

Mobile Learning – knowledge enhancement and vocational training on the move

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Abstract

Trends such as progress in mobile information technologies, lifelong learning and societal changes are at the basis of the development of mobile learning.

A survey among 380 tourists and residents in the region of Tyrol / Austria investigated attitudes and expectations of persons interested in (mobile) learning offers during their leisure time as well as their preferred learning settings including time, content or learning style. The results indicate a clear interest in using mobile learning for the enhancement of their knowledge. The paper tries to point out the relevant aspects of mobile learning for knowledge management issues and identifies relevant target groups, as mobile and internet solutions show to be an efficient way to solve time-poor needs for enhanced vocational and leisure learning services.

Keywords: mobile learning; knowledge enhancement; vocational training; collaborative learning;

Suggested track: J

1 Introduction

An organization can benefit from their employees' individual learning in different ways. First, employees have to learn about a company's organization and structure as well as corporate processes and values. Second, training and further education leverage an

organization's collective knowledge. Finally, the organization benefits from its employees' broadened spectrum of knowledge, competencies and skills.

Learning is a constructive process of acting within an environment and reflecting upon it. Action includes solving problems, engaging in dialogues of enquiry and acquiring new knowledge (Sharples 2000). Mobile information technologies offer new possibilities for knowledge enhancement and also for value creation through unique services. Learning supported by mobile technology enables learning independent of time and location constraints and with increasingly customized contents. Furthermore, technology has created the opportunity for individuals and organizations to preserve and organize their personal information in digital form over a lifetime. While training used to be a minor function offering isolated events, it now plays a strategic role as a part of on-going professional development integrated at all levels of the company.

Technological development causes knowledge to change at an increasing pace and to become quickly obsolete. It also allows for the accumulation of knowledge to an extent that raises the issue of "delearning" in order to stay up-to-date. Also, employees and executives become increasingly empowered on their individual knowledge creation concerning relevant contents and the design of learning situations. On the other hand, information technology has become an enabler for innovating pedagogic strategies of teachers and for widening the contexts within which learning can occur. Teaching and learning are no longer confined to time and place. With mobile communication technologies, the time and physical boundaries of the traditional classroom are being stretched to a learning space (Figure 1).

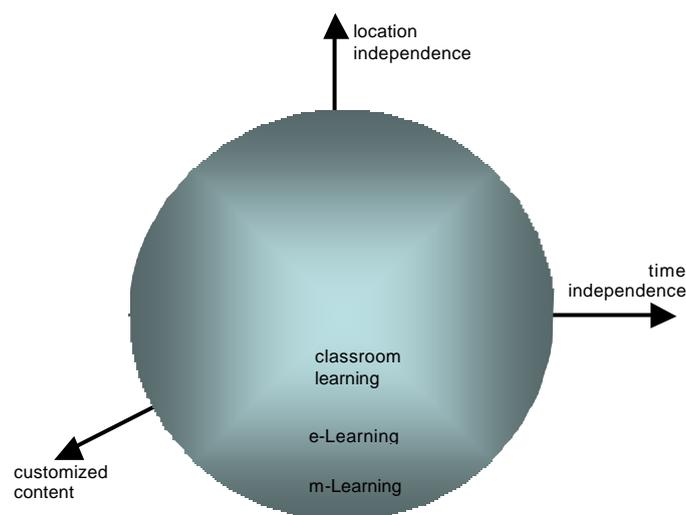


Fig. 1. Development of degrees of freedom (simplified illustration)

2 Theory / Issues

One of the concepts underlying the present research is the idea that individuals never stop to learn throughout their lifetime (lifelong learning) and that Institutions seek for employees who are able to adapt, adopt and improve processes in a flexible way. This notion has implications on the possible users and designs of mobile learning settings.

2.1 Lifelong learning

Lifelong learning has emerged as a complement to institutional education. The assumption underlying the lifelong learning concept is that it is impossible to supply all the knowledge and skills learners need throughout their lifetimes at school or at university (Sharples 2000:178). People need and desire to constantly enhance their knowledge and skills for the sake of their professional or personal development or for problem solving in both areas. Learning is a process of mental and social change of an entire lifetime. In future, learners will not be bound to particular locations. New technologies offer the opportunity to learn and study at any time and anywhere in different ways – according to the user's preferences. Also, lifelong learning is primarily collaborative rather than competitive involving joint and cooperative learning as well as the exchange and critical discussion with others.

