Mobile Scenarios: Supporting Collaborative Learning among Nomads

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Abstract. This master thesis reports on the design and development of competence development activities for mobile people with implications from experiences from a stationary setting. The Viktoria Institute has previously successfully worked with multimedia scenarios as a form for learning, but there also were drawbacks. Mostly regarding the users ability to find time and opportunity for the activities even though the scenario only requires that the participants attend for about three hours each session. Hence, we want to enable spatially distributed professionals to take part in collaborative learning in a more opportunistic way. We believe that the key is to design the multimedia scenarios to help structure and facilitate competence development for individuals and groups distributed both in time and space. We want to offer possibilities for mobile professionals to engage in continuous mobile competence development. This thesis reports upon the construction of an experiential environment designed to address the problems mentioned above: the Mobile Scenarios Demonstrator (MSD). Work presented in this thesis will also be presented at IRIS 2001.

1 Introduction

Technologies such as wireless telecommunication networks and small, powerful handheld devices give the mobile worker new possibilities to communicate and access various kinds of services online. This will make it possible to partake in competence development activities on demand, wherever you are. The MobiLearn project situated at the Viktoria Institute in Gothenburg tries to develop models and activities that use this new technology and tries to rethink the way competence development for professionals can be conducted and managed. This thesis is written within the framework of the MobiLearn research project.

The setting of the multimedia scenarios is an environment where direct interaction and vivid discussions among the participants take place. Redesigning the multimedia scenarios for mobile use we have worked with two platforms. The reason for using two is mainly because we did not feel that we had the opportunity to experiment with truly mobile video communication and streaming media with the infrastructure and technology at hand today and the element of multimedia is a basic building block in our methods. We therefore constructed an environment for working with the ideas in a local but very mobile setting. The Mobile Scenarios Demonstrator (MSD) uses sub-notebooks connected with a wireless LAN. In addition to this we use small handheld computers to simulate the look and feel of the small mobile terminals that will appear in the future, for example 3G connected devices. The sub notebooks gave us the multimedia capabilities we required, but to really achieve the feel of mobility we had to use the smaller, more limited handheld computers.

The main research question in this thesis is: ***Are mobile scenarios a feasible tool for providing competence development for nomads?***

Work presented in this thesis will also be presented at IRIS 2001.

The remainder of this thesis is structured in the following way. The background to the project is explained followed by a chapter about the theories related to this work. The demonstrator we develop is based upon the ideas contained in the PIER approach and this approach is presented in a section about related work. After this a description of the MSD follows, what it is and why we designed it the way we did. Results from two demonstrations and a workshop follow. These results are discussed and we draw some conclusions, this ends the thesis.

2 Background

The way we work is evolving from a predictable, stationary setting to a more dynamic and flexible approach. The industrial age's assembly line factories are taken over by robots and the

role of humans instead changes from being a robot into being a creative member of different project groups (Dahlbom, 1996). This is not true for all kinds of work but should instead be seen as a general trend.

The environment that is evolving in the new information era places new demands and creates new possibilities upon the notion of competence development (Söderström, 1990). This can be said both regarding businesses and individuals. While conventional models of education are suitable for many types of employee development their role as a means for raising the employee's and thereby the company's competence have been challenged by new approaches. Some of these approaches are problem-based learning, interactive multimedia, experiential learning and Role-playing.

Work conditions demand that people become more mobile and our aim is to take these new approaches into a new setting. A setting more suitable for the mobile worker and to develop and extend these methods into new forms that might be better suited for the new environment. The key factors to successfully educate in a mobile environment we have established to include means for asynchronous and collaborative educational activities.

2.1 Problem Area

Organizations in the new economy are dependent upon organizational knowledge and Competence (Prahalad & Hamel, 1990). However mobile workers find it difficult to participate in conventional educational activities. As one participant in a study of employees at a global cooperation handling logistics put it (Hardless, Lundin, Lööf, Nilsson and Nuldén. 2000, P. 4):

> "I have two criteria, it should not interfere with my work and it should not take too long time to complete."

This response came when the researchers wanted to get insight into the employees attitudes towards the relation between work and competence development. The responses given during the research show that there is a conflict between the time available for work and the time available for competence development. A new means for competence development have to bee provided for these people. They need to be able to participate in collaborative activities at the time and place of convenience.

Collisions between work time and time for competence development activities can also bee seen as an organizational problem. Today competence development activities for professionals are seen as something that interferes with work and we develop methods and technologies that try to minimize the conflict between the two. If more time would be allocated for educational activities and if the status of these kinds of activities were raised, this could be a way to address this problem and it might no longer bee so big? A course can also bee seen as a possibility to get a break from work, give time for reflection and get away from daily routine. Possibilities the

professionals might want to keep? These topics however fall into another area of research and we will not delve deeper into them.

2.2 Aim

This thesis describes the MSD application developed to enable spatially distributed professionals to take part in collaborative learning activities and to do it in a more opportunistic way than they have been allowed to by means of conventional learning methods. The ideas and considerations behind the design are described as well as the lessons learned. Our aim in this thesis was to evaluate the MSD application developed and to see if the ideas and assumptions incorporated in its design where correct. Our aim was not to develop new technologies or suggest new theories. Instead we wanted to practically evaluate existing theories concerning mobile competence development

3 Theoretical framework

The MSD application discussed in this thesis is designed according to certain theories and also builds upon work earlier done at the Viktoria institute. In this section we will describe some of the theories that have influenced the MSD design.

