SOCIAL PATTERNS IN MOBILE TECHNOLOGY MEDIATED COLLABORATION AMONG MEMBERS OF THE PROFESSIONAL DISTANCE EDUCATION COMMUNITY

Jari Laru*
Research Unit for Educational Technology
The Department of Educational Sciences and Teacher Education (www)
Faculty of Education
P.O. Box 2000, Snellmania
FIN-90014 UNIVERSITY OF OULU
Fax. +358-8-553 3744
Jari.laru@oulu.fi

Sanna Järvelä
Research Unit for Educational Technology
The Department of Educational Sciences and Teacher Education (www)
Faculty of Education
P.O. Box 2000, Snellmania
FIN-90014 UNIVERSITY OF OULU
Fax. +358-8-553 3744
Sanna.jarvela@oulu.fi

*responsible author

Keywords: Collaborative Learning, Communities of Practice, Problems and Challenges in Mobile Learning, Social Network Analysis, Virtual Collaboration in the Design of the Distance Education

Abstract:

The aim of this study was to identify social patterns in mobile technology mediated collaboration among distributed members of the professional distance education community. Ten participants worked for twelve weeks designing a master’s programme in Information Sciences. The participants’ mobile technology usage activity and interview data were first analyzed to get an overview of the density and distribution of collaboration at individual and community levels. Secondly, the results of the social network analyses were interpreted to explore how different social network patterns of relationships affect online and offline interactions. Thirdly, qualitative descriptions of participant teamwork were analyzed to provide practical examples and explanations. Overall, the analyses revealed nonparticipative behaviour within the online community. The social network analysis revealed structural holes and sparse collaboration among participants in the offline community. It was found that due to their separated practices in the offline community, they did not have a need for mobile collaboration tools in their practices.

Keywords: Collaborative Learning, Communities of Practice, Problems and Challenges in Mobile Learning, Social Network Analysis, Virtual Collaboration in the Design of the Distance Education
1. Introduction

Distributed work and virtual communities have increased in the realm of organizational learning. The popularity of the concept of learning communities is growing and so are ideas on how to support these communities with technology. The idea of learning communities is derived from a theoretical discussion, which emphasizes the social aspects of learning (Resnick 1989; Lave & Wenger 1991; Rogoff 1990). In addition, in order to achieve flexibility and to enhance the knowledge and productivity of mobile workers, many organizations adopt information and communication technologies that support mobility, context and location awareness, networking and ambient interfaces (Malone, 2004).

Ever since Mark Weiser (1991) coined the term "ubiquitous computing", an increasing amount of attention has been paid to technologies that provide support to people on the move and in practice (Brodt & Verburg, 2007; York & Pendharkar, 2004). Better quality and decreasing costs have paved the way for the emergence of the so-called mobileworker in the workforce of the European Union. So far, research on mobile work is in its early stages and definitions and concepts are still emerging (Brodt & Verburg, 2007). Recent research on the innovative use of mobile technologies has focused on mobility and other contextual issues, such as spatial and temporal flexibility of workers (Henfridsson & Lindgren, 2005; Bellotti & Bly, 1996; Luff & Heath, 1998). It has also highlighted ways in which collaboration between mobile workers (Lundin & Magnusson, 2003) or K-12 learners (Roschelle & Pea, 2002) can be supported with mobile technology. However, a considerable amount of research effort has been driven by technical challenges while few studies have dealt with the question of how meaningful and productive mobile technology-supported collaboration is (Naismith, Lonsdale, Vavoula & Sharples, 2005; Cousins & Robey, 2005; Chatterjee & Sarker, 2007).

The aim of this study is to identify social patterns in mobile technology mediated collaboration among the professional distance education community. Specifically, usage activity and interviews were first analyzed to get an overview of the density and distribution of collaboration at individual and community levels in offline and online communities. Secondly, the results of the analyses were interpreted to explore how different social network patterns of relationships affect online and offline interactions. Thirdly, the descriptions of participant teamwork and technologies were analyzed to provide practical examples and explanations and to confirm the network analysis.

1.1 Communities of Practice as a framework for understanding workplace learning

The idea of Community of Practice (CoP) was developed by Lave and Wenger (1991) and was then further developed by Wenger (1998). The concept is grounded in an anthropological perspective that examines how we learn through everyday social practices in self-organizing teams of informal learners rather than focusing on environments that are intentionally designed to support learning. Communities of practice are viewed as emergent, self-reproducing, and evolving entities that are distinct from formal organizational structures (Brown & Duguid, 1991; Schlager, Fusco & Schank, 2002; Schwen & Hara, 2004).

