

Designing Computer-supported Collaborative Learning at Work for Rural IT Workers: Learning Ensembles and Geographic Isolation

Sean P. Goggins, PhD
University of Missouri

ABSTRACT

This paper presents the results of a 9-month ethnographic and action research study of rural technology workers where computer support for collaborative learning through workplace technologies was introduced to a US-based technology firm. Throughout the implementation of this support and participation, issues related to geographic isolation are contrasted with the information and learning needs of 89 employees. The development of information seeking, cataloguing, and coordination practices through technology are described. Resulting insights have led to the identification of *learning ensembles* as an informal, socio-technical unit of organization within geographically isolated firms. Learning ensembles are hypothesized as a bridge between the mid-level, limited knowledge required in order to perform particular duties at the firm, and the greater potential of individual team members that is enabled by participation in the firm's technologically mediated, geographically dispersed customer teams. The discussion calls for future research on learning ensembles to further inform technologically mediated workplace learning.

Author Keywords

Group Informatics, rural, regional science, social worlds, geography case study, socio-technical, working spheres, CSCL at Work.

Practitioner Notes

What is already known about this topic

- Computer support for collaborative learning in the workplace occurs in a myriad of different ways that are specific to the work context (Goggins & Jahnke, 2013).
- A key component for contemporary workplace learning is recognizing that collaborative learning through technology extend beyond any particular organization; workers learn through their personal social networks (Goggins & Jahnke, 2013).
- Designing computer support for collaborative learning in the workplace can simultaneously help a firm adapt its workforce to new, required skills and facilitate organizational change (Goggins & Jahnke, 2013).

What this paper adds

- A clear description of the impacts of formal and informal collaborative learning at work in rural setting, where access to information and resources are more scarce.
- Knowledge of how isolated workers develop IT and computer programming related information seeking skills that support workplace learning.
- Insights regarding how computer mediated communication skills aid in the development of a distributed workplace *learning infrastructure* between urban firms and their rural outsourcing partners.

Implications for practice and/or policy

- CSCL@Work can help raise the level of a geographically isolated, lower skilled workforce up to the point where skills are sufficient for performing mid level IT and computer programming work.
- The geographically isolated workforce studied here reached a plateau in their learning through technology that corresponded with limits of the firm's needs.
- Exploring CSCL@Work designs that both support the firm, and a workforce's intrinsic desire to continue to gain knowledge may reap additional benefits.

INTRODUCTION

Small technology firms in rural regions develop new forms of virtual organization as they use information and communication technologies (ICTs) to collaborate with metropolitan partners and customers. In doing this, they bridge social and geographic boundaries among metropolitan and rural areas that date back to the first cities (Williams, 1973). These areas

are separated by distance and by socially-constructed perceptions regarding education and social sophistication (Malecki, 2009; Williams, 1973). ICTs enable a new type of computer support for collaborative, workplace learning that allow these small technology firms to exist through a process of recruiting and retraining local residents with capacity to learn technology skills, but little experience in computing.

The design and study of collaborative workplace learning in rural firms demands a reflexive exploration of employees' technology use within and outside of their company. Two technology use practices that are now common in rural areas of developed countries diminish the sense of social isolation experienced by those living in rural (geographically isolated) areas. Social interaction, learning and play through social media and other technology, removes physical location as the limiting factor it often becomes in daily life, enabling individuals living in rural areas to increase their connectedness to more populous regions (Ellis, Oldridge, & Vasconcelos, 2004; Scacchi, 2007). For both firms and individuals, learning to use ICTs and performing mid-level IT work from rural areas (Negroponte, 1995) leads to the creation of a type of organization doing work at a distance that is (Goggins & Mascaro, 2013) not previously examined in research on learning or work.

