AWARENESS APPLICATIONS FOR CONNECTING MOBILE STUDENTS

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ABSTRACT

Mobility across multiple learning arenas is critical to learning, especially in practice based education. Mobility can however impact negatively on students feeling of being connected to others, with consequences on knowledge sharing and learning. Feeling connected requires awareness of other persons involved in the learning process, as well as awareness of the ongoing learning processes. In this paper we discuss how mobile and ubiquitous awareness applications could be used to promote the feeling of connectedness among students, considering not only social aspects but also pedagogical and intellectual connectedness. We present a scenario where different awareness applications are used to promote different needs of mobile students. The focus in the scenario is on teacher education, as a specific case of practice based education. The scenario is discussed in terms of requirements and is then evaluated.

1. INTRODUCTION

In this paper we investigate how mobile and ubiquitous awareness systems can foster connectedness to multiple communities, with focus on practice based education, i.e. educational programmes where students spend periods in the field to gain practical experience. Mobility is critical in this case because it is mostly on the mobility of the students that the courses rely on to enable the access to different physical arenas. This also involves being mobile between and participate in different communities.

The feeling of being connected is critical within communities for sustaining membership and belonging (IJsselsteijn et al. 2003; Rettie 2003). There are however a number of factors that might negatively impact on how much the members of a community feel connected, such as geographical distribution, mobility, distribution of competencies and knowledge.

This paper focuses on practice based teacher education, a setting where the students are part of different groups and learning communities formed by their peers. At the same time, when out in the field, they participate, often with a peripheral role, in the community of practice of the school. Teaching practice promotes exchange of experiences between these communities. Practice based education brings along a number of risks since it is characterized by a high degree of distribution, in terms of space, time, and competencies. Distribution not only increases the complexity of coordinating activities, but it might also impact on students' feeling of connectedness. While at school students might feel disconnected from their peers and their teaching staff, while at the university they might feel unable to sustain the connections that they have built with teachers at the practice school. Feeling disconnected not only impacts on social well-being, but also on the processes of sharing experiences and reflection that are critical to the learning process (Schön 1983). To limit these risks most of the programmes adopt mechanisms to bring students together and to strengthen the relationships among students and the teacher at the schools. Mechanisms adopted might include co-location at the same practice school, meetings, dedicated rooms, and discussion groups.

Recently, technologies that focus on fostering social interactions have been proposed to bring communities together (IJsselsteijn et al. 2003; Kuwabara et al. 2002). The adoption of these technologies in the context of practice based education is however problematic for various reasons. First, the existing tools

tend to create one community, while there is a need to acknowledge the co-existence and interleaving of different communities and groups, with different priorities and rules of conduct. Second, practice based education is highly mobile, both in the short and long term. Students and teacher seldom are sitting in front of a computer. The proposed solutions must therefore take into account students' mobility and the way it impacts on the interaction with other actors. Third, students' experiences are situated and applications that de-contextualize the interaction with others are problematic.

The remaining of the paper is organized as follows. In Section 2 we discuss the notion of awareness and connectedness, surveying how connectedness is addressed in the literature. In Section 3 we present a scenario to illustrate how mobile and ubiquitous awareness applications could be used to meet the needs for connectedness in practice based education. The scenario is fictional, but it is based on the collaboration with the department of teacher education at our University. In the paper we will however not focus on pedagogical aspects specific to teacher education, but rather on the interactions that strengthen connectedness within learning communities. In Section 4 we discuss the scenario to identify core requirements for awareness applications to be used in practice based education to promote connectedness. While our scenario focuses on creating an infrastructure for interaction aiming at creating more occasions for this, we acknowledge the importance of face-to-face interaction and are not trying to substitute this. In Section 5 we present the evaluation of the proposed scenario. The evaluation is based on interviews with people involved in the teacher education program at our University.

2. FEELING CONNECTED

There is a considerable amount of work related to awareness and connectedness. While awareness has been defined as "…an *understanding of the activities of others*, which provide a *context for your own activity"* (Dourish et al. 1992, p. 107)*,* connectedness has been defined as: " a positive emotional experience which is characterised by a feeling of staying in touch within ongoing social relationships" (Baren et al. 2003, p. 1).

