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Mobile Learning in corporate settings[1] Results from an Expert Survey

ABSTRACT
Against the background of the rising mobility of employees, technological innovations and the increasing importance of work based learning, a central question is whether and how mobile devices can be used to support employees' learning processes in the near future. This question was addressed to 56 international experts in a two round survey, combining Delphi and scenario-based methods. They evaluated four mobile learning scenarios, described the scenarios they expected in the immediate future and identified benefits as well as barriers and conditions of implementation. In addition the interviewed experts evaluated inherent tensions and proposed ways of addressing these.

The findings of the survey show that social interaction and reflection on learning processes received the most positive evaluation as did content-based scenarios with examples focusing on contextualised learning. The integration of learning at work was described as the most important area of inherent tension which has to be addressed. In the near future mobile learning in companies is anticipated mainly in the form of learning "just-in-case", based on human-computer interactivity.

Author Keywords
Mobile learning in companies, work based learning, contextualisation, reflection, coordination, coaching

THEORETICAL BACKGROUND AND RESEARCH QUESTION

Definition of corporate mobile learning

Although mobile learning may blur the lines between work and learning, research requires a clear definition and demarcation of the subject addressed:

Corporate mobile learning takes place *when **mobile** employees are supported in their **learning** activities with **portable** computational devices.*

An activity is defined as learning when it leads to a deeper understanding and takes place within a didactical framework. The framework is defined by the curriculum, teachers, or by the learners themselves (compare Göth et al., 2007, p. 2). Pure information retrieval which does not to lead to more in-depth knowledge or skills acquisition will not be considered as learning (Frohberg, 2007, p. 8).

Distinctive to mobile learning is the mobility of the learner, rather than the portability of the technology (Sharples et al., 2005b). Mobile learning "happens when the learner is not at a fixed, predetermined location" (O'Malley et al., 2003, p. 6). Employees may learn either while they are locally mobile (wandering), moving around within an area such as a hospital or a construction site or when they are moving between different work locations (visiting, travelling), as is the case for field staff or sales representatives (compare Kristoffersen and

[1] Including the health sector

Ljungberg, 1999, p. 31). However, the use of portable, computational devices[2] such as Smartphones, PDAs, Tablet PCs or Notebooks for learning purposes is also a prerequisite.

Mobile learning in companies – literature review

Mobile learning has mainly been implemented and examined in schools and institutions of Higher Education. Companies seem to be more hesitant to deploy mobile technologies for learning (Härtel et al., 2007). The existing body of literature clearly reflects this finding. "Corporate mobile learning" was addressed by Pasanen (2003) in a chapter of the book "Mobile Learning". The author describes mobile learning as using the flexibility of mobile devices for the access to and the production of learning material, for learning communication and for the management of learning. He stressed the importance of an integration of mobile learning into the corporate information infrastructure and the strategic importance of mobile solutions: Mobile learning encourages innovation and offers new business opportunities. Moreover, Pasanen identifies further benefits from the different perspectives, for example, effective learning material collection (student's viewpoint) or improved customer service (customer's viewpoint) (Pasanen, 2003). His arguments are based on a review of the literature and his own conclusions without collecting primary data.

Non-scientific contributions from the field of commercial and industrial training indicate that companies might benefit from this barely-established form of technology-enhanced learning. According – for example – to a "case study" from a bank – which distributed audio messages to employees– the feedback from the involved managers was "100% positive" (Weekes, 2008). Another large financial institution delivered compliance training courses to their employees using the Blackberry. The results included a more timely completion and a 12% higher completion rate compared to the control group within a two month testing period (Swanson, 2008).

