socio-technical scripts for learning (Dillenbourg & Hong, 2008). There is little discernable movement of this knowledge to learning contexts outside of traditional school environments.

CONTRIBUTIONS FROM CSCW

Knowledge management research, in contrast, examines the practices, technologies and cultural conditions required to ensure that knowledge moves from experts and formal information sources through an organization. Coakes (2002) defines knowledge management as "the capture, consolidation, and reuse of knowledge and the translation of new best practices to tangible programmable processes to be automated through IT where possible." Such sociotechnical information systems focus on the storage and distribution of discrete information or processes as a basis for knowledge sharing within an organization.

Examples include groupware systems used for knowledge management, or content and enterprise management systems. There exist different methods, guidelines and principles to organize the knowledge of members within a firm (e.g., Eason, 1988; Mumford, 1995; Cherns, 1987; Bygstad, 2006) that support the development of sociotechnical systems. A good overview is provided by Fischer and Herrmann (2011). But as Herrmann, Loser, and Jahnke (2007) point out, "whether these types of systems really contribute to knowledge sharing or not, depends on the corporate culture and on how well organisational and technical structures are adjusted to each other and how they are integrated.. But these systems do not focus on collaborative learning. Knowledge management is a field of research that emphasizes the accumulation and redistribution of identifiable tacit and explicit knowledge. Further, this research initially emerged during a time when organizations did not need to adapt to changing conditions as quickly or as often as they do today (Easterby-Smith et al., 2009; Easterby-Smith & Prieto, 2008). Empirical work on knowledge management is widespread in CSCW literature, which is primarily centered in workplace settings (e.g., Herrmann et al., 2004; Coakes, 2002) that is changing (Grudin, 2010). For example, Herrmann et al. (2004) illustrate how to design technology along work processes. A not useful technical design is a system that is not linked tightly enough to work processes. Such systems act like a satellite around the organization.

There is some research available that connects both disciplines (for example, Fischer, Rohde, & Wulf, 2009). In addition, the works by Wenger et al. (2001) on communities-of-practice showed how people work together and how new employees move from the outside of the knowledge circle into the center. But this concept supports more or less only the apprenticeship model. It means it explains how new employees learn the rules and existing knowledge by the experts. There is no 'movement' or learning among the experts or insiders within a firm. Nonaka and Takeuchi (1995) introduced the "knowledge-creating company" but today with new Social Media much more possibilities emerged and we have to ask if the concept of them are already useful or valid for designing CSCL@Work. To summarize, what has already

been done with regard to work-based learning is relatively small when compared to the opportunity for discovery and positive social effects from a multidisciplinary CSCL@Work research program.

EXTENDING CSCL AND CSCW TO MAKE LEARNING MORE EXPLICIT IN WORK

CSCL literature has focused on school based learning contexts, which are distinguished from workplace learning. For example, learning at work is directly connected to the performance of a specific job in a specific organizational context (school based learning focuses more or less on textbook learning).

The CSCW community, for its part, has been too timid with regards to considering the application of 'learning approaches' in studies of cooperative work. The connection among the interdisciplinary domains of CSCW and CSCL, and articles that span these disciplines are often more implicit than explicit (overview in Stahl, Koschmann, & Suthers, 2006).

One research focus in this boundary-spanning field is developed by Yrjö Engeström, who introduced a conceptual approach titled "activity theory – expanding learning" as a framework for analyzing and redesigning work (Engeström, Miettinen, & Punamäki, 1999). In his more recent books, he and his team illustrate the connections among learning and work, e.g., "Between School and Work: New Perspectives on Transfer and Boundary Crossing" (Tuomi-Gröhn & Engeström, 2003; see also the works by Mørch & Skaanes, 2010, "learning across sites"). Their case studies reflect new concepts for a) new pedagogical practices and b) for new work practices, such as "mirror therapy." New pedagogical practices include his use of a cultural laboratory, methods for what he describes as horizontal working and the notion of "boundary zone activities". Boundary zone activities could be conceptualized as related to the work of Lee (2007) who described boundary-negotiating artifacts.

