CHALLENGES AND OPPORTUNITIES IN E-LEARNING

Ioana MOISIL *
Iulian PAH **

Abstract: The paper is a position one, discussing the challenges and the opportunities offered to education by the new information technologies through the e-learning paradigm. It starts with different definitions for e-learning and then approaches several learning models, advocating for an e-learning centred on the student, adapted to different learning styles, to different knowledge backgrounds. Web 2.0 implications on e-learning are discussed. A proposed e-Learning system developed by a team of researchers from Babes-Bolyai University in Cluj-Napoca and Lucian Blaga University of Sibiu is used as an argument. The DANTE project – Socio-Cultural Models implemented through Multi-Agent Architecture for eLearning - is based on a global model for the virtual education environment, student centred, that facilitates the learning through collaboration as a form of social interaction.

Keywords: e-learning, learning methods, social learning, socio-cultural theory, multi-agent systems, web 2.0

I. INTRODUCTION

E-learning - electronic learning - has appeared on the educational stage as a true successor of the 20th century paradigms of Computer Aided Learning (CAL), Computer Aided Training (CAT) and Computer Aided Instruction (CAI), encompassing Computer Based Learning (CBL), Computer Based Training (CBT) and all forms of web based learning. It was, and it is, a natural evolution product generated by technological advances. We are witnessing today a proliferation of e-learning products, most addressed to continuing education, distance learning, but also for students in schools and universities. Generally speaking, we can consider e-learning as a term used to refer computer enhanced learning [1], but when coming to define it, we must take care to specify the context in which it is used. Moreover, as technology is so rapidly evolving, e-learning is now accompanied by M-learning that is e-learning using mobile technology. In the followings we will start by briefly explore some of the most used definitions of e-learning, trying to extract the common features. And then we will look at the technology used to support e-learning and at the accompanying terminology; all with the final goal to expose challenges and opportunities that e-learning is bringing to the 21st century.

1.1. Definitions of e-learning

First of all let’s have a look at how the scientific community is defining e-learning. In 0.25 seconds Google will bring us no less than 458,000 definitions. Some of them are putting the accent on the “online” character of learning:

- learning facilitated and supported through the use of information and communications technology. e-learning can cover a spectrum of activities from supported learning, to blended learning (the combination of traditional and e-learning practices), to learning that is entirely online. Whatever the technology, however, learning is the vital element [3].

- A process that facilitates education using a network (Internet, LAN or WAN). Software created to teach the user new skills and delivered using web technology and methods [4].
• **training or learning** that takes place **via the web**. Training programmes can be conducted partially or fully using the Internet [5].

Other definitions are less restrictive: e-learning meaning “learning activities based on any electronic format”:

- **Education offered using electronic delivery methods** such as CD-ROMs, video conferencing, websites and e-mail. Often used in distance-learning programmes [6].
- **Learning activities based on any electronic format** [7].
- **learning** that is accomplished **over the Internet, a computer network**, via CD-ROM, interactive TV, or **satellite broadcast** [8].
- Learning that is facilitated by the use of **digital tools and content**. Typically, it involves some form of interactivity, which may include online interaction between the learner and their teacher or peers [9].
- Any technologically mediated **learning using computers** whether from a distance or in face to face classroom setting (computer assisted learning) [10].
- **The delivery of a learning, training or education program** by **electronic means**. E-Learning involves the use of a computer or electronic device to provide training, educational or learning material [11].

Last but not least, here are some definitions from the group that consider e-learning to cover all aspects of learning using ITC:

- A key issue in pedagogy is individualization, i.e., adapting the teaching to the needs of various learners. In many cases, however, IT supported education has so far focused most on porting existing courses with traditional teaching methods onto the web, just making non-individualized teaching even more widely available. The semantic web has potential regarding the creation of more intelligent e-learning applications, providing individualization without a prohibitive increase in man-power [12].
- This term has two different meanings. It can mean a comprehensive offer of courses and "on-the-job" e-business training modules for all levels of management for the purpose of accumulating internal e-knowledge and promoting e-business-related networking and the exchange of know-how. It can also mean learning via electronic media [13]
- E-learning most often means an approach to facilitate and enhance learning through the use of devices based on computer and communications technology. Such devices would include personal computers, CD ROMs, Digital Television, PDAs and Mobile Phones. Communications technology enables the use of the Internet, email, discussion forums, and collaborative software [14].
- Covers a wide set of applications and processes such as web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet/extranet, audio and videotape, satellite, and CD-ROM. However, many organizations only consider it as a network-enabled transfer of skills and knowledge [15].