Technology-mediated workplace learning is an emerging area of inquiry built on literature from knowledge management, education and virtual community (Goggins, Jahnke, & Wulf, 2013). Many case studies document the mechanism of virtual community (Bers, 2001; Blanchard & Markus, 2002; Ellis et al., 2004; Gabriel, 2004; Healy et al.) and an equal number shed light on the collaboration practices of nomadic and geographically isolated individuals who connect to an organization remotely (Gloor, 2005; Gutwin, Penner, & Schneider, 2004; Mark & Su, 2010; Scacchi, 2007; Turner et al.). Few prior studies, however, focus on the mechanics, practices and effects of the introduction of collaborative workplace learning in general, or workplace learning in rural technology firms. A small number of studies describe the influence of ICTs on economic and social development at the scale of a nation or region in the developing world (Ali & Bailur, 2007; Friedman, Kahn Jr, & Borning, 2006; Mark, Al-Ani, & Semaan, 2009). More broadly, literature in management information systems (MIS) is replete with studies of large-scale global outsourcing efforts, while few articles (Goggins & Mascaro, 2013) focus on practices that could create and sustain an isolated, rural workforce in a developed nation.

Small, isolated rural firms are important cases for understanding workplace learning because these firms, out of necessity, must construct complex *working spheres* to extend their work and learning objectives beyond social and geographical boundaries. A *working sphere* (Mark & Poltrock, 2004) is composed of a collocated team, a distributed team and an organizational structure. When the distributed team is located in an isolated region with a low to medium skill workforce, systematic support for employee learning of technical and social competencies may be necessary. Such systematized workforce learning is often referred to as *workforce development* by government agencies in the US. From the perspective of regional studies literature, the economic development plans of scores of communities around the world (Maitland & van Gorp, 2009) could be advanced by the use of computer supported collaborative learning designs and implementations in rural work settings.

This paper characterizes the nature of rural location as a unique collection of obstacles and possibilities for workforce development and workplace learning. We are specifically focused on collaborative workplace learning, which is a form of informal learning. The exemplar case presented here is a micro-example of how informal workforce development may be able to function in concert with more traditional forms of training in order to build up a region's economy. We present an overview of the efforts of firms to overcome these obstacles. A literature review of regional studies, organization science, distributed teams and Computer Supported Collaborative Learning (CSCL) at Work sets the stage for the design study. We then present an ethnographic case study of the uptake and use of CSCL at Work strategies by 89 rural workers in a single firm over the course of 9 months. This is followed by a description of continuing efforts to introduce computer supported collaborative work technologies to workforce development efforts within the firm, and a discussion of future design research in workplace learning.

RELATED WORK

Regional Studies & Organization Science

Gilligan (2005) critically examines rural adoption and use of information and communication technologies (ICTs) by exploring what is meant by "rural", and how rural sociologists define "rural" as a partly social construction. "Rural" is a category of thought, viewed as unwavering against the forces of change and time, while "urban" is a category of thought which marches forward and defines the next age. These categories influence the perception of a region. Gilligan (2005) found that ICT uptake and use varies greatly in rural areas, and greatly according to the specific technology used; but the general perception is that of incorporation of ICT is uniformly lower for rural areas, even in cases where uptake is rapid. Gilligan frames her exploration using the European Union's five-stage continuum of rural, which moves from economic vitality to economic despair. This continuum is displayed in table 1.

Table 1 - European Union Categorizations of Rural

Rural Category	Characteristics
Urban Imprint Zone	High population densities and in-migration
High Amenity and Advantaged Areas	Relatively high densities with strong in-migration pressures
Developed and Balanced Areas	Intermediate densities and a balance of in-migration and out-migration
Areas with potential for development	Low densities and moderate out-migration
Areas requiring economic restructuring	Low densities and significant out-migration

In the United States, where the firm in our case study is located, a standard measure of rurality is metropolitan influence, which the United States Department of Agriculture (USDA) prescribes as a continuum of 1 to 12, with “12” having the least urban influence, “1” representing a large metropolitan area (avg. 558 people/sq. mile), and “2” representing a small metropolitan area (avg. 132 people/sq. mile) (Parker, 2004). When we imagine country life, our visions no doubt occur to us with less categorical precision, but conceptually along a continuum like this. Comparing Gilligan’s social construction of rural on this continuum, we see “1” reflects an “urban” social world, and 2-12 reflect increasing levels of social “ruralness”.