In (Nardi et al. 2000) the authors argue for addressing not only how to support the actual communication in CMC systems, but also how to establish a feeling of connection with others. "A feeling of connection is a subjective state in which a person experiences an openness to interacting with another person" (ibid, p. 92). This feeling is important for sustained interaction over time, and they also argue that this feeling needs to be nurtured as it is likely to decrease as time goes by.

Rettie (Rettie 2003) provides a discussion of whether awareness is a necessary prerequisite for connectedness. As seen from the usage of, for example, postcards, there is "an experience of connectedness to an object rather than to a person, although the meaning embodied in the experience is derived from the other person." (ibid, p. 4). This implies that connectedness does not need to be tied to awareness of a person, but alternatively awareness of an object that in one way or another is related to this person.

In (IJsselsteijn et al. 2003) the authors report from work that has been done to support awareness in more personalized settings: "Lightweight, emotional, informal forms of communications are being facilitated by systems that help people to effortlessly maintain awareness of each other's whereabouts and activities" (ibid, p. 927). One characteristic of these systems is the low demand for attention and in line with this, mainly support for asynchronous communication. These systems can very well support connectedness, without the need for the media richness that for example a social presence system calls for.

A similar line of argumentation can be found in (Kuwabara et al. 2002) where the authors discuss what they call connectedness oriented communication as opposed to content oriented communication. While in traditional content oriented communication language play an important role and the communication mainly is intended for discussion and notification, in connectedness oriented communication the aim is to maintain and enhance social relationships. This implies that less data need to be transmitted.

Most of the work related to connectedness has focused on support for family and friends. In (Markopoulos et al. 2004) the authors describe a system to help family members to keep in touch when living apart. As an analogue to the ToDo list, they use a ToTell list that contains pictures and messages to remind the users about things to share. The system combines the usage of mobile devices and tablet devices that can visualize pictures and messages posted by the mobile devices. What they in their article call *awareness systems* are systems that is aiming at supporting peripheral awareness of others activity. The idea is to support affective awareness as described by (Liechti et al. 2000). Connectedness is one of the benefits

identified in this work. They found that "most affective benefits are attained from informal, social and emotional communications, when the initiator of the communication wants to share some personal news or story" (p. 1352).

Dey and Guzman (Dey et al. 2006) argue that in many projects involving the use of presence displays to support remote presence of family and friends, "the real goal is to improve a user's sense of connectedness to those remote loved ones" (p.899). Presence displays are defined as "physical, peripheral displays of online presence of close family and friends". Examples from the article are picture frames and augmented mirrors. In their work studying the usage of presence displays, they found that "the continuous sense of awareness from our displays led to users learning about a friend or loved one s daily routine. This in turn led to an increased sense of connectedness." (p.900).

Though some of the research on connectedness among family members and friends is relevant for educational settings, there is a need for further research to understand the specific elements of connectedness in learning settings. In (Hug et al. 2005) the authors report from a study they have done of their collaboration as teachers educators. Here they identify three different categories of connectedness:

- *Intellectual connectedness*, which is related to sharing and developing ideas about teaching and research
- *Emotional connectedness,* which is related to the importance of "not being alone" and offer each other support
- *Pedagogical connectedness, which* allows examining beliefs about teaching and learning

These categories of connectedness, they argue, were a key for their enhanced learning. We have related our work to these three categories of connectedness in the work presented in this paper. In the following section we present a scenario illustrating different aspects of connectedness in teacher education.

3. SCENARIO

Pamela has started at the teacher education programme. She follows courses in the two subjects she wants to become a teacher for, plus lectures in pedagogy. She will also have some practice periods. The organizers of the study programme have been struggling hard for making students feel connected and collaborate. Unfortunately, since learning is distributed across different arenas, it is difficult to develop a feeling of community and the university has decided to offer students some services to help them to be more aware of each others.

