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IMPROVING E-PERFORMANCE BY END-USER APPLICATION DEVELOPMENT

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Abstract. *In order to be successful, e-Learning has to be integrated into the concept of e-Performance and end-users should be motivated in organisations to contribute as application developers and to integrate learning objects into their real workplace environments. In this paper after a short presentation of e-Learning, e-Performance and of end-user application development in the process of learning, we present some practical results and examples of European project work.*
Keywords: *e-Learning, e-Performance, end-user development.*

Introduction

It is known that Information and Knowledge have a primary role in the success of organisations. Through integrating and adopting new technologies, teams and individuals can generate measurable performance improvement – e-Performance (Bernadez, 2002). By using new technologies, the e-Learning, a paradigm shift in the way of instruction, was developed and it was forecast a booming growth.

Now e-Learning is facing a deep crisis characterized by a surplus of "e-content" and a declining acceptance by the corporate market due to end-users' lack of interest (Rossett, 2000, Parks, 2001). In order to be successful e-Learning has to be integrated into the concept of e-Performance and end-users in organisations should be motivated to contribute as application developers and to integrate learning objects into their real workplace environments (Engert et al., 2002).
This last requirements result from recent studies of e-Learning that show also that actually e-Learning does not meet the requirements of effective performance, thus generating disappointing rates of actual usage and "drops outs" (ASTD, 2001).

In this paper after a short presentation of e-Learning and e-Performance (part 2) and of end user application development (EUAD) in the process of learning (part 3), some practical results and examples of end-users work are given.

e-Learning and e-Performance

Cisco Systems describes e-Learning as "Internet-enabled learning. Components can include content delivery in multiple formats, management of the learning experience, and a networked community of learners, content developers and experts. e-Learning provides faster learning at reduced costs, increased access to learning, and clear accountability for all participants in the learning process."

e-Learning is typical characterized by:

- focus on learning, not just presenting information,
- feedback mechanisms (e.g., quizzes) to measure learner's understanding of the material.
- personalization, often by dynamically combining "learning objects",
- administrative functions such as registration, payment and charge-backs, monitoring learner progress, testing, and maintaining records,
- collaborative tools such as online chat and discussion groups.

e-Learning presents some advantages also in connection with knowledge management (KM) which is a key success factor for individuals and organisations: KM and e-Learning are merging, being supported by facts like the following:

- The technology infrastructure employed for knowledge acquisition is often the same in the knowledge management concept and e-Learning.
- Technology tools let employees contribute new pieces of knowledge in the context of work knowledge archived in a repository or in the context of a learning-course (with chat or discussion forum). This new knowledge can be archived in the knowledge repository.

However, in spite of all this enormous potential, e-Learning results have been surprisingly disappointing. One reason can be because the adoption and use of e-Learning and its merging with KM demand from the user (Hamburg et al., 2002):

- high self directed learning skills and attitudes,
- computer literacy and "fluency",
- ability to organize existing knowledge, search and create new knowledge,
- ability to develop learning strategies and adapt learning tools.

New resources and practices of e-Learning have to be included as part of the user organisational culture, to the extent that the user can move learning objects easily in and out in his daily work routine and even more important can create small applications of these resources to his own tasks and projects.

The experience of the leaders in the field of e-Learning shows that one condition for e-Learning to be successful is to integrate it into the concept of e-Performance; it requires not only to embrace and use technology, but also to rethink and redefine the nature of jobs, roles, teams and organizational practice, following a process that can be described as following: “Concepts and tools, history teaches again and again, are mutually interdependent and interactive. One changes the other. That is now happening to the concept we call a business and to the tools we call information. The new tools enable us–indeed, they force us to see our business differently.” (Drucker, 1995).
Adopting an e-Performance approach allows companies to align and integrate e-Learning initiatives as part of a overarching performance system that has to produce meaningful and sustainable performance improvement in the workplace.

Some of the e-Performance requirements are explicit and can be gathered by communication and active participation of the real end-users, others are tacit and require analysis of the processes and technologies of the actual work.

An e-Performance platform (Figure 1) includes e-Learning objects in a learning intensive working environment, products in process and new concepts, definitions and applications developed along a collaboration process.

