

## Remarks on the Variety and Significance of Advanced Learning Technologies

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### **Abstract**

This paper provides a reflective overview of the eight papers collected in this special issue of *Educational, Technology and Society* that is based on ICALT-2003. We provide a very brief description of the conference and then discuss the eight papers in the context of a focus on learning and a focus on systems. In the conclusion, we offer our thoughts on the notion of borderless research and development, the inseparability of the different aspects of learning and instruction, and likely trends and innovations.

### **Keywords**

Advanced learning technology, Authentic learning, Collaborative learning, Learning objects, Metadata, Problem-centered learning

### **Introduction**

The third IEEE International Conference on Advanced Learning Technologies (ICALT) was held in Athens, Greece in July 2003. There were 337 submissions to that conference. The acceptance rate for full papers was 14%; for short papers the acceptance rate was 28%. There were 145 papers published in the proceedings for that meeting along with descriptions of 56 poster, 4 workshop and 4 panel sessions (Devedzic, Spector, Sampson & Kinshuk, 2003).

The conference was richly international at every level. The conference chairs represented Greece and New Zealand. The program chairs represented Serbia-Montenegro and the USA. The steering committee included representatives from the Finland, Greece, Japan, The Netherlands, New Zealand, Russia, the UK, and the USA. Keynote speakers represented North America and Europe. Papers came from every region of the world and

represented a rich variety of perspectives and activities. The focus of the conference was on design and development issues involving advanced learning technologies. Topics covered included architectures for learning systems, artificial intelligence applications, collaborative learning, distance learning, instructional design issues, integrated learning environments, learning communities, learning objects, metadata, pedagogies, virtual reality and much more.

The organizing committee (Sampson, Kinshuk, Devedzic & Spector) selected 8 of these papers to be further elaborated and refined for publication in this special issue of *Education, Technology and Society*. The selection of these papers was based on several criteria, including innovation, quality and representation. Obviously much excellent work presented at the conference is not represented here. It is our hope that readers of this special issue will then seek out the larger Proceedings (Devedzic et al., 2003) and pursue other work presented in Athens. As the program co-chairs and reviewers of these papers, we offer in what follows our reflective comments on this selected collection of research and development in the area of advanced learning technologies.

## **Discussion**

It is difficult to categorize these papers as belonging to any one of the themes or topic areas indicated earlier. This difficulty will be addressed in our concluding remarks. For the sake of the discussion, we will comment on these papers in terms of issues involving learners and issues involving systems. We recognize that these are somewhat arbitrary categories and that nearly all of the papers make comments about both learners and systems.

### **Focusing on learners**

What do these papers have to say about advanced learning technologies in terms of learners? Several papers address innovative uses of technology in school-based settings. Morozov, Tanakov & Bystrov (this issue) examine the use of pedagogical agents in science classes for children between the ages of 10 and 12. The authors implemented an authoring environment called NATURA that allows for the creation of rich and realistic multi-media environments and promotes active learning about science from a child's perspective. The authoring framework is apparently cost-effective, powerful and easy to use. More significant, however, is the perspective assumed in generating learning environments. NATURA encourages authors to assume the child's point of view in learning about science as the users – children – are asked to assume roles in game-like activities organized for the purpose of discovering or uncovering various scientific principles. What is especially notable in NATURA is that the instructional design principle to emphasize or integrate authentic or real-world problem-solving activities is interpreted from the child's perspective (Brown, Collins, & Duguid, 1989; Bruner, 1986). The assumption behind this learning environment is that it is the child's real world that should be integrated into active learning.