Scene 1 – week 1: The university has set up a service that allows students to see a map of the campus indicating where the registered students are located. On the map, students' locations are indicated with their nicknames. By clicking on a nickname, it is possible to open a conversation or leave a message.

Scene 2 - week 2: Students think the system is threatening their privacy, though most of them like the idea of getting information about others. They decide to modify the system so that it provides only cumulative information about people presence at the campus, revealing only the identity of the ones who are in the canteen.

Scene 3 – week 3: Lerkendal School (LS) has defined a special agreement with the university to offer students teaching practice. However, they feel that the short periods that students spend with them are not enough to develop a strong connection. They therefore install a large display in a corner of the teacher room and activate an awareness service allowing audio/video connection. This service is intended to help connecting with the students and allow their peripheral participation to the teacher community. Sensors detect presence of people in the room and the service visualizes to students whether there is anybody in the room. If students are interested they can ask for authorization and if the teachers agree, an audio/video connection can be established.

Scene 4 – week 4: There are some problems with the service activated by LS. Pamela has tried to get in contact a couple of times and she has been refused connection. She is afraid other might think she is annoying. So, she has stopped using the service. Teachers also find it annoying to be interrupted if they use the sofa in the corner for a meeting. They decide to get more control and rather than using sensors, they choose to activate the service only when they are welcoming students' connection. They decide to make the activation procedure as simple as possible. If one of the persons in the area swipes her card, students can activate a connection without authorization.

Scene 5 – week 8: The first week of practice has started. Pamela is spending the whole week at LS. Many of the students of her group are at the same school but they have different time schedules. They would like to get a better overview of what others are doing and be able to share more experiences also with others that are not at the school, in particular with their pedagogical supervisor. They get the authorization from the school to use the display in the teacher room as shared display. The display is used to visualize SMS messages from students, a blog they use to share experiences, and pictures that they want to share.

Scene 6 – month 3: The exam time is approaching. Some of the students decide that it would be nice to be more aware of what others are doing. They develop the "I am working on…" awareness service. This provides students with an augmented version of the syllabus. Students can check a box when they are working on a paper or on a specific lecture. The information is then available to other students and they can easily contact other students that are working on the same topic.

Scene 7 – month 3: Magnus decides to make available to the other students a service that he has used previously with some friends. It is easy to feel lonely when one is sitting studying till late at home, and it is nice to know that there are others around. He and his friends have used a traditional IM application for a while, but they decide it is more fun to show presence of others using objects around. Students can visualize availability information on their PC or use other enabled devices with different degrees of precision. Pamela decides to use her lamp, setting the intensity of light to increase depending on the number of students who are connected. After a while she finds it very annoying and decides to connect the service to her digital rabbit, putting it to sleep when there is nobody else around. That is the sign that she should also go to sleep!

4. DISCUSSION: TOWARDS REQUIREMENTS

In practice based education feeling connected is important because it might promote a general feeling of social well-being. Possibly more important, it is for students to feel connected in order to create a feeling of belonging and trust that promotes a supportive environment, where learners can get support from others in performing their work and promotes reflection. In the scenario we have portrayed different situations to illustrate these needs. Scenes 1 and 7 focus on the social aspect of connectedness. In these scenes awareness technology is used to create an infrastructure to help students staying aware of each others and their availability. The driving idea is to create occasions for social interaction and informal communication (Scene 1) and to help students not to feel alone (Scene 7). Scenes 3 and 6 sketch instead situations where awareness is helping students to stay in touch and feel connected, but with more focus on the work that they have to do and on creating occasions for focused discussion. Finally, Scene 5 focuses on the usage of ICT to help students be aware of what others are experiencing. This awareness is not intended as in Scene 6 to trigger focused interaction, but rather to promote general reflection.