3.1 Competence

To claim that a person or organization possesses a certain kind of competence does not always give a clear meaning, this due to the fact that the meaning of the word competence isn't universally agreed upon. A couple of similar explanations of the concept can be discerned. It is often described as having the requisite or adequate ability or qualities to do something. Sometimes it is also described as having the capacity to function or develop in a particular way (Söderström, 1990). This far the concept is connected to individuals, but today it is often used in an organizational context. When it is claimed that an organization possesses a certain competence it refers to the accumulated ability or potential in an organization to manage a certain task.

Söderström claims that we sometimes say about a person that she is competent without referring to in what regard she is competent. Sometimes the nature of competence can be deduced from the context in which it is used and sometimes it refers to being skilled in general. Most of the time competence is claimed in a context. In an organizational context it is used as a description of the meeting between the organizations recourses and needs respectively the employees. This thesis focuses on competence in both the individual and organizational context.

Economists according to Söderström view competence as a production factor when used in an organizational context. Developing employee competence is seen as an investment among others,

which introduces to us the problem of measuring the effects of competence development activities initiated by an organization. The management wants to be certain the yield from investing in these kinds of activities exceeds the cost of performing them.

Lennerlöf (1981), a psychologist, view competence development as a working environment issue. Employees who have control over their own competence development feel more secure and content with their situation than employees with none or little control of their professional development.

3.2 Nomads

Many people today work in an environment where they are mobile. They work in temporary constellations, at different locations and at varying times. These people can be referred to as Nomads (Kleinrock, 1995). Three types of situations typical for the mobile worker have been proposed. These are travelling, visiting and wandering. Travelling is the person who moves from one place to another in a vehicle. Visiting involves staying at a location for a prolonged period of time before you move on. Wandering people move extensively in a local environment, for example a building or an area (Ljungberg & Kristoffersson, 2000).

3.3 Learning

In this section we7 will describe our general ideas about learning and the Constructivistic paradigm they build upon. Our work is based upon three ideals for learning. These ideals assert that learning is supported by being conducted in a constructive manner, in cooperation and with possibilities for reflection (Hardless et al, 2000). The meaning of the concept of learning something is debated but common to the different perspectives usually are (Hardless et al, 2000, P.2):

> "(1) Learning is an active process of constructing rather than acquiring knowledge, (2) instruction is a process of supporting that construction rather than communicating knowledge."

When a person is learning something in cooperation with others it occurs by expressing ideas, to get them criticized by others, and to be given an opportunity to reformulate or abandon them. "This way the learner actively constructs knowledge by formulating ideas built upon reactions and responses from the environment" (Nuldén, 1999). Computer based discussion groups enables establishment of continuous discussions witch span over a prolonged timeframe. This gives a greater possibility for reflection than a conventional meeting or lecture. The participants can use the time not connected to reflect upon the issues at hand.

1.1.1. The paradigms of learning

There exist mainly two paradigms of learning, Objectivism and Constructivism. The Objectivistic model basically claims that facts and figures exist objectively out there and the role of the teacher is that of the intermediary who filters, selects and conveys the information to the students. The students are then asked to recite this information either orally or in written exams. Constructivism denies that there exists one version of reality that is to be thought to the learner. Instead every person builds knowledge based upon his or her experiences. The role of the teacher becomes that of a facilitator or guide.

Objectivism – Surface learning	**Constructivism** – Deep learning
Focus on the signs (e.g. words and sentences of the text, or un-reflected on the formula needed to solve the problem)	Focus on what is signified (e.g. arguments and concepts applicable to understand and solve the problem)
Atomistic view of knowledge	Holistic view of knowledge
Focus on unrelated parts of the task	Relate previous knowledge to new knowledge
Memorize information for assessments	Relate previous knowledge from different courses
Associate facts and concepts unreflectively	Relate theoretical ideas to everyday experience
Fail to distinguish principles from examples	Relate and distinguish evidence and argument
Treat the task as an external imposition	Organize and structure content into a coherent whole
External emphasis: demands of assessments, knowledge cut off from everyday reality	Internal emphasis and intrinsic motivation: a window though which aspects of reality become visible, and more intelligible

Table 1: Objectivism and Constructivism (Nuldén, 1999, p. 9)

1.1.2. Communities of practice

Most people agree that organizations cannot learn, it is the individuals in the organization that learn and this knowledge is raised into an organizational context based upon social interaction among the members of the organization. One social structure within organizations that receive a lot of attention today is Communities of practice. Cross & Israelit (2000) suggests that communities are being either found or established to facilitate collaboration in a multitude of different settings. This to provide an effective forum for individuals with specialized knowledge where they can collaborate and learn from each other. They also claim that while technology can help support communities of practice, both research and consulting experience have shown the social bonds formed in these kinds of groups to be the most important determinant of success. Even so the forming of social bonds demand means for communication and collaboration and this is what we provide with the MSD.

4 Related Work

The mobile scenarios Demonstrator (MSD) builds upon theories and experiences from a stationary environment, mainly from the ideas expressed by Hardless et al (2000). In this section we will describe the PIER approach suggested by them and the special circumstances that rise when using these ideas in a mobile environment.

