Technology-enhanced learning in the workplace

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Introduction

Workplace learning has a long history but experienced only modest recognition as something valuable for human resource development in organizations. Lately, however, interest in workplace learning has grown, caused by a number of developments, including the rise of emerging technologies conducive to learning. These emerging technologies fundamentally change our contemporary understanding, and allow a more prominent position of workplace learning in today's human resource development policies.

This chapter commences with exploring the concept of workplace learning. The next section offers an overview of the evolving field of workplace learning during the past decades. Then, the fundamental features of workplace learning are discussed. What are they? And which factors predict the learning opportunities in the workplace?

Thereafter, the focus of this chapter shifts to how technology enhances workplace learning. Attention is paid to the evolution of technology from media-supported learning, via computer-based training, web-based training, to what we now call technology-enhanced learning. These technologies are not just supportive but in many cases they are prerequisites for creating and organizing learning in the workplace.

The power of technology for expanding the opportunities and value of workplace learning is further elaborated in a section that presents three examples of contemporary workplace learning. These examples could not exist or really flourish without the latest technology: a learning network, micro-blogging, and personalised learning environments, respectively. The final section summarises the main trends and discusses topics that deserve further research attention.

The evolving field of workplace learning

This section discusses some of the major changes in opinions and practices regarding workplace learning. Table 1 presents the main shifts in the perspectives on workplace learning and the role technology plays in each period.

Table 1. Perspectives on learning in the workplace (based on Van der Klink, 2010).

	Human Relations Movement	Professionalizing organizational training and learning	Human Resource Development	Lifetime employability
	Until 1970	1970-1990	1990 –	2000 -
	Apart from preparing for jobs there is attention for employee well-being and commitment	Training is costly but necessary for preparing employees to the increasing pace of change	Training is a necessary investment in the human capital. Emphasis on integrating HRD, HRM and OD	Individual employee becomes increasingly responsible for his/her own learning and career
	Standardized off-the-job courses	Mainly off-the-job courses	Mix of off-the-job and increasingly on-the-job training and learning	Informal learning at work, use of digital means, learning in networks
	Media-supported training. Use of mass media (radio, television, video) in classroom-based training	Computer-based training. Computer as stand-alone, especially for training skills and knowledge in separate computer rooms	Web-based E-learning. Rise of technology, such as internet, for flexible learning in daily work.	Technology-enhanced learning, strongly embedded in the daily work setting. Increased use of mobile devices that foster learning in different places and time zones
	Job-specific but also soft skills and for personal development purposes	Job-specific and emerging attention for career development	Job specific, career development, learning competences	Stronger focus on broad transferable competences. Working and learning increasingly intertwined, thus working becomes learning

From the Second World War until the late sixties, training was mainly geared to preparing employees for entry-level jobs. In many industries new employees received some firm-specific and job-specific training during their entrance period. Partly, this training was off-the-job and partly this was allocated in the actual work setting itself. The latter was mainly unstructured in nature and has been called very different

names, such as 'sit by Nellie training' or 'follow Joe (or Jane)' (McCord, 1987). There was growing recognition that organizations are human cooperative systems and in order to assure a better fit between employees and organizations it was considered worthwhile to increase investments in improving employees' social skills and work motivation (Kaufman, 2001), especially for employees working in supervisory or managerial job positions.

The innovations that emerged during the seventies of the former century forced organizations to expand their training investments. No longer was it sufficient to limit training to newly-hired employees and managerial staff. The introduction of automated and more complex work processes, followed by the further computerization of work, required more frequent training during employees' careers (Sloep et al., 2011). The need for training as a means to ensure organizational performance contributed to allocating the organizational training and learning efforts into a separate unit: training departments became common in organizations. The training expenditures increased dramatically during this period. Most of the training was classroom-based in settings away from the actual workplace, but there was growing concern about the effectiveness of classroom-based training because of the absence of convincing evidence for its actual contribution to employee's on-the-job performance (Baldwin & Ford, 1988; Latham & Crandall, 1991).

During the eighties, organizations became aware of the significant meaning of their human resources for surviving in a globalising economy with high speed developments, such as the emerging information technology. Cost-reduction, permanent attention for quality improvement, elimination of work inefficiencies, flattening and downsizing are just a few examples of responses to cope with the ever changing circumstances. The nature and division of work fundamentally changed towards broader jobs consisting of a wider range of tasks and higher levels of autonomy for individual workers, even for employees with shop-floor jobs (Swanson & Holton, 2008). Improvement and innovation became no longer the exclusive domain of R&D departments but increasingly a responsibility for large segments of

the workforce. This change boosted the attention for integrating work, innovation and learning.

The growing acknowledgement of the paramount importance of training as a means to stay ahead of the global competition is reflected in the positioning of the training departments within organizations. Training departments transformed into human resource development (HRD) departments, which was not merely a replacement of labels but an expression of the acknowledgement that training and learning became a strategic issue and a crucially important tool of management. Organizations attempted to better align HRD with their organizational goals and, one step further, even work on redesigning their entire organizational HR policies and practices through integrating HRD with Human Resource Management (HRM) and organizational development (OD) (Ruona & Gibson, 2004).

The critique on the lack of evidence concerning the effectiveness of classroom-based training resulted into a shift from off-the-job towards on-the-job training and learning. Learning in the actual workplace became highly appreciated since it appeared to be more effective, more practical, allows to integrate innovation and everyday learning and, not unimportantly, it demanded fewer financial resources than conventional classroom-based types of training. Unfortunately, the empirical evidence to support the positive claims of learning in the workplace was, and still is, rather modest (Van der Klink & Streumer, in press).

