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Smart Workplaces as Smart Learning Environments

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Abstract. This paper is focused on possibilities and circumstances enabling to view smart workplaces as a kind of smart learning environments. When we wish to increase the smartness of a workplace also its smart learning abilities must be increased accordingly. When designing a workplace that should be smart, we have to take into account, that it is necessary to respect different areas and professions, different working cultures, and the fact, that learners in the workplace come from different age groups with different educational and professional backgrounds. They also have different positions in organizations, so the particular workplace must be, if we really want to have it smart, tailored in accord with all these circumstances and requirements.

Keywords. Smart workplaces; Smart learning environments; Ambient intelligence; Workplace learning

1. Introduction

Smart learning environments, intensively developed as a result of focused research in the area of *Ambient Intelligence* (*AmI*), deserve also attention of the large community oriented on intelligent workplaces and technology enhanced learning at workplaces. Smart learning environments are considered a new degree of computer enhanced learning, with a considerable number of interesting facilities.

An intelligent workplace can be, among its other positive features, helpful in managing knowledge, which can be usefully needed by the users working in the workplace. Such knowledge can be used not only for solving various problems requiring some expert knowledge to be properly solved, but also for learning related knowledge at the workplace when creating sophisticated decisions or looking for solutions of complicated tasks. In that sense, any smart workplace could be considered and used as a smart learning environment, because any real smart workplace should be enhanced with learning facilities related to the workplace's purpose.

In the paper, we intend to map the recent state of the art in the area of smart environments oriented on learning with a focus on those their features that could be beneficial for workplaces. Our idea is that design of smart workplaces can be positively influenced with a number of features that are typically used is smart learning environments, and that both approaches can be combined aiming to reach a new quality of smart workplaces. Based on our recent research, we shall focus on smart learning

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possibilities on workplaces enabled by the recent results of smart workplaces area research.

2. Smart Workplaces

A manager, or any worker, working in a smart workplace, in order to be able of producing the best possible working decisions, should have the right information in the right time, as it is nowadays naturally understood. However, without having the appropriate knowledge the production of good decisions would not be easy, if not impossible.

Such a decision making should involve the following steps [17]:

- Identifying and defining the problem (a decision situation: an opportunity or trouble).
- Classifying the problem into a standard category.
- Constructing an abstract model that describes the real-world problem.
- Finding potential alternative solutions to the modelled problem and evaluating them.
- Selecting and recommending a good enough and appropriate solution to the problem.

The nowadays decision making environment is changing very rapidly, because business and its environment are more complex today in the global market. The decision making function has become more complex than in the past.

Factors causing complexity of managerial decision making are mainly as follows [27]:

- More alternatives of managerial decisions because of growth and advancement in ICT, as well as advancement and diversity in technology in general.
- Larger error cost because of increased competition, as well as increased structural complexity.
- More uncertainty because of increased consumerism, as well as decreased and fluctuating political stability.
- It is a need for quick responses because of decreased and fluctuating political stability, as well as growing, complicating and fluctuating market economy.

As a result of such complexity, managers must either become more sophisticated or must have the tools to overcome increased complexity. In our opinion, the latter case is the promising direction that should be expected from the ambient intelligence (AmI) approach as a collection of sophisticated intelligent tools for managerial decision support (cf. [1], [3], [7], or [13]). These tools could be a basis for a significant increase of the workplace smartness, making the workplace very close to the concept of smart learning environments.

The central design element of a smart learning environment is usually a dynamic learner profile, which includes learning history, learner specific information and learning goals. However, this is just a small (yet important) part of a really usable learning environment based on ambient intelligence principles. We do believe that the AmI principles can be considered as being very suitable for creating smart environments for learning in organizations, as a part of more general intelligent environment for managerial support. Usage of the AmI principles is in this case concentrated not only on solving managers' profiling problem, but it is more complex,

with a number of equally important issues (e.g. customization, context-based services, privacy issues, applications of AmI algorithms, intelligent interfaces, smart learning objects, etc.).