Making new, explicit connections between work and learning, which we frame as *collaborative work-based learning,* holds much potential for research. For example, the potential measurable impact on organizations and individuals is large. Organizations that demonstrate an institutional capacity for learning are more likely to adapt well as market conditions change (Easterby-Smith & Prieto, 2008). Learning is not, in this case, viewed as the school activity it is traditionally conceptualized as, but instead learning is viewed as an institutional characteristic whose presence is closely tied to the rate of change possible within an organization. The more learning is institutionalized within a firm, the more quickly the firm is able to acquire the new knowledge required to sustain itself (Easterby et al., 2009). As Fischer (2010) notes, the boundary between work and learning is dissolving. Just as the boundary between work and learning, in general, is disappearing, so is the justification for a sharp boundary between CSCL and CSCW research.

A General Design Model for Collaborative Work-Based Learning

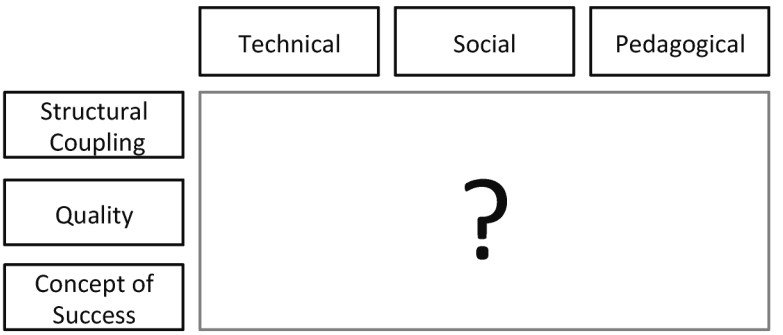
CSCL and CSCW each have traditions of including *design interventions* and the subsequent study of *new designs*. This shared frame of reference provides a starting point for CSCL@Work's basic design model.

When designing learning at work the overall research question is how to design (develop, introduce, evaluate) it *successfully* and what elements can be designed (general model). But the central problem is what does "successful" mean, to what extent is a *design* useful or not?

Jahnke et al. (2010) describes one possible model. In her study of designing remote-controlled laboratories in mechanical engineering, they demonstrate a design model with three elements, which provide a set of opening factors for CSCL@Work inquiry, Figure 2.

X-axis. The *key factors* (technical, social, pedagogical factors) are placed on the x-

Figure 2. General design model for CSCL@Work



axis of a two dimensional model we propose. The key factors are three basic elements and its interconnections:

- Technical elements include learning management systems like Moodle, or Social Media technologies like Facebook. The researcher then uses the model to scrutinize the concept of technology (e.g., passive, reactivity, pro-activeness, interactive, transactive, autonomy).
- Social elements include forms of communication, roles of learners, organizational issues and social structures.
- Pedagogical elements embrace concepts of learning, phases of individual/group learning, informal and formal learning, support of developing new skills (which ones), and interconnections between instruction from work and opportunities for co-construction of new knowledge (collaboration).

Y-axis. On the y-axis, the model maps a meta-view focused on important considerations for designing those three elements:

1. The model maps the degree of *structural coupling* (degree of interdependency) of the three elements on the y-axis with its complex interconnections to the *key factors* on the x-axis. This design dimension can be used to ask to what extent the elements are connected: are they strong and formalized or flexibly usable, and how closely/loosely are the elements connected?
2. The concept of *quality* is described. This intersection between the y-axis dimension of quality and its x-axis *key factors* is useful for driving analysis of design elements. For example to what extent are knowledge sharing, and co-construction of knowledge and learning connected?
3. The model describes the concept of *success*. Success, compared with each of the key factors, drives the designer to consider whether technologists, teachers or peers within a system would view the design as a success. Analysts should consider this difficult to pin down design element forces critical thinking about the overall design. Different target groups, people in different roles have different cognitive conceptions of success. Managers, pedagogical experts, employees, knowledge management experts, define success in different ways. A good design includes a visible concept of what is meant by learning and involves different views, or at least, supports a common understanding (Herrmann et al., 2007).