According to Brown & Duguid (1991) workplace learning can be best understood in terms of the communities being formed and personal identities being changed. The central issue is the importance of becoming a practitioner, not learning about practice. In a community of practice, participants who share a common interest for the field in which they work, come together to help each other out, solve problems, and create knowledge collaboratively. A community of practice therefore is a group of people informally bound by shared practice related to a set of problems.
Over time these mutual interactions and relations build up a shared body of knowledge and a sense of identity. They constitute an informal, social structure initiated by members and reflecting their collective learning (Wenger, 1999).

1.2. Supporting collaboration in online communities of practice with mobile technologies

Although the original concept of CoPs addressed learning that took place in face-to-face situations, more recently researchers have begun to examine how technological platforms can support distributed CoPs (Barab, Kling & Gray, 2004; Wenger, White, Smith & Rowe, 2005). The goal of the designers in attempting to build online CoPs is to create the infrastructure and tools for participants to share information and to engage in social dialogue for developing social networks to make learning meaningful. Research focusing on online CoPs can be divided into two categories: studies of offline social networks in physical or virtual spaces and studies of infrastructures for online communities within different educational settings (Barab, Kling, & Gray, 2004; Schlager, Fusco, & Schank, 2002).

In geographically distributed CoPs face-to-face contact is infrequent; thus, social situations where members are able to share knowledge and learn collaboratively are rare. Growing interest in the use of technologies to sustain geographically dispersed CoPs emphasizes the importance of the role of technological tools. Currently, more technologies have been incorporated into the life of communities, alone and in combination with each other, and yet their use has become more varied and inventive (Wenger et al., 2005). According to Schlager and Fusco (2004) CoPs’ communication, productivity, coordination and knowledge generation can depend on the broad use of tools and the generation, reuse and refinement of community artefacts, not only within projects but also across projects over time.

Knowledge workers’ use of computing and communication services is often limited to solitary moments at an office desk. As the business world becomes more fluid and networked, organizations will continue to be more mobile than ever before. According to Liebowitz (2007) a part of the challenge for future mobile organizations is how to better communicate and collaborate among their employees, customers and stakeholders. Recent models of Computer-Supported Cooperative Work (CSCW) and Computer-Supported Collaborative Learning (CSCL) have gained in popularity for enhancing teamwork and collaborative learning; there has been little research done on supporting collaborative work communities employing mobile technology (Chatterjee & Sarker, 2007). Instead, the current debate distinguishes between issues of mobility (Bellotti & Bly, 1996; Kristoffersen & Ljungberg, 2000; Luff & Heath, 1998), social impacts (Yoo & Lytyinen, 2005), knowledge management (Fagrell, Ljungberg & Kristoffersen, 1999) and the technologies themselves (Lytyinen & Yoo, 2002; Sorensen & Gibson, 2004).

The aim of the study was to identify social patterns in mobile technology mediated collaboration among the professional distance education community. The research questions are:

1) What is the density and the distribution of the collaboration at individual and community levels in the online and offline communities?
2) How do different social network patterns of relationships affect online and offline interactions?
3) How do participants describe teamwork and the technologies used to support it?

2. Methods

This study followed the principles of a design experiment (Brown, 1992; Collins, Joseph & Bielaczyc, 2004). In design experiments the outcomes are used to guide revisions for tools,

instructional designs and practical arrangements themselves. The outcome also serves to help researchers understand the learning processes and how these are affected by the tool, the instructional design and the arrangements itself. In this design experiment mobile software for handheld computers, instructional design and practical arrangements was designed and then was taken into the real context where it was used with real participants. The term “online community” is used in this study to refer to that context and the term “offline community” refers to the context before the experiment.

2.1 Participants and research settings

The study was conducted in realistic settings with the University Learning Center, which offers education through retraining programs in seven independent regional learning centres within master’s programs on information processing sciences. The task of the distributed organization (later in this study: ViMa) in the Learning Center was to design and coordinate activities in the virtual master’s programmes. The voluntary participants (N=10) were distributed into three teams and to two different locations in a Northern area of Finland (See Table 1): Location A (Team 1, n=5) and Location B (Team 2, n=2; Team 3, n=3). The participants (nine males and one female) comprised four project managers, one lecturer, one computer specialist, one educational designer and three new media designers. All participants had previous experience in working together in the same distributed organization.

---Insert Figure 1 here---

2.3 Procedure

Activity in the online community was organized for the purpose of designing a new master’s program on information security. The research setting was suggested by the project’s managers who had recognized challenges for collaboration in the distributed organization. Although their community for the virtual master’s program was regionally dispersed, they didn’t frequently use a shared workspace, knowledge management systems or other collaboration tools for supporting their work practices. In this study mobile technologies were implemented to foster collaboration among the participants in the online community.

The online virtual working period lasted twelve weeks, from June to August, but the whole process started one month beforehand with two preliminary meetings. Meetings instructions were given on how to use the shared workspace and mobile technologies. During the virtual working period the participants were not required to change their normal working practices and roles. They were not given any specific tasks for collaboration or mobile handheld use; instead they were encouraged to define their problems and issues to be discussed on a shared workspace provided by the mobile devices.