2.2 Time-poor – money rich

Although designed to ease our lives, progress in information technology has paradoxically created even more work and pressure on our society. Characterized by a high correlation between time-poor and money-rich (Lindskog and Brege 2003), learning even during leisure time has become a trend in our knowledge society. Levels of education are rising; still time has become one of our scarcest resources. Time-rich segments are composed of retired people, children and youth as well as unemployed, whereas most professionals and parents with young children can be considered time-poor. Consumer behavior of time-poor persons has shown to be clearly goal-oriented (Lindskog and Brege 2003), so that mobile and internet solutions show to be an efficient way to solve time-poor needs for enhanced vocational and leisure learning services.

The authors propose that mobile learning approaches within companies should be targeted to those employees who are consistent with the time rich – money poor

concept presented earlier in this paper, i.e. executives with a high degree of discipline and self-initiative. Earlier research studies have indicated that third generation distance learning systems which include interactive video, email, internet, intranet, and audiographics technologies, are especially suited to higher education and to adult learning mainly as a result of the interactivity embedded in the system (Katz 2000).

2.3 Mobile learning

The enormous growth of the Internet over the past decades has paved the way for the emergence of e-Learning as an educational concept. Web-based Learning Management Systems (LMS) such as Blackboard, eLearning Suite or WebCT are fixed components of institutional and vocational education. The speed at which coverage of mobile phones developed after the year 2000 added the dimension of mobility to the learning offer.

Mobile devices can help to combine work, study/education and leisure in a meaningful way. Mobile Learning can be considered a lifelong activity that can take place in changing communities and mixed with everyday life situations where people repeatedly enhance their knowledge and skills (Sharples 2000). M-Learning or mobile learning is an emerging form of distance learning that offers both trainers and learners the “opportunity to interact and gain access to educational material using a wireless handheld device, independent of time and space” (Dye, Solstad and K’Odingo 2003). Research in m-Learning for Higher Education is steadily progressing. In a survey of young adults’ (16-24 years) use of mobile phones in the UK, almost half expressed an interest in using their mobile phone to improve their reading, spelling, maths or language skills. Although only 5% currently use palmtops, 55 % stated that they might use one under other conditions, especially lower prices (LSDA 2003). Whereas the diffusion of PDAs is still not frequent among younger users and private use in general, most business executives use PDAs or Smartphones as part of their day-to-day work. Frequent business trips and external appointments add to a high use of mobile devices for time-poor persons. A comparison between the concepts of knowledge management, e-Learning and m-Learning is made in Table 1. It is interesting to note that according to this distinction several aspects of the m-Learning concept seem closer to organizational knowledge management than to the e-Learning concept.

Table 1. Characteristics of Knowledge Management, e-Learning and m-Learning

	Knowledge Management	e-Learning	m-Learning
Content	edited contents	instruction-driven content	context-driven content
Origin of content	internal	external	both internal and external
Frequency	ad-hoc usage	planned usage	both ad-hoc and planned usage
Scope of content	short items	longer items	short items (customized)
Location	workplace	workplace & home	any place
Time	working hours	working & leisure time	working & leisure time
Up-to-dateness of content	fast obsolescence	medium	medium to short-term
Target group	entire staff	entire staff according to specified needs	executives according to individual requirements
IT	CMS (Intranet / Extranet)	LMS	mLMS

2.4 Technical Requirements

New technologies such as handheld mobile devices allow for wireless connections to the Internet and a range of associated services such as location-based services such as the Global Positioning System (GPS), tracking or mapping services. Mobile devices can be a Laptop or Tablet PC equipped with w-LAN / WiFi or PCMA, Palmtop, PDA (Personal Data Assistant) or the cell phone. This opens new prospects for a whole range of mobile services including learning. After the introduction of first computers, then desktop computers and third the development of the Internet and the worldwide web, it is claimed that handheld computers are at the forefront of the “fourth wave” in the evolution of technology (Pownell and Bailey 2001). The following chart shows the architecture and mandatory layer caused by the integration of mobile Learning services to a classical eLearning environment. To display a special content to a PDA the “context discovery” detects the characteristics of the device, retrieves the adequate content from the e-Learning Management System redesigns it and presents it after the packaging and synchronization process.

