



In the last decade the use of information and communication technologies (ICTs) for teaching and learning (e-learning) has been considered one of the key policy topics in the international agenda: many countries as well recognized in various ways the value of e-learning based projects, and the community of researchers is working in order to develop new tools and methods. This is happening because the conviction and the expectation that ICT applications may increase the quality of the educational activities and promote and support the circulation and sharing of knowledge. E-learning exists thanks to Web technologies that allow to easy update, storage, retrieval, distribute and share knowledge. It becomes clear that the critical factor of success of e-learning is not only represented by technology, but rely on the quality of contents and on people competencies in develop and share those contents.

Artificial Intelligence (AI), since the beginning of its history, focused on the role of technology in educational contexts. Such field of study were called Computer Aided Instruction (CAI). The objective of CAI researchers was initially the design of individualized educational programs, embedding in a unique course a number of different learning materials useful for different cognitive and learning styles. The '70s Intelligent CAI (ICAI) systems was characterized by a distinction between learning materials and the procedures used to deliver that materials: the scope was to generate learning paths and comments clipped for each individual student. From these early studies onwards, until the latest Intelligent Tutoring Systems (ITSs) or Intelligent Educational Systems (IESs), AI has played an important role in the development of applications/educational techniques, making possible the creation of new generations of learning environments.

I won't go over into these short notes regarding AI history in education (see for instance, Barr & Feigenbaum, 1982<sup>1</sup>, Wenger, 1987<sup>2</sup>, Devedzic, 2003<sup>3</sup>), but

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<sup>1</sup> A. Barr, E. Feigenbaum (1982), *The Handbook of Artificial Intelligence – Volume 2*, William Kaufmann, Inc., Los Altos, CA.

<sup>2</sup> E. Wenger (1987), *Artificial Intelligence and Tutoring Systems: Computational Approaches to Communication of Knowledge*, Moragan/Kaufmann Publishing Co., Los Altos, CA.

<sup>3</sup> V. Devedzic (2003), Key issues in next-generation Web-based education, *IEEE Transactions on Systems, Man, and Cybernetics, Part C – Applications and Reviews*, 33(3):339-349.

in this introduction I would try to sketch some ideas on the relation between the following two research areas: artificial intelligence and e-learning.

Let's start with an initial question: "Although potentially interesting, why applications of AI in ICT based education are not yet used on a large scale (but only within niche markets)?"

A possible answer, using the Web as a source of knowledge, comes from Saul Carliner, consultant specializing in e-learning of Brookline, MA, USA: "available AI applications are expensive to program. Many of us (i.e., e-learning professionals) are just getting started with design for online learning, we are not yet ready for the sophisticated programming required by AI applications".

Then a second question arises: "But what are the methods and applications of AI with a relevance for e-learning practitioners?"

The list we can make out isn't exhaustive, but certainly includes systems able to learn from interaction with the user and/or able to adapt themselves effectively on the bases of user's responses, suggestions and recommendations; systems that look smarter; systems able to customize the content for individual users by creating courses based on a user's profile, designing and reusing standardized educational materials (learning objects - LOs), designing intelligent agents in support of the user.

Reusable Learning Objects<sup>4</sup> and the theory of instructional design<sup>5</sup> derives from the methodologies of rapid application development typical of software engineering, and have established themselves in recent years as the reference point in the design and creation of online courses. Support systems for the management of these courses, the Learning Contents Management Systems (LCMSs), are still lacking on certain aspects, such as:

- "semantic" recovery through LO metadata for both the authoring that for their use;
- sharing databases of LO on the basis of ontologies, credited but distributed;
- brokering educational services;
- intelligent annotations and review of concepts in collaborative learning.

Moreover, it worth to note how the W3C Semantic Web Initiative<sup>6</sup> has strengthened and improved some classical AI sectors such as the knowledge representation formalisms for building ontologies, or the intelligent agent-based systems for the Web, with a single large objective: to design Web contents semantically significant for programs and software agents, and not only readable

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<sup>4</sup> IEEE LTSC, Learning Technologies Standardization Committee. <http://www.ieeeltsc.org>.

<sup>5</sup> D.A. Wiley et al. (2001), *The Instructional Use of Learning Objects*. <http://www.reusability.org>.

<sup>6</sup> Semantic Web Organization. <http://www.semanticweb.org/>

by humans.

In this scenario, where on one hand converges:

- the needs of e-learning technologists to have effective international standards for LO indexing, packaging and distribution<sup>7 8</sup>;
- the declared intentions of Governments, institutions, companies and universities to invest in the design and production of large deposits of digitized knowledge (i.e., digital libraries);
- the commitment of technologists, documentary makers, librarians, educators in standardizing the metadata necessary to build “vocabularies” adequate and semantically valid useful for latest generation search engines of (typical problems of polysemy, synonymy and linguistic ambiguity-terminology in textual documents, not to mention the semantic interpretation of multimedia objects);

and on the other are emerging:

- technological solutions and formalisms for building ontologies appropriate to the Semantic Web;
- software tools based on the use of web agents if possible open-source- for the implementation and management of cooperative and collaborative processes (user profile management assistants, information brokering web services, knowledge management tools, etc.);
- soft-computing applications and neural networks for mining and classification of concepts applied successfully to the Web,

it becomes more and more evident and valuable to underline the contact points between AI and education and become evident the opportunities both for the development of e-learning technologies and for new methodologies in the field of intelligent teaching design.