The three structural elements and three key factors in CSCL@Work design interact,

conceptually, to drive designers to ask focused questions about the design process and resulting designs. In many respects, the framework could be useful outside of CSCL@Work settings. However, it is also useful for CSCL@Work designs because it emerges from an understanding of important design considerations for social media, learning and knowledge management. It is an integrated, meta design model that is explicitly targeted at CSCL@Work's unique characteristics.

A META CASE STUDY – EXPERIENCES AND EXPLORATIONS

CSCL@Work is a design-based enterprise. Striving towards a new research agenda for CSCL@Work, one objective is to understand how different firms handle different concepts of learning in their organizations. There is a need to know, how and to what extent firms have integrated a concept of learning *explicitly,* and, to what extent they avoid use of the term 'learning'. Are there any key factors for socio-technical systems designers, researchers and practitioners in the field of workplace learning what we can make more visible than it is? To gain perspective on these questions, we gathered case studies representing early examples of CSCL@Work.

To collect the case studies we designed and conducted a workshop that featured solicited CSCL@Work case studies, at the ACM Group conference in 2010. We selected the ACM Group conference because it draws researchers from both the CSCL and CSCW communities to participate. The call for papers was distributed to CSCL and CSCW communities, and also to mailing lists where interdisciplinary socio-technical researchers participate, including sociotech, cscw-all, chi, POD, and SEDA. This enabled us to reach researchers in different sociotechnical and pedagogical domains. The call for papers and our solicitation of papers in the field resulted in a snowball sample of representative CSCL@Work research. At the workshop we had participation and papers from 12 researchers from the US and Europe who presented 8 individual case studies of CSCL at work in different contexts. The workshop took place in November 2010 on Sanibel Island, Florida. Following the workshop, we performed an analysis of the presented papers and presentations for the purpose of identifying key aspects and key dimensions of CSCL at work.

The analysis of the cases included the examination of 8 cases using a bottom-up open coding process. Open coding drove a natural emergence of key themes and principles with regard to socio-technical factors (e.g., media design for learning at work), organizational factors (e.g., organizational constraints for work-based learning) and pedagogical factors (e.g., support of learning). The guiding analysis questions were: what is the underlying concept of learning (how is learning operationalized) and what do the cases focus on?

Once the coding list was established, the cases were axially coded, and categorized into groupings of similar organization practices following Strauss and Corbin (1998). This enabled us to discover relationships between the codes in a manner that was grounded in the data. Then, the coding list was integrated into the general three key clusters of social, technical and pedagogical dimension. Cluster A embraces codes related to a social design. Cluster B includes codes of a technology design. Cluster C focuses on concepts of a collaborative pedagogical design.

- A1 = Focus on how to bring people's different expertise together (social).
- A2 = Focus on informal learning outside the organization (social).
- B1 = Focus on supporting distributed learning in product design (technology design)
- B2 = Focus on new technology to enabling social proximity in distributed teams (technology design).
- C1 = Creating new learning approaches for a specific context (pedagogical design).
- C2 = Focus on fostering collaborative reflection (collaborative pedagogical design).

Table 1. Case studies

Case No./Title	Context	Concept of Learning	Code Focus	Reference
1 Nurturing Learning Communities	Serious Games	Connecting diverse people with different expertise in the Internet to a specific field (here project management)	A1	Prasolova-Førland and Hokstad (2010)
2 Online gaming and informal learning	Games	Connecting developed skills (learning outcomes) in online gaming to the workplace	A2	King (2010)
3 Collaborative learning with an ePortfolio	Learning	Connecting learners at universities to workplaces and vice versa via an ePortfolio system	A1	Schleiff and Wanken (2010)
4 Pivotal Decisions in Manufacturing	Manu-facturing, Product Design	Learning is… Making 'decision making' for distributed teams visible through an specific online system	B1	Cassier, Lund, and Prudhomme (2010)
5 Remote Lab for Material Testing	Manu-facturing	Connecting both, students and trainees at different physical places through an online environment	C1, B2	Terkowsky, Jahnke, and Pleul (2010)
6 Mammography Practice	Medical sector	Work-based education in the medical sector, learning takes place when doctors collaborate through the Internet	A1, C2	Hartswood, Blot, Procter, Wilkinson, Taylor, and Gilchrist (2010)
7 Facebook & Corporate Learning	Social Media	Learning takes place in online personal networks that are connected to the workplace	A2	Gurzick and White (2010)
8 Rural Technology Workers	Technology	New Employee Training	C1	Goggins (2010)

Table 1 contains a listing of all 8 cases including the codes. The context and the concept of learning are described. The cases are from the fields of gaming, learning, manufacturing (product design), medical and technology area as well as social media.