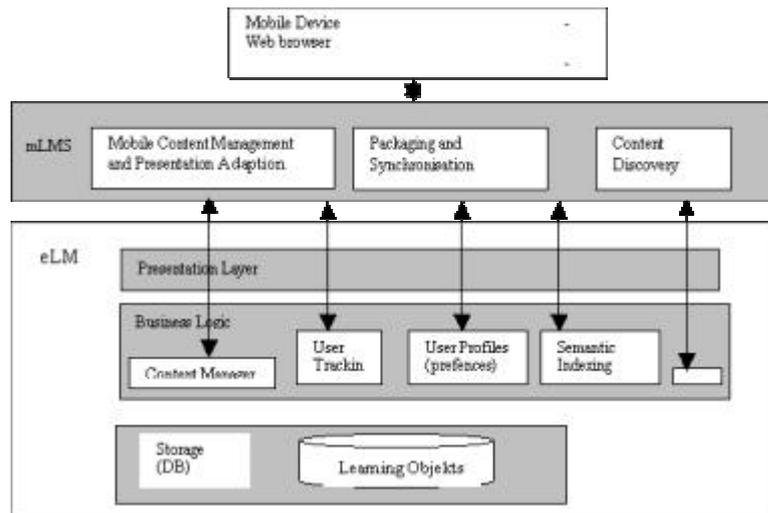


Fig. 2. General and Generic m-Learning Architecture (Trifonova and Ronchetti 2003)

This new mobility eases access to information for anyone, anytime, anywhere, thus enabling learning issues such as teaming, lifelong learning, collaborative, explorative and hands-on learning. Although palmtop computers have been available for the past 6 or 7 years, their use for learning is still a relatively new area (Savill-Smith and Kent 2003:30). Advantages are the relative low price for palmtops compared to desktop or laptop computers, the possibility of ubiquitous computing, the ease of access to information, and the possibility of collaborative learning and of independent learning. Major drawbacks are still the existence of several incompatible technology platforms competing in the marketplace and – possibly – their physical fragility as well as the need to keep batteries re-charged (Savill-Smith and Kent 2003:15). Table 2 gives a short survey of peculiar strengths and weaknesses of mobile learning concerning learning and organizational settings as well as technical aspects. The threat of low or even no acceptance of the m-Learning concept and of information overflow through unstructured learning or content or the technical constraints represent the major drawbacks.

Table 2. m-Learning SWOT analysis

	Strengths	Opportunities	Weaknesses	Threats
Learning settings	Learning on demand Mobile media delivery Personal learning diary Annotations	Opportunities for individual & collaborative learning	Requires self-management and self-discipline learners Requires highly-skilled (content, technology & e-moderation) trainers	Information overflow
Organisational settings	Customized offer No time and location constraints	Organisational and individual flexibility	Difficulties in monitoring	Low acceptance
Technical aspects	Online access – anytime anywhere Communication (ICQ, Newsgroups etc.) Semantic indexing	New possibilities through mobility Well-structured meta-data	Technical incompatibility Connection speed Data entry Performance of handhelds Small display & graphical resolution Physical fragility Battery life	Limited use due to technical constraints

2.5 Mobile opportunities

Whether mobile phones with Internet access or handheld data devices with phone capability are used, the objective is wireless access to data applications for individuals. Handheld digital devices are becoming more common, and their quality and capability is increasing due to technological breakthroughs in miniaturization and advancements in wireless bandwidth and data networks (Keegan 2002). Important characteristics for mobile learning devices and tools should include that they are highly portable, can be individually adapted to the abilities, knowledge and learning styles of the user, are unobtrusive, available anywhere and adaptable, persistent, useful and intuitive for people who have no prior experience with technology. Beyond that we know that portability can foster a greater feeling of ownership over learners' work (Passey 1999).

Mobile learning solutions also enable the consideration of location-related features for the service, considering the user's location or some aspects of general context in order to present information or provide an interaction relevant to the learner's situation. For

instance, a museum guide could use location tracking in order to determine the position of the user and present information on the work of art in front of him. These solutions may also take into account different levels of concentration or distraction in different locations or, for instance regarding travelling, different lengths of time that can be devoted to a learning session (Bull et al. 2003) and be integrated into an individual work schedule.

2.6 Learning motivation and collaborative settings

Contrary to organisational trainings that can be considered “push” offers in a sense that learners consume prepared learning units mostly presented by trainers within the company’s facilities, mobile learning can be considered a “pull” activity. Users have to actively request their information and learning inputs. This requires a lot more learning discipline and self-initiative. On the other hand it is important to note, that using e.g. communication services within e-Learning or m-Learning settings requires also well educated trainers.

