Journal of Universal Computer Science, vol. 11, no. 9 (2005), 1454-1457
submitted: 8/9/05, accepted: 15/9/05, appeared: 28/9/05 © J.UCS

Computers and Education: Research and Experiences in eLearning Technology

J.UCS Special Issue

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Computers have long been used in education and today their use is having an ever greater impact on society thanks to the increasing educational success of the Internet and easier access to it. This broad field, which may include any kind of learning process aided by Information and Communication Technologies, is usually referred to as e-learning. E-learning is commonly recognized as a powerful and valuable extension to traditional educational initiatives and Learning Management Systems (LMS) are key tools that support these new educational models. For this reason a significant amount of research and development on both technological and educational issues in e-learning has been taking place with striking results. The field is beginning to come of age and is making important advances in the development, reusability and interoperability of educational content fostered by maturing standards and specifications (e.g. IMS, ADL/SCORM).

Nevertheless, even if we take these advances into account, more research and application work is needed in order to produce more cases of success and to generalize e-learning in industry, universities and schools. Certain problems have been identified such as those regarding costs, the knowledge needed to effectively apply this approach, or the fact that in many cases traditional LMS sometimes lack the required flexibility and adaptability to implement innovative educational models that need to be addressed. There are other issues also open such as how to involve learners further in the instructional process, how to stimulate the collaborative creation of educational contents, how to ease the creation and reuse of contents for non-experts, how to make more open and collaborative environments, or how to put into practice the effective integration of mobile devices in educational settings.

This special issue on research and experiences in e-learning technology is an attempt to reflect several different views and efforts. We have chosen to do so not only from the research point of view but from a practical point of view as well. In this regard we present several experiences highlighting some of these new approaches in real domains.

From Contents to Activities: Modelling Units of Learning by Manuel Caeiro-Rodríguez *et al.* discusses the modelling of units of learning using educational modelling languages (EMLs). Current EMLs consider elements and relationships required for modelling the more common perspectives involved in learning activities. But they do not provide a good support for modelling other perspectives involved mainly in collaborative learning scenarios. This paper identifies a set of perspectives and patterns that should be considered in an EML in order to support the design of collaborative units of learning.

Semantic Web Technologies Applied to e-learning Personalization in <e-aula> by Pilar Sancho *et al.* proposes the use of semantic metadata for learning object annotation and contextualization in order to adapt instruction to the learner's cognitive requirements. The key idea is to use ontologies as the knowledge representation mechanism to allow for the delivery of learning material relevant to the current situation of the learner. The long term goal is to obtain educational systems that automatically adapt their behaviour and content to each individual user's needs.

A Tool for the Reinforcement of Conceptual Learning: Description and Use Experiences by Roberto Moriyón *et al.* presents DeepTest a tool that is intended to reinforce the conceptual learning of any subject by means of interactive exercises for the detection of incorrect texts. This tool allows for a new type of test that can assess the knowledge acquired by students better than more traditional ones (e.g. multiple choice). Because the tool encourages learning by pointing out mistaken concepts, it can be useful when students learn concepts that are difficult to assimilate correctly.

Ubiquitous Computing in the classroom: An Approach through Identification Process by José Bravo *et al.* shows how some ideas of ubiquitous computing can be used to enrich an educational scenario. The main goal is to provide support in daily activities through radio frequency identification (RFID) technology without any extra interaction cost for users. Services like access, location, attendance, homework control and visualization are accessible with the only requirement that users wear little devices (tags) in the classroom. This new paradigm of Ubiquitous Computing opens up a new age and provides an excellent scenario for exploring new ideas in computerized learning.

Integrating Educational Tools for Collaborative Computer Programming Learning by Crescencio Bravo *et al.* presents several educational computer tools successfully used to support Programming learning and an environment which integrates them to support a broader approach to the teaching and learning of

Programming. These tools take advantage of program animation, visualization, and collaboration between students during program development as well.

From Chasqui to Chasqui II: an Evolution in the Conceptualization of Virtual Objects by Antonio Navarro *et al.* presents virtual objects, which is an application of the learning object concept to the construction of virtual museums also aimed at educational purposes. Virtual objects were conceived for organizing learning and scientific information and have been applied in the implementation of two museums devoted to American History and Computer Science. Aspects such as interoperability and reusability are crucial in system implementation and maintenance but facilitating the use of these objects for teachers and students is one of the main goals. The issues of web services use for accessing system information and several aspects of collaborative learning are also addressed.

Authoring and Diagnosis of Learning Activities with the KADDET Environment by Begoña Ferrero *et al.* describes a cognitive diagnostic environment created to assess students' conceptual and procedural learning activities. One of the main goals of this environment is to provide teachers with easy-to-use tools that facilitate the construction of learning environments with diagnosis capabilities customized to their particular subject domains and adaptation styles. With this in view, this paper addresses how some of the ideas proposed by intelligent tutoring systems (i.e. diagnosis, domain modelling) could be used in e-learning systems.

A System to Support Asynchronous Collaborative Learning Tasks Using PDAs by Ana I. Molina *et al.* addresses some of the technical aspects of using mobile devices (i.e. PDAs) in a collaborative educational domain. The objective is to effectively use PDAs in the collaborative planning of design applied to the practical activities of domotical design. This objective is reached by starting out from a previous version based on a desktop computer. The problems of developing a mobile version (e.g. user interface, new ways of working) from a desktop computer version are also discussed.

Case Studies in Tele-Education: Research and Projects by Miguel A. Vega-Rodríguez *et al*. presents several educational systems specifically developed for different domains such as teaching computer architecture or helping people with hearing impairment. These systems are characterized by the high interactivity use of content and simulations to improve learning outcomes.

Integrating Ontologies into the Collaborative Authoring of Learning Objects by Juan Manuel Dodero *et al.* presents an integrated framework for collaborative authoring and annotation of learning material. The objective is to use ontologies as a collaborative approach and to reduce the effort of the annotation task while improving the quality and reusability of the learning objects at the same time. The paper also addresses the implications this approach has on the facilitation of constructivist approaches in the development of learning material.

The editors wish to thank Professor Hermann Maurer (Managing Editor) and Ms. Dana Kaiser (Assistant Editor) of the Journal of Universal Computer Science (J.UCS)

for all their kind help and for providing us with the opportunity to edit this special issue on research and experiences in eLearning Technology. We are also grateful to Dr. Tiffin for his collaboration and participation in our activities. Finally, we would also like to express our thanks to all our referees for their critical evaluation of the papers within such a short stipulated time and to James W. Flath for his fine revision and normalization of all the papers.

Madrid, Spain
July, 2005

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