Mobile learning has been also deployed in the ICT sector. An international telecommunications provider delivered mandatory compliance training sequences to nearly 30.000 on-the-road engineers. Another, complex engineering scenario was depicted by a French research institution (David et al., 2007, p. 3): A mobile learning platform provides engineers with the opportunity to study small contextualized and personalized learning sequences while repairing manufacturing plants. The contents are displayed via WiFi and RFID technology on see-through goggles with an integrated screen. If the engineer has a problem he can contact an expert by chat or contextualized e-mail which automatically includes machine references. The purpose of the activity, beside the plant repair, is the internalisation of important functions and repair principles. However, the scenario has not been tested in companies so far. In a third example, a huge multinational computer technology and consulting company provided small personalized information for a group of employees. The profile was based on Human Resource data and completed by the employees according to their qualifications, expertise and interests. If relevant content was available the learners were instantly notified via mail or SMS. Due to high technological requirements, only a small percentage of the employees had the capability to download the contents on their mobile devices (von Koschembahr and Sagrott, 2005, p. 165).

In an on-the-job learning project a mobile feedback and diary application was developed for apprentices who work temporarily in companies. The students answered daily questions about events and feelings on their mobile phones. In addition, they could document their experiences and enrich their feedback with pictures, videos and sound taken with a camera phone. The evaluation with 23 students concentrated mainly on the usability of the product. The impact of using the tool has not been evaluated so far (Pirttiaho et al., 2007, p. 221). Another project illustrated how learning materials can be created and shared by learners: Staff at an Intensive Care Unit videotaped how they handled technical equipment with a video camera. The sequences were provided to colleagues who viewed them on handheld mobile computers immediately on site via RFID technology. The scientific evaluation showed that these practices augmented informal peer-to-peer learning (Brandt et al., 2005). However, in spite of widespread camera phones and mushrooming online video platforms the practice of producing and sharing videos has not entered mainstream use in businesses so far.

In conclusion, no systematic research on mobile learning in companies has been conducted as yet. There are some papers on the use of mobile learning in companies. Most of them are non-scientific, without serious evaluation, conducted by internal evaluators. Consequently, they are of little scientific significance. However, they might provide ideas of upcoming mobile learning trends.

Generally speaking, corporate training is more content-oriented than based on social interaction (Kukulska-Hulme and Traxler, 2005, p. 39). It remains to be seen whether this focus will be shifted by mobile devices,

[2] In the following shortened to "mobile devices"

whose communication capabilities have been considered amongst the most useful features in mobile learning projects (compare for example Sharples et al., 2005a).

Catalysts for mobile learning in enterprises

In 2003 – in a Delphi study on the development of mobile learning – broadband technologies and 3G portable devices were considered important and wireless Internet access was described as the „backbone of mLearning" (Dye et al., 2003, p. 49). Today mobile broadband coverage has remarkably improved and mobile technologies such as cell phones are widespread (compare for example BAKOM, 2007) and multifunctional: Smartphones are combining more and more capabilities – ranging from telecommunication and video capturing to personal information management (Livingston, 2004). At the same time costs for telecommunication have been decreasing (compare European Statistics e.g. eustatistics.gov.uk, 2006) . This is a key factor in the spread of mobile learning (Dye et al., 2003, p. 49). The Horizon Report seeks to identify emerging technologies likely to have a significant impact on teaching, learning, or creative expression within learning-focused organizations. It also emphasised the importance of mobile technologies: G*rassroot videos* and *mobile broadband* are two out of six technologies that are likely to enter mainstream use (New Media Consortium and EDUCAUSE, 2008, p. 3). Both are closely related to mobile learning.

Mobile employees with poor access to stationary IT infrastructure are also considered as important drivers for mobile learning in companies: Nowadays jobs are decreasingly performed at fixed locations, project teams are formed temporarily (Bergmann, 1999, p. 14) and, consequently, the number of mobile employees is on the rise (Lesser, 2005, p. 3). If mobile workers are supported with mobile devices, the existing technology is likely to be used for learning purposes as shown in the health sector: When analysing the use of PDAs in medical and nursing professions, Luanrattana et al. (2007) reported that PDAs are widely used for work routines and increasingly for educational purposes. In a more general analysis on the potential of mobile learning in the health sector the author claimed that: "Mobile learning is being embraced because mobile computing is being embraced in this sector" (Burger, 2006).