With few exceptions (Tapia, 2004), prior studies of collaborative computing tool adoption assume metropolitan infrastructures, social configurations and lifestyles. Organization science literature includes analysis of the incorporation of ICTs with large, complex organizations (Mark & Poltrock, 2004; Orlikowski & Barley, 2001; Finholt & Sproull, 1990), how this use reframes and restructures structural power and organizational roles (Barley, 1986; Eschenfelder, Heckman, & Sawyer, 1998; Lamb, King, & Kling, 2003), and how work groups are technologically mediated (Brown & Duguid, 1991; Keisler & Cummings, 2002; Muller & Gruen, 2005). Nowhere is there a clear examination of collaborative learning in the workplace in general, or of the rural workplace.

Regional studies literature tends to focus its analysis beyond individual firms. Measurements are chiefly macro-economic. Consequently, the internal characteristics and practices of firms are less studied. In regional studies research, technology appears in terms of the “digital economy” and the “analysis of ICT diffusion into isolated communities” (Hollifield & Donnermeyer, 2003). For instance, Malecki & Moriset (Malecki & Moriset, 2008, p. 200) define the digital economy as the pervasive use of ICTs. Moriset argues that networked connections to metropolitan areas combined with widespread availability of ICTs make rural technology firms likely to succeed (2003).

In contrast to Moriset’s optimism about the future of rural technology firms, there is evidence that pioneers in this space are struggling (Malecki & Moriset, 2008, p. 200). Rural firms must overcome the social and geographical barriers described above. Some concern exists related to the urban-rural “digital divide”, but this seems to be a disparity related to home access, not to business access (Horrigan, 2009). Engaging the digital economy requires rural areas to overcome their isolation, and the perception of scarce human capital due to this isolation is a key limiting factor to this engagement (Malecki & Moriset, 2008, p. 11). The rural human resource gap may include perceived and genuine labor scarcity, depending on the region in question (Henderson & Abraham, 2004).

Technology firms that thrive in rural communities must overcome social, geographical and resource-related barriers, but the way in which they do so is unexplored. Malecki (2008) characterizes firms located in smaller economies that draw investment from metropolitan areas as sophisticated consumers of space. Here connections are found between studies of work and studies of workplace learning in a rural context. A difference exists between learning at work and workforce development, though the two are intertwined in a rural setting.

Previous Inquiries of Distributed Work Teams

Rural work teams primarily interact with groups based in local and remote offices as well as with customer groups. Faced with distributed work inquiries similar to ours, past researchers have used *social worlds theory*, *communities of practice* and *ensembles*, a proposed additional analytical level in Activity theory. This section briefly reviews applications of each of these theories in prior studies of distributed work teams.

The development of multiple virtual workgroups within the same organization *vis a vis* ICTs is explored by Mark and Poltrock (2004), who examine instant messenger adoption across multiple locations within a single organization. Their study

focuses on firms recently merged into Boeing using the Social Worlds construct (Denzin, 1978). Mark and Poltrock use Clarke's (1991) definition of social worlds: *groups with shared commitments to certain activities, sharing resources of many kinds to achieve their goals, and building shared ideologies about how to go about their business*. Each member's workgroups are framed as distinct *working spheres*, which are a special type of social world that focuses on the work of the organization. For example, I may be a member of a team who works around my desk, but also a member of a distributed team involving a customer, and subject to supervision as part of a more formal, hierarchical organization. Each of these components of my work life would constitute a distinct, but overlapping working sphere, as represented in figure one.

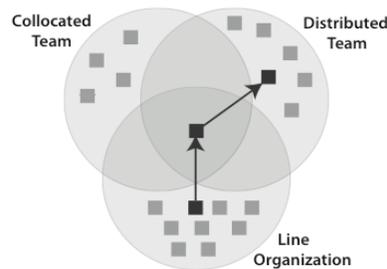


Figure 1 - Mark & Poltrock's (2004) working spheres – *The fundamental principle of a working sphere is that an individual has multiple, overlapping virtual work groups that constitute the social interactions in work life. In the case of Mark & Poltrock's operationalization (and ours), these working spheres involve significant distance work.*

Explaining the construct of working spheres as an extension of social worlds, Mark and Poltrock (2004, p. 305) point out that this construct frames the study of distributed, highly virtual organizations without the premise of the intricate and longitudinal mutual engagement required by Communities of Practice (Wenger, 1998). Further, *working spheres* incorporate the local characteristics of each group more directly than social capital theory (Coleman, 1988) or social network analysis (Wasserman & Faust, 1994).