2.7 3Cs of effective learning

Effective learning involves *constructing* an understanding by relating new experiences and existing knowledge (Brown et al. 1989). Next, *conversation* with teachers and other learners as well as oneself through questions and experiments and their interpretation is essential. *Control* of the process and actively pursuing knowledge instead of passively consuming it finally empowers the learner (Sharples 2003). Successful self-management of learning comes when the learner has development competence and skills in learning how to learn. Tools can be divided into three sets: Tools for learning actions, such as a web browser for accessing learning resources and input technology in order to store objects that result from learning experiences. Basic tools for learning descriptions could include a timeline in order to track the learning objects in the timeline they’ve been created or topic maps that link the objects by conceptual association. Learning conversations can be enhanced through direct communication tools (ibid.).

Although mobile learning fosters an individual approach in terms of creating possibilities which fit best to the personal learning settings and preferences, it also opens possibilities for collaborative learning. For a long time technical learning support has focused on the individual e.g. through interactive and multimedia presentation of content. Still, the individual learning process can be supported and improved by adequate interaction and collaboration in groups. The shift towards support of

relationships of individuals is a rather new development. An online community of practice, for instance, can complement real world debate with m-Learning.

2.8 Dispersed collaborative learning

Learners are able to meet and exchange their thoughts, ideas and products independent of space or time constraints in so called “Virtual Collaborative Learning Spaces” and to experience novel ways on learning without the need of teacher presence.

Dispersed collaborative Learning is interesting for companies and organisations seeking more efficient ways to design their training activities, saving amongst other things travel cost and time. Learning on demand saves planning and coordination work and allows for a customized learning and training offer for each employee.

Problems that are different to face-to-face situations: Social Presence can be a problem as it may be difficult to define and know the learning partners, to know where they are and what they are doing at a certain point of time. Also, cognitive orientation in a sense that the focus and structure of a topic and whether there is consensus or dissent about it are present to the learner, may be a problem. Finally, it may be difficult to coordinate the course of communication and action due to missing nonverbal signs.

The value of successful mobiles learning applications will depend on the extent to which they are easy to use, cost-effective and whether they will be able to generate a culture of learning. It is advisable to design mobile learning products according to the learners’ needs instead of technology driven products.

3 Methods / Procedures

In order to receive information on voluntary learning behavior and preferences of individuals, a survey among 380 tourists and residents in the region of Tyrol / Austria has been conducted. The survey used a questionnaire with close-end multiple-choice questions and statements that had to be rated on 5-point-Likert scales. Scale reliability was tested using Cronbach’s α . Topics investigated include attitudes and expectations of persons interested in (mobile) learning offers during their leisure time as well as their preferred learning settings including time, content or learning style. Questions focused on leisure learning in order to emphasize the dimension of voluntariness of learning activities. The willingness to pay for the respective service has been taken as an indicator for explicit interest in the service. The results indicate a clear interest in using

mobile learning for the enhancement of their knowledge and opening opportunities for vocational use as well.

4 Results

Results of the study are presented in order to derive conclusions on the issue of mobile learning. The sample showed slightly more female (58 %) than male respondents. 11.3 % of the respondents are aged from 16 to 25 years, 34.9 % are aged from 26 to 35 years, 24.4 % are aged from 36 to 45 years and 17.7 % of the respondents are aged from 46 to 55 years. Another 6.7 % of the respondents are aged between 56 and 65 years and 5.1 % are older than 65 years. The level of education is rather high, 40.6 % have finished their A-Levels, and another 23.4 % hold a university degree or diploma from higher education institutions. The majority of the respondents work as employees (47.8 %), 4.0 % in leading positions, 14.9 % are self-employed. About a third are not currently working, being students (17.1 %) and retired persons (9.6 %).

4.1 Technical equipment

The high coverage of mobile phones throughout Europe is also shown in our sample where nearly all respondents dispose of mobile phones (99.7 %) for their personal and office use. Still, the use of laptops (18.0 %) and PDAs (4.3 %) is less frequent and clearly dominated by office use, thus usage for leisure purposes (including learning) is actually low. Mobile phones are mostly used for telephony (97.6 %) and short messaging (79.4 %), but also as an agenda and organizer. Still their entire range of possibilities such as E-Mail (10.9 %), WAP (9.4 %) or MMS (5.0 %) is not utilized.