The first decade of the 21st century is characterised by increasingly unpredictable developments in innovations and global economic circumstances, which force organizations to reconsider their HRD and HRM policies. Lifetime employment within the same organization became no longer a prerogative for all employees. The traditional bonds between employer and employee were less apparent, which is also reflected in the strong increase in the numbers of self-employed workers, who do not have permanent job contracts anymore but work for a particular employer only during the course of a specific project.

Today, the notion of lifetime employability seems more appropriate for our understanding of employees' careers. The concept of lifetime employability implies that employees become more accountable for investments in their own human capital and hence in their own job security, learning and career development (Van

der Heijden et al., 2009). Next to being competent in a particular vocation or profession, possessing certain key competences is perceived as a critical condition for one's employability. These key competences guarantee more flexibility in moving across the labour market, and allow one to adapt more quickly to constant changes within one's occupation, but also the key competences enhance transfer to employment outside one's original occupation (European Commission, 2007). An example of such a key competence is 'sense of initiative and entrepreneurship', which refers to remaining proactive in exploiting opportunities and organizing one's own future work and employment. For today's workforce it is important to learn constantly and to be active in different kinds of networks in order to keep informed about the latest developments in one's occupation or profession. As a consequence, the workplace becomes the prime learning setting for today's workforce.

Defining workplace learning

One of the most persistent and discussed problems in the contemporary debate on workplace learning concerns its definition. Such debates are usually rather futile, particularly in growing fields and disciplines such as the present one. Conceptual change reflects the maturation of the field, rather than fundamental disagreement between its practitioners. Any attempt to fix a particular definition forever and for all is counterproductive as it stifles development by focusing on the need all to agree rather than on the necessity to discuss pending issues. Furthermore, definitions that list characteristics that are each individually necessary and jointly exhaustive – something people in these kinds of discussions often seem to portray as the ideal – are seldom possible. It is much more productive to stick to a list of characteristics that matter but are not individually necessary, and that jointly cover the intended meaning without exhausting it fully.

This approach was adopted by Van der Klink and Streumer (in press) and Streumer and Kho (2006). So, in accordance with Jacobs and Park (2009), we see workplace learning as the fruitful interaction of two processes, working and learning. Furthermore, we propose to discuss workplace learning in terms of dimensions that allow one to distinguish various kinds of workplace learning. The idea of dimensions allows nuanced positioning of the various workplace learning practices on each separate dimension. Here two of the main dimensions, formality and location, will be

briefly outlined. In being brief, we can, of course, do not full justice to the rich discourses in which workplace learning practices usually are embedded.

One might expect that there exists considerable agreement on the location of workplace learning, which is usually the work setting. However, the terms 'work' and 'workplace' are problematic, " for their conventional usage tends to ignore important spheres of unpaid work in homes and communities" (Fenwick, 2001, p. 3). Moreover these terms assume that work is based in unitary, identifiable, geographically organized places and activities.

The expanding possibilities provided by the latest technologies question even further the definition of the workplace as a demarcated location. The latest advanced ICT software and tools allow many employees to perform their work activities from other places than their office, like one's own home. There is also an increase of project groups with group members working at different locations and/or in different time zones. It is therefore becoming appropriate to define the workplace as any setting in which an employee is performing work duties, even if this location is his/her home. In addition, the rise of opportunities for designing high-fidelity simulations of work settings also questions the notion of the workplace. These simulations allow an optimal correspondence between simulated work activities and one's competences, offering possibilities to learn and experiment safely which cannot be easily arranged in the authentic work setting because of various kinds of severe risks for individuals and/or work processes.

Tynjälä (2008) claims that if researchers were asked to mention the most typical feature of workplace learning most of them would probably mention informality, which refers to the unplanned nature of learning experiences in the workplace. In general, workplace learning experiences occur incidentally, as a side effect of other (working) activities. Formal learning only represents a minor fraction of the learning that takes place in the workplace (see for example Lave and Wenger (1991) and Resnick (1987). Marsick (2006) argued that 60% to 80% of the learning in today's workplace occurs informally, whereas Canadian national surveys revealed that even 82% of the

employees considered themselves to be engaged in job-related informal learning with an average of six hours a week (Livingstone & Eichler, 2005).

The learning potential of the workplace

A very well-elaborated theory regarding the factors conducive for workplace learning has been proposed by Onstenk (1997). His theory is strongly rooted in earlier notions such as the work of the German researchers Baitsch and Frei (1980) and also integrates the findings of quite different streams of inquiry. In this chapter, we mainly rely on descriptions of Onstenk's theory as included in the work of Van Zolingen and Wortel (2011) and Van der Klink (2004).

The likelihood of learning in the workplace stems from three different but interrelated determinants: 1) the repertoire of an employee's competences; 2) the employee's willingness to learn, ranging from resistance to motivation for active and deliberate learning; and 3) the learning opportunities embedded in the workplace (see Figure 1).

Competences
experience
job skills
learning skills

Willingness to learn
Varying from resistance to active willingness

Job and Task Characteristics
Variety in tasks
Autonomy in task performance
Development in tasks: New problems, new methods and techniques
Multiple contacts with others

Information environment
Availability of information
Access to information through job aids, databases, networks, help utilities