Technology may also take a more central role in adoption studies. For example, activity theory creates space for the role of technologies and artifacts in distributed work and is used to frame CSCW and HCI research. Many researchers struggle with dynamic group work and with whether to classify aspects of dynamic group work as either action or activity. There are limitations to how action or activity may “*account for the way individuals in practice conceptualize, delimit, and represent those practical intermediate units of work that allow them to instantiate their activities through sets of thematically connected actions*” (Gonzalez, Nardi, & Mark, 2009, p. 2)

In an effort to apply activity theory to more dynamic group constructions where work efforts encompass actions but are not as clearly object related as activities, Gonzalez, Nardi & Mark (2009) explicate the construct of ensembles. In this conceptualization of activity theory, an ensemble is an “*intermediate unit of work between actions and activity in the hierarchical framework proposed by classical activity theory*” (Gonzalez, Nardi & Mark, 2009).

Ensembles are sets of thematically related actions defined by a purpose (Gonzalez et al., 2009, p. 110), and are in this way more adaptable than standalone concepts like *working spheres*, projects and tasks. Ensembles help to make actions meaningful beyond their immediate scope, and serve to make workloads visible within teams -- both powerful explanatory attributes in the study of virtual teams. When groups lack intimate, longitudinal relations, as many do which are examined here, the concept of *working spheres* is more salient.

CSSL at Work: Framing Workplace Learning Beyond Knowledge Management

Cook and Pachler (Cook & Pachler, 2012) describe the informal learning practices enabled through mobile technologies and present a typology of factors for the use of this technology. These could be conceptualized as “learning ensembles”, building on the work of Gonzalez, Nardi and Mark. Typological categories include work practices where learning is a byproduct, with learning activities located within both work and learning processes at or near the workplace. Identifying and making sense of principally indirect mechanisms for workplace learning is a focus of this typology. In contrast, MacLean and Scott (MacLean & Scott, 2011) inventory competencies for the design of more formal workplace learning across a range of professional societies. Learning ensembles hold the potential to serve as a conceptual organizing tool to support the design of technology that supports formal and informal workplace learning; a challenge particularly suited to isolated firms with specific workforce development needs.

In a workplace, learning outcomes can be operationalized as newly developed skills that learners use to solve a specific problem, to create new ideas with other people, or to create new actions (Anderson et al., 2000; Barr & Tagg, 1995). The result of learning becomes visible in the changed behavior of the learner (Biggs & Tang, 2007; Collins & Halverson, 2009),

but also in the evolving work practices and social worlds within the firm. Computer Supported Collaborative Learning (CSCL) at Work extends the knowledge of CSCL researchers, who are focused on learning, to the domain of workplace learning. CSCL at Work research aims to understand the way that organizations create the knowledge they require when that knowledge is not already known internally, or when a large organization is not aware of all its knowledge.

Summary

Working spheres and ensembles are constructs that theoretically frame the study of collaboration and collaborative learning in rural firms. Both working spheres and ensembles are applied in established, structured organizations and demonstrate the explanatory power of good theory. Our design based research on CSCL at Work in a rural setting is informed by these theories, but will take a reflexive stance toward the data.

DESCRIPTION OF PILOT STUDY SITE & METHODS

The firm in this study is referred to as “Rural-Co”. Rural-Co is headquartered a small town with a population of about 4,000, located over 200 miles from the nearest city with a population of over 150,000. The three firm locations and dimensions of rurality for each are summarized in Table 1.

Table 2 - Study location summary (December, 2008 Census)

	Rurality ¹	People
Rural-Co HQ	9	35
Rural-Co Satellite 1	5	7
Rural-Co Satellite 2	2	9

Rural-Co is conceived as a company that relocates technology jobs from large metropolitan areas to rural communities; it receives revenue from IT outsourcing. Employment at Rural-Co has ranged from 8 to 70 employees during the period of our study. The main business of Rural-Co is IT outsourcing, including software development, data analysis and testing.