4.1 The PIER approach

Learning from experiences is important for individual and organizational improvement. Sharing of experience and knowledge among professional people is crucial for them in their professional role and their professional practice. From an educational perspective, there are several organized approaches to learning from experiences that can enhance and complement the learning that takes place in everyday work. Mobile scenarios are based on the PIER (Problem based learning, Interactive multimedia, Experiential Learning and Role-playing) methodology, which is an approach to help individuals learn from their experiences. In order to provide the reader with a frame of reference for understanding PIER, we will relate PIER to three other approaches for supporting learning from experiences: action learning, case based teaching, and goal-based scenarios. Following this, the four building blocks used for the design of PIER are described: problem based learning, interactive multimedia, experiential learning, and role-playing.

Action learning is learning from experience in an intentional and sustained fashion within the context of real life challenges (Marsick and O'Neil 1999). Hardless et al view action learning as an approach where relevant work problems builds the foundation for the design of the learning experience. The focus is on situated issues, issues directly related to the participants. Conventional teaching instead focuses on teaching knowledge in a manner disconnected from the real work practise of the learners. Instead action learning places the problems in the participant's context and lets the context influence the issues being thought. Action learning often involves the participants in the learning process and is based on collaborative learning. This classifies it as learner centred. Collaborative learning occurs when groups of learners help each other reflect and learn from experience.

Case based teaching involves construction of a model of real life by means of different media such as text, computer simulations, video, and role-play (Richardsson 1994) The case study presents approximations of the kind of situations and possibilities that have been faced by people in the learners position in real-life situations. This gives the learner a possibility to practise decision-making and reflect upon possible outcomes of the presented case. The learner is given the possibility to make recommendations and draw conclusions. The case is presented by means of a selection of different media and gives the learner the possibility to prepare for situations before they occur in real-life. After the case in run through usually a debriefing session is scheduled. This to give the learner a possibility to discuss the actions taken and the decisions

made during the case. Conventional use of case studies focuses on general cases, which essentially means learning from how other professionals have acted in certain situations.

The PIER approach has some similarities with goal-based scenarios, especially in terms of technology use. Goal-based scenarios use computer simulations and individual role-playing to support learning from experiences (Schank 1997). Hardless et al mentions different situations and possibilities where these can bee used. A sales person for instance can practice how to deal with difficult customers, one can also imagine many other situations where a simulation of reality would be beneficial. The learner is placed in a virtual environment and is presented with a number of tasks that needs to be accomplished. By use of interactive multimedia the learner can influence what takes place in the scenario and try different approaches to reach the scenarios goal. A goal-based scenario always has a clear goal to help the learner focus. The learners is placed in realistic environment, is given access to the knowledge required and instructions from experts when needed (Shank 1999).

4.2 Problem based learning

Problem based learning (PBL) is a significant challenge to orthodox beliefs about education and learning (Margretson 1991). PBL is "a way of constructing and teaching courses using problems as the stimulus and focus for student activity" (Boud and Feletti, 1991). PBL is defined as learning that results from the process of working towards the understanding or resolution of a problem (Barrows 1986). The starting point of problem-based learning is a real world phenomenon or problem the learner wishes to learn more about. It is not simply the addition of problem solving activities to otherwise discipline centred curricula, but a way of conceiving of the curriculum that is centred around key problems in professional practice.

4.3 Interactive multimedia

Multimedia for educational use has undergone a revolution during the last years, from simple drill-oriented programs to advanced simulations where students receive support for understanding complex matters. Interactive multimedia has been used to add dimensions, such as capturing the learners' imagination and visualizing processes, to various learning activities. Thesis based case studies have been transformed into interactive case study simulations for individuals (e.g., Kendall et al. 1996; Farrimond 1997). IMM applications have been used to enable individual learners to practice in a safe environment, for instance a sales person can practice how to deal with difficult customers (Shank 1997).

4.4 Experiential learning

Experiential learning refers to an encounter that the learner experiences. From this encounter, learning is initiated. In experiential learning "the learner is directly in touch with the realities

being studied … [experiential learning] involves direct encounters with the phenomenon being studied rather than merely thinking about the encounter or only considering the possibility of doing something with it" (Kolb 1984). Simulations of different types are the most applied way to conduct learning activities focusing on experience. Different types of interactive multimedia have often been used to support these activities (Graf and Kellog 1990). In experiential learning, learning and human development is seen as a social process based on experience. The emphasis shifts from learning in a classroom setting to learning through participation in social practice in the workplace, community, and society.

4.5 Role-playing

There is a long history of simulations, games and role-playing in various educational contexts (Hardless et al, 2000). In a Role-play the participants will take the role of someone else. No lines or instructions to how act is provided other than those implied by the context of the situation they are placed in. By taking on a new role that differs from who they usually are. The participants are given an opportunity to rethink old ways and are encouraged to look upon a situation from a new perspective. Role-plays might be used to take on the roles of the other participants in the group to support understanding and group building among the members of the group. We also believe that some people feel freer to express themselves when they can "hide" behind a role. The purpose and structure of a role-play can be to initiate reflection and discussions on issues directly related to a group of professionals, for instance project managers.

4.6 Multimedia Scenarios

The four points of departure briefly discussed in the previous section serve as the foundation for the PIER approach, which is described in this section. PIER consists of four activities:
Activity one - concrete experience through role-playing with a multimedia scenario. Here a group of five to eight learners are engaged in a role-playing activity supported and guided by an interactive multimedia scenario and a facilitator (see figure 1). The activity lasts for two to three hours and during this time the learners experience a problematic situation, which is relevant and realistic, and discuss problematic issues. This will be described further later in the thesis.