Social environment
Feedback and support of colleagues and supervisors
Contacts with others, like clients/customers
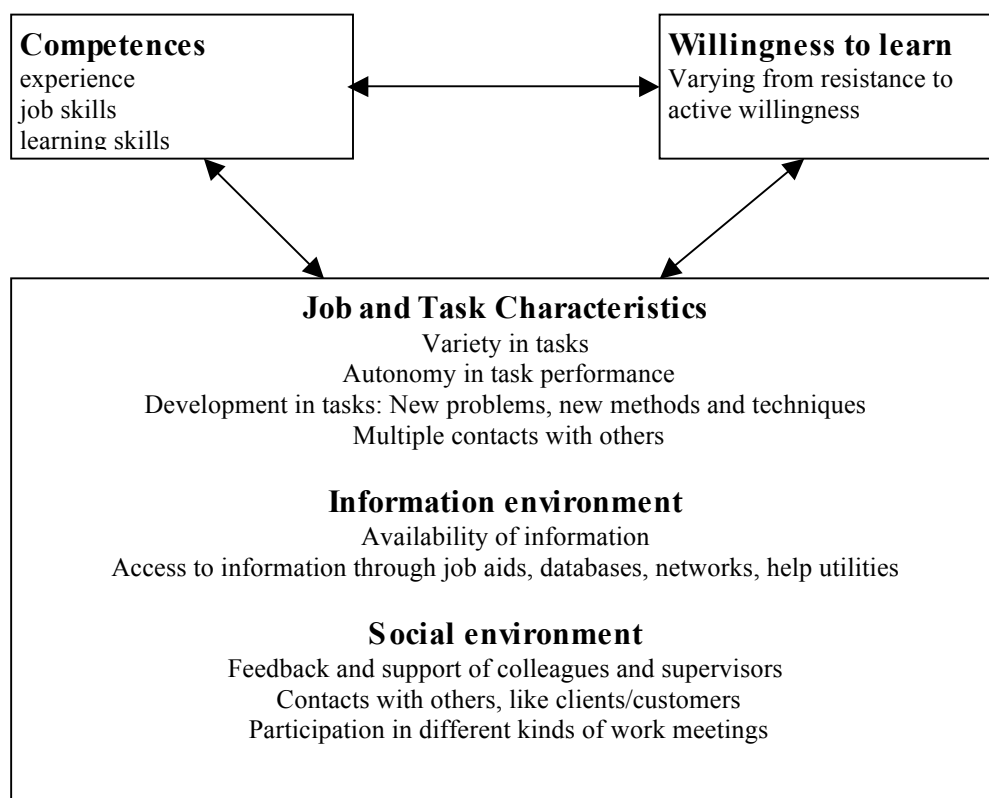Participation in different kinds of work meetings

Figure 1   The learning potential of the workplace (based on Van Zolingen & Wortel, in press)

Apart from the employee's motivation and his/her competences the possibilities for learning in the workplace depends strongly on three factors: job characteristics, information environment and social working environment, respectively.

The first factor, the content and complexity of a job, determines to a large extent the learning opportunities within a work setting, especially the following job characteristics appear to be important:

- Different types of tasks included in one job: planning and coordination, executive and controlling tasks;
- Sufficient autonomy for employees to perform their job tasks;
- Opportunities to be regularly engaged in dealing with unknown problems, so they remain familiar with the latest methods, techniques and products;
- Opportunities to build and maintain contacts with significant others (e.g., colleagues, customers) (Onstenk, 1997).

The second factor, the information environment, affects the learning opportunities since employees need to have access to different kinds of up-to-date information (availability of computer, access to intranet, internet, manuals, and handbooks). Access to job aids that synthesize in a visual manner the task execution could be supportive, especially for tasks that are seldom carried out (Van der Klink, 2004).

The third and final factor concerns the social environment, since the behaviour of others, such as the manager, team members, and other colleagues play an important role in providing or inhibiting learning opportunities in the workplace. It is vital that employees receive support from their colleagues and manager (through feedback, instructions and encouragements) for performing their daily tasks and for meaningful and critical reflection on problems and problem solving. In addition, being engaged in different kinds of conversations at work offer employees information and cues supportive for learning purposes (see for examples: Lave & Wenger, 1991; Solomon, Boud & Rooney, 2006).

During the past decade, several studies have been conducted regarding factors that are most conducive to workplace learning (see for example Ashton, 2004; Lohman, 2005; Skule, 2004; Van der Heijden et al., 2009; Van der Klink & Streumer, 2006). These studies also revealed some critical threats. The opportunities for workplace learning differ strongly between jobs, companies, and branches (Skule, 2004). Most workplace learning is strongly related to the 'here and now' and caters for mainly

minor changes in tasks, procedures, and methods. It allows one to increase one's competences to perform better on the current tasks but, because of its limited scope, it is questionable to what extent it contributes to expanding one's long-term employability (Garrick, 1998; Van der Heijden et al., 2009). In general, present workplaces do not provide sufficient ' space' to reflect thoroughly on work, learning and career (Boud, 2006; Poell, 2006; Tjepkema, 2003). Additional organizational interventions are necessary to establish more favourable learning conditions at work, especially if workplace learning ought to contribute to the development of new knowledge, or improvements in existing work practices. The recent technological enhancement of learning could well be the kind of intervention that creates conditions that are more conducive to learning at the workplace. In the next sections we will further explore the emerging field of technology-enhanced learning.

From media-supported training to technology-enhanced learning

This section highlights the evolution of e-learning by distinguishing four phases: Media-Supported Training, Computer-Based Training, Web-Based Training, and the current emerging Technology-Enhanced Learning. It discusses these phases and shows how the development of the technology is linked to the evolution of our understanding of workplace learning, as displayed in Table 2. This section does not claim that technology development causes this evolution but it does state that technology served as an enabler of reconsidering aims and position of workplace learning practices.

It should be emphasized that the technology phases described in Table 2 are not separate developments; most of the technologies still exist and are applied next to each other nowadays. The phases described therefore show the peak-periods of the technologies.

