MOBILE TECHNOLOGY FOR LEARNING ENVIRONMENTS

Lauri Kurkela*

Oulu University of Applied Sciences, School of Engineering,
Kotkantie 1, 90250 Oulu, Finland

ABSTRACT. Mobile technology and services built on top of that technology facilitate the development of future learning environments. Pedagogy is strongly correlated to learning achievements in technology, services and media. Equally, we must be aware of the technological prospects to be able to determine how to benefit from new possibilities in education. This research was made in cooperation of 6 European countries for the ViCaDiS Project which is implementing Social Software and mobile features into learning environments of cooperative universities.

This paper is focused on: (1) understanding the process of educational technology implementation, (2) identification of relevant mobile technologies, (3) educational potential of mobile technologies and their probability to be used. The educational technology implementation problem area was analyzed by using Soft System Methodology. The relevant mobile technologies were identified in cooperation with a mobile technology expert. The educational potential of mobile technology was analyzed on European level by using the ZEF method.

Soft System Methodology helped to create a multilayer rich picture about the problem area. Relevant mobile technologies were recognized as: Short Message Service (SMS), Multimedia Messaging Service (MMS), Wireless Application Protocol (WAP 2.0), Digital Rights Management (DRM), Push to talk over cellular (PoC), Voice over Internet Protocol (VoIP), Near Field Communication (NFC), Global Positioning System (GPS) and Assisted Global Positioning System (AGPS). The use of ZEF method helped to figure out what technologies should be implemented first. It also pointed out that there is urgent need for communication: Teachers with eLearning experience find much more potential in mobile technologies than IT Specialists! Mobile services to support awareness of the ongoing learning process had a great potential.

Keywords: learning environment, mobile technology, social web

1. Introduction.

The focus of this paper is to present an approach to obtain shared understanding of the potential and problems related to mobile technology possibilities for learning and teaching. The problem area was analyzed through a multilayer model, which was composed of recognized problems or development challenges and relations between them. The paper is based on Kurkela's papers: "Paradigm Shifts and Learning Resources, Synergy Enablers for eLearning and Blended Learning" paper presented at ED-MEDIA 2006 [1] and "The Potential of Design Patterns for Vocational Teacher Education in Finland" presented at Netties 2006 [2], "eLearning and Organizational Learning in Vocational Educational Institutions" published

* Corresponding author, email: lauri.kurkela@oamk.fi, phone: +358 451 309 248

by IEEE Computer Society Technical Committee on Learning Technology (LTTC) [3] and Culture as Innovation in Vocational Higher Education presented at IIT2007 [4].

2. Key Concepts

Mobile Technologies are related to mobile phones, multimedia phones, personal digital assistant (PDA) devices etc. and services tailored for mobile devices. The concept *Dual Device Option* describes services which can be used with mobile devices or computers.
A Learning Environment consists of all the learning resources which are available or in use. *Institutional Learning Environment (ILE)* is specified and offered by the university. *Personal Learning Environment (PLE)* is a personalized instance of the ILE to respond to the needs and selections of an individual student or group of students. Both ILEs and PLEs can include features related to informal learning also.
Innovations are new, renewed or enhanced processes, services, pedagogical improvements, research & development competencies, learning, practice of work, strategies etc.. *Innovation process* consists of discovering ideas, developing ideas and implementation of ideas.
eLearning and *Blended Learning* are seen here broadly as synonyms. They are involved in the flexible use of information and communication technology in learning, teaching, cooperation and working related situations. They are involved in the innovations of pedagogy or technology enhanced learning. *Learning Resources* can have (see Fig. 1) pedagogical, functional and content-related features. Mobile Technologies affect all these features.