The corporate learning landscape is also changing: Work-based and informal learning are gaining in importance (Lundin and Magnusson, 2003, Hardwig, 2006, p. 191). Recent empirical studies show that the majority of professional competences and skills are acquired through informal learning (compare for example Dehnbostel, 2006, p. 165, Livingstone and Scholtz, 2006, p. 45) such as self-directed efforts or the mentoring of more experienced co-workers. Only few employees regard formal training courses as the most important source of job-specific knowledge (Livingstone and Scholtz, 2006, p. 45).

It is claimed that skills such as problem-solving abilities and autonomy cannot be adequately taught from the outside. They have to be developed by self-direction in appropriate learning conditions (Hardwig, 2006, p. 191). Employees should not learn *"just-in-case"*, but in their work setting, through ongoing changes in their companies (Loroff et al., 2006, p. 7). The main route of learning is to be found by engaging in tasks (Bergmann, 1999, p. 108). *"Learning can no longer be dichotomised into a place and a time to acquire knowledge (school) and a place and a time to apply knowledge (the workplace)"* (Fisher, 2000). It is therefore becoming increasingly difficult and ineffective to train employees only in a classroom setting (Hardwig, 2006, p. 7, Loroff et al., 2006, p. 9). However, classroom training should not be played off against other forms of learning. Combined, they can lead to new ways of learning (Hardwig, 2006, p. 199) with the potential to improve the learning transfer from traditional classroom training into work routines (Bigalk, 2006, p. 184).

Mobile learning could also address these demands of the changing corporate learning landscape: Employees can access information autonomously in informal settings without access to stationary IT-infrastructure. Mobile devices might encourage work process oriented learning: It is theoretically possible to bring training and practice together and "to access theory and knowledge in the context in which it is to be applied - in the work process" (Attwell, 2007, p. 3). Due to a focus on "efficiency gains and cost savings in short timescales" (Kukulska-Hulme and Traxler, 2005, p. 39), some companies might try to enhance productivity through "just-in-time" learning with mobile devices (compare von Koschembahr and Sagrott, 2005, p. 165). Learning sequences can be accessed exactly when needed (Kukulska-Hulme and Traxler, 2005, p. 39). Sharing images and videos to solve immediate problems might lead to improved mentoring. Mobile devices could also encourage learning processes and reflection, as was the aim of an on-the-job learning project (Pirttiaho et al., 2007, p. 218 ff). In addition, they may aim to improve the learning transfer from face-to-face training into work routines, as in the case of a project carried out by an international airline (Lison, 2004).

Guiding question

Against the background of the increasing mobility of employees, technological innovations and a changing learning landscape, the central question is whether and how mobile devices can be used to support employees' learning processes in the near future.

RESEARCH METHOD

Due to the limited number of corporate mobile learning applications and the dearth of scientific literature on the subject, the authors have primarily used an explorative research strategy. The study was conducted as an expert survey consisting of two rounds. The research design combined Delphi and scenario-based methods. The Delphi method is particularly well suited to new research areas and exploratory studies (Okoli and Pawlowski, 2004, p. 15). It can be characterized as a tool for highly structured group discussions to create solutions for complex problems (Bortz and Döring, 2002, p. 261) and to obtain a reliable consensus among a group of experts. Delphi methods have not only proven to be a popular tool in the general field of research on information systems (Okoli and Pawlowski, 2004) but have been also used in the field of mobile and work-based learning or for the evaluation of evolving learning technologies (compare Dye et al., 2003, Pehkonen and Turunen, 2004, New Media Consortium and EDUCAUSE, 2008). Finally, the Delphi method does not require the experts to meet physically. This would have been impossible for such a huge number of international participants from various fields.

The experts evaluated short, manifold scenarios that might be broadly implemented in the future. Scenarios typically illustrate significant user activities and support reasoning about situations of use (Carroll, 2000, p. 42). The rough scenario descriptions comprised the target group (*who is learning?*), the framework (*in which business context does the learning take place?*), learning methods and social forms (*how the participants learn*) as well as technology (*which mobile and network technologies are used?*). The scenarios should illustrate manifold applications and, therefore, do justice to the variety of mobile learning forms.