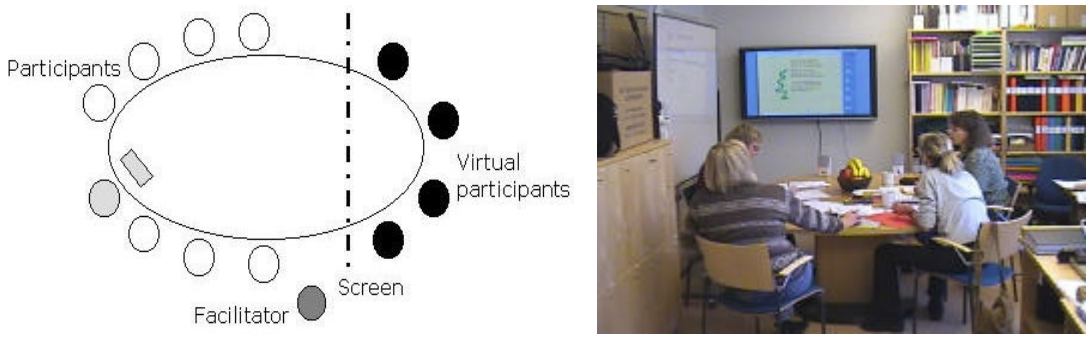

Figure 1 and 2: The left picture shows the basic setup of a stationary multimedia scenario. The right picture shows a group that participates synchronously in a stationary multimedia scenario.

Activity two is individual reflection for about one week. During this period each of the participants will have a chance to individually reflect on what happened in the scenario and they will hopefully relate their experiences from the scenario to their daily work.

Activity three - seminar where the scenario is discussed. After a week of reflection the facilitator meets the group during a seminar lasting for two to three hours. The purpose is to discuss the experiences the participants encountered during their work with the scenario in activity one and explicitly relate them to their experiences from daily work. An important part of discussing their experience in activity one is the intention to debrief the participants, i.e. make sure they understand that they are not to blame for mistakes and failures in the scenario. The purpose is also to discuss possible ways to deal with the issues covered in the scenario.

Activity four - ongoing and organized learning processes. Whereas activity one through three should be understood as a starting point for learning, activity four is meant to be an ongoing and organized learning process. Examples of learning activities could be a series of conventional seminars and lectures, new scenarios, or a net-based continuation. The aim is to nurture the initiated learning processes by providing solutions and answers, new opportunities for reflection, and places for knowledge sharing.

The basic multimedia scenario is based around a story, made vivid by multimedia that is introduced to the participants. The group is guided through the scenario and they are confronted with information in different forms that forces them to interact in the story. In figure 3 the basic structure of a multimedia scenario is presented. The participants are asked to make decision frequently in the scenario. However, the outcome of the scenario always is predetermined. This is to be able to focus the scenario on a main problem and to be able to leave the participants with a key question. Hence the scenario is not simulation training the participant to do right. It rather lifts up a complex question for discussion in a context relevant to the participants, this without trying to provide the learners with an easy solution.

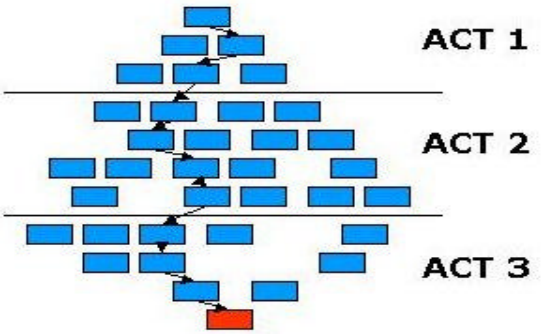

Figure 3: The basic overall structure of the multimedia scenario

As mentioned the idea is to let the multimedia scenario be the initiator of a series of more distinct learning activities. This however we leave to the competence development managers in the organizations we work with. The multimedia scenarios have been successfully tested in face-to-face settings in various organizations (Nulden & Scheepers, 1998)

4.7 Moving From the Stationary Setting

Nomads, described above as mobile people often find it difficult to attend educational activates at a certain time and location. Conventional education and stationary e-learning attempts are not suitable for these kinds of professionals. The mobile application addresses the problem of distribution of participants both in time and space. Rather than participating for one three hour session the users in the distributed scenarios will be able to participate for short periods of time, such as sixty occasions, three minutes each, spread over a longer period of time. They will also be able to participate from their current location. Be it in an airplane, a train or at a restaurant waiting for a business meeting. At the moment this is not technically possible. However new technologies are being developed that will change this. Among these are the 3G networks and the hot spots further described below.

When using experiences from stationary competence development activities for design of applications for mobile, distributed people we are aware of the context in which the application will be used. Designing mobile IT with implications from desktop applications and experiences are often problematic (Luff & Heath, 1998). Looking at Viktorias previous work with the stationary multimedia scenarios we see it primarily as a driver and a base for structuring and initiating discussion. To be a participant in a multimedia scenario is a collaborative, engaging, stimulating and unpredictable experience. This we have to preserve and enhance even more to make the single user feel as passionate about using the mobile scenario even though a user will not have the instant visual feedback from other participants as in the stationary setting.