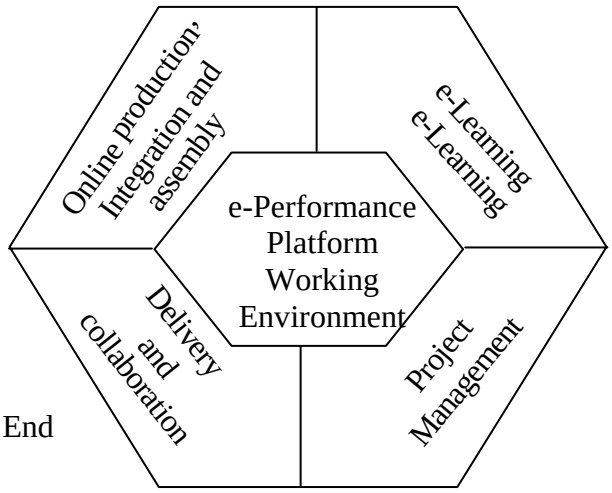

Figure 1. e-Performance and working platform

In the following part we present some aspects of EUAD in a learning intensive working environment.

Learning and end-user application development

A fundamental challenge for the next generation of computational media and new technologies is not only to deliver information to individuals, but also to offer facilities and resources for social debate and discussion, for collaborative design and development. In many activities, learning cannot be restricted to finding knowledge that is "out there". In many cases the knowledge to understand, frame and solve the problems in connection with these activities (e.g. urban design) does not exist; rather it is constructed and evolved during the process of solving these problems (Fischer, 2001). From this perspective access to existing information and knowledge (often seen as the major advantage of new media) is a very limited concept and should be complemented by creating opportunities for users to engage in participation, for example to develop end-user applications (EUAs) in a learning intensive working environment.

End-users are individuals who, although skilled in a task domain, lack the necessary computing skills or motivation to harness traditional programming techniques for the environments they use in support of their work. Typical areas of EUA include:

- mobile systems and their application (e.g. gaming and commerce),
- office, industrial and scientific applications (e.g. decision support and machine control),
- home applications (e.g. consumer embedded devices and information management).

The main distinction between an EUA and an organisational application is that the EUA is originally:

- developed by the end-user,
- from his/her own initiative and activity,
- mostly for the use of the end-user him/herself but also for the use of other people.

One of the important aspects in this context is the motivation of EUAD. This aspect should be considered not only from an organisational point of view but also from an individual one. According to Davis et al. (1989) the motivation structure of persons consists of three factors:

- The intrinsic motivation – the activity is performed because it is enjoyable.
- The extrinsic motivation – it is linked to the "perceived usefulness" of the action in relation with the outcomes.
- Subjective norms – the person thinks that he has to perform the action in order to be a good worker in the eyes of others.

The activity of EUAD in organisation is an issue of learning. In this context it is known that learning includes both conscious and cognitive as well as unconscious and social features. When studying motivation, the social and psychological features make sense in the process of learning. On the other hand, the learning of new software technology is also cognitive and goal-oriented in nature. These features work differently among individuals: some people are more social and practically oriented, whereas actions of some others one is based on systematic rules and theoretically argued concepts.

One important approach of learning in connection with EUAD is the "productive learning" given by Engeström (1990). According to him, learning is a construction where the "learner constructs a picture of the world. The student always ends up correlating and merging newly acquired material into his or her ongoing activity and earlier construction".

Engeström draws a frame for productive learning that we present in Figure 2 and use in our projects:

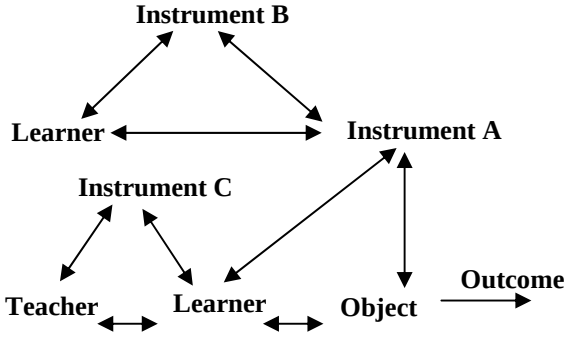

Figure 2. The structure of productive learning

In this context, the learning process that concerns the EUAD covers two topics:

- the organisational task to be done,
- new technology in the form of instruments used in the organisational task (Instrument A), at learning the organisational task(Instrument B) or to develop an application (Instrument C) – Figure 2.

In the case of EUAD, the end-users use technological instruments to develop applications and this development can be regarded as a good way of productive learning and of improving the e-Performance.