Each participant was provided with a Hewlett-Packard Jordana 586 handheld computer, which was equipped with wireless Internet connectivity. The tools used in the experiment consisted of the re-designed FLE3, called FLE3mobile, and a proprietary software suite. FLE3\(^1\) is designed to support collaborative knowledge building and progressive inquiry learning (Leinonen, Kliytye, Toikkanen, Pietarila & Dean, 2003). The FLE3mobile offered a semi-structured communication interface for participants where they were able to publish problem statements or questions, and engage in a knowledge building dialogue around these problems by posting their messages on a shared workspace.

---\(^1\) FLE3 was developed by the Learning Environments for Progressive Inquiry Research Team at the UIAH Media Lab, University of Art and Design Helsinki with the Centre for Research on Network Learning and Knowledge, Department of Psychology, University of Helsinki---
2.4 Data collection and analysis

For data collection, log-files and participant interviews were used. Summarized results of the databases (see Tables 2 and 3) were created from the log-files and used as a stimulus for participant interviews. Secondly, Social Network Analysis (SNA) was used to identify and compare underlying patterns in the data of social relations in online and offline communities (Liebowitz, 2007; Scott, 1991; Wassermann & Faust, 1997). SNA was chosen as the main method since the SNA approach has developed a battery of concepts and methods that can aid analysis of offline and online communities. SNA helps researchers see how different types of relationships interrelate, detect structural patterns, and analyze the implications that structural patterns have for the behaviour of network members (Koku & Wellman, 2004; Zack, 2000).

2.4.1 Log-file Analysis

Log-file analysis focuses on the number of page views and logins, length of logins and the number of written and read messages. Page views and login information are the most commonly used methods to evaluate interest in Internet resources (Jana & Chatterjee, 2004). Such measures were associated with unique participants by using the ‘Sawmill’ analyzing toolkit2, while the amount of written and read messages was gathered from the shared workspace.

2.4.2 Semi structured interviews

Semi structured interviews were conducted among all the participants. The interviews lasted for one hour and they were audio taped and then transcribed. First, the interview data was used to characterize network data for SNA analysis. The interview focused on participants’ networks at a team and community level, where each individual was asked to denote for each participant whether or not they have collaborative work practices with each other. They were asked also to describe, to whom they most often turn for advice and information, or to whom they gave advice and information as well as to whom they reported their practices.

Secondly, interview data was used to characterize the participants’ work practices, as well as technologies they used to support their work and collaboration. The questions asked dealt with participants’ backgrounds, roles and tasks in the virtual master’s program, social network(s) within a team and between teams, working practices, the role of non-digital/digital artefacts in work practices, attitudes towards mobile technologies, and the shared workspace used in the study.

A content analysis (Savenye and Robinson, 1996) was used for analyzing interview data. The data was transcribed word-for-word and evaluated several times. During the analysis, participants’ evaluations of their offline community, working practices and the role of artefacts in their work practices were captured by analyzing their explanations of their own and other’s practices. The coding scheme was developed after two rounds of reading and with the help of the NVivo qualitative data analysis software (Richards, 1999). During the first coding round, themes from the semi structured interview were used as a coding scheme. During the second round, all units where the participants expressed explanations for low participation in the online community were explored and chosen from all themes.

2.4.3 Social Network Analysis

Information retrieved from the interviews and the databases was treated as relational data and was stored in the form of case-by-case matrices in which each agent is listed twice: Once in rows and

2 http://www.sawmill.net/
Once in columns. The separate matrices were created for social network analysis: the offline community and the online community matrix. The offline community matrix consists of interview data focused on participants’ networks at a team and community level. This information was collected by interviewing participants in their own offices. The online community matrix, on the other hand, consists of messages written or read in the shared workspace, FLE3mobile. The data of both matrices are dichotomised so that the presence or absence of connections between pairs is represented by 1 or 0 in the appropriate cells of the matrices.

After constructing matrices the data set was analyzed by a social network analysis using the UCINET program (Borgatti, Everett, & Freeman, 1996). The social network analysis focused on analyzing the density, centrality and centralization of both communities. It aimed at examining network centers and was carried out both at the individual and network level. Density is a property of a whole network and describes the general level of linkage among the participants in an interaction network: The more actors have relationships with one another, the denser the network will be. The density of a (binary) network is the total number of ties divided by the number of possible ties. This measure can vary from 0 to 1 (Borgatti et. al, 1996; Scott, 1991). While density describes the extent to which all participants of a particular network are interconnected, centralization describes how tightly interaction within a network is organized around a particular participant or group of participants. Thus, density and centralization are complementary measures (Wasserman & Faust, 1997).