Rural-Co employees live within 30 miles of the Rural-Co office where they work. Because there is no existing IT industry in these towns, Rural-Co is responsible for developing what they refer to as an organic workforce; they train individuals without IT skills or white collar business skills to perform web development and data services for clients. For the past five years Rural-Co has been successfully recruiting and training local workers using a three step process. First, candidates are screened using a computer programmer aptitude battery test (CPAB). The overall scores over the past several years are shown in Figure 2. Each group of accepted recruits has a different combination of strengths (diagramming or reasoning alternate in dominance), but the overall trend of the composite score is upwards. Education is not a key differentiating factor in this hiring process. Instead, the key consideration when using this test is objectively tested cognitive capacity to do computing work.

¹ USDA categories, numbered 2-12 for rural areas, with 12 being the most rural. “1” is reserved for large, urban areas.

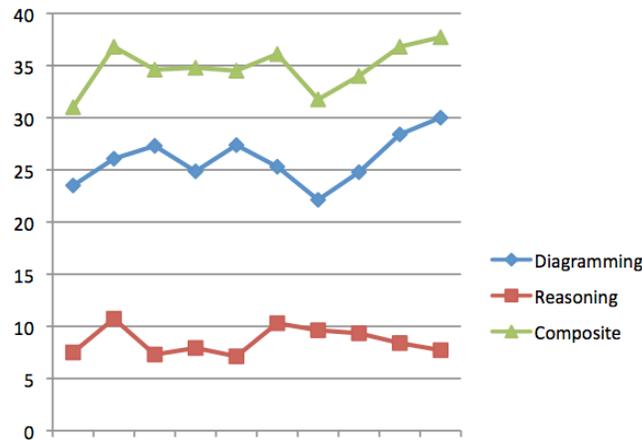


Figure 2 - CPAB Score Trends. The Y axis contains CPAB scores. The X axis represents cohorts of new hires over the previous five years. Diagramming and reasoning are the two components of the test, and the composite is the total of the two.

Second, candidates participate in a 12 week ‘boot camp’ experience where they learn specific information technology and programming skills. Most are trained to develop web applications using the Microsoft .NET framework, though several classes have been trained in the java 2 enterprise environment (j2ee). Finally, as work grows, students are hired by the firm to perform information technology work. A typical new hire is experienced in working with local light agricultural industries such as ethanol manufacturing, local service industries such as fast food or, in many cases, he or she takes whatever position is available in their limited local economy. Once hired, members go through an informal “learning in the workplace program”.

Methods

Organizational ethnography, particularly if carried out with a significant longitudinal dimension, is capable of generating richly textured data on organizational members’ daily working practices, leading to insights into wider organizational culture and behaviors, such as organizational responses to changes in technological environments (Barley, 1986). From 2006 to 2009, the ethnographic research was conducted at Rural-Co and extended this study to daily observation of work at Rural-Co for 8 months in 2009. LeCompte & Schensul’s (1999) guidance was used in the interpretation of our ethnographic data and conducting our data analysis, observing meetings, and maintaining field notes and memos, and conducting interviews. In the field, our data analysis focused first on description of how each organization worked and how members made sense of the socio-technically constructed relationships with distant partners, customers and locations.

Our “in the field analysis” integrated a constant awareness of the “hermeneutical process” principle. The hermeneutical process involves a constant consideration of the interdependent meaning developed through interaction with and interpretation of the environment. This process is central to our analysis and the experiences of the organizations that were studied. Out of the field, data was analyzed first from the bottom up using a grounded theory approach. The patterns of workplace learning framed in our findings emerge from this coding. The data was then analyzed from the top down using a coding scheme for organizational traits, identified during the initial bottom-up coding. The facets of geographical isolation emerge from these codes. Constant comparative analysis was used to reveal patterns of workplace collaborative learning and unique workplace learning practices were identified.

This study draws on three methodological approaches. First, a grounded understanding of what each organization member did at work was established through extended, daily participation by Rural-Co members who worked closely with deliberate attempts to inject collaborative, computer supported learning into daily practice. This approach follows ethnographic research traditions, but the author’s close work with the firm includes dimensions of action research, creating deeper embeddedness than a more observational form of ethnography (Reason & Bradbury, 2001). Second, relationships with local organizations, customers and distant offices led to a focus, to some extent, on how cross-location learning occurred. Third, regular analysis of data in the field ensured that changes in computer supported collaborative learning practices over time were recorded, noted and addressed in the analysis.