The paper by Kravcik, Kaibel, Specht & Terrenghi (this issue) reports on a project that involves a mobile form of e-learning intended to support students on field trips (RAFT). Whereas NATURA is aimed at enhancing or enlarging or extending a classroom by allowing for rich multi-media experiences, RAFT assumes that children leave the classroom on occasion to explore and investigate the world around them. RAFT provides the means to collect data, capture digital photographs and audio, and take and organize notes. The authors report that RAFT is easily learned and that the users – children between the ages of 10 and 14 – found RAFT useful and were able to create rich and well-organized reports of field trips. Motivating learners is a recurrent theme and is obviously important to learning effectiveness (Keller, 1983). This paper adds the notion that learners want to encounter the real world and can be actively involved in these experiences using tools and technologies that can be carried back into classroom activities.

The paper by Avouris, Komis, Margaritis & Fiotakis (this issue) focuses on an environment to study collaborative learning, which has received much attention in the educational research community in recent years (Dillenbourg, 1999; Salomon, 1993). The authors rightly recognize that while there has been much attention devoted to collaborative learning there is rather sparse empirical evidence describing outcomes on which to base prescriptions for the planning and implementation of effective learning environments. The activity analysis tool and the collaboration analysis tool represent important contributions towards evidence-based research and development in learning and instruction. The relevant instructional design principle involved in such efforts can be called WYMIWYG (pronounced 'whim-ee-whig'), which stands for "What you measure is what you get" (Spector, 2001). If teachers do not assess learning outcomes, then they do not know what learning progress is

occurring. If developers do not evaluate systems, then they do not know whether, how or why the learning environments they create are effective.

A particularly important kind of measurement important to learners, teachers, designers and developers involves the determination of a problem's difficulty. Many learning environments are now problem centered (Merrill, 2002; Seel, 2003). One problem with regard to problem-centered learning and instruction is knowing which problems to present to which learners in different situations. Making this determination involves knowing the relative difficulty of various alternative problems that could be presented. The paper by Kuo, Lien, Chang and Heh (this issue) addresses this issue directly and offers a methodology based on the use of neural networks and knowledge maps. The authors report evidence that their methodology, which is based on a four-step problem-solving strategy (identification, elaboration, planning and execution), works and can be used in the context of an intelligent tutoring environment and other contexts. The assumption behind this work is that learners naturally perceive problems to be of differing difficulty and that the determination of the relative or perceived difficulty of a problem should be learner-centered rather than problem-centered [the authors do not state this principle explicitly but we believe that is consistent with their findings].

### **Focusing on systems**

What do these papers have to say about advanced learning technologies in terms of systems? The topic of learning objects was much discussed at the conference and is a central topic for instructional technologists (Wiley, 2000). Two papers in this collection focused on the use and implementation of learning objects in peer-to-peer network-based instructional systems. The paper by Qu and Nejdil (this issue) reported on the Edutella open source project that aims to exchange metadata based Resource Description Frameworks (RDF) from one repository to another. The learner is in the background in this discussion as someone who will benefit from the reusability of learning objects in one setting and residing in distant data repository by gaining access to those objects in a local repository. Erik Duval, one of the conference keynote speakers also addressed the importance of standards for learning objects that cross network and other boundaries, echoing the centrality of the technical challenges associated with designing, developing, implementing and managing reusable, accessible, and customizable learning objects to support a variety of learners distributed in a variety of settings and situations. The Edutella project transforms SCORM XML metadata into a standard form that can support exchanges across learning object repositories. This is an important technical step in providing the basis for globally usable local learning objects.

The paper by Brase and Painter (this issue) is also aimed at improving reusability and retrievability of learning objects. These authors describe an inference engine based on Prolog for the generation of metadata when none exist. The engine queries course descriptions and uses a semantic network to create meaningful metadata to support reuse of learning objects. This effort was based on the Dublin Core set of 15 basic metadata elements. It should be obvious that metadata generated by such a system is ultimately on human descriptions (e.g., the course description). A learning environment could be designed with all metadata tags in place and still not promote reusability if the tags do not contain correct, relevant and meaningful information. The limits to automatically generating metadata for existing learning environments and instructional systems remains a largely unexplored and highly challenging area of investigation.