The next step was to further analyze the cases within their coded groups. This led us to develop three theses about CSCL@Work, at a higher level that we expect will be useful for framing CSCL@Work research, broadly construed. The method we followed enabled us to compare and classify CSCL@Work research sites, and look for similarities and differences between them in future studies. We make no claim that these 8 cases cover all possible configurations of CSCL@Work, only that they represent some of the more active CSCL@Work research programs, and are therefore useful for beginning to frame discussion around an emerging area of workplace learning inquiry.

FINDINGS FROM A META ANALYSIS OF CSCL@ Work CASES

Six codes have been identified from the meta analysis. Following these, we derived three design principles for CSCL@Work from the cases, which we illustrate in this section.

Finding 1 – Unexpected Unusual Online Places

- Code A2 = Focus on informal learning outside the organization.
- Code C2 = Focus on fostering collaborative reflection.

Cases with codes A2 (informal learning outside the organization) and code C2 (collaborative reflection) inform this finding. The finding accentuates unexpected, unusual online learning places and its unstructured connections to the employee's work places to *find* new knowledge, to enable co-construction of new knowledge. However, new knowledge needs to be reflected. For example, whether the new idea is helpful or not is important. Reflections can be the start for a learning process but a *change of behavior* is a consequence (a learning outcome) followed by reflections.

Why is learning that occurs in unexpected places useful for developing new skills for the workplace? New knowledge and experience from different areas can be merged into new ideas *when* overcoming solidified structures and established *old* patterns (creativity). It is obvious that collaborative reflection methods are needed to reflect such new insights and new perspectives. Regarding the framework for CSCL@work, design challenges are a) *where* the reflection takes place (large or small groups, individually, organizational level, in the daily work routine integrated, etc.) and b) how *deep* is the reflection. c) Reflection is good but changed behavior must follow.

Informal learning. Examples are given by Case No 2, King (2010) and case No 7, Gurzick and White (2010). Both looked at unusual places of learning and analyzed the opportunities for the workplace. King studies different literacies people developed at a virtual game (World of Warcraft), for example, how to collaborate in a team effectively, and saw that they use this developed skills also at work. Gurzick and White studied different policies of firms and how they prevent or foster online personal networks at the workplace (like using Facebook at work). They learned that online personal networks are not time-consuming in each case but are helpful for employees at work to solve unexpected problems emerged at the workplace.

Collaborative reflections. In spite of the specialized nature of each workplace, general support for reflection in practice emerges from our analysis as a factor for CSCL@ Work, regardless of the degree of domain specialization. Case No 6 (mammography practice), illustrates how medical doctors discuss mammography photos online in order to find the best diagnosis (e.g., when the findings are new, or not clear). Collaborative discussion through the new technical solution emerged but just for a temporary period of time. This reflective community helps radiology employees to build new skills, reading mammograms by interacting socially with other specialists, particularly more experienced members. This case also shows us how workplace-based training enables trainees as well as experts to benefit from each other. They can develop several new competencies (professional expertise as well as discussion skills, etc.) through collaboration.

Lessons learned. What we learned from these cases is that learning is not restricted to the workplace inside an organization. Traditional employee training is limited to a special time at the workplace. But what can (senior) employees do when they need new answers to problems where the answer is not known? What to do after the training? To foster learning is such situations, new conditions for supporting employees to use unexpected and unusual places (physically, Internet places) are required. Such unexpected learning places *in* Technology embrace places where people have the possibility to learn and to acquire new skills. Learning *can* occur there but it is not limited to these places.

Thesis 1. Learning in a CSCL@Work setting is enabled by unexpected and unusual online learning places.