Despite its importance, it is difficult to create and maintain this feeling of connectedness. There are different reasons behind it. First, practice based teacher education deeply relies on a complex social infrastructure. Students have to participate, in different forms, to a number of social networks of different types, ranging from small focused groups to possibly large and loosely coupled communities (Morken et al. 2005). For example, in Scene 2 the community in focus is the one formed by all the students of the course. In Scene 3 the community involves a subset of the student community, i.e. the students having their practice in the specific school and the teachers of that school. These communities are characterized by different degrees of homogeneity and role distribution. Second, the participation in these social structures varies with time depending on specific tasks that students have to perform, but also, and most importantly, on the learning trajectories of students. For example, at the beginning of the course (Scene 2) there might be a general need to feel socially connected and get to know new people, while towards the end it might be more important to create connection with specific people, for example the ones studying the same topic (Scene 6). Finally, practice based education is characterized by a high degree of mobility, with students moving across different learning arenas. In the scenario, we see students being mobile in the campus (Scene 1), between the campus and their practice school (Scene 5), and between campus/school and home (Scene 7). Mobility implies at any moment different geographical configurations of students and teachers. Mobility strongly impacts on the possibility for students to participate in the different groups and communities they belong, to creating new possibilities of interaction while preventing others.

The complex role of connectedness in practice based education and the problems that arise in creating and sustaining this feeling poses precise requirements on the supportive technology, both in terms of content and modality of interaction. First, the technology must support participation to multiple communities and a smooth transition from one community to the other. This is a problem with most of the existing widespread awareness applications, like chat and IM tools, which provide little support to present awareness and availability differently to different groups. In the scenario we have chosen to rely on a suite of light-weight tools. This requires that these tools are built on shared abstractions and can easily communicate.

Second, the system has to support different content and formats. As we see from the different scenes in the scenario, the type of information that has to be provided to users is very varied. Awareness might be related to a person's availability (Scene 7), but also to specific experiences (Scene 5), or specific tasks that one is performing (Scene 6). Even the same type of information might be presented in very different formats. For example, availability information is presented very differently in Scene 1, 2, and 7. It is also important to acknowledge that the feeling of connectedness is not always dependent of real-time presence support. For example, we use pictures to remind us about family and friends. In the same way, students might share common history with each others in form of pictures of common events and short histories of their experiences together (Scene 5). When designing the awareness system it is also important to take into account that some of the involved communities involve people with different roles and rights. The technology must therefore provide filtering mechanisms to account for these differences. In Scenes 3 and 4, for example, Pamela is a full participant in the students' community while being only a peripheral member of the teachers' community. Some of the information in the teachers' community is not meant for the students, while students are not likely to be willing to reveal all information in their community to the teachers. The format that is more appropriate to present awareness information strongly depends on the specific situation one user is in. For example, in Scene 7 Pamela is at home alone and gets information about others in a very lightweight way. In other cases, as for example in Scene 1, information about student's location is contextualized in a map to trigger contact among people that are in proximity. The system should therefore support the presentation of information in different formats to adapt to the specific context of the user.

Third, the high mobility of students requires the system to support multiple forms of interaction, considering the need to sustain different forms of participation to different communities at the same time. For example, there are a number of situations where promoting participation to a community must be sustained with interfaces that are as little obtrusive as possible, to keep alive the feeling of being connected but without distracting from the main task, as in Scene 7. Support for mobile learning must take into account students mobility and the way it impacts on the interaction with other actors of the learning experience. This includes the need to strengthen the interactions among physically collocated communities as well as creating virtual arenas to nurture the geographically distributed ones. We believe that mobile learning requires the adoption of different types of support, taking full advantage of the contamination of virtual and physical environments. This implies that support must be provided not only through mobile personal devices, as in Scene 1, but also by enriching the physical environments that are inhabited by communities, as in Scene 4.

Finally, the required flexibility of support can be provided only with a technological infrastructure that supports the rapid development of learning services and their deployment, promoting grass-root innovation, as in Scene 2, 4, and 7. In fact, designing systems that satisfy the varying and dynamically changing needs of learning communities is challenging. Different communities might have, for example, different requirements in terms of visibility and privacy, as in Scene 2 and 4; the same person might change her preferences, as in Scene 7. Though a system might function well at a certain point in time, it might not necessarily be able to evolve with the community. It is important therefore to design learning systems that are not monolithic entities, but are rather a dynamic and contextualized composition of services satisfying specific needs. In this perspective one of the challenges ahead is to look at commonalities among different learning contexts to identify basic services that can then be combined, possibly by end-users, to provide more complex support. Design and development, in this perspective, have to be strongly coupled with deployment. In fact, systems to support connectedness are complex socio-technical systems and their adoption requires an intricate co-evolution of organizations, communities, pedagogy, and technologies. Support must be provided to promote this co-evolution, in the form, for example, of guidelines, tailoring facilities, end-user development tools, pedagogical and organizational mechanisms, and learning theories.