FINDINGS

The ensembles of learning within Rural-Co and across employees and locations were found to have three dimensions that are useful for guiding future CSCL at Work design and implementation. First, workers at Rural-Co first needed to develop required skills for obtaining information. The technology designs to support workplace learning were secondary to simply learning how to use Google. Second, communication skills within technology proved significant for developing necessary

informal learning connections – people one could ask for help. Finally, members of work teams experienced plateaus in their development, principally related to the limitations of the work required. This finding suggests an opportunity for future research and development.

Technology Skill Development at Work: Patterns for Learning How to use Google

Prior to this study, members of Rural-Co worked with a bricolage of different tools, including editable web pages, shared physical notebooks and libraries of paper books. Each small work team operated with their own, unique set of shared tools, though individual members of all groups maintained their own paper notebooks and books for easy reference. Employees' reliance on printed reference books at Rural-Co was a contrast to the researcher's experience studying firms in more urban contexts, where social learning within and outside the workplace are more common mechanisms for problem resolution. Early on, Rural-Co members commented that

“Google does not get me the answer I need when my code breaks”.

A team of more experienced Rural-Co members focusing on testing safety-critical software developed a strategy for using Google effectively. There were two notable changes to the skill level of Rural-Co employees and their use of technology to support informal learning that resulted from this observation. First, the team using Google put together a “cheat sheet” for how to use quotations and focus on top programming websites when searching Google for programming language related solutions. Second, within teams, members began keeping this “cheat sheet”, along with solutions to specific, work team problems that arose routinely.

Reflecting on the transformation from the beginning of our focused study to the conclusion, 9 months later, one Rural-Co member reflected,

“I can't believe we had to learn how to Google; it seems second nature now. I could always find World of Warcraft cheats, but it's kind of bizarre how difficult getting programming advice online is; there's so much of it, and so much of what there is <expletive>”..

Building Communication Skills: Practices and Trajectories

Rural IT Workers also face challenges of figuring out what technologies are best suited for which types of collaboration; that which may be obvious to a seasoned, urban texter, is less so to those whose work history is principally composed of small organizations doing coordination work in close physical proximity. The introduction of electronic tools for communication with distant customers altered the fundamental experience of belonging, place, identity and information dissemination needs. Two main tools emerged to support collaboration within local teams, and between local teams and distant customers. Worth noting is that the specific, customer collaboration tools varied by customer (Goggins, 2013), but each fell into the categories of “instant messaging” and “task lists”.

For some teams, instant messaging between team members and a client occurred in a public message space where members could see each other's questions and responses. In these cases, archiving messages seemed like a way to ensure that Rural-Co team members could continue to gain new knowledge; but this process proved difficult. One Rural-Co manager noted,

“They find the windows useful for about a day; after that it's just a bunch of text jambalaya.”

The use of task lists was, surprisingly, also a collaborative learning tool for 6 different teams working with 2 different customers. New members looked at the task list as a forum for asking questions that helped to define the work; there was no active process for bringing new people into teams. Members were expected to perform from the outset. Working through the list of tasks to perform generated a list of skills, and drew questions about skill development of team members. Over time during our observations, 4 team leaders made the task list a more formal mechanism for keeping track of what team members needed to develop which new skills. For example, SQL and PHP programming were required for different tasks, and knowing which tasks were coming up was used as a way of assigning informal learning goals to team members. In this sense, the work team became a learning ensemble as well.

Types of Work and Plateaus in the Development of Transferable Skills

Technology-mediated, informal learning allowed Rural-Co to meet customer needs with a rural workforce effectively and efficiently, and in a novel way as compared with employees in more urban settings. Through this success, the firm faced an increasing number of people entering work with high degrees of basic competency for computing work as measured by the CPAB, and who quickly mastered the medium level jobs that they were assigned. Developing roles that moved beyond the medium level, and the associated formal and informal learning required, proved a source of frustration, though not for everyone. Most pointedly, 2/3 of Rural-Co members interviewed in the “data team” — the team that performs data analysis and cleaning work for customers — expressed these concerns.