Table 2.   The evolving technology

	Media-Supported Training	Computer-Based Training (CBT)	Web-Based Training (WBT)	Technology-Enhanced Learning (TEL)
	Until 1980	1970-1990	1990 –	2000 -

	Mass media, broadcasting via radio and television	Not connected PC (stand alone) but interactive training	Connected PCs - Learning Management Systems (LMS)	Internet as digital habitat, Personalised Learning Environments (PLE)
	Allows many learners to attend pre-defined fixed learning contents	Designed for individual learners in front of a PC	Designed for online group-based training	Designed for learners with individual learning goals and learning communities
	One size fits all training	First personalized learning approaches by adaptive learning models (learning styles)	Computer supported training systems that are aligned to state-of-the-art education system	Highly personalized delivery of learning content
		Formal learning scenarios, replacing teachers with PC's	Formal learning scenarios, teachers and students remain in traditional roles	Informal learning and social learning scenarios, learning in networks and communities
	Created by mass media providers	Created by universities and companies	Created by universities and companies Learning material standardization (IMS, SCORM)	Created by universities and companies Partly made publicly available as Open Educational Resources (OER)
				Users generate content Mobile learning
				Educational data and Learning Analytics

Media Supported Training traditionally consisted of paper-based correspondence courses, using the regular mail for communication between teachers and students. This traditional way of training is still applied today in universities that offer distance education and in corporate training. The first electronic media-supported learning approaches were broadcasted over radio and later on over television. These media stimulated the rise of broadcasting universities that could easily broadcast their training content to schools, companies, and other large organisations (Bates, 2005). Still, many of today's learning scenarios apply a similar approach, although the

regular mail, radio or television have been swapped with faster, computer-supported communication techniques.

Computer-Based Training (CBT) consists of self-paced learning activities that are accessible via a computer. CBT was initially delivered by CD-ROMS or DVDs and presented the training content most of the time in a linear way, comparable to reading a book. The added value of CBT was the extension of text with interactive animations and videos, as well as assessment tests. CBT is often used for teaching facts, procedures or guidelines. Examples are mastering new software (e.g. word processing), learning safety procedures, or training in product features for marketing staff (Pritchard, 1989). Especially during the early 90's CBT was applied on a broad scale in universities, schools and enterprises, but the rise of Internet significantly decreased its use. However, even today there is still a market for CBT. A huge variety of different learning topics such as languages, math, and physical games are offered and it is especially valued by parents who want their children to do something useful at the computer.

Web-Based Training (WBT) marked a new decade of media-supported training. The training content is no longer delivered via CDs or DVDs but via the Internet. The web-based learning technologies stimulated the development of infrastructures for education and training within organisations (Mioduser et al., 2000). At present, various Learning Management Systems (LMS) such as Moodle or Blackboard appear as open-source or commercial product for the delivery of online courses. The main purpose of LMSs is to deliver learning content, offer communication facilities, and keep track of the learners from an administrative point of view. LMSs are still used in larger organizations and by almost every university. The rise of LMSs also forced several standardization processes, such as those involving SCORM[1] and IMS-LD[2], to

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[1] SCORM – (Sharable Content Object Reference Model) is a collection of standards and specifications for web-based e-learning. It defines communications between client side content and LMS systems. For instance it allows to export an e-learning course from one LMS and import it into another LMS system (http://scorm.com/scorm-explained/technical-scorm/).
[2] IMS-LD- IMS Learning Design supports the use of a wide range of pedagogies in web-based e-learning. It provides a generic and flexible metadata structure to express how a resource should be applied for certain

make course contents exportable and exchangeable between different systems. The typical features of a LMS are fairly comparable to each other and consistent across different LMSs. They are strongly tailored to ideas such as instructional design and formal training models.

Typical features are:

- Course Management
- Administration of learning content
- Self-assessment quizzes
- IMS and SCORM importer and exporter
- Asynchronous (email, forums) and synchronous communications (chat, whiteboard, teleconferencing)

Technology-enhanced Learning (TEL) focuses on the technological support of any pedagogical approach that utilizes technology, including informal learning approaches.

TEL deploys technologies from various technology-driven research fields. In that way, it creates new kinds of learning scenarios and enhances the development of novel learning and teaching approaches. Besides the traditional features of LMS systems, the emerging technologies help learners to reflect (e.g., Wopereis, Sloep & Poortman, 2010), connect peer learners (Van Rosmalen et al., 2008), and offer personalised information support. Examples of these emerging technologies are tools for measurement, collecting data, analysis and reporting data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which this learning occurs.

Especially, the growth of educational data created by CBT, WBT, Open Educational Resources, and the increasing amount of user-created content on the web are a driving force for TEL. This growing amount of data made information retrieval technologies applicable for the educational domain (Johnson et al., 2011; Retalis, 2006). Such technologies are used to analyze data and offer personalized information to the needs and the context of individual learners. It is expected that

pedagogies. It can be used to express many different pedagogies. The language was originally developed at the Open University of the Netherlands (OUNL) and is now IMS-Global standardized http://www.imsglobal.org/learningdesign/

increased opportunities for personalized learning will have a two-folded effect; reduction of delivery costs accompanied by more effective learning experiences, accelerating competence development, and increasing collaboration between learners. This matters in higher education as well as in workplace learning scenarios (Schoefegger, Seitlinger & Ley, 2010).

In that way, TEL can play a role in documenting the development of employees throughout their learning trajectories. Furthermore, knowledge exchange and social interactions can be made visual. Such visual representations of knowledge exchange can bring new insights and enhance reflection on learning at the workplace.

Emerging practices in workplace learning

This section presents examples of emerging workplace learning practices in which technology plays a critical role. These examples share some fundamental characteristics.

First, the examples demonstrate that people tend to learn and work in different settings (home, office, on-the-road, holiday), which questions the notion of workplace learning as a demarcated setting.

Second, these examples point at the critical role people themselves have in organizing their own learning. Technology-enhanced workplace learning is often rather informal by nature. It is far less designed by trainers or controlled by employers and it allows, or maybe even demands, that people act as self-directed and independent learners who are able and willing to steer their own learning.