4.2 Attitudes towards Learning

Respondents have been asked about their agreement or disagreement with a range of 9 statements concerning their attitude towards "Learning" and "Leisure Learning" as an expression of voluntary learning. The questions used a 5-point Likert scale (ranging from 1 = I strongly disagree to 5 = I strongly agree), scale reliability was tested using Cronbach's alpha ($\alpha = .725$), after removing the control question "I prefer to learn alone", Cronbach's alpha yielded $\alpha = .760$. Results above .7 are generally considered reliable.

Within this set of questions, respondents stated a very positive status of learning in general, confirming that "I steadily try to extend my knowledge" and "Persons with extensive knowledge are respected in our society". Willingness to pay for adequate learning offers is about neutral: "The price for the learning offer must not exceed the

price for a domestic mobile call” and “I would be prepared to pay for an adequate learning offer”, still about a third of the respondents would be prepared to pay – a rather high percentage given the development status of such offers.

Concerning the personal way of learning, respondents agreed to “prefer learning on site (with direct contact to my learning object)”, that “it is important for me to exchange with others what I’ve learnt” and that the “learning offer has to be adapted to my personal level of knowledge”. Interestingly, the statement “I’m interested whether other persons inform themselves about the same topics at the same time as I do” has been agreed on by 39 % of the respondents, an indicator for the surge of collaborative learning.

Table 3. Respondents’ attitudes towards learning

Status of learning	Mean value	Percentage of agreement 4-5 (strongly agree = 5)
I steadily try to extend my knowledge.	4.38	92.0 % (50.7 %)
Persons with extensive knowledge are respected in our society.	4.11	79.5 % (43.4 %)
The price for the learning offer must not exceed the price for a domestic mobile call.	3.01	25.2 % (12.0 %)
I would be prepared to pay for an adequate learning offer.	2.87	29.3 % (11.5 %)
Personal way of learning		
I prefer learning on site (with direct contact to my learning object).	4.23	84.4 % (47.7%)
It is important for me to exchange with others what I’ve learnt.	3.77	66.5 % (25.2 %)
The learning offer has to be adapted to my personal level of knowledge.	3.67	56.5 % (27.7 %)
I’m interested whether other persons inform themselves about the same topics at the same time as I do..	3.02	39.0 % (13.7 %)

4.3 Propositions

Results of the present study are finally presented in a range of propositions that try to link the lessons learnt to the organizational context:

1. *There is no indication of a strong prevalence of a single learning style. Learning offers have to be adapted to the personal preferences of the user.*

Most respondents preferred to combine different styles of learning such as seeing/reading (69.0 %), discussions (48.4 %), hearing (40.4 %), feeling (22.3 %)

and writing/drawing. Mobile learning approaches bear possibilities for all learning sites, assumed that a “feeling” experience can be provided on site.

2. *Learning offers have to be adapted to the personal knowledge and learning preferences of the user.*

A distinction can be made between Initial Learning involving the presentation of new skills and concepts, Continued Learning where the learner has a foundation of knowledge in the topic area and is trying to enhance it, Remedial Learning targeted at refreshing contents, Upgrade Learning aiming at progressing from competence at an early level to competence at a higher level in the topic area and Transferred Learning where the learner purposes the transfer of concepts of the topic area to a different operational area. Respondents stated very high agreement with the adaptation to their individual standard of knowledge.

3. *The variables age and the level of education are important indicators for the learning needs and requirements of learners.*

Whereas other socio-demographic variables such as sex showed no significant influence on the attitudes towards learning, the variable age showed a strong positive influence on the notion to acquire as much information on a topic as possible (Pearson's $\chi^2 = 43.916$, $p=.002$), on the desire to exchange with others (Pearson's $\chi^2 = 38.997$, $p=.007$) and to learn on site ($\chi^2 = 32.314$, $p<.040$) and the willingness to pay for a learning offer ($\chi^2 = 34.898$, $p<.021$).

The level of education showed to be an important factor as respondents with A-levels or higher education state a higher interest of personally adapted learning content. This implies the need to develop learning contents that can be individually customized by users with different knowledge standards. Respondents with higher education also state a significantly higher interest (90.7 %) in having access to learning contents on site. There is a relationship between the level of education and the desire to learn on site (Pearson's $\chi^2 = 41.994$, $p=.000$) as well as the desire to receive learning material that is appropriate to the actual standard of knowledge (Pearson's $\chi^2 = 32.648$, $p=.008$).