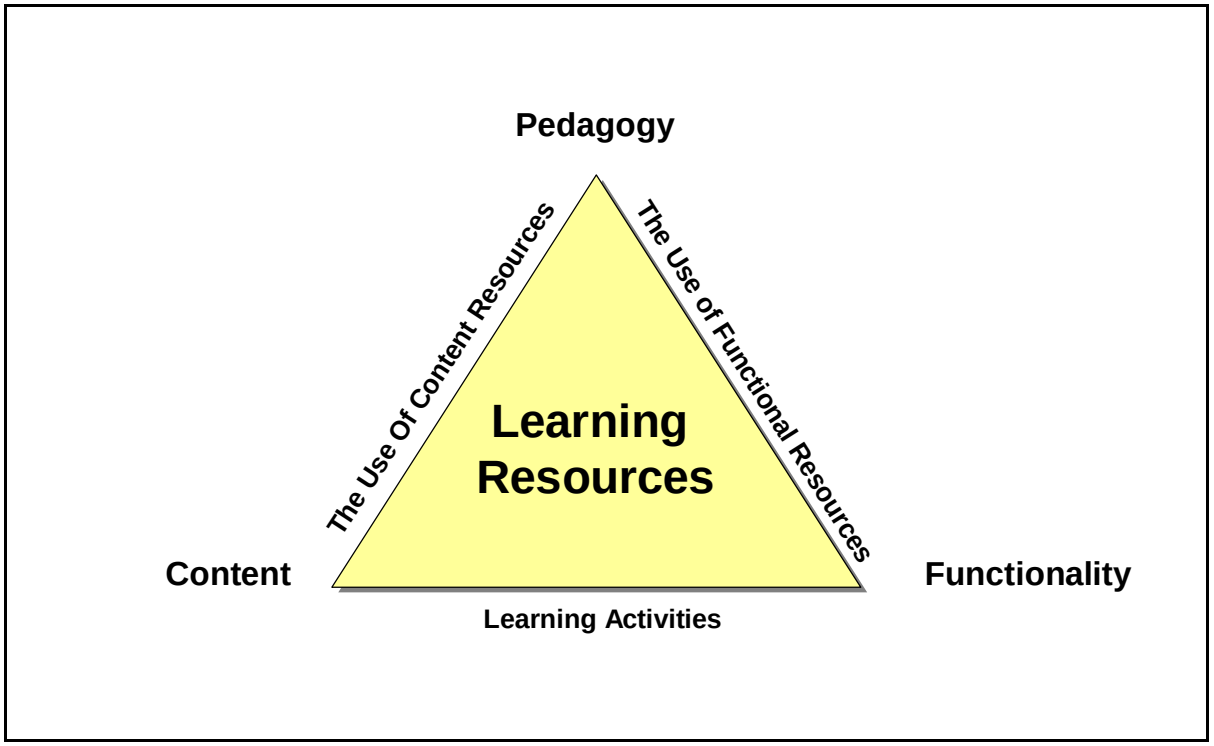

Figure 1. Learning Resources

Mobile technology related learning resources consist of functionalities, contents and pedagogical paradigms adapted to benefit from the use of mobile technologies.
Innovative Information Technology (IIT) related learning resources consist of Social Web and R&D-related innovations implemented in higher education and working life. *Learning*

Objects are defined as any entity, digital or non-digital, which can be used, re-used or referred to during technology supported learning (LOM 2000). Learning Resources are seen here as Learning Objects in a broad sense.
Paradigm refers to the functional model which guides a system or its subsystems. Paradigms have *visible* and *invisible features*. The visible formal side of a paradigm consists of processes, roles, tools etc. The invisible informal side (culture) of a paradigm consists of customs, values, beliefs, taboos, stereotypes, traditions, language behaviours etc. [5].
Paradigm shifts include both the *formal and informal features*. A paradigm shift must be *technically possible* and *culturally acceptable* [6], [7], [8]. Usually the desired cultural change is more demanding than the technological one [5]. *A successful paradigm shift* requires four elements: (1) pressure for change, (2) a clear shared vision, (3) capacity for change and (4) actionable first steps [9]. If any of these elements is missing, the paradigm shift will fail. Paradigms affect to what kind of learning resources are needed. On the other hand learning resources affect to what kind of paradigms can be used or developed. Paradigm shifts are organizational development tools.
Synergy is related to the benefits and added value gained in fulfilling the needs of different actors, systems or subsystems in the design of paradigms, resources and value chains. *Synergy enablers* and *synergy disablers* are features which facilitate or prevent the growth of synergy. From one point of view synergy is growing if the (sub)system produces added value for its environment (effectiveness), if the added value is produced by using purposeful means (efficacy), if the added value is produced by using minimal resources (efficiency) [6], [7], [8]. From another point of view synergy is growing, if an organization shares its well balanced goals at all levels.