To determine the most central participants in the communities, centrality values were calculated for each participant using Freeman’s degree measures (Freeman, 1979). Freeman’s degree measures determine the network activity of participants – the proportion of communication with other participants. The received information was performed as ‘in-degrees’, and sent information as ‘out-degrees’ in the offline community, which were both collected during interviews. In the online community “read notes” in the shared workspace were performed as in-degrees, and ‘sent notes’ as out-degrees. In centrality measures, asymmetric data was used only in calculating degrees. In other cases symmetric data was used.

In addition, to look more closely at the structure of the communities a block model analysis was used. The block model analysis is a descriptive method with a focus on associations among relations rather than on subsets of actors (Wassermann & Faust, 1997). In this study, descriptions of individual blocks (positions) and the overall block model were made. To create the block model the matrices were first partitioned into structurally equivalent subsets (see Table 1), each of which represented one team of the ViMa community. Secondly, density tables, image matrices and reduced graphs were created for analyzing relations between and within blocks (see Table 5). A density table is a matrix that has positions rather than individual actors, and the values in the matrix are the proportion of ties that are present from the positions in the row position to the positions in the column position. An image matrix is a summary of the ties between and within positions, so that each tie is coded as either present or absent between each pair of positions. In a reduced graph positions are represented as nodes, and ties between positions in the image matrix define the arcs between the nodes.

3. Results

3.1 Usage activity of the online community as revealed by the log-files of the shared workspace

Table 2 shows the participants’ activity extracted from the log-files of the FLE3mobile: the number of page views and logins, first and last login and total logged-in time per participant. Participants 1-4 shared 70% (n=34) of the total logins (n=46) and 70% (n=1308) of the total number of page views.
This team of participants made approximately triple the amount of logins as compared to the other participants. These participants shared 84.6% (5 hrs 18 min) of total time in the workspace (6 hrs 16 min), while other participants’ login times varied between 23 minutes (P6, three logins) and 1 minute (P5, one login).

Table 2 reveals non-participative behaviour in Teams 2 and 3 based on the number and length of the logins. While P1-P4 logged in for longer time periods, participants in more peripheral teams made all their visits during one day.

---Insert Figure 2 here---

Table 3 shows that the participants wrote 19 notes in total in the shared workspace, with an average of 1.9 notes per person. The data indicates that the most active participants could be found among P1-P4 with respect to both sent and/or received notes. These participants produced approximately seven times as many notes as did the other participants. It can be seen that they also had more interaction partners (n=7) than other participants in Teams 2 (n=3) and 3 (n=3). On the contrary, Participants 5, 7 and 10 didn’t make any contributions and Participants 4, 8 and 9 made their contributions to the discussion just after most threads and activity had faded away. Only one of the participants (P5) who didn’t read or write any notes was isolated from the rest of the online community.

---Insert Figure 3 here---

In fact, investigation of the notes revealed that apart from the threads created by the members of Team 1, there had been minimal online interaction between and within the teams. The data shows that the online discussion was limited to a relatively small team, which decreased rather quickly: three of six threads were created and answered during the same day and only two threads had more than three notes. Yet, the last three topics were started in two consecutive days. The total set of notes was threaded into six topics with zero to four responses each, and yet only one of the six discussion threads was created by the members of Team 2 or 3. However, lurking levels (by lurking we mean participants who only read notes without posting any) were low within Team 2 and 3 where only participant (P6) read 42.1% of posted notes while his colleague (P7) read only 21.1% of written contributions. Yet, Participants P8 and P10 show higher lurking levels than P6 and P7.

When considering the content of the notes posted in the shared workspace there are no references to the team in the messages, which is regarded as an important indicator of community. Instead, the content of message threads tends to be about issues such as FLE3mobile, the master’s program, network technologies and computer software, without expressing any bonds between participants. According to interviews, participants saw that general aspects of the FLE3mobile were unclear, including how collaborative learning was accomplished with such technologies. For example, Participant P9 was asking for functions typical in a computerized conference, having gained his former experiences from Usenet, where participants can vary their involvement in different communities, participating actively in some and occasionally in others:

P9: “I think that one should know about the theory underlying these thinking types before using FLE. Some of us have got used to read news within Usenet-network in this fashion: Hey I have a problem could you help me and almost immediately someone answers that here is solution for you. For me thinking types were difficult for that reason”
3.2. Comparing density and distribution of collaboration at individual and network levels

The results with respect to the density and centralization of the offline and online communities can be seen in Table 4. The analysis indicated that both networks were sparsely knit (online 0.41 and offline 0.44) when small networks tend more often to be dense. From Table 4 it can be seen that none of the networks of incoming ties were especially centralized. On the contrary, the outgoing links (out-degree) were somewhat more centralized. The outgoing ties of the offline community were revealed to be quite centralized. When measuring centrality at an individual level, different “star persons” in offline and online communities were recognized. It can be noted that P7, who had a central position (Degree 8) in the network of the offline community, had almost an isolated position in the network of the online community (Degree 2). This finding illustrates a structural hole in the online community network. Such a hole can be regarded as disconnection between actors, which prevents the flow of collaboration.