3. Smart Learning Environments

Maybe the best specification of smart learning environments can be found in the seminal paper [12] by Kinshuk and his colleagues. Their opinion is that "*a learning environment can be considered smart when the learner is supported through the use of adaptive and innovative technologies from childhood all the way through formal education, and continued during work and adult life where non-formal and informal learning approaches become primary means for learning".* That is, Kinshuk and his colleagues support the meaning of smart learning environments as neither pure technology-based systems nor a particular pedagogical approach, but a mixture of both. Nevertheless, this is just a conceptual specification, telling us very few about real smart learning environments.

According to [29], a smart environment for learning (or a smart learning environment) can be defined as any space where ubiquitous technology influences the learning process in an unobtrusive, social, or collaborative manner. It means, that a smart environment can be also an 'aware' workplace, capable of understanding something about the context of its inhabitants or workers. These ideas are very close to that of original ISTAG Scenario 4 *Annette and Solomon in the Ambient for Social Learning* (ASL).

The ISTAG Scenario 4 [4] was a vision of a learning environment, based on a position that learning is a social process. The scenario certainly was a nice incentive for a number of new initiatives focused on more or less successful attempts to design and introduce various types of smart environments capable to support different aspects of learning process. In our paper [21] we intended to suggest conceptually a new multi-agent architecture aiming at achievement of the "ideal" architecture inspired by the ISTAG Report [4].

Hwang [9] published an important idea about smart learning environments that have to be taken always into account: "*A smart learning environment not only enables learners to access digital resources and interact with learning systems in any place and at any time, but also actively provides the necessary learning guidance, hints, supportive tools or learning suggestions…in the right place,…right time and… right form"*.

Hwang [9] also summarized the following potential criteria for a learning environment being considered as smart:

(1) A smart learning environment is *context-aware*; that is, the learner's contexts in the real-world environment are taken into account by the smart learning environment, therefore the system is able to provide learning support based on the learner's online and real-world status.
(2) A smart learning environment is able to offer *instant and adaptive support* to learners by immediate analyses of their needs from different perspectives (e.g., learning performance, learning behaviours, profiles, personal factors) as well as contexts in which they are situated. Moreover, it can actively provide various personalized support to the learners, including learning guidance, feedback, hints and learning tools, based on their needs.

(3) A smart learning environment is able to adapt the user interface and the subject contents *to meet the personal factors* (e.g., learning styles and preferences) and learning status (e.g., learning performance) of individual learners. Learners can interact with the learning environment also via mobile devices (e.g., smartphones or tablet computers), wearable devices (e.g., Google Glass or a digital wristwatch), or even via ubiquitous computing systems embedded in everyday objects.

The context aware and ubiquitous learning as being naturally close to the educational perspective of Ambient Intelligence as well as to the idea of smart learning environments, was defined and studied by many authors. In one of our previous papers [20] we pointed out that ubiquitous computing has tremendous potential for framing learning, particularly in informal and socially constructed contexts. To reach this potential it is necessary designing, developing, and testing of new ubiquitous prototypes for learning systems. A more general overview of the AmI possibilities in education brings the paper [2], or earlier [19]. The aim of both papers was to present selected ideas supporting the vision of smart environments for higher education in the Czech university settings. Related ideas can be found also in our papers [18], [22], or [23].

4. Conditions and Possibilities for Workplace Learning

Without any doubts, learning is nowadays taken into account as an even more strategic factor for global competitiveness. Workplace learning is a key part of this process, driven by the impact of changes in demographics, skills demands, technologies, and people's relationships and roles within various institutions, organizations and communities. Learning is no longer confined to occasional formal activities in classroom environments. Work and career are no longer static and predetermined entities [16].

It is well known that one essential aspect of professional work is continuously developing competence and that one key aspect of professional work is that the professions drive their own knowledge development. Parding [25] describes workplace learning as intentional, in that it goes hand-in-hand with organisational development; it is also supposedly affecting both employees, employers and "customers" positively. The learning can take place within ordinary daily operations; it can be integrated in regular work activities often on a more informal basis, even though some external courses on a formal basis may constitute parts of this.

Previously, learning and development in various professions focused usually on formal learning taking place outside of everyday work, considering those professionals as passive content receivers [25]. The focus then shifted towards learning and development in everyday work, highlighting the importance of work organisation in such a form that enables time and place for learning. The terms *professional learning* and *continuous professional learning* are sometimes used to signal this shift in perspective.