Some of these concerns were mitigated by Rural-Co's rapid growth during the study period, which demanded new team leaders on regular basis. The most competent team members were offered management instead of expertise challenges. A few (~2) left Rural-Co during the study period to take more rigorous technical jobs in larger cities at least 3 hours from Rural-Co. Together, these observations signal that an area for development of informal, workplace learning at Rural-Co may be tangential to the work demanded of people today. Informal, technology-mediated workplace learning at Rural-Co created a drive for knowledge and challenge that requires facilitation. Providing this facilitation is the next major challenge for understanding how to better support workplace learning in geographically isolated firms.

DISCUSSION

The purpose of this research is to expand workforce development in Rural-Co using concepts of CSCL at work in three phases. First, collaborative learning technologies are introduced to the existing workforce. Second, to leverage the existing workforce as an environment for accelerated training, existing CSCL environments are applied to established workplace learning practices. Third, software engineering and software development tools are integrated directly into the collaborative learning at work system. Framing this type of technology-mediated learning as "learning ensembles" was found to be a helpful way to conceptualize how informal, computer supported collaborative learning could function within Rural-Co.

Phases 1 and 2 were completed successfully. Phase 1 involved the development of an infrastructure of collaboration between the three offices. This includes improvements to the network at Rural-Co, and the introduction of a collaborative learning environment (a wiki and task manager) integrated with a work notification system built around Google Docs. One of the challenges for workers in distributed offices conducting planned, collaborative learning is maintaining an awareness of how and to what extent others are participating in the environment. A large corpus of prior work outlines the benefits of context aware notification for distributed, collaborative learning.

Phase 2 involved the development of new work skills among Rural-Co employees. These employees face two principle challenges due to their geographic isolation. First, there is no local community of technology workers with whom to interact, effectively eliminating the legitimate peripheral participation and development of networks of practice common in more urban regions (Brown & Duguid, 1991; Brown & Duguid, 2001). Second, the absence of large, corporate cultures in the local area limits the opportunities of Rural-Co employees to build communication and collaboration skills that are a basic expectation in more urban firms. Rural-Co refers to this skill set as "white collar skills". Rural-Co employees face significant difficulties in obtaining the technical and communication skills required of them throughout their career.

The development of new skills in the existing, isolated Rural-Co workforce is a key finding that can be built on, and developed more specifically in other contexts in the future. Two different programs for CSCL at Work are in the process of being introduced (Goggins, Jahnke, & Wulf, 2013) to Rural-Co. The first is called 'technical special forces'; where a single member of the Rural-Co team independently pursues a new area of technical expertise, and, under the editorial review of their Training Director, constructs curriculum that three other Rural-Co employees will follow. The 'lead worker' maintains a 3 week lead in knowledge development, and skills are developed among other Rural-Co workers using an asynchronous, collaborative approach. Senior members of the Rural-Co technical staff also monitor the discussion and artifact exchanges within this 'special forces' group. Though not especially novel to those engaged in highly technical, startup type work, this approach is not previously tied to technology-mediated, collaborative learning design explicitly. The institutionalization of practices that are known to work may be beneficial.

The second program is focused on communication skills. Here, the practice of communicating with customers is integrated with professional writing curriculum and peer review of customer communications prior to "hitting send". The distinction between these two approaches to CSCL at Work and prior studies of workplace collaboration is the planned nature of the learning. There is no a priori knowledge base within Rural-Co, which is an artifact of the firm's isolation and the lack of other workers with needed technology skills. The reference materials and skills that do exist were built organically, using a bricolage of tools.

Pressing beyond the plateau after mastery of a job is achieved through informal, technology enhanced workplace learning is an area of exciting future inquiry and possibility. Technology enhanced workplace learning in geographically isolated regions could serve needs beyond the bounds of a single firm. A local, community-level institution for managing and supporting workplace learning of "the next big skill", especially as a natural extension of current skills, like data analysis, is worth exploration in the future. The construct of learning ensembles, building on social worlds and ensembles constructs developed by Mark and Poltrock (2004), seems like a mechanism for framing inquiry for workplace learning through technology that recognizes the informal, social connections that support mutual learning within a firm. Of particular interest in future studies will be the formal development of learning ensembles focusing on computer supported collaborative learning technologies.

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