1.1.3. 3G networks

To make the multimedia scenarios as rich and rewarding as possible for the participant's different forms of communication is provided for them. Scenario content is provided in a multitude of different formats. Some of the communication options and some of the formats used for scenario information demands a high bandwidth between the server and the client and also between the different clients. One means of providing the required bandwidth is to connect the clients with 3G technologies. 3G are a new radio communication technology that will provide high-speed mobile access to the Internet. Clients connected by means of 3G will have simultaneous access to high-speed data, speech and video. The networks will be packet switched with the ability to stay logged on anytime, anywhere. This technology will offer high-speed data rates of up to at least 144 kbps in all radio environments and up to 2 Mbit/s in low-mobility and indoor areas. There will be possibilities for roaming with Personal- and Local- Area Networks, such as Bluetooth and HiperLAN/2.

When 3G will be available to the public depends mainly on the licensing procedures in the different markets. Japan will go into service first, starting in the second half of 2001. In Europe the first 3G networks are expected to enter commercial operation in 2002. The American situation is harder to describe since the American market consists of a mix of second-generation systems today. A presumption is that the first 3G capable systems will be up during 2002.

There is nothing revolutionary about the functionality of the 3G technologies by itself. It is the possibilities it offers to move applications and services that previously required a personal computer into a mobile environment. A 3G terminal will have possibilities to send and receive messages of different media types, video, voice and text. Transmission can be carried out in the background as best effort. Streaming media will be used for a multitude of services and will require real time processing but can withstand large delays from a receiving buffer.

Conversational video or video telephony has similar real-time and delay requirements as speech services. The error prone radio channels set high requirements on error handling at the receiving side. From subjective testing and experience from experimental systems Ericsson has found MPEG-4 to have the best tools for handling these transmission errors at high compression rates. Normal video communication will use around 64 kbps.

3G technologies are not the end of the evolution for wireless broadband. No 3G networks are in commercial operation when this thesis is written. But research is already underway to develop the next generation mobile technologies, currently called 4G (En Basstation i varje lyktstolpe, 2001). These networks will offer tens of megabits per second, possibly hundreds and imagination rather than technology will place the limits on the new services offered.

1.1.4. Infostations/Hot spots

3G-networks will provide connectivity to users anytime, anywhere. But it comes with a high cost in price and power consumption. In addition the bit rate of 3G-cellular networks are very low compared to wired solutions. Alternative approaches for wireless communications have been proposed. Goodman (2000) proposes a solution based on adaptive, ad hoc and asymmetric networks and questions the need for everyone to be connected all the time. Many people use their mobile devices to read their e-mail when they are travelling, an activity that does not require a constant connection to the Internet. Distributed synchronisation points where new mails would bee received and sent could bee an alternative. Many services could use this approach instead of the ubiquitous symmetric approach offered by 3G, which will lower the cost of transferring large amounts of data.

Infostations or hot spots conform to this idea. Infostations would be located where people travel and when a mobile device comes in range of the Infostation an ad hoc network will established and data will be synchronized. The user never needs to be aware of the exchange of data but will still receive up to date information every time he uses his mobile device. Possible locations of Infostations include airports, restaurants and gas stations.

The mobile scenarios could benefit from this kind of technology. Files in the forums and new pages from the web application could be downloaded and sent at synchronization points. It is only during a videoconference the parties need too bee connected to each other. Currently suggested payment models for 3G networks involve charging for the amount of data sent instead of per time frame or even the fixed cost systems common today. This will make it interesting to send as little information as possible by means of the 3G networks. Infostations could then be used when transferring large amounts of data. A combination of Infostations and 3G networks could therefore provide a feasible solution as a carrier of scenario content. The 3G networks can support synchronous information and asynchronous information can be delivered when you are close to a hot spot.

Technologies for switching between different types of networks in real-time without disturbing the user are being researched and tested today (Zirn, 2001, KTH bryter ny mark, 2001). Technologies that enable effortless switching between different networks and network technologies are a requirement for making the proposed model with Infostations and 3G technologies a feasible solution.

5 Method

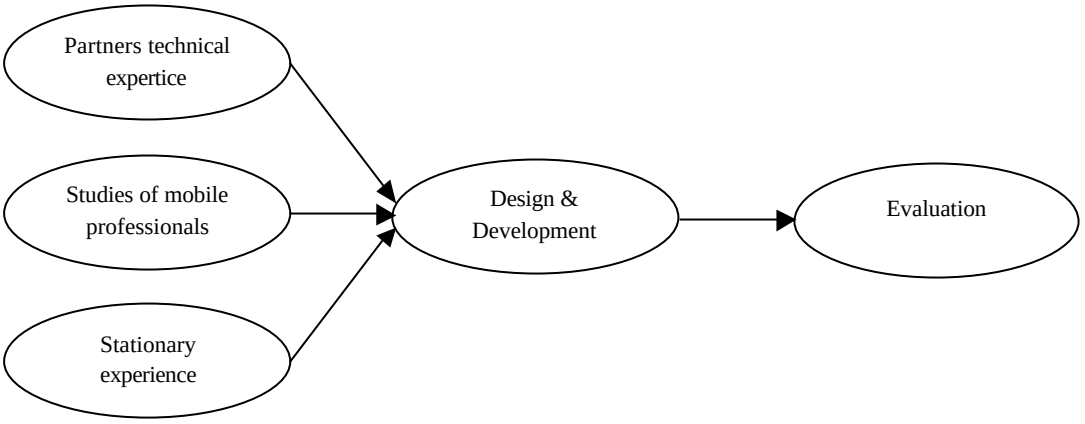

Figure 4: The method followed during the development of the MSD

Figure 4 shows the method we followed during the development of the MSD. We took the Viktoria Institutes experiences from scenario learning in a stationary environment as a foundation for development of the MSD. We also made use of the Expertise held by our partner Ericsson during the design and development. Their contributions mainly consisted of technical knowledge about streaming media, videoconferences and the IPULSE application. Observations and experiences of mobile professionals in everyday work also played part in the design considerations. These observations will not be further explained in this thesis. The MSD application and infrastructure developed where demonstrated with two different audiences. The main goal of the demonstrations where to get some preliminary feedback on our ideas, which if positive, would validate further research.