Third, all examples show learning opportunities that are enabled because of the use of a specific technology. This does not necessarily imply that the learning opportunities only occur because of the existence of particular technology. However, it does point out that technology truly helps to create learning opportunities that were not obvious to the point of being practically absent.

Contemporary social networks, such as Facebook and LinkedIn, encourage people to contact others, become 'friends', and stay informed about each others' lives and work experiences. In short, they are about communicating. A learning network is in many ways akin to these social networks, but differs from them in that they are

specially designed to foster learning, emphasising informal and non-formal kinds of learning. Learning networks have two central features.

Firstly, they focus on supporting learning processes in which people learn with and from each other. In them, a participant has access to both other participants and resources that are accessible through the learning network. Instead of adopting primarily a re-active consumer role, the participant becomes a proactive co-creator of his/her own competency development, actively searching for resources, and asking for input and feedback from fellow participants. Moreover, participants can easily and actively contribute to enlarging the existing body of knowledge stored in the learning network, for example through answering questions posed by other members, and by adding information themselves, like documents, blog posts, videos, etc.

Secondly, as already indicated, learning networks are online environments that have explicitly been designed to support learning processes. They could be built from scratch, could make use of a blend of existing social software tools only, or could be designed as a mix of both.

An example of such a learning network is the recently launched Handover Toolbox for medical professionals (note that the name toolbox is a little confusing). It addresses the issue of the mistakes that are made at the 'handing over' of patients between medical professionals. Usually patients receive hospital treatment from multiple medical professionals. They do not always hand over the relevant patient information to each other properly and this then results in errors which can seriously impact a patient's health. A group of well-informed medical professionals worked on collecting a broad range of information, grouped into subtopics in the Handover Toolbox. This learning network offers them opportunities for retrieving information, for discussions, and/or for sharing their own ideas (by posting blogs or adding documents).
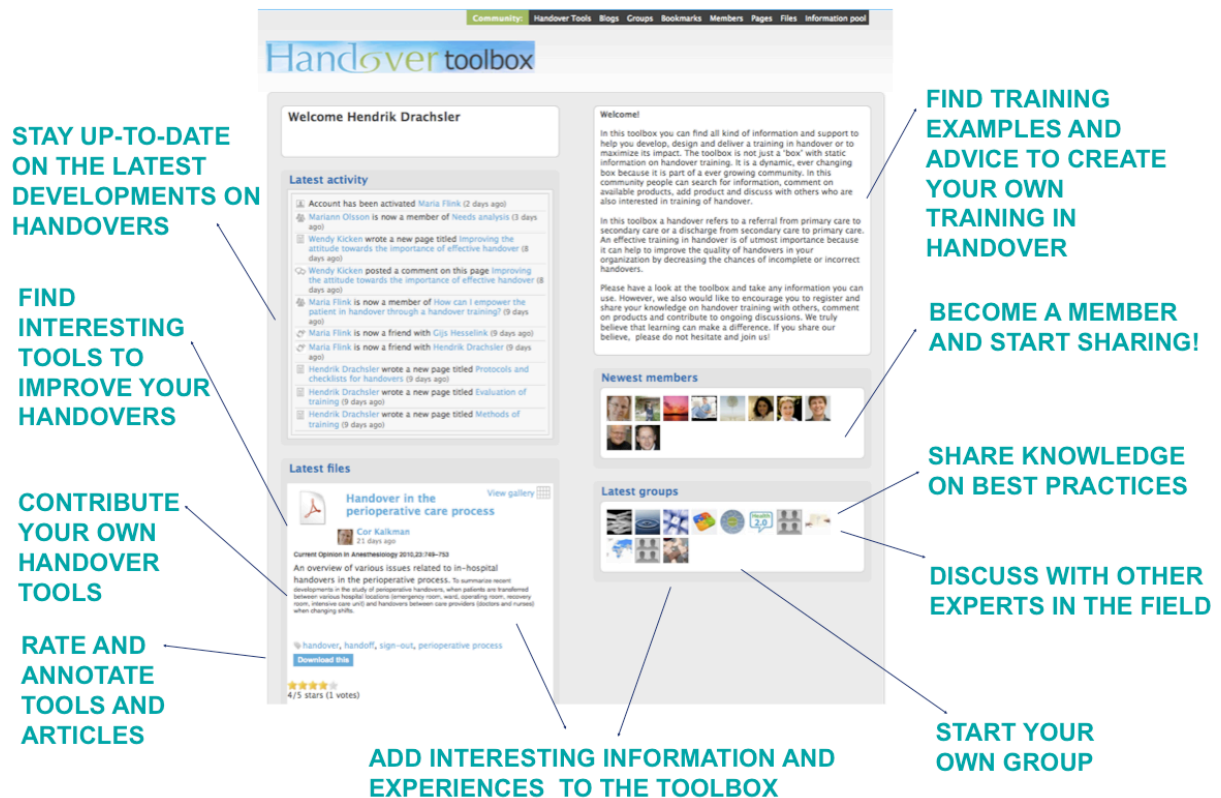
Figure 2   The homepage of the Handover Toolbox