Another approach of learning is the "experiential learning model " by Kolb (1984) that helps to understand the learning process and the differences between different people as learners (Figure 3). It is a four-stage cycle. According to the Kolb model, people differ substantially from each other in how they acquire new knowledge and how they act in problem solving situations.

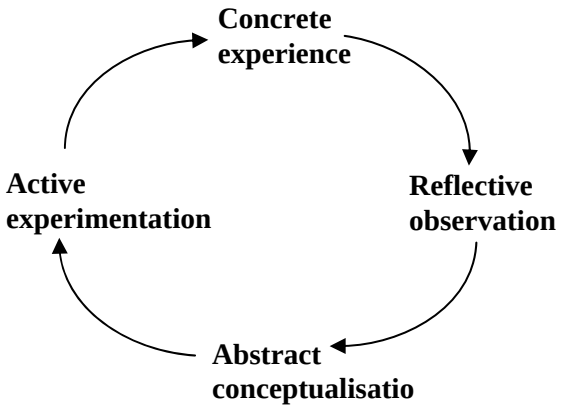

Figure 3. Experiential learning model

Kolb categorises the individual learning styles into four classes (Table 1) by using two dimensions:

- active experimentation orienting people to acquire knowledge by testing and application of their ideas to see if they work in practice,
- reflective observation orienting people on reflection of the experience.

The concrete experience/abstract conceptualisation indicates the personal styles of problem solving.

Table 1: Kolb´s learning styles

Knowledge	**Acquisition**	
Problem solving	**Active experimentation**	**Reflective observation**
Concrete experience	Accommodator style of learning	Diverger style of learning
Abstract conceptualisation	Convergent style of learning	Assimilator style of learning

In EUAD activity the people apply their individual e-Learning styles when solving problems and adapting computer software.

There is a difference between the two theories of learning described above: Engeström stresses the rational and conscious part of the human being actor and learner, Kolb stresses the differences between individuals as learners.

In the next part we present some research results and EUAD examples.

Research results

The research results presented in this paper are based on interviews with active EUA developers carried up at the University of Tampere (Rantapuska, 2000) and at the IAT, Gelsenkirchen within the German project ÖFTA (Brödner et al., 2003).
Research results of the two projects show that the most EUAD activities are:

- desire-driven ones mainly based on intrinsic motivation,
- requirement-driven activities based on extrinsic motivation.

The Tampere research results show that the developers of EUA can be grouped as following:

- inventors taking the EUAD as a hobby,
- utilitarians who take the EUAD as a tool to improve their actual work performance,

- work enrichers wanting to make their work more interesting,
- opportunity seekers for whom the activity plays an important role in their position in their work place.

The following table (Table 2) refers to tools, working methods and problems which EUA developers have used in the process of implementation.

Table 2: Properties of EUAD

Category/ Properties	**Tools and Methods** Dimensional range
Tools	spreadsheets – data base – programming languages
Working methods	no systematic methods used
Method of information acquisition	trial and error, courses, friends/colleagues, manuals, Internet (WWW, discussion groups), help systems, magazines/journals
Problems	isolation, no courage to ask help, organisational disharmony, difficulties in analysis, difficulties in implementation

The German project OFTA is about aspects of the application of new technologies for learning, particularly critical ones. One important problem is the motivation of end-users as developers of learning environments.

Two negative aspects we found in our project research were lack of continuity of EUA over time and not enough collaboration betweenteh end-users, so there was a lack of synergy.

A conclusion of the project research is that one successful model of collaborative EUA can be open source development. This is an activity where a community of software developers collaboratively constructs systems to help solve problems of shared interest and for mutual benefit. Powerful tools and environments such as the Linux operating system and Apache Web server have become both useful and reliable because of the evolutionary contributors. Open source software provides technical mechanisms allowing users to become EUA developers.
One of the principle for using open source as a success model for collaborative EUAD is that open source environments must support working tasks that people engage in in order to improve the e-Performance. But great effort is required to include aspects of e-Performance into learning processes.

5. Conclusions

There is a need for enterprise risk models, to identify areas suitable for EUD within organisations. Without the existence of such an approach it is felt that end-users could underestimate the complexity of what they are trying to achieve and possibly do harm to the organisation.
Processes and policies are needed to ensure that end-user developers are both accountable for the applications they develop as well as being recognised for the extra work done.

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