5.1 Mobile Scenarios Demonstrator (MSD)

To investigate the feasibility of making the multimedia scenarios mobile we developed the MSD application. The MSD is an environment that makes it possible for eight people to simultaneously try and experience the ideas of mobile multimedia scenarios in a locally mobile setting. The main objectives with the MSD are to get implications and ideas for further design from mobile use and to get some initial feedback on our ideas concerning mobile competence development. We envision 3G to be a major carrier of distributed applications and services in the future. The demonstrator presented at CHI 2001 is designed to model a possible design of an educational tool using the PIER approach aimed at mobile professionals. The technology used simulates mobile devices globally connected by 3G technologies and locally by different Wireless-LAN technologies. We expect these kinds of devices to be used by mobile professionals in the coming years. The following sections will in more detail describe the different parts of the demonstrator.

Figure 5: The hardware used for the demonstrator

1.1.5. The Scenario

In the multimedia scenario the initiation of discussions is mainly dependent on how well the scenario managed to create involvement among the participants. To achieve this the scenarios must present problems relevant to the participants in a stimulating way. It is logical to think that this will be even more important in the distributed and mobile scenario. When used in a stationary environment the presence of the group helped to increase the feeling of participation. Group members where at a designated place at a designated time with a number of people aimed at the same task. This helped the participant to engage in the scenario, the role and the discussion. When this instead is to bee conducted in a truly mobile environment, without the support of other group members other things in the surrounding environment can be judged to be more interesting than the scenario. The scenario not only has to be relevant and engaging to a number of people as a group but also to each individual in the group when using the application unaccompanied.

We designed the mobile scenario to bee a driver of discussion, the basis for initiating and structuring role-playing as well as a fun and stimulating collaborative learning environment for the participants. We also tried to reinvent and refine the methodology not simply making a change of the setting from a stationary platform to a mobile.

The stationary setting (being face-to-face) is highly suitable for discussion and direct interaction. When providing the distributed multimedia scenario as an initiator for collaborative activities we also have to provide channels for communication. We tried various forms of communication and have decided that providing a large range of different channels will give the participants the ability to choose the most suitable channel for the information they want to convey.

The distributed multimedia scenario is being designed with a notion of tempo so that even though the users will access it asynchronously for only short periods they will get a feeling of time passing in the story. By controlling the information available to the users in synchronization points we will keep the participants in the same part of the story to stimulate discussions concerning events in the scenario. In the portioning of information we also try to create "cliff-hangers", making users eager to see what will happen in the next sequence. This will hopefully also create some pressure on the group members to keep moving forward in the story at a common pace. If the whole group is waiting for one user this will hopefully motivate him to proceed in the scenario.

Personalization of the information given out will create more dynamics in the discussions. Having different information and aspects of a problem also resembles real life more. The ability to provide special information for each participant will be used to make the discussions more vivid.

Just as in the stationary scenarios we tried to make the scenario the driving force of the discussion. To do that it has to excite the participants enough to make them eagerly partake in the development online. We do this through using real and relevant problems and multimedia. To make the net-scenarios as vivid as possible we use many different kinds of multimedia such as videoconference, video clips, voice clips and text chat. We will also give the users these media as communication channels to use at their choice.

We will use the demonstrator with focus groups for short periods of time to receive input for the design of mobile use as well as the choice and use of mobile technology. So far we have used it during a Viktoria demonstration and at a demonstration at CHI 2001 in Seattle.

1.1.6. The application

Essential to the MSD is the web application, which contains the scenario information and also gives opportunities for textual communication and sharing of files. The web based scenario is adapted to fit small screens and mobile users.

The MSD is based around the Video Demonstrator (Figure 6) constructed in cooperation with Core Unit Video Codecs at Ericsson AB. The Video Demonstrator contains information about the state of the other participants through the IPULSE client. It also gives the user opportunities to initiate or participate in videoconferences with other participants in the scenario. The Video Demonstrator also contains a small web browser, which is used to browse the scenario web pages. The web application is the same for the users of the sub-notebooks as for the users of the handheld computers with one exception. The users of the sub notebooks can, by selecting a link in the web application, record a video message. This option is not supported on the handheld computers due to their lack of recording hardware.

Figure 6: The Ericsson Video Demonstrator communication platform

The IPULSE client contained in the Video Demonstrator application shows the current state of the participants in the scenario. This gives the party who is interested in initiating a videoconference an indication of the receiving parts possibilities to participate. Due to the problem of information overload a lot of effort recently has gone into different methods for filtering incoming messages. Many have suggested solutions based upon sharing the responsibility for this between the different parties in the information exchange (Pedersen, 2001). The IPULSE user gets enough information to bee able to decide when initiating a videoconference is appropriate and when it is not.