Due to the complexity and interpretative scope of the rough scenario descriptions the goal is much better achieved by qualitative data collection techniques. Quantitative methods have primarily been used to triangulate qualitative results. Through this triangulation more credible and dependable information should have been achieved (compare Decrop, 1999, p. 157).
The international group of study participants consisted of 56 experts in the first round: academics in the disciplines of pedagogy, psychology and information technology and managers in charge of in-company training and mobile and e-learning vendors. 39 of them participated in the second round[3]. As differences between University education and corporate training should not be overstated (Kukulska-Hulme and Traxler, 2005, p. 39) experiences in the field of mobile learning can be extrapolated – with care – to business contexts. Therefore the involvement of academic scientists with experience in mobile learning was considered to be very important. A majority of the interviewed persons were from German and English speaking regions. The research design and results of the surveys were discussed in a sounding board, consisting of experienced scientists and managers in charge of in-company training. Pre-tests served to validate the instruments of data collection.

In the first round the participants evaluated the potential benefits of four mobile learning scenarios. They made quantitative evaluations of potential benefits on a five point Likert scale (ranging from very high benefit to no benefit at all). They were asked to give reasons for their choices. They also described potential future forms of mobile learning in companies and their benefits as well as barriers and conditions. In the second round they were asked to re-evaluate the potential of the four scenarios, taking into consideration contradictory arguments from the first round. In addition, the importance of the mastery of various inherent tensions was evaluated on a four point Likert scale (ranging from very high relevance to no relevance) and approaches to solutions to these tensions were identified.

Limitations

The generalisation of the results corresponding to individual scenarios has to be made with caution, due to the interpretative scope of the given examples. However, the goal of this research was a rich discussion of manifold scenarios and influencing factors in order indicate the direction of mobile learning in companies.

[3] Participants/professional background:

	Academics	Managers	Vendors	Not stated	Total
1st round	28	23	5	-	56
2nd round	17	17	3	2	39

RESULTS

Evaluation results of the four scenarios

Qualitative results

1. The first scenario describes a sales representative who learns with personalised learning objects on his mobile device in quiet moments. The study participants positively highlighted [4] the flexibility in terms of time and space and the personalised, self-directed approach. At the same time they questioned the use of quiet moments for learning purposes. These moments would be frequently used to fulfil working tasks, to relax or to reflect. Critical to success is the learning atmosphere, which should be free of distractions and noise.
2. In a further example – where engineers access learning materials on display goggles during repair activities – the situational and problem-based approach was seen as positive. Criticism referred mainly to the difficulty in implementing this scenario caused by the automatic contextualisation of learning materials. An increased error probability through learning while working will also affect the scenario negatively. Lack of time for reflection at work should be compensated by additional phases of reflection after finishing the repair process. This may lead to better internalisation of acquired competences.
3. When nurses document how they handle important work tasks in short video clips, learning and reflection processes are already taking place during the production phase. These videos can be accessed context-sensitively on site by other colleagues on their PDAs. The interviewees criticised that nurses rarely have quiet moments to produce and consume the videos. The experts also questioned whether the nurses had the necessary didactic and technical skills to produce learning materials of high enough quality.
4. In the fourth scenario apprentices in companies answer daily questions from their classroom teacher to reflect on their learning progress and document their learning experiences in an electronic learning diary. They are said to have a particular affinity to mobile phones. The interviewees commented on the consistency of the learning processes through daily incentives. This should positively stimulate motivation and acceptance. Learning transfer between school and work-based learning was considered as beneficial. The huge effort required by teachers and the high level of self-discipline of apprentices may affect the scenario adversely. In order to realise the scenario successfully, many participants recommend the pedagogical use of the feedback in the next classroom training session.