Finding 2 – Incorporate Feedback from Sources from Social Media

- Code A1 = Bring people's different expertise together.
- Code B2 = New technology to enable social proximity to foster learning.

Cases with both, codes A1 (bring people together) and code C2 (technology-mediated social proximity) explain this finding. The finding emphasizes that collaborative work-based learning *is* learning by fostering disruptive connections emerged in social media. Such disruptive connections build a bridge among people's expertise *through ephemeral interactions*. The term 'ephemeral' stresses the change of different feedback partners and learning loops.

Bridging people in their roles as learners & mentors. Cases No 5, 3, and No 1 are useful examples to describe what we mean in detail. In case No 3 "Collaborative learning with an ePortfolio," the designers use a collaborative learning technology to bring people from two domains together,

- Students at universities who need *theoretical reflections* regarding scientific work, and
- Practitioners (e.g., new employees, vocational education) who need *practical reflections* regarding their work at the workplace.

The interactions are enabled through an electronic portfolio system, which fosters active reflection and establishes a deliberate culture of participation. The portfolio system is a collaborative learning site where members assemble portfolios. Mentors read and comment on them. The novel idea in this case is that students and practitioners switched the roles depending on the situation: they are learners but at another time, they are the mentors for the learners.

Similar is case No 1 "Nurturing Learning Communities through serious games." The researchers and designers presented an online community platform for employees who rapidly need to develop new skills in project management. Here, a serious game approach was the underlying concept. In a form of game, the employees planed and conducted a project that simulated the activities associated with planning and executing a project. Through play, participants develop skills and new expertise in project management.

Fostering technology-constructed social proximity to enable learning. Case No 5 "Remote Laboratory for Material Testing" describe PeTEX, which is a CSCL@Work system that mixes an open source course management tool (Moodle), a self-programmed module for learner's at different levels and interfaces to existing laboratories (with video and data interfaces, etc.). PeTEX is an experimental online learning prototype that includes remote laboratories for learners at distributed production engineering workplaces. With such a system for remote-controlled, distance-observed live-experiments in mechanical engineering, employees get the opportunity to work together although they are at different physical places in different manufacturing domains. Technology-constructed social proximity. This case illustrates the design for a socio-technical system for CSCL@Work that balance existing knowledge, experimental learning activities, and peer-reviewed assessment in order to create new knowledge. In this case it became obvious that different learner levels need different socio-technical-pedagogical solutions.

Lessons learned. What we learned from these cases is that learning takes places when disruptive connections in the Internet enabled people to merge information from different fields and peoples to new knowledge. With the cases it becomes clear that it is not

enough to have established teams within the organization to reflect problems or to discuss new ideas. Problem-oriented learning approaches need input from different people over time. For creative learning loops, it is not enough to keep the same feedback partners or the same feedback loop. Instead, CSCL@Work points out that a change of feedback partners is necessary – keeping in mind that a person has always different roles, a learner, a mentor and a knowing person at the same time – what means that a person *can* give advice at the same time s/he is looking for answers.

Thesis 2. Learning in a CSCL@Work setting is enabled by fostering learning activities that incorporate feedback from diverse sources who are not available within traditional organizational boundaries. Such new sources are available through personal connections, developed using social media, which are disruptive to our classic conceptualization of what an organization is.

Finding 3 – Learning across Established Boundaries via Social Media

- Code B1 = Focus on supporting distributed learning in product design.
- Code C1 = Creating new learning approaches to a specific context.

Codes B1 (new technology for distributed teams) and code C1 (new learning approaches to a specific context) lead to this finding. The finding underlines that CSCL@Work *requires* collaborative learning across established boundaries using Social Media inspired technologies and approaches. Such boundaries are social- or technology-constructed constraints, or both.

New technology for distributed teams. Case No 4 "Pivotal decisions in product design" illustrates how designers argued a series of problems and solutions for laying electric cables in a truck cabin during a 2-hour project review meeting for Volvo in France. At those meetings many experts in different professions participated. The case incorporates a complex design-interaction-framework based on a complex software system for fostering distributed learning. The case demonstrates how designers with different expertise keep track of previous solutions, and shows that learning takes places when specific criteria in a decision making process are *visible* for the participants as well as future participants.