---Insert Figure 4 here---

Results suggest that ViMa organization forms a sparsely knit offline community, and FLE3mobile forms a sparsely knit online community. Instead, based on interviews, the actors had many ties with people who are not members of ViMa network. For example, participants in Team 1 appeared to be members of multiple parallel educational networks. The regional learning centre was organized around several non-permanent educational projects, which emerged quickly and appeared to be dismantled when they were over. As a result, they had to keep up their offline educational networks by contacting other members from other educational institutions once in a while. Their local community appeared to be the nexus of intentional networks and local communities of practice, which is reflected in the interview responses by Manager P2:

P2: “For example, I work for another university and the local town, but I am also a project manager at the ViMa. Some of us work for the university or polytechnic. None of us have the same employer; even so we share our practical issues, help each other and have a lot of discussions. Moreover, we are a kind of hub for higher education in our region”.

Interviews reveal that organizational structure in ViMa is flat and there is no strict social control in the offline community. According to ViMa Manager P7 (Team 2) their task as managers is to aid others to internalize and follow common rules, instead maintaining strict control.

P7: “Our main task at the “headquarters” is to create and disseminate common rules for each regional actor to be sure that their work is in parallel with ours. Our task is also to help them to follow such rules. Our communication with regional actors is typically giving practical answers to their questions concerning ViMa”

In order to look more closely at the offline and online communities, the matrices were partitioned into sub matrices. Notable differences between networks may be identified by comparing structures presented in reduced graphs (See Table 5). Because the members of Block 1 (Team 1) have the core position within the network in the online community and other positions have ties to that position, but not to each other, pattern of centre-periphery (Mullins, Hargens, Hecht & Kick, 1977 in Wassermann & Faust, 1997) is a possible structure for that community. In contrast, offline community Block 2 (Team 2) has the core position while Blocks 1 (Team 1) and 3 (Team 3) both have primary positions. In such a position the participants receive ties from the other positions and
from their own members. However, all ties in that network point away from Block 3 suggesting a pattern of a centralized system (Knoke & Rogers, 1979 in Wassermann & Faust, 1997).

---Insert Figure 5 here---

Findings suggest that Teams 1 and 3 are densely bound groups in which limited numbers of people are fully engaged with each other in performing collective tasks. Yet, according to Wellman (1997) almost all communication is inward, within the fishbowl, so they didn’t see the benefits of a shared workspace. However, although almost all of the relationships remain within the teams, both teams had gatekeepers, who had routine contact on behalf of the team with the rest of the organization, namely with managers in Team 2. One of these gatekeepers, P10, described his role in the offline community:

P10: “I am like a small-scale project manager with responsibility for smaller tasks and timetables... I have discussions with lecturers concerning recording their lessons, and also keep our bosses informed about how our tasks are going, and if needed, ask for more time to complete them.”

Both teams saw the learning value of open office plans with co-workers having full visual, aural and physical access to each other. In the following excerpt Designer P9 describes his experiences:

P9: “We have a small team where our expertise draws on separate experiences, but we support each other. I have to say that one learns from peers a lot within our team. Because we share this room it’s easy to solve problems and generate different solutions. And, it’s possible to just follow and learn.”

3.3 Participants' descriptions of technologies used to support their practices

The scattered nature of the ViMa network illustrates that participating organizations had to rely on a variety of communication technologies to facilitate various modes of work in the sparse offline community. However, the only mediums that all participants used for communication were email and telephone. They didn’t have any shared workspace or a shared folder to be used for common issues in the offline community. In spite of that, there was considerable cross-talk, both online and face-to-face in more densely bound teams. At the time of the study they used email, telephone and fax, but also more advanced technologies, such as shared folders on local area networks, teamware, video conferencing, shared whiteboards and internet relay chat. Half of the participants used laptops as their personal computers and mobile communicators as their personal phones. The interviews revealed that the physical team room was often used for collaboration instead of modern technology in densely bound teams, as noted in P10’s interview response:

P10: “In our shared office it’s really easy to follow what’s going on at this moment and get help. You just ask a co-worker a question and you get help immediately. We handle most of our communication here in our office. It’s quite difficult to name other communication methods that are better than talking at our office.”

Despite minimal online interaction through mobile devices, all participants were interested in the PDA functions of their mobile devices. They valued administrative and referential tools, which were not explicitly designed to facilitate, encourage or support collaboration or learning in communities. Participants liked to use programs that allowed them to store, access and annotate
documents that would normally be accessed on desktop computers, but also some of them frequently used mobile Outlook for checking mail. P4 (Team 1) reveals his favorite method in the following excerpt:

P4: “I really loved to write small notes. It was a really good tool for me. I have to say that I wrote hundreds of those notes. I wrote both personal notes relying on our project by using the note taker application.”

