Chapter XII
Cognitive Learning Approaches to the Design of Accessible E–Learning Systems

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ABSTRACT

The creation of exciting, new, powerful and accessible e-learning systems depends upon innovations in cognitive science, human learning, e-learning implementation principles and derivative, technological e-learning solutions. The issues of user sensitive design and user diversity are central to such developments and so must be one of the focuses of any effective e-learning system. This chapter shows how a unique characterization of the interaction between e-learning requirements, accessibility and cognitive user modeling generates an inimitable set of solutions to current e-learning problems, through a simple and supportive conceptual framework. In so doing, the authors show how evidence and insights from diverse subjects such as cognitive science, computing science and social sciences can be integrated to provide a robust platform for the next generations of pedagogically enriched e-learning systems.

INTRODUCTION

In the emerging inclusive Information Society (Savidis & Stephanidis, 2004), the intended users of e-learning systems are becoming much more demanding, expecting systems that are fast and powerful, customized and accessible, intelligent and adaptive, effective and efficient for human learning (Adams & Granić, 2007; Granić, 2008).

Focusing on e-learning, i.e. an instructional content or learning experience delivered or enabled by electronic technology (Pantazis, 2001), it is the case that, despite so much publicity and activity, progress in the field has been unexpectedly slow. In order to improve the learning experience and effectiveness and increase an e-learning system's intelligent behaviour, interactive mechanisms merit additional consideration and enhancement.

There should be a synergy between the learning process and a user's/learner's interaction with the e-learning application (Squires & Preece, 1996), additionally taking into account the different ways users learn, so supporting their natural and flexible interactions with the host system. Most current e-learning applications are static and inflexible, designed with little or no consideration of users' preferences and abilities. It is vital to overcome this one-size-fits-all approach and provide users with individual learning experiences through e-learning systems with intelligent and adaptive user interface.

BACKGROUND

In this background section, we provide broad definitions of helpful concepts that form the basis of 21st century e-learning. They include, but are not limited to, such concepts as: learning environments, e-learning, accessibility, adaptability, adaptivity, ambient intelligence, system smartness and user modeling (Adams, 2008).

A *learning environment* is a setting that is arranged to enhance the learning experience. In order for learning to take place, according to Pulkinen and Peltonen (1998) there are three essential components of any learning environment: pedagogical and psychological functions (learning activities, teaching situations, learning materials, assessment, etc.), appropriate technologies (how the selected tools are connected with the pedagogical model) and social organization of education (time, place and community). From another perspective a learning environment can be defined as constructivist in nature, enabling the learners to engage in "sense-making" about extensive information. On this view, the learning environment comprises four components: an enabling context, resources, a set of tools and scaffolds (Hannafin, Land, & Oliver, 1999). In addition, realistic contexts motivate learners, and involve them in complex, real-world tasks.

Piccoli, Ahmad and Ives *(*2001) argue that learning environments are defined in terms of time, place and space. According to them, it is also possible to expand the traditional definition of learning environment to include three further dimensions: technology, interaction and control. However, their definition did not include the consideration of learning the system usage and the corresponding skills required. A simple definition of e-learning is instructional contents or learning experiences that are delivered or enabled by electronic technology (Pantazis, 2001). One of the most technically advanced form of e-learning can be seen as the virtual learning environment. In early versions (Pimentel, 1999) students learn through an interactive environment that deploys text, images, voice, video, touch and graphics. In later versions (Little, 2008) virtual reality applications such as Second Life™ can proffer virtual realities than can become almost totally immersive and offer enhanced learning opportunities, including social or inter-personal skills.

Accessibility is another of our key concepts. It can be defined as the absence of barriers that would stop or impede user exploitation of a learning system. Adams (2007) has identified at least six types of accessibility problem. The barriers identified are summarized as:

a. hardware barriers,
b. communications barriers,
c. sensory / perceptual problems,
d. cognitive barriers, particularly in navigational demands and comprehension of contents,
e. barriers to learning and performance objectives and
f. unrealistic response requirements (see further ahead in this chapter for more details).

Accessibility is an increasingly noteworthy concept and is more and more supported by punitive legislation. For example, in the UK the Special

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