And we can go on…… So what are the features that constitute the core of e-learning? Of course the most important is learning. e-Learning is mainly about learning and that the “e” can be for electronic or enhancing or even enable, but it is not the target. e-Learning has to be centred on people that are learning. It has to address different learning styles, different levels of basic knowledge. The technical aspects of electronic delivery of knowledge are, of course, very important, but they must be adapted to the learner and her/his environment. It is obvious that students learn better if the text books are well organized, richly illustrated, with clear headings, etc. And if we can add to all these animation and colors, the results are encouraging. e-Learning applications are manipulating a lot of different learning objects, from courses to projects and home works. The efficiency and the efficacy of these systems depend greatly on how well they adapt to the individual student profile. Many critics have attacked these products for their low psycho-pedagogical validity and a lack of standard quality
assessing criteria. Challenges that e-learning software developers have to cope with are linked to these psycho-pedagogical and social characteristics that depend on the student’s individuality. Learning Management Systems (LMS) offer, in general, facilities for managing authors, tutors, administrators by maintaining password systems and catalogues with roles, functions for controlling access to content, but they have a very few options for monitoring students evolution (only quizzes and multiple choice grids for evaluation) and deal with feedback. In spite of all these deficiencies, the fact that LMSs are Web based makes them very popular.

1.2. Technologies for e-learning

Many virtual study programs started by being text based, using HTML, PowerPoint, or PDF documents, eventually incorporating a wide range of multimedia technologies. Lately animation and virtual reality (VR) are gaining space (Macromedia Flash, VRML and other animation and VR software). Today the list of technologies used to design, develop and present e-learning applications is quite long: hypermedia, classroom response systems, blogs, e-mails, cooperative systems, computer aided assessment systems, electronic performance support systems, learning management systems, screencasts, simulation, web 2.0 communities, ePortfolios, games, video and audio based courses, wiki, multimedia CD-ROMs and DVDs etc. In general, an e-learning application is using more than one of these techniques.

Due to the spreading of e-learning applications the need of standardization became stringent, to enable to reuse and to share learning objects. We have today several standards that solve a number of problems: the description of technical, administrative, and pedagogical aspects of content (IEEE LOM), the interconnections between content and learning actors (IMS Learning Design), the aggregation and ordering of content for deployment (IMS Content Packaging), and how content should be sequenced for the learner (IMS Simple Sequencing). It is true that commercial interests are influencing the standardisation process and we still do not have standards targeting deep learning and psycho-pedagogical social aspects. In addition there are a number of Web technologies very promising like the use of XML, XSL, and the Resource Description Framework (RDF) for the separation of structure, presentation, and semantics, web services, for system-to-system integration and interoperability. Advances are to be forecast as many research projects are tackling these topics. For example, the LT4eL project, developed in the frame of the EC FP 7 R&D programme, uses multilingual language technology tools and semantic web techniques for improving the retrieval of learning material. The developed technology will facilitate personalized access to knowledge within learning management systems and support decentralisation and co-operation in content management.

II. ABOUT LEARNING

Researchers in psychology and sociology have offered us a multitude of theories trying to explain how learning occurs. Many of these, as social constructivism, communities of practice (situated learning), socio-cultural theory, are explaining learning through social interaction. Most of the classical learning activities are involving abstract knowledge and very often the context is neglected. Situated learning considers that usually learning is dependent of the context, of the activity and of the culture in which it is situated. In situated learning, an important role is played by social interaction. The student (learner) becomes involved in a "community of practice" which embodies beliefs and behaviors to be acquired. This community of practice is viewed as a spherical universe. When you start learning, you are on the periphery of the community. In the process of acquiring what is taught, the student becomes more active, more opened and engaged within the culture and she/he evolves towards the center of the community, becoming more experienced and eventually an expert. Lave and Wenger called this process the "legitimate peripheral participation". Situated learning is mainly unintentionally and that makes it difficult to be modeled. Another learning theory, the social learning theory of Bandura is centered on the importance of observing and modeling the behaviors, attitudes, and emotional reactions of others. Bandura [18] considers that: "Learning would be
exceedingly laborious, not to mention hazardous, if people had to rely solely on the effects of their own actions to inform them what to do. Fortunately, most human behavior is learned observationally through modeling: from observing others one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action. What is common between situational learning and social learning theory is social interaction. The idea behind social learning is that cognitive, behavioral and environmental factors are interacting in determining a certain human behavior. The domain of this theory is covering activities and functions as attention, memory and motivation and therefore is including the cognitive and behavioral paradigms. Interacting factors that influence behavior are grouped in four categories (processes): group 1 - attention (modeled events as distinctiveness, affective valence, complexity, prevalence, functional value, and observer characteristics: sensory capacities, arousal level, perceptual set, past reinforcement), group 2 - retention, (symbolic coding, cognitive organization, symbolic rehearsal, motor rehearsal), group 3 - motor reproduction (physical capabilities, self-observation of reproduction, accuracy of feedback), and group 4 - motivation and external, vicarious and self reinforcement.