3. Soft System Methodology

Since 1974 *Soft System Methodology (SSM),* developed by Peter Checkland et.al., has been successfully used to ensure that the process of inquiry into real world complexity is itself a system for learning. The use of SSM creates shared understanding of complex real-world situations and guides organizations in their organizational learning and developing process. [6], [7], [8].
Soft System Methodology is often applied as a *multilayered analysis*. *A complex system* is something more than the sum of its components. Components affect each other by paradigms, information exchange and resources. A complex system also affects its subsystems and – when it is changed - also the subsystems are changed. Respectively by purposeful paradigm shifts and development of resources on subsystem layer the whole system can be coached to desired direction.
The interaction which affects the functional paradigms of a complex system can be called *critical interaction*. Critical interactions are often related to situations in which the organization doesn't have any pre-planned paradigms. Critical interaction increases the chaotic features and complexity of the system and affects the stability of the system. A learning organization reacts to critical information by paradigm shifts and/or by developing and implementing new learning resources. Through purposeful paradigm shifts and the development of learning resources an educational institution can seek Internal and External Synergy Benefits. SSM can be applied through following steps: (a) Analyses of the Current State of the System, (b) Description of the Major Problem Areas, (c) Identification of Synergy Enablers and Disablers, (d) Description of the Desired Future State of the System, (e) Development Steps towards the Desired Future State of the System. The questionnaires described in this paper increase our understanding about mobile technology potential as a synergy enabler for learning environments.

4. Mobile technology related innovations and leaning environments

Mobile technologies as SMS, MMS, WAP 2.0, DRM, PoC, VoIP, NFC, and GPS/AGPS facilitate the educational use of mobile phones, smart phones, PDA devices etc. Mobile communication is often based on services for mobile devices on the internet, wireless communication and mobile devices. Some of the services have a dual device option. They can be used both from computers and mobile devices. The user's role benefits from social web related features. Communication and content production features enhance the educational potential of m-learning.

The educational use of mobile technology can be seen as an innovation process which affects the activities of an educational institution. The quality of m-learning solutions is based on three factors: (1) teaching and learning competencies, (2) paradigms and paradigms shifts, (3) infrastructure and technology. All these factors should be in balance on every layer and between the layers of the educational organization (See Fig. 2). The paradigm refers to the functional model(s) which guides a system or its subsystems. A paradigm shift must be technically possible and culturally acceptable [6], [7], [8]. Usually the desired cultural change is more demanding than the technological one [5]. Paradigms affect to what kind of m-learning resources are needed in learning environments (LE). And m-learning resources affect the decision of what kind of paradigms can be used or developed.

SSM guides us to identify the major mobile technology related problem areas and related development challenges and possibilities on every layer. *Mobile technology related innovation processes* consist of paradigm shifts, restructuring of cooperative entities and development and implementation of resources. Higher education institution and its major problem areas as a purposeful system are described in Figure 2.