A consequence of this finding is that (time-poor) business executives or senior employees that are able to build on an existing knowledge base might be more eligible for mobile learning services than new entrants.

4. *Laptops and PDAs are still primarily used for business purposes.*

While the coverage of cell phones is nearly full, this is not yet true for laptop computers and PDAs that are primarily devoted for business purposes. Although

this situation might change in the future with the diffusion of PDAs for mobile learning purposes at schools and universities, this circumstance adds another argument to the proposition to mainly target business executives and vocational services for mobile learning. Still, the possibility of enhanced services such as learning could boost the market development.

5. *When designing and promoting (mobile) learning services, it is important to keep a possibly bad connotation of the word “learning” in mind.*

Interestingly, although the questions reveal positive attitudes towards the enhancement of knowledge, subsequent open questions on the respondents' connotations and attitudes towards “learning” indicate negative associations such as “boring”, “work and effort” or “stress”. It is important to note that although enhancement and reorganization of employees' knowledge belong to the day-to-day requirements for a wide range of professions, these associations might appear negative due to past experiences. When developing, designing and realizing knowledge offers, this insight should be kept in mind.

4.4 Learning as an integrated part of the strategic process

It is important to state that experiences made within the field of e-Learning showed that the starting point for an e-Learning initiative is rarely initiated by an strategic process asking what kind of needs and visions the company or university has – nor, as a second step, an analysis of the customer needs of the targeted group. Especially educational institutions often follow a bottom-up approach where single pilot projects cover and translate specific parts of electronic learning. In general, these projects are not coordinated or harmonized with other projects within the institution. Comprehensive coordination usually occurs when joint resources are required for the realization of projects. An example for this procedure could be the implementation of a Learning Management System, where further coordination is done throughout the implementation process such as a ex-post training of teachers or evaluation of legal aspects. This fact might lead to a general feeling of dissatisfaction which could be avoided using a top-down approach, implementing processes after having strategically considered their integration and diffusion into the institution's or company's innovations. Results of a Delphi study suggest a mixture of both approaches (Euler and Seufert 2004).

Many aspects such as technology, didactics or organization are equally valid or can actually be transferred from the field of e-Learning to the mobile learning concept.

Successful implementation of a companywide m-Learning concept underlies about the same principles and rules. After a well coached experimental stage it is important to retrieve, evaluate and integrate the strategic added value of an innovation for the company.

Collins and Van der Wende (2002) interviewed executives from 174 universities in 7 countries. Results reveal that most universities are at the transition from the bottom-up experimental stage to the stage of institution-wide adoption of e-Learning innovations. Three steps of development have been identified: (1) the implementation of technological infrastructure throughout the institution, (2) the implementation and evaluation of didactics and (3) the strategic orientation of e-Learning in order to realize competitive advantages.

5 Conclusions

This article tried to identify the possibility and potential for mobile learning services especially in a professional context. Mobile Learning can play an important role as it uncovers further possibilities for creating and controlling the learning situation.

The societal trends described point to a respectable potential of mobile learning. Despite the fact that there has been widespread discussion on the need to provide learners with the technology to help them learn when and wherever they want to, little empirical research has been undertaken in order to investigate possibilities and acceptance of mobile learning offers away from classical learning institutions such as schools or universities. Most examples of m-Learning experiments concern e-learning through mobile devices, often WAP and/or Smart Phones. Mobile learning solutions are still in their infancy, research mostly dealing with evaluation of possibilities and impacts of technical features (see e.g. Bull et al. 2003; Lundin and Nulden 2003; Sharples 2003; Katz 2000).

Future research should address questions such as cost-value relationships or possibilities for content development and organisation in/for collaborative learning settings. Investigations into the use and effectiveness of mobile learning services as a means to enhance employee satisfaction would be an interesting field of research. Further research should also be conducted in the individual perception of learning, i.e. when people perceive that they learned something new and interesting, in order to further develop mobile learning offers.

Although the technical development status is not yet sufficient for optimal use of the technology, the years to come are promising considering e.g. the current roll out of UMTS technology. Still, many technical questions remain unanswered so far. There is a notable lack of detailed academically reviewed research studies of projects and trials using mobile technologies. Still, several projects, partially funded by the European Union, are on their way, such as the m-Learning (<http://www.m-Learning.org> [February 27, 2004]) or the MOBIlearn projects (<http://www.mobilearn.org>; <http://www.mobilearn.at> [February 27, 2004]).

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