5. EVALUATION

The scenario has been evaluated by five persons involved with different roles in the teacher education programme we cooperate with: two members of the university staff playing a central role in the organization of the programme and of the specific courses, and three students of a teacher education course who had just been out in their second practice period at the time of our evaluation. These 5 persons all have a very good understanding of the students' situation seen from different viewpoints. The main objective of the evaluation was to collect feedbacks on the relevance of the addressed problem as well as the suitability of the envisaged solutions, with special focus on system evolution. The evaluation was conducted in form of individual semi-structured interviews. Interviews were conducted by two of the authors and each one lasted approximately one hour. At the beginning of the interview the respondents received a brief presentation focusing on different aspects of the notion of connectedness. Due to time limitation the presentation used a simplified version of the scenario with steps organized around different types of connectedness. As guideline in the evaluation we have used the taxonomy presented in (Hug et al. 2005) and referred to in the related work.

5.1 Supporting connectedness

As discussed in Section 4, the scenario highlights different aspects of connectedness. While one of the students felt strongly that supporting connectedness would be beneficial in terms of sharing experiences about teaching and learning, the other two seemed more interested in the social aspects. One of the teacher also pointed out that, especially at the beginning of their studies, students do not seem to feel the need to discuss their teaching with other students.

Based on the collected data, the need to support connectedness seems to be structured into two distinct and sequential phases. First the connection is established and thereafter maintained. This was for example evident in that one student stated no need for supporting social connectedness since he already had a well established social environment. This also led us to think that there might be a third phase in between where the focus is on increasing the feeling of connectedness.

In regards to supporting connectedness most of the students preferred to meet people physically. Two of the interviewed students specifically remarked that they found the presented scenario to be less desirable than meeting people face-to-face. One of these students also remarked that in his opinion such technologies would possibly create a *"social barrier"*[1] in that individuals might avoid or limit the initiatives for real world social interactions. The student therefore envisioned that a possible cost of adopting the technology might be less physical encounters with fellow students. This might be influenced by the fact that these students had positive experiences with their participation in groups that were good at organizing meetings providing an environment to share experiences and stay in touch while distributed at different schools. At the same time one student stated that the work load during practice leaves little time for this kind of social interaction. The solution was therefore to use familiar applications such as IM and SMS to stay in touch. Actually two of the students felt that such more familiar applications were enough to satisfy their current needs for feeling connected socially. A challenge therefore seems to be to provide technological support that is perceived as both suitable and adequate to support needs in relation to connectedness, addressing areas where technology is not currently used. One student, for example, remarked that using a technology like the media link presented in the scenario (Scene 3) would make teachers more available for tutoring when in practice, though another student pointed out the importance of respecting the conventions of usage of physical spaces. For example, the lunch room is often regarded as a space where one does not want to be disturbed. Privacy was also a concern. Using a semi-public display might be problematic when discussing sensitive information. One teacher in particular felt this scene to be intrusive, while the other suggested that such means of communication could be supported for making teachers available from their office.