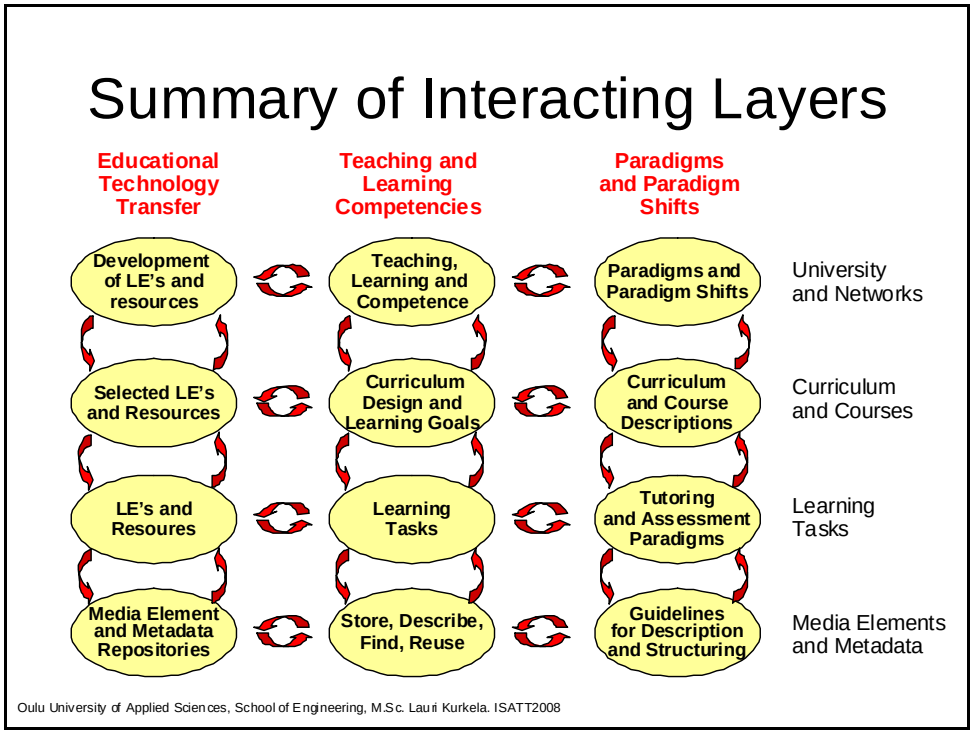

Figure 2. Higher Education as a Purposeful System

In educational technology transfer the following aspects should be considered: How to be aware of mobile technology related possibilities? How to evaluate the educational potential of

those possibilities for institutional and personal learning environments? How to implement selected technologies? How to support the use of mobile technologies?
In the development of learning and teaching related competencies the following aspects should be considered: What are the current competencies related to mobile and non-mobile learning and teaching? Are the competencies used in their greatest potential? How should the competencies be developed? How to use the competencies in a purposeful way?
In the development of paradigms and planning of paradigm shifts the following aspects should be considered: What are the benefits and restrictions of current paradigms? How to innovate new paradigms? How to evaluate the potential of new paradigms? How to evaluate the need of paradigm changes? How to conduct a paradigm shift in a successful way?

5 Educational potential of mobile technologies

ViCaDiS (Virtual Campus for Digital Students) Project collected information in two questionnaires related to the educational use of mobile technology. Respondents to both questionnaires were recruited through e-learning related e-mailing lists or through e-learning courses. *The 1st questionnaire was targeted to find out the educational potential and probability to be used of mobile technologies* [11], [12]. The questionnaire was made using the ZEF methodology[1] [14] [15] and the related service. The results help to find out on which technologies one should concentrate first concerning the implementation of mobile technologies. The greatest potential was found in VoIP – audio and video communication and conferences with mobile devices. The possibility to access services with computers and mobile devices (dual-device-option) was evaluated high. Other technologies with great potential were: WAP 2.0 – Secure login to web pages, learning environments and social web services, web browsing with mobile devices, web based calendar and calendar activities, timed messages from calendar activities, PoC – immediate sharing of documents, and SMS – rich content download services.
From m-learning quality perspective we should start the implementation process from these technologies. *The most important finding from the 1st questionnaire came out when the answers were grouped by roles*. Teachers with e-learning experience (N=71) evaluated WAP 2.0 related potential much higher compared to IT-specialists (N=37). See Figure Y which is in the normalized form.