Quantitative results

The scenarios were evaluated similarly as having between *some benefit* and *high benefit (*with arithmetical means between 3.2 and 3.8 on a five point Likert scale[5]). The discussion, however, was controversial: While the scenarios based on human-computer interactivity (*engineer* and *sales representative)* were judged more similarly in the second round[6], the variation in the scenarios with social interaction (*nurse and apprentice*) remained equally high[7].

For three of the scenarios, changes from the first to the second round were not significant. Only the *apprentice scenario* was evaluated significantly more highly in the second round[8]: As shown in the matrix below, 13 persons increased their rating, whereas only 9 experts reduced their rating. Overall, this scenario was rated most highly in the second round. However, there was some disagreement in the evaluation of the scenario, as shown in Table 1. The boxes marked in grey highlight the changes in opinion that contributed to a relatively high standard deviation.

[4] All the arguments of this chapter were named at least seven times in the two rounds

[5] numerical values: 1=No benefit at all, 2= Little benefit, 3= Some benefit, 4= High benefit 5= Very high benefit

[6] Standard deviaton of 0.6

[7] Standard deviaton of 0.9

[8] T-Test, n=35, arithmetical means in 1st /2nd rnd: 3.46/3.66 standard deviation: 1/2 rnd: .919/.906, statistical significance at test with paired samples: .324, numerical values: 1=No benefit at all, 2= Little benefit, 3= Some benefit, 4= High benefit 5= Very high benefit

2nd round / 1st round	☺☺	☺	😐	☹	☹☹
☺☺	1	2	1		
☺	1	9	3		
😐	1	8	2	2	1
☹		1	1	1	
☹☹	1				

Table 1. Evaluation of potential benefits between the first and second round.

Considering the means of both rounds, the potential benefit of the scenario *engineer* was – in comparison to the other scenarios – rated most highly[9]. However, also the requirements for realising this scenario were – with little deviation – rated most highly compared to the other scenarios[10]. This reflects the qualitative evaluation results.

A framework for classifying mobile learning scenarios

The question describing future scenarios – considering target group(s), learning framework and methods, social forms and technology – has led to a comprehensive range of more than 30 examples in various thematic and working contexts. These are classified in the framework below according to their value to work process and their media function (compare also Gröhbiel and Pimmer, 2008).

		Learning based on	
		Human-computer interactivity	Social interaction
Learning has	Immediate value to work process: "just-in-time"	**Individual «just-in-time» learning**	**Interpersonal «just-in-time» learning**
	Potential value to work process: "just-in-case"	**Individual «just-in-case» learning**	**Interpersonal«just-in-case» learning**

Figure 1. A framework for classifying corporate mobile learning scenarios

The framework helps to make the distinction between different degrees of integration of learning in the work process on the one hand and between human-computer interactivity and social interaction on the other hand:

Vertical axis:

Just-in-time learning has an **immediate value to work process.** It comprehends the acquisition of knowledge and skills on-the-job due to immediacy and relevance (Harris et al., 2001, p. 276). Just-in-time learning is job-embedded and, therefore, might consist of learning by doing, reflecting on the experience, and generating and sharing new insights and learning with others (compare Wood and McQuarrie, 1999).

Just-in-case learning has a **potential value to work process**. It is learning for potential future application (compare Harris et al., 2001, p. 276). The emphasis is on knowledge and skills that might be useful later. It is hardly possible to predict whether and when it will be needed (Kirsh, 2000, p. 30).

Horizontal axis:

Individual learning is primarily based on **Human-Computer Interactivity**. It describes the possible courses of action of the individual learner with a learning object (Schulmeister, 2004, p. 12). Feedback is given implicitly or explicitly by the learning object or by the (electronic) learning environment (Schulmeister, 2004, p. 15) in dependence on the learner's previous actions.

[9] arithmetical means in 1st /2nd rnd: 3.84/3.59

[10] Numerical values: 1= Very low, 2= Low, 3= Medium, 4= High 5= Very high. Arithmetical mean of scenario engineer: 4.47; The other scenarios were all evaluated similarly as having between medium and high requirements (3.2-3.5).