A number of findings from the data were related to the expectations when adopting such a scenario. One of the students used the word *"warmer"* to describe the electronic rabbit (Scene 7) comparing it to more traditional technology such as mobile telephones, IM, etc. However, the same student also perceived the technology as*" childish and feminine"*. Two of the students commented that such technology would require

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[1] All quotations are freely translated by the authors from Norwegian to English.

that one knows the person in advance. The specific example was therefore perceived by the students as a way of retaining or maintaining social connectedness, rather than creating it. A second issue that became evident was the perceived need to be unavailable despite increasingly pervasive communication technologies. One student explicitly stated that he at times felt a need to limit the use of communication technologies. Also, one of the teachers' reactions to the scenario was that such technology would become "*another disturbing element*", and that it was already difficult enough for the students to concentrate on studying because of technologies such as email, internet, and SMS. One challenge therefore is to provide mechanisms that can be tailored to the preferences of each individual to limit their availability to others. One student stressed another problem connected with the expectations created by awareness technologies. Discussing the electronic rabbit she pointed out that having such an artifact with the sole purpose of fostering emotional connectedness might become a disappointing experience in situations were done does not receive any messages from other people. The expectations by the user to the technology might therefore be a challenge and, as remarked by one student, a community oriented deployment of such a system might lead to some form of peer pressure.

5.2 Evolution of the system

The feedbacks during the interviews clearly pointed out the importance of developing systems that can evolve and adapt to the needs of its users, and as stated by one of the teachers "*a prerequisite for introducing such communication technology is adaptability*". This perception seemed to be shared by everybody we interviewed. The possibility to adapt the system might be needed for different reasons, actually more than we expected. First, practice based education might take different forms and the various courses might apply different mechanisms to help students get in touch. In some cases, for example because of geographical distribution, it is difficult to create a feeling of belonging to a common community. In other cases, students feel connected from a social point of view but that is not enough to create the feeling of identity and trust that can promote cooperation and common reflection. The types of services that are needed in the two situations are clearly different. Second, in other cases adaptation of the systems is due to personal preferences. For example, one student stated that he did not feel the need to be socially connected to other students, but he still felt the need to feel connected to them to share experiences. A second student felt it was important not be forced into using the system described in the scenario, and none of the students wanted to be forced into using the presented technology. In addition to the possibility for personally adapting the technology this might also present a challenge in regards to how the deployment of such systems should be conducted. Finally, changes might be needed to adapt to the evolution of student's needs as their participation to the student community changes and their identity as teacher becomes stronger. As pointed out by a student, there is a need to help establish a connection and then to nurture it as students get distracted by demanding schedules.

To present the notion of system evolution we used the map of Scene 1 and 2 as an example. This example uniformly made both the students and teachers react to what they perceived as a possible threat to privacy thereby also relating to what is described in Scene 2. More specifically, one of the teachers remarked that she sensed "*shivers down her spine*" just thinking about the notion that somebody would know where she was located. Also, using such an application all students remarked that it would be important to have total control of how information about them was presented.

Despite the importance that was recognized related to system evolution all the five interviewees found the concept difficult to grasp. One student stated that "*it is difficult to answer if system adaptation as described in the scenario is useful before one actually tries it*". This poses some serious challenges to the end-user tools that must be provided to adapt the system. First, this will require defining interactional metaphors that are as easy and understandable as possible. However, the difficulties that we have noticed during our interviews seem to relate mainly to imagining future scenarios of usage and get out of the traditional patterns of technology use one. But when discussing familiar computer environments all recognized that a possibility to adapt systems would be beneficial. As one specific example one of the students envisioned a merge between an IM application and a groupware system currently in use to give better access to teachers when out in practice.

6. CONCLUSIONS

In mobile learning there are a number of factors that might negatively impact how much the members of a community feel connected, such as geographical distribution, mobility, distribution of competencies and knowledge. In this paper, we have used the notion of connectedness in educational settings to create a scenario where mobile and ubiquitous technologies are used to address this problem. Requirements on the technological support are discussed, and the scenario as well as the envisioned support have been evaluated through focused interviews with relevant subjects. In particular, our work has pointed out the need to look at connectedness not only at the social level, but to address more thoroughly other forms of connectedness to provide a more complete support to students in working and learning processes. The evaluation has also pointed out the difficulties related to end-user development and adaptation of the system. Our work is currently proceeding in two directions. First, we aim at gaining a better understanding of the notion of connectedness and the relevance and impact of different aspects on learning. Second, we are working at the development of a platform for supporting the development of applications like the ones that are described in the scenario, together with tools that can support the end-user development of innovative services.

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