In the constructivist theory of J. Bruner, the student (learner) uses cognitive structures (mental models, schema etc.) to build knowledge from prior and current information and knowledge. Cognitive structure provides meaning and organization to experiences and allows the learner to "go beyond the information given". Learning is considered an active process. The trainer, the teacher or the instructor must try to and help the student to transform information, to discover new concepts and principles, to build hypothesis and to verify them, to make rational decisions. Between the teacher and the student there is a continuous, active dialog as in Socratic learning. The educational system has to enable the student to receive the information into a form that is appropriate to her current level of understanding. The learning process must evolve on a spiral, the student continually building from prior learned items. In his book, Toward a Theory of Instruction, Bruner addresses four major aspects: predisposition towards learning, the ways in which a body of knowledge can be structured so that it can be most readily grasped by the learner, the most effective sequences in which to present material, and the nature and pacing of rewards and punishments. More recently, the constructivist theory has been enriched with social and cultural aspects of learning. Current conceptualizations of socio-cultural theory draw heavily on the work of Vygotsky (1986), as well as later theoreticians (see, for example, Wertsch, 1991, 1998). According to Tharp and Gallimore (1988) "This view [the socio-cultural perspective] has profound implications for teaching, schooling, and education. A key feature of this emergent view of human development is that higher order functions develop out of social interaction. Vygotsky argues that a child's development cannot be understood by a study of the individual. We must also examine the external social world in which that individual life has developed. Through participation in activities that require cognitive and communicative functions, children are drawn into the use of these functions in ways that nurture and 'scaffold' them" (pp. 6-7). Kublin et al (1998) succinctly state that "Vygotsky (1934/1986) described learning as being embedded within social events and occurring as a child interacts with people, objects, and events in the environment" (p. 287). Vygotsky's theory of social cognitive development is complementary to Bandura's social learning theory.

III. WEB 2.0 IMPACT ON E-LEARNING

Web 2.0 is defined in Wikipedia as a trend in World Wide Web technology, and web design, a second generation of web-based communities and hosted services such as social-networking sites, wikis, blogs, and folksonomies, which aim to facilitate creativity, collaboration, and sharing among users.

In table 1 you can find a list (not exhaustive) of the Web 2.0 characteristics.
Web 1.0  Web 2.0
DoubleClick  -->  Google AdSense
Ofoto  -->  Flickr
Akamai  -->  BitTorrent
mp3.com  -->  Napster
Britannica Online  -->  Wikipedia
personal websites  -->  blogging
evite  -->  upcoming.org and EVDB
domain name speculation  -->  search engine optimization
page views  -->  cost per click
screen scraping  -->  web services
publishing  -->  participation
content management systems  -->  wikis
directories (taxonomy)  -->  tagging ("folksonomy")
stickiness  -->  syndication

Table 1. Web 2.0 by examples (from What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software, by Tim O'Reilly)

In O'Reilly vision the core competencies of Web 2.0 Companies are:

- Services, not packaged software, with cost-effective scalability
- Control over unique, hard-to-recreate data sources that get richer as more people use them
- Trusting users as co-developers
- Harnessing collective intelligence
- Leveraging the long tail through customer self-service
- Software above the level of a single device
- Lightweight user interfaces, development models, AND business models

In figure 1 we have reproduced a "meme map" of Web 2.0 that was developed by Markus Angermeier on November 11, 2005 at a brainstorming session during FOO Camp, a conference at O'Reilly Media. As the later emphasized, it is very much a work in progress, but shows the many ideas that radiate out from the Web 2.0 core.