New learning approaches to a specific context. Case No 8 "Rural Technology Workers" studied rural IT outsourcing firm and shows that members participate to a greater and lesser degree in collaborative workplace learning based on what they need to learn. For example, computer-programming techniques are frequently developed through collaboration with others, while more basic skills like data type conversions are learned using reference materials. The designers explicate the role of specific domain attributes in CSCL@Work design in a context where the artifacts and knowledge requirements are highly variable. In contrast with case No 3 (ePortfolio), the analysis of collaborative feedback around a common set of artifacts with diverse participants, case No 8 explicates the role of specific domain attributes in CSCL@Work design in a context where the artifacts and knowledge requirements are highly variable.

Lessons learned. Several cases illustrate how people develop different skills at the workplace and in unexpected places but what they have in common is, that learning takes place across established boundaries: Cases 1 (serious game about project management), 2 (Gaming and its impact on the workplace), 6 (mammography practice) and 7 (online personal networks and its impacts on working). The cases show how competency acquisition is supported through informal learning in the Internet. Such skills include professional knowledge and other skills like self-organization,

team-leading skills, facilitation skills and organizational coordination.

In case No 8, we learned that a CSCL@Work design will need to carefully consider how the needs and capacities of members constrain collaborative learning in heterogeneous and homogeneous groups, and how specific learning situations require greater and lesser degrees of pedagogical design in the design of new Social Media. In addition, from case No 4 we learned that to come to decision is a learning process itself. In this meaning, *learning will be supported by* making the evaluation criteria for distributed teams supported by Social Media methods visible. This enables decision making as a learning process. To put it in a nutshell, making Technology-Embraced collaborative learning at the workplace visible.

Thesis 3. Learning in a CSCL@Work setting is enabled by designing technology-embraced collaborative learning across established boundaries.

IMPLICATIONS FOR CSCL@Work

Our inquiry into CSCL@Work is framed by three guiding questions and our analysis of eight early case studies of CSCL@Work resulted in three core findings presented as derived theses. The guiding questions surely framed our inquiry and meta analysis of the cases, and there is a connection between the theses and our three guiding questions, though it is not entirely linear.

The first question was: What is the underlying concept of collaborative learning within organizations? Thesis 1 states: *Learning in a CSCL@Work setting is enabled by unexpected and unusual online learning places*. This thesis suggests that the cases of CSCL@Work selected here lead the researcher to frame collaborative learning more as arising out of interaction in social media across established boundaries than in traditional organizations or technologies. Such a concept of learning does not focus on a particular place, but focuses on discovery of natural knowledge construction and, ultimately, designing systems to facilitate more of it. For example, enabling unstructured connections between an employee's work, personal networks and collaborative reflections emerging in social media that span them both.

The second question was: What kinds of opportunities to enable collaborative learning in the workplace are available? One answer is given by thesis 2: *Learning in a CSCL@Work setting is enabled by fostering learning activities that incorporate feedback from diverse sources across established boundaries*. Such new sources are available through personal connections, developed using social media, which are disruptive to our classic conceptualization of what an organization is. This thesis suggests that *opportunities for learning* are at once member defined, but can be facilitated by engaging more diverse sources deliberately. The subtle distinction between this second thesis and the first one is the implication for design of CSCL@Work. There are opportunities for collaborative learning available in the case examined, but both in practice and technological mediation, they are not fully sought out. There is unrealized potential for collaborative learning. Reflective practice of CSCL@Work help us to close the gaps and enable work-based learning.

The third question was: Do sociotechnical designers, researchers and workplace learners need to focus on a new balance of formal and informal learning? To what extent? Regarding question 3, the answer is yes, we need a new balance of informal and formal learning at work with a greater emphasis on informal learning than it is presently practiced. Thesis 3 states: *Learning in a CSCL@Work setting is enabled by designing technology-embraced collaborative learning across established boundaries*. New connections can be made across non-workplace centered social- and technology-constructed boundaries that foster learning. A central theme in CSCL@Work research, therefore, is that collaborative learning in this context occurs in new places, with a dynamic set of people and

in a markedly more informal manner than other forms of learning or knowledge management.