To facilitate the process of knowledge sharing, groups are formed that are dedicated to particular subtopics, which support participants in finding others with highly similar interests (see Figure 3). Examples are a group working on Training Methods (effective training methods to increase professionals' skills in performing handovers), and a group dedicated to improving handovers in developing countries. To further encourage knowledge sharing, the learning network offers advanced options, for example RSS feeds for 'subscribing' to the latest adds on particular topics, or search utilities to quickly find persons and materials related to one's search terms.
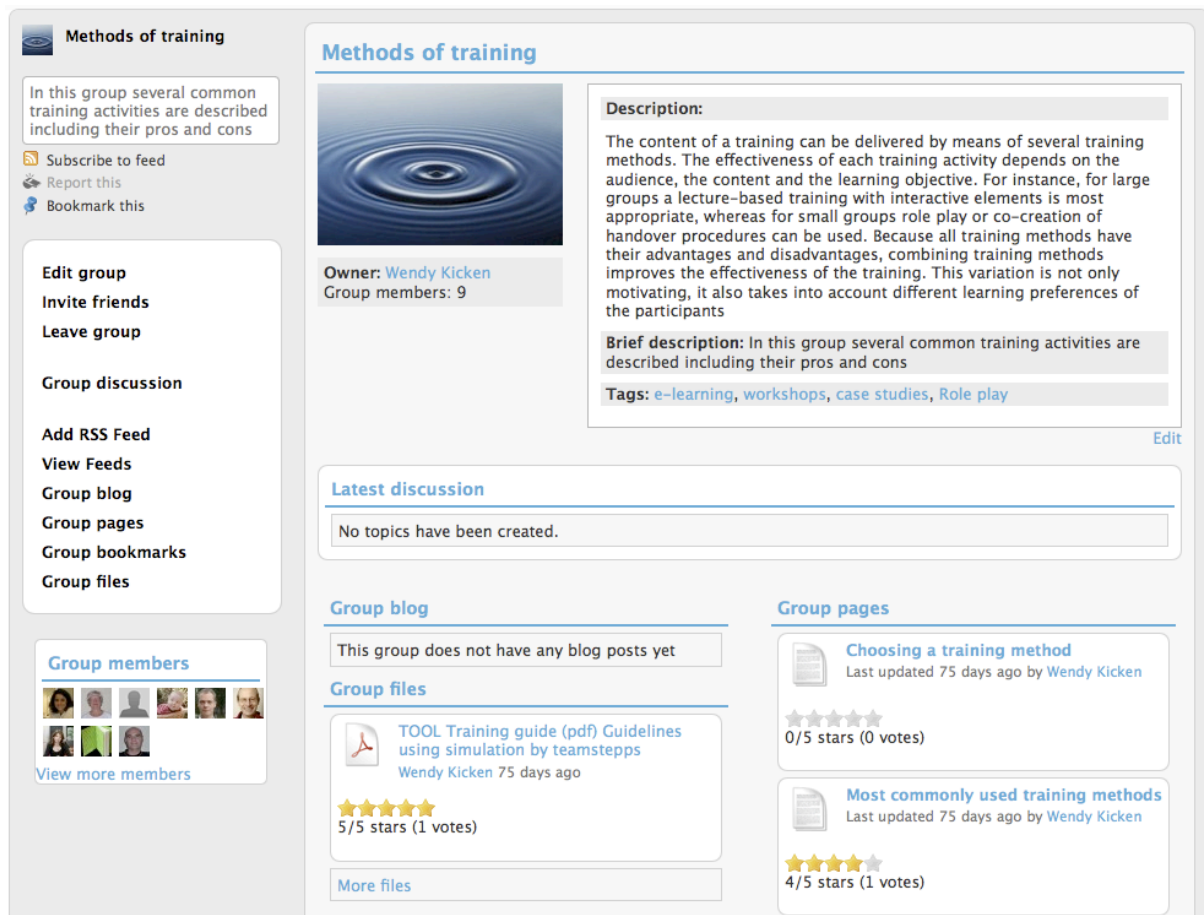
Figure 3   An example of a group within the Handover toolbox

In practice, learning networks differ strongly with respect to the topics they are devoted to, their openness and their purposes. Networks vary, for example, in their membership policies. Some of them are developed by and restricted to a closed, predefined group, such as employees of a particular company; other networks rather attempt to attract a broad range of potential participants. Although from the viewpoint of a company it is quite understandable to remain cautious about open entrance policies, for example, to protect that vital information is shared with competitors, networks that attract heterogeneous groups of participants appear to be more vital and successful in the long run (Sloep, 2008). The ultimate success of any learning network lies in its potential to attract large groups of people who are interested in learning through sharing and creating knowledge. A successful learning network usually has a number of communities that are devoted to learn about specific subthemes (e.g., the groups in the Handover Toolbox example).

The purposes of learning networks range from a principal focus on sharing ideas and exchanging information to a focus on the actual development of new knowledge. In the latter case sharing existing knowledge is then usually considered as a valuable precondition that supports participants in establishing common ground.

The concept of the learning network is strongly grounded in theories on communities of practice (Wenger, White & Smith, 2009) that investigate conditions under which digital groups will flourish in their learning endeavours, theories on social learning phenomena (Bandura 1977), notions on social capital in organizational contexts (Nahapiet & Ghoshal, 1998), and notions regarding team learning processes (Verdonschot, 2009). These different theories are combined and integrated by Sloep (2008) and Sloep and Berlanga (2011) in their work on the further underpinning of the learning network concept.

Mirco-blogs can create very dynamic and fast growing learning networks. A micro-blog is a type of blog in which the postings are limited to, say, 140 characters. This posting is called a tweet and mostly consists of a single sentence and/or a link to an online source. To structure and categorize these tweets, micro-blogs take advantage of so-called hashtags, which are like normal tags but with a hash symbol ('#') in front. They are a community-driven convention for adding additional context and metadata to tweets. Like normal tags, hashtags can be followed through RSS feeds.

Micro-bloggers can follow persons they are most interested in. In that way, micro-blogging strongly supports the connections between learners. Groups of learners who share an interest in and actively follow a set of hash tags effectively constitute a learning network. The posted tweets are directly displayed in learners' personal micro-blogging interface. From this, it becomes clear that for micro-blogging to be effective it is important that all tweets are public, as the purpose of micro-blogs is to express and share concise ideas with other learners within the network. The most prominent micro-blogging services are Twitter, Jaiku and identi.ca. More recently, varieties of services and software have been developed. Squeelr, for example, adds geolocation and pictures to the micro-blog with a time line. In that way, the micro-blogs can become contextualized to physical locations and time stamps.