Figure 1. A "meme map" of Web 2.0 (from http://www.oreillynet.com)
In close conjunction with Web 2.0 a new term has emerged: e-Learning 2.0. This term refers mainly to the use in e-Learning of blogs, wikis and podcasts, known as social software, and of virtual worlds, as Second Life.

Web 2.0 has changed the whole pedagogical approach of learning. Before Web 2.0, we had a hierarchical way of learning and a collaborative one. In the hierarchical way of learning the teacher has the control of the learning process and the student has a very limited possibility to choose what to learn. The teacher is the source of knowledge to be learned. Moreover, in general, the teacher is in her turn subordinate to an institution that imposes certain directions of learning. If the process is computer-based, the software can give to the learner some freedom to choose the path and the pace through the learning objects, to choose between several kinds of knowledge. We can say that this time the software has the control. The Learning Management Systems is organizing the content, accesses, etc. In the collaborative way of learning the control of what is to learn is shared between teachers and learners. The learners have something to say about what to learn and they are encouraged to collaborate, to work together and to share their learning experience. Collaborative learning is also less formal than hierarchical learning. Group of learners are coagulating in order to achieve some goals and once the goals achieved, they are dissolved. From the social point of view this is enriching; you share opinions, you communicate much easier. However, the weak structuring of the learning environments may result in poor achievements on the cognitive side. Web 2.0 is ideal for collaborative learning. It generates ad-hoc communities and learning environments and wipe out communication barrier. When you put a question on your blog, you get answers from the whole world. There are still some language constraints but not for long. What is happening today is that we have, on the institutional level, a hierarchical way of learning, flavored with some collaborative learning ingredients introduced through technology, and in parallel, a new collaborative learning environment, hundred per cent online, based on Web 2.0 technologies, and where the control is totally distributed. We do not have for the moment a clear image of the future, but as educational systems are in a crisis all over the world, rethinking the ways of learning taking advantages of what technology is offering, may be at least a palliative.

IV. THE DANTE PROJECT

Having in mind that social aspects are important to be captured in the design of any e-learning application, a team of researchers from Babes-Bolyai University in Cluj-Napoca and Lucian Blaga University of Sibiu have started a large project DANTE-Socio-Cultural Models implemented through multi-agent architecture for e-learning. DANTE has as main objective the development of a global model for the virtual education system, student centred, that facilitates the learning through collaboration as a form of social interaction. In our vision, the global model requires its own universe in which the human agents interact with software agents. In the virtual worlds of software agents, things must be similar with what I happening in a real world, and this is visible if we look at the metaphor “computing as interaction” or at the “emergent synthesis” design methodology. The global model is considered the core of an e-learning system. From a pedagogical point of view, DANTE is combining the hierarchical way of learning with the collaborative one. The proposed e-Learning system has a general architecture with three levels: user, intermediary, supplier-educational space, on each level heterogeneous families of human and software agents are interacting. The main human actors are: the student, the teacher and the tutor (fig. 2).
In the virtual learning environment we have the corresponding agents. The human actors are interacting with the e-learning system via several agentified environments. The teacher (human agent) is assisted by two types of software agents: personal assistant (classic interface agent) and didactic assistant. The SOCIAL agentified environment (fig.3) has social agents and a database with group models (profiles of social behavior). The agentified DIDACTIC environment assists the cognitive activities of the student and/or of the teachers. The student (human agent) evolves in an agentified environment with three types of agents. He/she has a personal assistant (software interface agent) who monitors all the student’s actions and communicates (interacts) with all the other agents, with the agentified environments of other students and with the teacher’s agentified environment. The student has at his/her disposal two more agents: the TUTOR and the mediating agent. The TUTOR assistant evaluates the educational objectives of the student and recommends her/him some kind of activities. The decisions are based on the knowledge of the students’ cognitive profile (which takes into account the social component). The TUTOR agent interacts with the personal assistant of the student, with the mediating agent and with the social agentified environment. As the system is conceived, the accent is put on collaboration activities between students, which consist in knowledge exchange, realization of common projects, tasks’ negotiation, sharing resources, common effort for the understanding of a subject, problem-solving in-group.
V. CONCLUSIONS

Winston Churchill said that “We shape our dwellings and afterwards our dwellings shape our lives”. Technology is offering to educators marvelous opportunities, but we must always remember the legend of the Sorcerer's Apprentice and be in control of the magic.

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* Ph.D., Professor, Lucian Blaga University of Sibiu, Sibiu
** Ph.D., Assoc. Professor, Babeș-Bolyai University, Cluj-Napoca