Interpersonal learning refers to the **social interaction**s between humans. It comprises collaborative learning, tutoring, teaching or coaching mediated by portable computational devices; consequently, feedback is provided primarily by peers, mentors, teachers etc.
Both the degree of interactivity and the social interaction are considered by many authors as very important for the success of virtual learning (Schulmeister, 2004, p. 12). The following figure illustrates the classification of beneficial scenarios expected by the experts in the next 2-5 years. The size of the boxes represents the approximate number of scenarios:

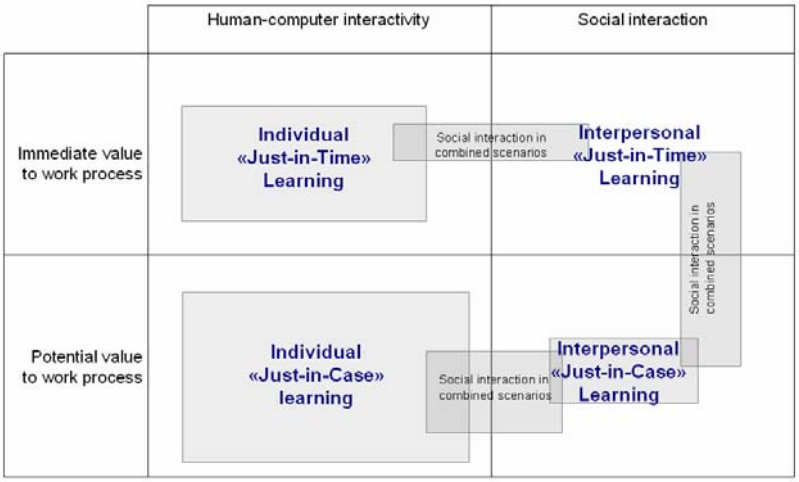

Figure 2. Expected mobile learning scenarios in companies in the near future

1. Scenarios situated solely in the area of just-in-case learning were described considerably more often than scenarios based on learning while working: It was primarily examples based on human-computer interactivity that were depicted in this field. This currently prevailing form of mobile learning (compare Frohberg, 2006) is also expected to predominate the corporate landscape in the near future: Examples were described where employees such as investment brokers or bank employees learn in advance and apply their knowledge in later phases: They are texted as soon as new materials are available, work on small learning items and then check their knowledge with quizzes.
2. In the area of just-in-time learning, most of the examples were described in the field of human-computer interactivity. Scenarios based on social interaction were cited only in combination with scenarios from other quadrants as illustrated by the following example: If mechanics, medics or builders who are working on a certain task for the first time face a problem they can't solve on their own, they can contact an expert with their mobile devices. Details of the objects are captured with the integrated camera. The expert explains the procedure while annotating the image. The indications are synchronously visible on the screen of the learner's device. If the session is recorded and available to other learners in similar situations, the scenario is expanded to the field of human-computer interactivity.

Beyond the documentation of coaching processes – as described in the example above – the production and sharing of further learning sequences such as incidents, unusual situations or the usage of products by customers were described several times.

Dealing with inherent tensions

When analysing answers related to benefits several areas of tension have been identified. A majority of the respondents attributed high or very high relevance to the mastery of the following four inherent tensions:

1. It is clear that the integration of learning at work is beneficial; at the same time learning and work processes may interfere with each other.
2. Although technical affinity to mobile devices is high for some (groups of) employees, prerequisites for learning such as motivation and self-discipline are sometimes insufficient.
3. Continuous innovation of mobile technologies will lead to noteworthy improvements. However, in the immediate future the technical requirements for the successful implementation of some mobile learning scenarios will not be met.
4. While the production of learning materials by employees creates additional benefits, privacy issues and poor technical or didactical skills of employees may limit this potential considerably.