As Manuti with colleagues pointed out in an interesting paper [16], already Stern and Sommerlad [26] proposed to re-define the term *workplace learning* by arguing different degrees of separation between *learning* and *work.* They suggested three broad approaches:

(1) *the workplace as a site for learning*; here the spatial separation of learning from work is supposed, learning activities are typically in the form of in-company training and usually take place outside of the immediate working environment – *off the job*;
(2) *the workplace as a learning environment*; here learning is planned and organized but takes place within the working environment and is largely *on the job*;
(3) *learning and working as inextricably linked*; here the best characterization is *continuous learning*; the workplace is structured to maximize processes of learning where employees learn how to learn as well as learn skills related to their own jobs and those of other workers [26].

Following Manuti and colleagues [16] and a couple of other authors (cf. [3], [14], [15], or [24]), the concept of workplace learning has acquired a broad array of meanings within the last decades. One of the commonly recognized result is that the efficacy of workplace learning is deeply linked to the efficacy of the types of learning that it can be referred to (see [28]). The types of learning can be specified as *formal* and *informal* learning, the informal learning is sometimes called also *non-formal* learning.

Formal learning is defined as structured learning that takes place *off the job* and outside of the working environment, typically in classroom-based educational settings. In the workplace, formal learning is composed of planned learning activities that are intended to help individuals acquire specific areas of knowledge, awareness and skills useful to perform their job well [16].

Informal learning recognizes that the acquisition of knowledge and skills in the work setting does not occur only from organized programmes, but learning also occurs during critical moments of need embedded in the context of practice. In contrast to formal learning, informal learning occurs frequently in situations that are usually not intended for learning, most notably in the actual work setting. Informal learning arises in situations where learning may not be the primary aim of the activity but is activated by some anticipated or existing problem situation that requires resolution. Informal learning may occur because of evolving activities including group problem solving, hypothesis testing, mentoring, coaching and job shadowing [16].

Smart learning environment approach can be naturally used in designing smart workplaces according the point (2) above, in the case, when the workplace is understood as a learning environment, as well as the point (3), when learning and working are inextricably linked. To design a smart workplace in such a way that intelligent learning facilities are its integral part is a challenge that certainly could increase the smartness of the workplace substantially. Here the novel methodology for designing smart workplace environments utilizing fuzzy relations can be used, as an working example [1], or suitable pervasive technologies, as described in [10]. In any case, the smart learning part of the workplace environment should be linked closely with the workplace purpose, approaches, and necessary knowledge behind the job. Knowledge management approaches could be helpful here, too.

5. Conclusions

According to [3], information and communication technologies has not only reshaped the traditional practices of formal education and work, but also our view of valuable

knowledge and competence. This was reflected in discussions about new kinds of complexities in work tasks and the need to identify new kinds of competencies to deal with an increased information flow. Another significant change provided by digital technologies is that learning activities such as workplace training and education can take place in the digital world. The use of intelligent technologies, such as cloud computing, learning analytics or big data, focuses on how learning data can be captured, analysed and directed towards improving learning and teaching, and supporting the development of personalised and adaptive learning.

This paper is focused on possibilities and circumstances enabling us to view smart workplaces as a kind of smart learning environments. Indeed, by increasing the smartness of a workplace also its smart learning abilities must be inevitably increased, in order to keep its smartness in the sense as understood commonly. Using new technologies, new approaches, new methodologies, as described e.g. in [1], [5], [6], [10], [11], or [30] certainly will contribute to higher smartness of smart environments in general, and particularly of smart workplaces, having in the future many of the positive features of smart learning environments [8]. However, as Tynjälä [28] pointed out, we should not to make the mistake of assuming that the workplace is a unified environment for all learners. Instead, we should recognize that people's situations and organisational positions with respect to working and learning in the workplace differ. Workplaces designed for different areas and professions have different working cultures and learners in the workplace come from different age groups, different educational and professional backgrounds and different positions in organizations. As Tynjälä [28] stressed as well, that important challenge for workplace learning is the tendency to design workplaces in such a way that they can provide a learning environment not only for their regular employees but also for students coming from institutions of vocational and higher education. That all should be taken into account when a smart workplace is going to be designed. We hope that some new methodologies or new approaches will be helpful in that.

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