[1] ZEF-method is a way to process survey results from absolute into normalized results. The combination of letters ZEF stands for Zscored Electronic Feedback. As the name indicates, the ZEF-method is based on z-scoring, which is used in processing the survey results. Z-scores are standardized deviations from their means and they always have a mean of 0 and a standard deviation of 1. The standardized e.g. normalized values provide a way of comparing results without opinion distortion.

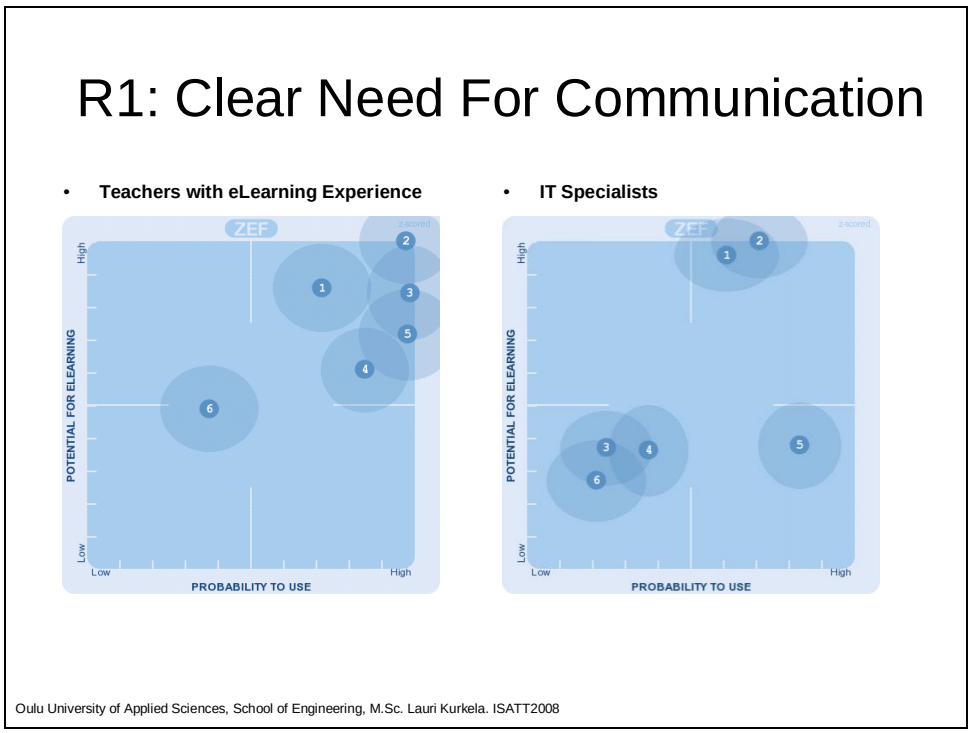

Figure 3. Clear need for communication

In figure Y there are WAP 2.0 related results of Teachers with eLearning Experience and IT Specialists. The Potential for eLearning and Probability to be Used were evaluated from the following viewpoints: 1) Web browsing with Mobile Devices. 2) Secure Login to Web Pages, Learning Environments and Social Web Services. 3) Web Based Calendar and Calendar Activities. 4) RSS Feeds from Calendar Activities. 5) Timed Messages from Calendar Activities. 6) RSS-feed for WAP 2.0 Services.

According to the 1st questionnaire (all roles included) the first implementation steps of mobile learning technology should concentrate on questions which have achieved top scores in the top-right quarter of the normalized diagrams: VoIP – Voice over Internet Protocol: Audio and Video Communication and Conferences with Mobile Devices. WAP 2.0 – Wireless Application Protocol: Secure Login to Web Pages, Learning Environments and Social Web Services. Web Browsing with Mobile Services. Web Based Calendar and Calendar Activities. Timed Messages from Calendar Activities. PoC – Push to Talk over Cellular: Immediate Sharing of Documents. MMS – Multimedia Messaging Service: Dual Device Option: Mobile Devices and/or email. SMS – Short Message Service: Rich Content Download Services.