The awareness of the contribute that AI may give to the innovation of e-learning context, was created a Working Group within the AI\*IA - Italian Association for Artificial Intelligence (Working Group on Artificial Intelligence & E-learning), which aims at promoting joint actions and pursue specific initiatives for research and training on the use of methodologies and techniques of AI, multimedia, hypermedia and Internet technologies, to improve the quality of learning, according to the “specific” setting theory and methodology of AI research.

Among the initiatives of this Working Group we mention here the organization of the Workshop “Artificial Intelligence & E-learning”<sup>9</sup> held in Reggio

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<sup>7</sup> IMS Global Learning Consortium. <http://www.imsproject.org>.

<sup>8</sup> ADL SCORM. <http://www.adlnet.org>.

<sup>9</sup> IV Workshop on “AI & E-Learning”. <http://www.aixia09.unimore.it/index.php/workshops>.

Emilia, Italy, on 12 December 2009 in conjunction with the 11th. AI\*IA National Conference. Objective of the Workshop, the fourth in the series, was to set up a framework of the updated relevant theoretical aspects and of the experiences made both in the research and organizational contexts, and to define a research agenda on methodologies and techniques of AI in the context of e-learning.

The first seven contributions of the present issue of JE-LKS journal, collects a selection of works presented during the Workshop.

The first contribution, the invited paper by Pavel Boytchev, presents a selected number of scenarios about the use of technology to enhance learning. In the second, third and fourth contributions authors have been invited to write together comparing the approaches and the results carried out in their laboratory research activities.

More precisely, in the second contribution the researchers of the Department of Science of Education at the University of Macerata and of the Department of Computer Science at the University of Palermo, discuss some aspects on the use of an e-learning platform open and modular in supporting high cognitive overload. In particular, they show the integration within the platform of two intelligent agents dedicated to conversation with the student and to finding new information sources on the network, in response to the perception of the system of student dissatisfaction over the content submitted.

The third contribution is proposed by the researchers of the Department of Mathematics and Computer Science at the University of Udine, of the Department of Communication, Computer and Systems Science at the University of Genoa and of the Institute for Learning Technologies of CNR – National Research Council, in Genoa. In the paper they compare two different approaches for the annotation of digital resources. The compared approaches are the following: the first a top-down approach, based on an authoritarian, centralized definition of markup language, and the second a bottom-up approach, which collects contributions of a community of users. These approaches are also analyzed in relation to the support offered to the mechanisms of reasoning in recommendation systems, and user profiling. The authors describe then three case studies that implement these approaches in the areas of e-learning and knowledge management initiatives.

In the fourth contribution the results of two research projects are compared: CADDIE - Content Automated Design & Development Integrated Editor, developed by researchers of the Department of Communication, Computer and Systems Science at the University of Genoa, and IWT - Intelligent Web Teacher, developed by researchers of the Department Computer Science and Applied Mathematics at the University of Salerno, both characterized by the

use of ontologies and semantic technologies to support the design of teaching materials and the design of learning processes.

Then, the fifth, sixth and seventh contributions present the topics of the relative AI\*IA Workshop presentations enriched by the comments emerged during the in presence discussion.

In particular, the fifth contribution by Antonella Carbonaro presents a summarization system able to support tutors in the communication management process and in the monitoring of the interactions between students in learning environments.

In the sixth contribution, Giovanni De Gasperis describes a methodology for the design and realization of chatter-bots, i.e. programs that emulate a human conversation and which can act a human-like behavior within a well-defined domain of knowledge using a text file of the most frequently asked questions in the domain of knowledge and a text file of the glossary of terms used.

Last but not least, the seventh contribution, written by Paolo Maresca, Giovanni Pascuzzi and Lidia Stanganelli, is relative to the design of answers to legal problems; the authors describe a simulation environment for the resolution of these problems using the open source Eclipse environment.

Let's go back to the question with which we opened this editorial: "Although potentially interesting, why AI applications in ICT based education are not yet used on a large scale (but only within niche markets)?"

The papers included in this special issues, show the soundness of AI application for education field; then, what is preventing from a concrete development of these kind of application techniques?

As it appear from Mr. Carliner reply previously mentioned, the issue is both economic and due to the practitioners mentality. There are not yet the necessary investments to bring prototypes to become marketing products because until now the actors of the educational field – provider and trainers – are not yet ready to understand the potentiality offered by AI tools or they are not still convinced about their educational and pedagogical utility. In addition to the little confidence with electronic systems, there is the concern that with AI tools the educational process may result depersonalized becoming "not-human".

The end users of an educational course that use AI applications (whatever immigrants or digital natives they are) do not constitute an obstacle to AI techniques diffusion: if the course proposed works (both from technical and educational point of view), users should not ask themselves about the nature of the tools they are using.

The real answer to the initial question seems it should will emerge from a closer dialogue among technologists, pedagogists and practitioners, a dialogue able to propose new approaches and theories for a sound integration of technologies in the education field with a humanist approach, assuring the growth and

development of every individual through training and based on the knowledge available and sharable on the Web.

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