KEY PRINCIPLES FOR DESIGNING CSCL@Work?

Through consideration of the three key aspects of CSCL@Work that emerge from the cases, researchers as well as designers will be able to anticipate obstacles within the organization. The three approaches form a new CSCL@Work research program. This is an important step to make collaborative learning more visible than it is today in many organizations. What can we learn from that comparative meta analysis?

- First, the conceptual framework provides a special analytical reflection, and each of six codes (design dimensions) are mapped to key theses that can be used to elaborate on a nascent area of inquiry.
- Second, the 8 cases show that each of them is unique. Regarding CSCL@Work, the cases focus on a special code but are not limited to.

From the eight cases, we learned how a special design dimension is focused differently. For example, cases Nos. 3 and 6 integrate especially two roles "experts" and "non-experts" whereas cases Nos. 4 and 8 do not consider special roles but the diversity of skills within a group. Following this insight, we know that each case is probably different. But what makes them successful is the consideration of the three theses and to conceptualize learning at work under this direction.

The conceptual framework drives domain specific research questions into a meta structure that enables CSCL@Work researchers in different disciplines (CSCW, CSCL for example) to communicate their findings across boundaries. Without such a conceptual framework, interdisciplinary work is likely to remain as cacophonous as it presently is. The CSCL@Work conceptual framework starts a discussion about 'to what extent' and 'how to' consider and design technology-enhanced collaborative learning for the workplace. As work continues, the dimensions presented here should be reconsidered and modified, keeping the following questions in mind:

- Are the six codes all of the dimensions or will new ones emerge through future case studies? Which of the codes might be diminished or merged with other dimensions as new research emerges?
- Are there any key design principles for CSCL@Work? Which dimensions have the most significance and importance for advancing CSCL@Work?
- Does a CSCL@Work research program need a discussion about methodologies to studying and designing such cases? For example, we did not investigate the interconnectivity among the three theses. We assume that a mix of existing or new methods like ethnographical methods combined with a network analysis is useful to studying CSCL@Work.

Beyond continuing to allow the design principles to evolve, we advocate for CSCL@Work researchers to perform more formal design and evaluation beginning with these dimensions as a conceptual framework for gathering empirical evidence to support CSCL@Work. As a practical matter, CSCL@Work research will be advanced through a combination of industry partnerships grounded in real world workplace learning and university conceptual research for experimentation with new socio-technical systems. To be successful, a CSCL@Work research agenda must focus on making contributions to both communities, and become an explicitly interdisciplinary place for scholarship.

Categories and Application Contexts for CSCL@Work Inquiry

This section frames the *domain boundaries* of CSCL@Work research with the goal of helping direct inquiry more concretely.

There are three main categories of inquiry, two of which are central to our framing of CSCL@Work, and one of which has a foundation more in the history of CSCL@Work research. The categories can be categorized as (1) having a focus on building networks within a geographically or discipline bounded community, or (2) as focused on internal knowledge management type activities and (3) workforce development/training.

The first category we focus on is community based learning, which has implications for technology transfer and economic development. The second focus is on knowledge management reframed as CSCL@Work, and focused on solving problems when the answer is not known. In the second case, CSCL@Work plays a vital role in the maintenance of organizational competitive advantage. The third category embraces workforce development and training and is the most peripheral, as these activities remain often individually focused. In CSCL@Work, such continuing trainings will be designed as a collaborative activity while doing the work. In the context of CSCL@Work these collaborative activities are subsumed under one of the other two categories.

First, the category of community based learning as articulated by Fischer, Rohde, and Wulf (2009) will be illustrated. Community-based learning *repositions* the role of the university in education from an institution with a mass media, instructionalist perspective on learning toward one that is more tightly woven into the knowledge society. This brings universities into partnerships with businesses and other regional economic forces. Such interaction with local enterprises increases the connection between university education and professional practice, but also more tightly integrates the university with regional economic development. CSCL@Work aims to study the advancement of connections between universities and industry.