The results show that participants used handhelds to support local mobility and personal productivity. They used devices in meetings to edit minutes, in their offices for updating notes, in their workplaces to carry notes related to work. In total, the sparsely connected network of ViMa workers invented multiple ways to utilize handhelds for personal purposes. They thought that personal value was so important that all participants bought handhelds for continuous use after the experiment.

In addition, the interviews also provided evidence that Team 3 was especially interested in exploring new uses for handhelds in contrast to their low participation in the online community. In practice, they were asked by managers (Team 2) to explore the applicability of handhelds to be used as students’ devices in ViMa. They evaluated how handhelds might be used for the streaming of multimedia, but also used handhelds for playing music, watching movies, playing games, and made work-related explorations related to ViMa, just as Designer P9 mentions in an interview:

P9: “We were supposed to use such devices to support our interaction within our team [team 3] so we tested that. We did a few mobile media tests; for example, real-time audio and video was pushed from the server to handhelds... also we tested how handhelds work as Voip telephones... It was really nice to talk with your colleague via a handheld.”

Participants had considerable difficulties with adopting mobile technologies and wireless networks. As handheld computers were a new technology for all of the participants, they were compared at every turn with corresponding technologies, and also with low-tech tools like pocket calendars, paper and pencils. Quite often participants valued paper based artefacts more than mobile or desktop counterparts. However, there were also practical design flaws in the study; for example, the start of the experiment was delayed due to lack of WLAN-cards from the local dealer and participants were restricted to in-house or on-site areas, which were covered with WLAN, both of which were also acknowledged by subjects in the interviews.

4. Discussion

In general, the results revealed minimal interaction in the shared workspace (FLE3mobile) in the online community of the ViMa network. The social network analysis showed that despite the involvement of some central participants, the offline community is sparsely knit, so that most of the people in the ViMa network are not strongly connected with each other. Further analyses revealed that each team of participants form densely bound groups in which participants are fully engaged with each other in performing collective tasks. Based on the interviews and the social network analysis participants didn’t constitute a community of practice together; instead each team had characteristics of CoP in their practices and their own networks. In summary, being a sparsely knit community without the need for daily collaboration, they didn’t have a need for dense collaboration in the shared workspace either.
In addition, the participants described several difficulties with respect to adopting mobile technologies and software which partly affected participants’ early abandonment of the online community. These technological and practical difficulties are in line with Sorensen’s and Gibson’s (2004) findings that mobilizing computing and communication in the workplace is a significant technical challenge. It’s interesting to note that alongside the minimal online interaction, the participants also reported that the mobile device was becoming an excellent personal organizer which many of them ‘could not live without’. Yet, previous research has shown that most handheld applications often reinforce the idea of the handheld computer as a personal assistant and the design of collaborative applications for mobile users present many socio-technical challenges (see also e.g: Chatterjee & Sarker, 2007; Guerrero, Pino, Collazos, Inostroza & Ochoa, 2004; Sorensen & Gibson, 2004). In this study, we learned that participants who use mobile technologies are a heterogeneous group and that it’s important to understand and consider the nature of collaboration, work or learning contexts and technical options available when designing collaboration software for mobile workers and learners.

Despite the technical problems, it can be concluded that the main reason for minimal interaction in the online community was the structure of the ViMa community. However, the problem of weak collaboration is not specific to the present study alone (see e.g. De Laat & Broer, 2004, Kreijns, Kirschner & Jochems, 2003; Liebowitz, 2007). Previous research on online communities (Barab, Kling & Gray, 2004) and collaborative learning (Lipponen, Rahikainen, Lallimo & Hakkarainen, 2003) has shown that developing a flourishing online community is a difficult task and relatively little is known about how to accomplish it. Many efforts end in fragile and even fractured teams communicating intermittently (Barab, Kling & Gray, 2004; Schwen & Hara, 2004). Destructive aspects of the online community in this study helped us to notice the importance of “technology stewards” who are members of the community acting as guides to the rest of the community, as they learn to utilize technology and benefit from it (Wenger et. al, 2005). It also helped us to consider that one community is something that cannot be designed on another; instead, it must evolve with a team around their particular needs and for purposes that they value as meaningful (Barab, MaKinster & Scheckler, 2003). However, we can favour the emergence of productive interactions and to improve the quality of collaboration in their communities, by using different pedagogical models and regulation tools to support their activities (Järvelä, Näykki, Laru & Luokkanen, 2007).