6 Mobile device base and mobile services

The 2nd questionnaire was targeted to find out what kind of devices and services are used and how fast the device base is renewed. What kind of mobile applications are needed? [13]. ViCaDiS project wanted to have at least 100 answers per partner country to be able to respond to the local needs of the countries. The target group of the questionnaire consisted mainly of e-learning innovators, early adopters and only partly of early majority. Invitations to answer were sent mainly through e-mail lists. 1515 persons opened the questionnaire, 917 started to answer and 541 answered all the questions. 61% of the answers were from the students with e-learning experience or students with limited e-learning experience. In one year nearly 60%

and in two years nearly 90% of the answerers are going to buy a new phone with enhanced properties. These facts should be considered in m-learning related decision making. One part of the 2nd questionnaire evaluated the e-learning and m-learning potential of some services.

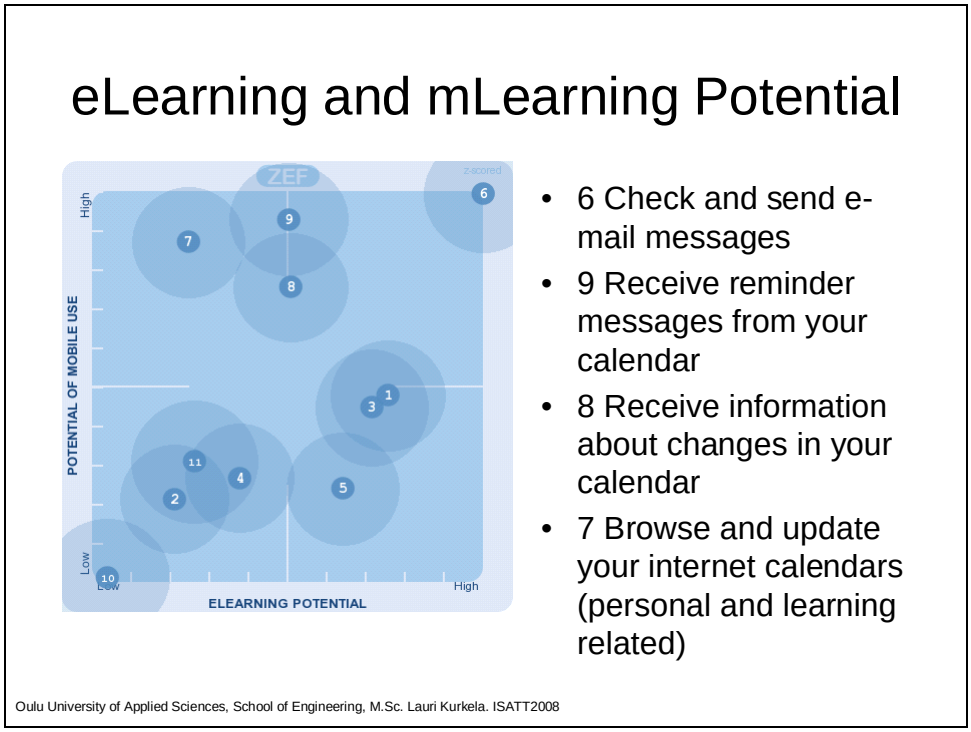

Figure 4. E-learning and m-learning potential of some services

The diagram in Fig. 4 is in a normalized form, too. The first implementation steps of mobile learning technology should concentrate on services which have achieved top scores in the upper half of the normalized diagrams: To check and send e-mail messages, to receive reminder messages from your calendar, to receive information about changes in your calendar and to browse and update your internet calendars (personal and learning related).

5. Summary

The usage of information technology can be classified into professional and general information technology. Innovativeness can occur in both classes. At the moment especially the development of Social Web (Web 2.0) is challenging higher education and working life. On the institutional level this means significant paradigm shifts in institutional culture. Informal learning, learning related cooperation and students as content providers could have a bigger role. Multimedia and social software related competencies are becoming more important. This is a huge challenge for teachers, pedagogy and curriculum development. In our university we are developing this subject area for example in the ViCaDiS Project (http://www.vicadis.net).