Figure 7 and 8: The application is being used at Compaq iPAQ:s and Sony VAIO:s.

1.1.7. The infrastructure

The MSD is set up with four Compaq iPAQs and four Sony VAIO:s. They are all connected through Wireless LAN following the 802.11b standard. This to give the users mobility while they still are connected to the Web application and the IPULSE server. We feel that the iPAQs however locally limited are a good, of the shelf, device for understanding design for mobile use whilst the VAIO:s will help us to better understand video as a communicational tool. We also use the EMIL, a future 3G-concept terminal developed by Ericsson to give the users a hint of what to expect from a very small mobile device (Figure 10). The EMIL concept terminal is connected too its host by means of Bluetooth technology.

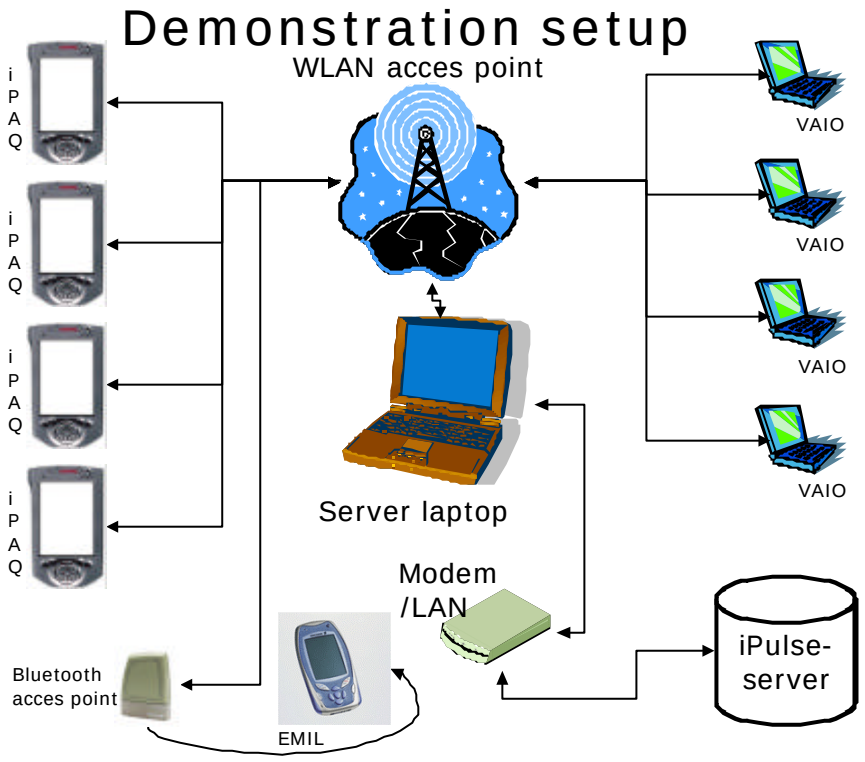

Figure 9: The architecture used at CHI 2001

Central to web application is a Windows 2000 Internet server running SQL Server 2000, IIS Server 4.0 and windows Media Server. The IPULSE application requires an active Internet connection to be able to reach the IPULSE server, which is currently located in Stockholm Sweden.

We use the described infrastructure to simulate mobile devices connected by means of 3G-technology. The access point can in our demonstration be viewed as an Infostation that provides the users with high bandwidth communication capacity in a limited area. If the user travels out of

range of the access point the connection would switch from using the 802.11b Wireless-Lan to a 3G-network if the demonstrator was used in a real future environment. Because of its role as a simulation tool and not as a suggested product architecture, we will not delve deeper into the design considerations taken during its development.

Figure 10 The Ericsson EMIL future concept 3G device.

1.1.8. Viktoria demonstration

Prior to the CHI 2001 conference we invited eight people from Ericsson and 6 from different parts of the Viktoria Institute, excluding the involved project members, to test and evaluate the application prototype and the contents of the scenario. The invited participants all had software development experience, which made this demonstration somewhat biased towards the technology behind the demonstrator. During the demonstration we also measured network traffic and server load to make sure that the response times would be fast enough to make a interactive experience possible.

The demonstration opened up with a speech and Video presentation that described the technology and the ideas behind the mobile scenarios. The speech and the video served to introduce the participants to the idea of mobile competence development and describe what they will meet during the hands-on part of the demonstration. This to make certain they will get as much as possible out of the demonstration in the limited time they have to acquaint themselves with the application. In a real-world environment an introduction to scenario thinking will still be required considering the lack of experience most users have with these kinds of tools.

1.1.9. CHI 2001 demonstration

The attendants at the CHI conference demonstration consisted of a mixed field of people from a multitude of different backgrounds. We estimated the number of people attending to be around seventy. No assumptions about the attendee's prior knowledge or abilities were made. We kept the application simple and compact enough to be graspable in the twenty minutes available to us for the hands-on part of the demonstration.

The demonstration started with the speech and the final version of the video, earlier presented at the Viktoria demonstration. The introduction video served to prepare the audience for the story of the scenario. After the video Viktoria employee's that acted as a facilitators and guides for the users walked around in the audience with the devices. During the hands-on demonstration the

events taking place on one of the devices was projected on a big screen. This was done to enable those in the audience, not in the vicinity of a device, to follow what was going on in the scenario.