This study is limited by the reduced number of participants that were observed. With such a sample it is not possible to derive findings that can be statistically significant and extend across larger populations. Since the social network of an offline community is collected by having people report on their own interactions, the accuracy of this self-report data is also a concern. Bernard, Killworth and Sailer (1985 in Wassermann & Faust, 1997) found that about half of what people report on their own interactions is incorrect in one way or another. Thus, people are not very good at reporting on their interactions in particular situations. In this study a relationship between the social network of the online and offline community is also an important issue, while data matrices for comparison between offline and online communities were created by using different data collection techniques.

Concerns can also be raised regarding the sensitivity of the analysis to the definition of the network boundary, i.e. the initial choice of researchers. While this is a well-known problem in SNA, in this study the sensitivity of measures are validated with respect to the results of the interviews. For example, participant descriptions on collaboration among participants mirror the results of the SNA. Furthermore, in this study sampling is based on a realist approach (Laumann, Marsden & Prensky, 1989 in Wasserman & Faust, 1997) which focuses on actor-set boundaries and membership as perceived by the actors themselves.
5. Conclusion

Findings from this study contribute to the emerging body of studies of negative or destructive aspects of virtual communities especially, while the emphasis recently has only been on positive or productive behaviour or CoPs (Schwen & Hara, 2004). This study is in accordance with Barley’s (1990) findings, shown in his seminal study, that the effects of a new technology are profoundly social, both as to how the existing social structure may constrain use of new technology and how that technology may alter the social structure.

This study is also a timely contribution to the emerging discussion on a mobile technology supported collaboration (Chatterjee & Sarker, 2007; Järvelä, Näykki, Laru & Luokkanen, 2007) and how productive and profound mobile technology supported collaboration can be. However, we do not attempt to offer explicit design guidelines already contributed by other scholars (Luchini, Quintana & soloway, 2004; Parsons, Ryu & Cranshaw, 2006); instead we want to challenge current research on mobile learning and mobile software, which has bordered on technological determinism (Chatterjee & Sarker, 2007; Naismith et. al, 2005). In summary, this can only be done by researching real collaboration in real contexts, and then designing for those needs.

References


This is an electronic version of an article published in Laru, J. & Järvelä, S. (2008) social patterns in mobile technology mediated collaboration among members of the professional distance education community. Educational Media International (EMI) Journal, 45(1),17-32. Educational Media International (EMI) is available online at:  


FIGURE 1

<table>
<thead>
<tr>
<th>Team</th>
<th>Participants</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>{P1, P2, P3, P4, P5}</td>
<td><strong>Regional learning centre: (Location A)</strong> Their overlapping activities include face to face services for students and local design and management. Also, their role as a distance education broker with multiple agreements with several universities keep this block in active and coordinated contact. They come from several disciplines and reside in adjacent offices in the learning center 200 km from the university where the rest of the blocks reside.</td>
</tr>
<tr>
<td>2</td>
<td>{P6, P7}</td>
<td><strong>Management office: (Location B)</strong> This block includes two participants who are managerially central, being responsible for ViMa’s practical management, relationships at the university and regional levels, instructional design and student counseling.</td>
</tr>
<tr>
<td>3</td>
<td>{P8, P9, P10}</td>
<td><strong>Production Unit: (Location B)</strong> This block contains three designers who produce digital learning content to be streamed to ViMa students, but also maintain distance education servers for the master’s programs.</td>
</tr>
</tbody>
</table>

FIGURE 2

<table>
<thead>
<tr>
<th>Auth user</th>
<th>page views</th>
<th>logsins</th>
<th>logged in time</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Team 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td>348</td>
<td>18.5</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>P2</td>
<td>410</td>
<td>21.8</td>
<td>10</td>
<td>21.7</td>
</tr>
<tr>
<td>P3</td>
<td>237</td>
<td>12.6</td>
<td>10</td>
<td>21.7</td>
</tr>
<tr>
<td>P4</td>
<td>313</td>
<td>16.7</td>
<td>8</td>
<td>17.4</td>
</tr>
<tr>
<td>P5</td>
<td>13</td>
<td>0.7</td>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>Subtotal</td>
<td>1321</td>
<td>70.3</td>
<td>35</td>
<td>76</td>
</tr>
<tr>
<td>M (SD)</td>
<td>264,2 (153,7)</td>
<td>7 (3,7)</td>
<td>-</td>
<td>6.6(5,1)</td>
</tr>
<tr>
<td>Team 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P6</td>
<td>143</td>
<td>7.6</td>
<td>3</td>
<td>6.5</td>
</tr>
<tr>
<td>P7</td>
<td>47</td>
<td>2.5</td>
<td>2</td>
<td>4.3</td>
</tr>
<tr>
<td>Subtotal</td>
<td>190</td>
<td>10.1</td>
<td>4</td>
<td>10.8</td>
</tr>
<tr>
<td>M (SD)</td>
<td>95 (67,9)</td>
<td>2.5 (0.7)</td>
<td>-</td>
<td>1 (0)</td>
</tr>
<tr>
<td>Team 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P8</td>
<td>89</td>
<td>4.7</td>
<td>2</td>
<td>4.3</td>
</tr>
<tr>
<td>P9</td>
<td>49</td>
<td>2.6</td>
<td>2</td>
<td>4.3</td>
</tr>
<tr>
<td>P10</td>
<td>229</td>
<td>12.2</td>
<td>2</td>
<td>4.3</td>
</tr>
<tr>
<td>Subtotal</td>
<td>367</td>
<td>19.5</td>
<td>8</td>
<td>12.9</td>
</tr>
</tbody>
</table>