To deal with sensitive and more confidential information organizations can take advantage of in-house micro-blogging solutions, such as Yammer, that make the tweets available within the network of the organization only. But also in that case the default is that tweets are openly available to all members of the organization.

Mirco-blogs especially support informal learning in the workplace and are therefore very powerful means for fast knowledge exchange. Using micro-blogging for workplace learning has two main advantages. Firstly, micro-blogs generate ideas in a cost-effective way. By posting ideas in a micro-blog everybody in the network can reply and further develop them. In that way, the collective knowledge within the entire organization can be utilised for sharing and developing knowledge in a way that requires very little effort because there is no need to arrange formal meetings. Micro-blogs increase the possibilities for informal knowledge sharing as usually takes place during lunch breaks or around the coffee machine. Secondly, most of the micro-blogging tools are also available on mobile devices such as smart phones and provide access to the latest information anywhere.

Micro-blogging combined with mobile devices could lead to unexpected and interesting micro-blogging networks, such as, for example, the tweeting farmer community in Nebraska that exchanges weather updates and other relevant information regarding farming in that region (CNN Tech, 2009). Not only farmers follow other farmers in that network, they are also followed by tourists and market traders who are interested in the latest news about the region and the new crop. The traders receive much faster an impression of the quality of the new crop and do not have to rely anymore on research studies forecasting the amount and quality of the future crop. The information that is presented in these studies is usually less up-to-date compared to the knowledge shared in the tweeting farmers' network.

People need tools to organize and manage the increasing amount of information available in their social networks, social bookmarks, blogs, and micro-blogging systems. Personalised Learning Environments (PLEs) help to organize the information in a way comparable to the traditional newspaper that combines different kinds in one view. The main difference between PLEs and a traditional newspaper is that the information provided in PLEs is provided by many individual contributors. Furthermore, PLEs have certain functionalities that go beyond a traditional

newspaper; they are perhaps better understood as some kind of highly interactive cockpit. PLEs aggregate different Internet sources and combine them in a personal view (see Figure 4). A web browser to surf through the web can be seen as standardized cockpit (Figure 4, left picture). Such a cockpit can be adapted and enriched with additional Web 2.0 functionalities (Figure 4, right picture). An adapted cockpit is a highly personalized environment as it contains a set of tools that an individual user prefers. It is a personal learning environment to navigate through the web and learning networks.
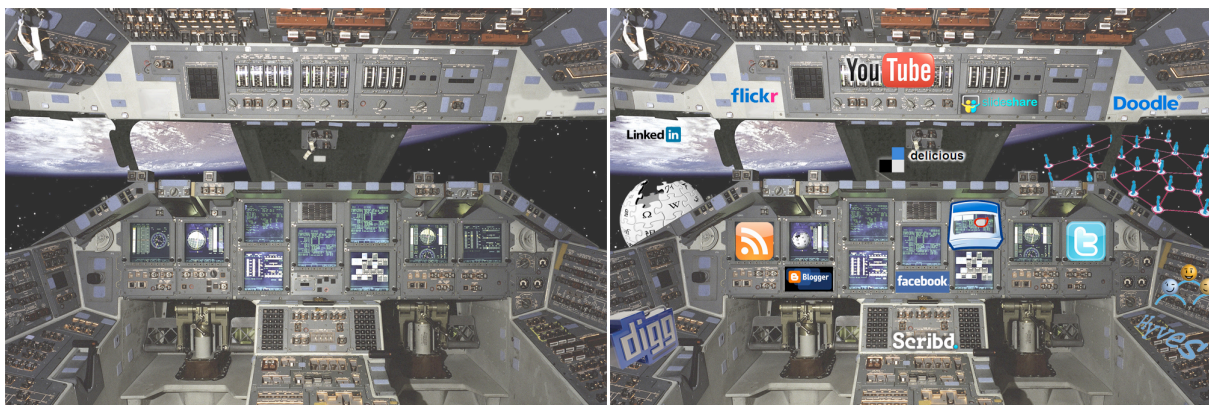

Figure 4. A standardized (left) and adapted cockpit (right)

Examples of personal cockpits are iGoogle or Netvibes, which allow their users to add and combine different information sources into one website. In their simplest forms, PLEs support informal learning as they require no institutional background, curriculum structure, and are free of use. Their functionalities focus on the needs of the individual learner rather than on institutional needs such as those of, say, a Human Resource Development department. Although they are most appropriate for informal learning, PLEs could be integrated and aligned with formal learning programs in universities and companies (Behnam, Martin & Sandra, 2009). PLEs posses more functionalities than micro-blogging systems and they can combine different social media sources in one environment. Users of PLEs usually integrate their micro-blogging system into their own PLE.