We refined the scenario somewhat for this demonstration in comparison to what was presented at the Viktoria demonstration. The scenario contained more background information and the text in the scenario had been broken into smaller sections to make it easier to read, this to help the user grasp the information provided in the scenario.

6 Results

6.1 Results from the Viktoria demonstration

When the demonstration started the participants first was a little puzzled about what to do. But with the help of the instructions provided in the web application and with help from the facilitators present at the demonstration most of them soon started to explore the background material. Those participants equipped with the Sony Vaio's quickly started to record video messages and engage in videoconferences.

Figure 11: A user engaged in videoconference on the Vaio

The participants mostly seemed to appreciate the video conferencing possibilities offered on the Vaio computers and did not delve deeply into the contents of the scenario. But some of the participants engaged in a discussion about what kind of knowledge they deemed as appropriate to convey in this manner. Said participants also showed a lot more interest in the contents of the scenario.

Some technical problems occurred mainly concerning video message recording and video conferencing. These problems were corrected before the CHI demonstration.

6.2 Results from the CHI 2001 demonstration

Prepared by the speech and the introduction movie the users quickly engaged in the scenario. The users started to discuss the mobile scenario as a tool and asked us about the technology that we were using. It was really interesting to see that many of the people present at the demonstration actually engaged in discussion of the topics and problems given in the scenario. People gathered around the seven devices present in the audience and those that could not get a clear view instead followed the action on the big screen.

7 Discussion

7.1 The demonstrations

The basic conditions of the two demonstrations conducted so far have been different. What took part during the demonstration and the focus of the participant's attention differed as well. The more technical inclined audience at the Viktoria demonstration quickly started to explore the different possibilities of the infrastructure provided. They found the rich possibilities provided for communications intriguing especially when provided in a manner that supported mobile use. The participants at CHI instead engaged more into the scenario and tried to understand and discuss the topics presented therein.

The scenarios in the CHI demonstration helped initiate structured discussions about the topics in the scenario. Even in an environment as chaotic as a conference demonstration a structure in the discussions could bee seen. The discussions however did not get time enough to become very deep and involved. Arguments could not get through the process of being entered into the forum and retorted to.

7.2 Related questions

A number of issues have been raised when people have been presented with the idea of the mobile scenarios, both during the demonstrations and by people introduced to it at other occasions. Concerns have been raised about people's willingness to share their knowledge. To be in possession of knowledge that is unique gives power and status and some people will not give this up freely. We feel that this depends very much upon the person and the circumstances. Both behaviours have been observed but if attitudes like knowledge hoarding will pose a problem the idea of sharing knowledge with the participants in a mobile scenario will have to bee determined

in further research. Examples where people have successfully exchanged knowledge without profit interest, have since long existed in the form of different bulletin boards and e-mail lists related to different topics or interest groups.

Another question that has been raised are – Do friendship play a part in the success of the discussions taking place in a scenario? Will people feel more free to express their thoughts and ideas among friends, strangers or perhaps even in anonymity? We have not ethnographically studied the topic since this would have too be included as a question when studying mobile scenario use over a longer period of time. It has been suggested that anonymity might make people feel freer to express themselves with no fear of looking stupid. To retort one might assume that close friends feel secure enough to express their opinions as well. This issue has to bee studied further.

We have not mastered e-learning in a stationary environment, why move to a mobile environment? To answer this we can look into how people traditionally learn something. They go to a classroom and listen to a teacher. In the classroom they have the possibility to ask questions and to discuss issues with the other people participating in the course. When not in class they read the literature provided and reflect upon the issues presented at the last lecture or in the literature. If they come up with an idea or question during this time they hopefully write them down or will have to remember them anyway so they can bring them up for discussion the next time the course participants meet. When using stationary e-learning one can not bring the information with you the way you traditionally can with a book, when using mobile devices this will not present a problem. The main argument for mobile learning is however found in the target group for the mobile scenarios. We look for ways to support mobile professionals, professionals who do not have the time or possibilities to participate in conventional classroom learning and do not always have access to a computer. We also feel that mobile learning provides something extra, something that has been missing from both conventional learning and stationary e-learning. This something is the possibility to share ideas and participate in discussions with course members and the teacher at the time and place of convenience. We answer the initiating question with a question of our own – Can the reason to the lack of success for e-learning in a stationary setting be found in its lack of mobility? We leave this question open for now and will not further address the topic in this thesis.

8 Conclusion and Future work

The mobile multimedia scenarios are designed to give the mobile worker a context and a forum for discussion about a certain topic or topics over a prolonged period of time. In the demonstrations we saw a great interest for this approach. The scenarios seemed to help structure and initiate discussions, which was our aim. Whether this kind of technology can be used to facilitate competence development for professionals will be further researched in a locally

distributed application at ADB-kontoret in Gothenburg. Currently available technology does not allow us to do a real field test of a truly mobile application as described in this thesis.

In our future work the MSD will be used and refined in different settings with the aim to provide an application for use when trying to convey the ideas of mobile learning, as well as the possibilities of future wireless networks.

We need to ethnographically study how anonymity and friendship influences the quality of the debates going on in the scenario context. We also need to establish if there is a willingness to share ones knowledge with the other participants in the scenario. Some participants might just consume the knowledge provided and not contribute themselves. If so, - will this bee seen as a problem by the other participants? These issues will be studied and evaluated in a future extended field study involving a new version of the demonstrator.

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