### FIGURE 3

**Table 3 Discussion activity in online community**

<table>
<thead>
<tr>
<th>Auth user</th>
<th>Notes Written</th>
<th>Read (of total)</th>
<th>Partners of interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td>4</td>
<td>21</td>
<td>12, 63,2</td>
</tr>
<tr>
<td>P2</td>
<td>5</td>
<td>26,3</td>
<td>14, 73,7</td>
</tr>
<tr>
<td>P3</td>
<td>4</td>
<td>21</td>
<td>13, 68,4</td>
</tr>
<tr>
<td>P4</td>
<td>2</td>
<td>10,5</td>
<td>16, 84,2</td>
</tr>
<tr>
<td>P5</td>
<td>0</td>
<td>0</td>
<td>0, 0</td>
</tr>
<tr>
<td>Subtotal</td>
<td>15</td>
<td>78,8</td>
<td>7</td>
</tr>
<tr>
<td>M(SD)</td>
<td>3 (2)</td>
<td>11 (6,3)</td>
<td>2,8 (1,6)</td>
</tr>
<tr>
<td>Team 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P6</td>
<td>2</td>
<td>10,5</td>
<td>8, 42,1</td>
</tr>
<tr>
<td>P7</td>
<td>0</td>
<td>0</td>
<td>4, 21,1</td>
</tr>
<tr>
<td>Subtotal</td>
<td>2</td>
<td>10,5</td>
<td>3</td>
</tr>
<tr>
<td>M(SD)</td>
<td>1 (1,4)</td>
<td>6 (2,8)</td>
<td>1,5 (2,1)</td>
</tr>
<tr>
<td>Team 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P8</td>
<td>1</td>
<td>5,2</td>
<td>5, 26,3</td>
</tr>
<tr>
<td>P9</td>
<td>1</td>
<td>5,2</td>
<td>1, 5,2</td>
</tr>
<tr>
<td>P10</td>
<td>0</td>
<td>-</td>
<td>7, 36,8</td>
</tr>
<tr>
<td>Subtotal</td>
<td>2</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>M(SD)</td>
<td>0,7 (0,6)</td>
<td>4,3 (3,1)</td>
<td>1,3 (1,2)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>10</td>
<td>19</td>
<td>100</td>
</tr>
<tr>
<td>M (SD)</td>
<td>-</td>
<td>1,9 (1,9)</td>
<td>8 (5,6)</td>
</tr>
</tbody>
</table>

### FIGURE 4

**Table 4. Collaboration between participants in offline and online communities (symmetrized matrix)**

<table>
<thead>
<tr>
<th></th>
<th>The whole network</th>
<th>Individual participants (n=10)</th>
<th>Centrality, Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Density</td>
<td>Centralization</td>
<td>Out %</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online community</td>
<td>41</td>
<td>43,2</td>
<td>50,9</td>
</tr>
<tr>
<td>Offline community</td>
<td>44</td>
<td>49,4</td>
<td>12,3</td>
</tr>
</tbody>
</table>

On the network level, the analyses have been done with asymmetric matrices. On the individual level the symmetric matrices have been used. Degree of centrality is between 0-10 (The higher the centrality, the more a “star” person)

Table 5. Blockmodels of the communities

<table>
<thead>
<tr>
<th></th>
<th>Online Community (FLEmobile)</th>
<th>Offline Community</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Block Density</td>
<td>Reduced Block Matrice</td>
</tr>
<tr>
<td></td>
<td>Reduced Graph</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>.60</td>
<td>1 1 1</td>
</tr>
<tr>
<td>2</td>
<td>.40</td>
<td>0 0 0</td>
</tr>
<tr>
<td>3</td>
<td>.47</td>
<td>.33</td>
</tr>
<tr>
<td>Rule: y(i,j) = 1 if x(I,j) &gt; 0.41, and 0 if otherwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduced Block Matrice</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>.80</td>
<td>.40 .67</td>
</tr>
<tr>
<td>2</td>
<td>.60</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>.00</td>
<td>.33</td>
</tr>
<tr>
<td>Rule: y(i,j) = 1 if x(I,j) &gt; 0.44, and 0 if otherwise</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>