In this first case, CSCL@Work may be used to accelerate technology transfer from research universities to industrial practice. Jahnke observes these phenomena with teams in the field of material science in the Telemetric Online-Learning Project at Production Engineering (e.g., Jahnke et al., 2010). Goggins (2010; Goggins et al., 2010) observes these phenomena in computer science and engineering technology transfer. Fischer, Rohde and Wulf (2009) advocate the cultivation of such connections between university research and industry. In each case collaborative learning in the workplace is applied as a mechanism for moving research findings into day-to-day industrial practice.

The second integrative approach capitalizes on a relationship between traditional knowledge management and dynamic capabilities in organizations. This approach is described by Easterby-Smith et al. (2008, 2009). Previously, the notion of organizational adaptability in the face of change was not closely connected to workplace learning in the business literature. Easterby-Smith et al. make an explicit connection between learning and organizational strategy by framing deliberate workplace learning as an essential vehicle for strategic organizational adaptation. They highlight extensive evidence showing organizations that acquire new knowledge quickly do better in the marketplace. What is left unexplored is the critical implementation gap in organizations that may build new knowledge, but not be able to effectively diffuse this knowledge through the ranks of their employees. CSCL@Work aims to close this gap by framing collaborative learning as a part of collaborative work. Community based learning from university to industry, and internal organizational adaptation are both connected to anticipated benefits at different levels; community & company. CSCL@Work research has the potential to address questions of how to successfully reach these goals.

In this second case, CSCL@Work may be used as a formal device for sustaining competitive advantage in fast changing, high technology industries. Engineering, research and technology service firms are especially likely to utilize computer-mediated training that goes beyond textbooks, recorded Powerpoint lectures and prepared material. In contrast with traditional workplace learning, focused on task oriented,

practice oriented or regulatory compliance objectives, CSCL@Work recognizes that the nature of innovation means that creativity and new innovation will at times emerge from collaborative learning. In this case, the line between collaborative work as research and collaborative learning is blurred. Our experience is that this is especially common when researchers, engineers or designers contribute to CSCL efforts aimed at those who apply their inventions.

CONCLUSION

CSCL@Work aims to fill a gap, we believe exists, between current research in CSCW and CSCL by taking an integrative look at the application of technologically mediated collaborative learning in the workplace. CSCL@Work is a timely challenge for researchers to develop a new, integrated understanding of working and learning embraced by Social Media.

The presented conceptual framework contributes to a foundation for a CSCL@Work research agenda. We offer this framework as a possible guide to help communicate early study results effectively. In this sense, the work outlined here is an essential component of defining the future role of CSCL research more broadly. Future CSCL@Work studies can use this in order to design collaborative learning at the workplace in an appropriate manner. One challenge is: How can we *teach* firms what learning integrated into the workplace (work-based learning) really means? What sounds simple is often implicitly done instead of *designing knowledge construction as an explicit way of learning*.

With this framework, we provide a start for making *learning visible*.

- Making learning in unexpected, unusual online learning places visible – enabling unstructured connections to the employee's work places by Social Media.
- Enabling learning by leveraging new connections in the Internet – enabling the change of the feedback partners and established learning loops.
- The key principle of CSCL@Work is to design collaborative learning across established boundaries (social- and technology-constructed boundaries).

In addition, we have shown that

1. Existing theories in both, CSCL and knowledge management, can help to frame empirical research questions in CSCL@Work,
2. Empirical studies of CSCL@Work are helpful to reflect existing theories of collaborative work,
3. A new conceptual framework structures this new discourse, since existing theoretical frames are limiting for the application of work-based learning.

We are optimistic that, as research focused on the unique potential of CSCL@Work emerges, findings from CSCL@Work will be systematically incorporated into the discourse of the broader CSCL and CSCW community and the broader community on knowledge management. Furthermore, operationalizing CSCL@Work research requires effective communication of findings in both the CSCW and CSCL communities. These two disciplines have historically been separate. They emerge from different traditions, but share the common dimension of applying computing to collaboration. We encourage CSCL@Work researchers to participate in both communities, and recommend participation in conferences and publication venues that bridge these communities.

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