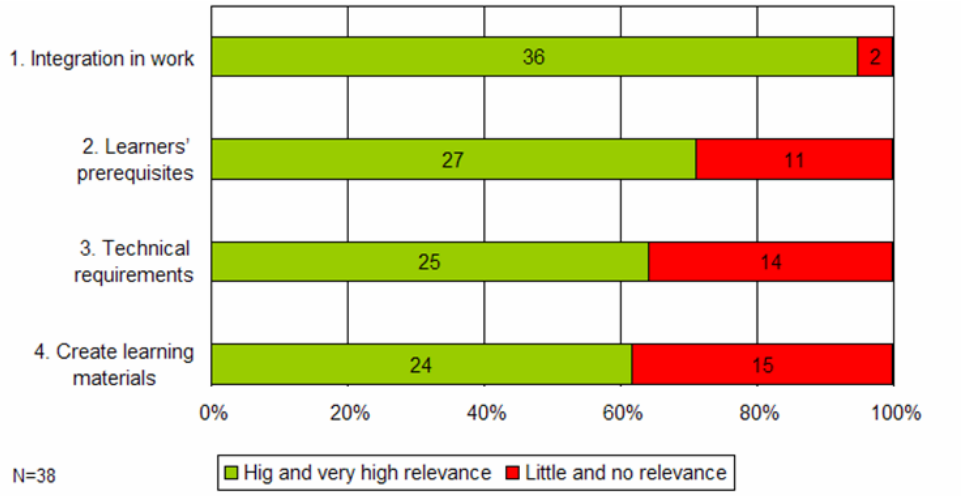

Figure 3. Importance of areas of tension to be reconciled

In order to overcome these inherent tensions the experts made the following suggestions:

To foster the integration of learning processes at work employees should have time that is explicitly designated for learning. The time used for learning should of course not be paid for by the customer. Mobile technologies should only be deployed if they provide an advantage over other technologies. If possible, employees should learn with devices they are already using for work. Quiet moments, if these exist at all, are rarely appropriate for learning.

Certain prerequisites are critical success factors for mobile learning. The interviewed persons proposed enhancing the learners' motivation by means of concrete incentives (for example, the implementation of ePortfolios) or by making mobile learning a requirement. The advantages of the application should be clearly demonstrated to the learner. Approaches related to the peer-to-peer production of learning material require training courses and quality control conducted by teachers. Learners should be able to delete their contents any time.

CONCLUSIONS AND FURTHER DISCUSSION

The findings of the expert survey indicate that the following development options deserve closer attention:

1. Just-in-case learning based on **human-computer interactivity** was described by most of the experts as the prevailing form in the immediate future. While having moderate **benefits,** the implementation of this kind of scenario seems to be relatively **easy**. The use of "quiet moments" for learning does not seem to be appropriate. The personalisation of learning contents and the learning atmosphere were considered as very important to success.

2. The **contextualisation** of learning and the **integration in work** processes is very promising. Nearly all experts pointed out the high relevance of this area, which is at the same time **challenging**: Technical and organisational challenges have to be tackled and learners should be given additional time for reflection.

3. Beyond human-computer based learning forms, scenarios focusing on **social interaction** also provide high potential benefits. Mobile devices can support **coordination, coaching** and **collaboration**. Trainers can send messages to **coordinate** learners' activities and to encourage learning and **reflection** processes. This can enhance the continuity of the learning process and increase the motivation of the learner as indicated in the apprentice scenario. With low requirements and predominantly positive feedback it is worthwhile to consider how this scenario can be applied to other fields.
   Integrated tele**communication** and **collaboration** features can make synchronous annotation of pictures possible. This is a capability which could ideally be used for **coaching**. In this way problems can be discussed and reflected on among learners and tutors.

4. Reservations were expressed in the evaluation of the **production and sharing of learning material**s. There are demands on learners in terms of the mastery of technical and didactical skills in order to produce learning materials of high enough quality. The learning and reflection processes taking place during the production were very positively highlighted. Particularly in the context of the increasingly popular Web 2.0 applications these kinds of scenarios should be kept in mind.

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