Figure 5. Screenshot of Personalised Learning Environments ()of Google (left) and
Pageflakes (right).
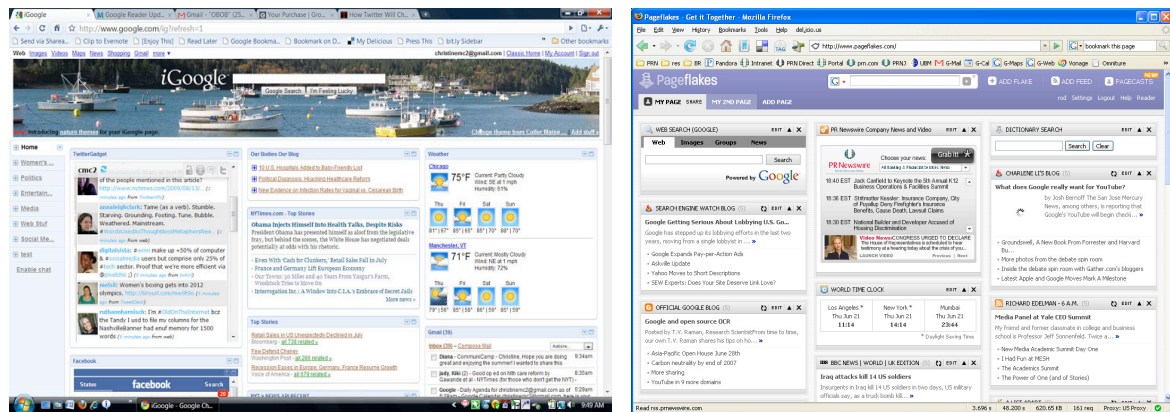
Conclusions

In this chapter we argued that technology-enhanced workplace learning is
increasingly recognised as a meaningful and promising concept that deserves further
exploration. This section presents the main conclusions and highlights the issues
that, in our opinion, deserve attention.

Firstly, there is a shift from formalised training to everyday informal learning in
the workplace. Traditionally, a highly structured and organised way of training was
deemed indispensable to efficiently teach students, using teaching methods, content,
assessments, and certificates. This model of training is nowadays increasingly
replaced by learning practices that are not necessarily structured and organized
according the old logics of training. That does not necessarily imply that everyday
learning in the workplace is by definition unstructured, rather it is organised and
considered with a mindset different from the traditional training philosophy.
The increased attention for informal learning in the workplace does not necessarily
imply a significant devaluation of the worth of traditional training. Training certificates
are still considered to be important and observable tokens of one's expertise and we
do not expect this deeply engrained societal belief to change overnight.

Secondly, closely related to the shift away from formalised training is the
changing role of employees. Society no longer sees them as passive consumers of

training modules, rather they are expected to demonstrate high levels of agency and need to steer their own learning. Especially growing numbers of self-employed professionals must rely on their own initiatives to learn about the latest developments within their vocation or profession.

Thirdly, it goes without saying that the emerging technologies are essential for many workers to stay in touch with the latest developments. The emerging technologies, as for example applied in learning networks, allow us to find different types of information and to become connected to others who share similar interests. What is very consistent in the evolving field of technologies is that they are under-used for the learning purposes for which they are most appropriate. For example, many workers approach their learning network as a traditional website, and they do not use it as an interactive environment that allow them to connect with their fellow workers. What they miss is its instrumental value in connecting with fellow workers. Admittedly, the way in which such sites have been designed and laid out often encourages this kind of thinking. So, the notion that they themselves can generate and add content to the learning network is, especially for novice members, at least one bridge too far. Apart from an interaction design that better highlights the networked character, novices almost invariably need guidance and support in utilizing the new opportunities for learning in a learning network. The availability of technology is no guarantee for its most effective use and people need to be supported in becoming more advanced users of the latest technologies.

Fourthly, technology-enhanced workplace learning is an under-researched field. A comprehensive understanding of its potentials and pitfalls requires significant research efforts. The lack of sound research findings follows both from the speed with which new technologies become available, thus leaving researchers always in pursuit of the latest and the newest, but it also follows from the relative novelty of the field. As we sketched in the above, we have just started to witness a re-evaluation of the formal training methods of the past, let alone that we could already have an evidence-based opinion of the opportunities of the present. We will discuss briefly what we see as the current, most prominent research topics that need to be addressed.

It is expected that the next generations entering the labour market have more experience with the latest technologies and therefore are presumably more willing to utilize them for learning purposes. Many youngsters now in high school cannot

imagine what life looks like without a mobile phone and permanent access to social media, like Facebook. So, we may surmise that the eagerness to use new technologies is presumably not the issue, but is it? It is becoming slowly clear that while the generation of the social natives is more inclined to use social media they do not necessarily use them better or wiser. And even if they were, other challenges remain that have to do with the best ways of, for example, supporting these next generations in advancing their abilities to find their way efficiently and effectively in an ever expanding and overwhelming load of information. This is about information literacy, if you like. Solutions for this overload can be partly technology-driven, like developing and implementing smart devices, such as recommender systems, that select and structure the information according to the user's requirements. But in addition to these devices, people need to advance their skills in finding and retrieving the most appropriate information (Pirolli, 2007; Gruwel-Brand & Wopereis, 2010).

Next to the required skills and knowledge there is also the need to raise awareness about the possible negative consequences of having a presence on the internet. So, people need to learn that online friends and offline friends are different concepts, with different social rules of 'engagements' attached to them (Boyd, 2006). We are only starting to scratch at the surface of the vast and profound consequences this will have for our online social life. More research, resulting in a better understanding and perhaps guidelines, is needed.

Related to this research topic is the need to maintain a coherent, online social identity, which is the online equivalent of our offline presence. As much as learning and work experiences at the workplace automatically are associated with the physical persons that we are, as little is this the case in the online world. There, we may have several, fragmented online identities that are spread over the various social networking sites and online learning providers that we happen to visit. And yet, a coherent online social identity matters. It matters, as it allows us to receive recommendations for learning events and opportunities that are better targeted to suit our own individual needs and preferences. It matters for our clients and employers, as they both can get a better impression of someone's suitability for a particular project or job. This requires research at the level of understanding what an online social identity is, what it entails in terms of privacy and regulations, and what it requires in terms of technical infrastructures and interoperability standards (Berlanga & Sloep, in press).

This set of prominent research topics can be extended, encompassing fields as different as the learning sciences, social science, and computer science. We predict that technology-enhanced workplace learning has an interesting and bright future!

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