Further, the role of IIT will come more essential in facilitating the transparency of learning, teaching and innovation processes. When the environment changes more rapidly IIT will be needed so support the role of higher education in responding to the developing needs of society.

The focus of this paper was on the usage of Soft System Methodology in order to create shared understanding and transparency of Innovation Processes and Cultural Development Processes in Higher Education. The problem area was analysed as a multilayered purposeful system. The SSM analysis was made on general – not on organisation specific – level. This

could be a starting point for organisation specific innovation processes. An educational institution has to find out what kind of synergy enablers or synergy disablers there exist in its case. Paradigm shifts should be made with small steps which are culturally acceptable and technically possible. A new SSM-iteration should be made to find out what is the new state of the system after a couple of paradigm shifts and development activities. The new SSM-iteration means also re-evaluating of the needed development tasks.

The quality of m-learning is based on teaching and learning related competencies, pedagogical paradigms or solutions in use, proper mobile services, cost effective communication channels and the mobile device base of m-learners, teachers and tutors. The questionnaires pointed out that Flexible Mobile Communication is highly appreciated (VoIP, PoC), Dual Device Interface is important when applicable and WAP 2.0 has a great potential. The potential of NFC and GPS Technologies has not yet been recognized widely. There is an urgent need for discussion between eLearning Experts and IT Specialists
Students need mobile features which support them to keep on track of the learning process and changes in the learning process.

Figure legends

Fig. 1	Learning Resources
Fig. 2	Higher Education as a Purposeful System
Fig. 3	Clear need for communication
Fig. 4	E-learning and m-learning potential of some services

References

[1] Kurkela L. Paradigm Shifts and Learning Resources, Synergy Enablers for eLearning and Blended Learning, ED-MEDIA 2006

[2] Kurkela L. The Potential of Design Patterns for Vocational Teacher Education in Finland, Netties 2006

[3] Kurkela L. 2007. eLearning and Organizational learning in Vocational Educational Institutions. IEEEE Computer Society Technical Committee on Learning Technology (LTTC)

[4] Kurkela L. & Hietanen T. Culture as Innovation in Vocational Higher Education. Innovative Infotechnologies for Science, Business and Education, Vol 1 (2) 2008. Vilnius Business College

[5] Neus, A. & Scherf, P. 2005. Opening minds: Cultural change with the introduction of open-source collaboration methods. IBM SYSTEMS Journal, VOL 44, NO 2

[6] Checkland, P. & Holwell, S. 1998. Information, Systems and Information Systems – making sense of the field. John Wiley & Sons

[7] Checkland, P. & Scholes, J. 1999. Soft Systems Methodology in Action. John Wiley & Sons

[8] Checkland, P. 1999. Systems Thinking, Systems Practice. John Wiley & Sons

[9] de Woot, P. 1996. Managing Change at University, Journal of the Association of European universities - CRE-action No 109

[10] Pekonen, E. 2002. A summary about the concept of the Interoperable Competence in a workshop (12.4.2002) written by Erkki Pekonen. Workshop participants: Erkki Pekonen, Anita Rubin, Jarmo Toiskallio and Lauri Kurkela.

[11] Support site for the questionnaire 1: http://www.oamk.fi/~laurik/mLearning/ [Accessed 30th of September 2008]

[12] Results by groups http://www.oamk.fi/~laurik/mLearning/results/SubGroup/Results%20by%20Groups.html [Accessed 30th of September 2008]

[13] Support site and results for the questionnaire 2: http://mtools.wordpress.com/ [Accessed 30th of September 2008]

[14] ZEF Solution, Products and Services http://eduzef.com/en/solutions.php [Accessed 30th of September 2008]

[15] ZEF related blog by Juhani Anttila http://qiblog.blogspot.com/2007_06_01_archive.html [Accessed 30th of September 2008]