The paper by Hadjileontiadou, Nikolaidou, Hadjileontiadis, and Balafoutas (this issue) is aimed at promoting online collaboration using a fuzzy logic inference system to extend the capabilities of another system called Lin2k. As mentioned in the previous section, collaboration is an important topic for educational researchers and collaboration at a distance is a particular challenge for learners. This system dynamically adjusts to user collaborations and creates pre-structured interfaces for the next anticipated interaction between collaborators. Evidence suggests that this kind of pre-structuring support helps keep the collaboration on task and on track but does not overly constrain a user who may select a new or unanticipated action and thereby change the dynamic model of that collaboration. The authors report that the cost of extending Link2k in this way was relatively minor, and they suggest the new system could generalize to support a wide variety of collaborative efforts. Of course the evidence will ultimately decide the issues of cost-effectiveness and generalizability.

The paper by Taurisson and Tchounikine (this issue) describes an application of artificial intelligence in the area of learning communities. Support for the developing and sustaining activities of communities of practice is of central concern to educational technology researchers (Steeple & Jones, 2002; Wenger, McDermott & Snyder, 2002). We mention the paper by Taurisson and Tchounikine here rather than in the section focusing on learners because the focus is on the scalable implementation of software agents to support learning communities. The

agent framework is based on an activity system (Engeström, 1987) and has been tested with university computer science students. It will be important to find out if such an approach works as well for English majors, school children and adult workers. In any event, we have included this paper because it represents an important extension of technology into group-based activities that may or may not be organized around schools and classrooms. Indeed, one might see such systems eroding the traditional distinction between learning and working.

## **Concluding Remarks**

Several things stand out in these papers. We mention three areas as particularly pertinent to the likely future of advanced learning technologies.

### **Research and Development without Borders**

Progress in this and many other areas of science and technology is likely to be improved when research and development proceed with minimal interference of artificial barriers and borders. As already mentioned, the conference brought together people from all parts of the world with richly divergent views. Areas of complementary work were identified and extended collaborations are underway as a result. This is a general benefit of international meetings and publications. In our case, we happen to be concerned with technologies aimed at enhancing this kind of global intellectual networking. As a community of professional practitioners, we ought to be using the same technologies we advocate in support of learning and instruction to enhance our own work. We all benefit when we can move in a facile way across traditional institutional, cultural, national and other barriers. In an important sense, the technologies discussed in this special issue of *Education, Technology and Society* – e-collaboration, metadata, mobile technologies, software agents, etc. – represent an important aspect of the future of society. Can we use these technologies for the benefit of all or will we continue to grow apart?

### **Inseparability of Issues**

We arbitrarily put the papers into two categories – those focusing on learners and those focusing on systems. However, a theme that emerged at the conference, that is echoed in the papers and that is hopefully evident in our discussion is that the topics treated are not really separable. One cannot ultimately separate learners from systems just as one cannot separate an interface from a user or collaborative support from collaborators. What is becoming more evident as we explore advanced learning technologies is that holistic and systemic views of learners and their environments are necessary if we wish to make progress (Spector & Anderson, 2000).

### **Innovations and Trends**

What can we say about the future of advanced learning technologies? If the future happens to resemble the past, then we can say with a fair amount of confidence that it will likely bring changes that we do not now envision. Nonetheless, tools and technologies to support distributed learners are likely to become more sophisticated and more prevalent, further eroding the traditional boundaries between learning and working in some cases. It is likely that standards to realize the potential of reusable learning objects will emerge and that tools will become more transparent and pervasive. The focus on learners appears well established in principle, but the practice of taking learners for what they are and as they are has yet to catch up. This is partly due to the view of many educators who believe the correct role of education is to transform, since learning is fundamentally about change.

What is not clear at this point is who will determine the nature of desired transformations. One might hope that it would be those directly affected by the transformation – namely, learners. What is not clear for us in the midst of these impressive innovations and the rapid advance of educational technology is what will become of the roles of learners and teachers. The popular adage that the role of the teacher is being transformed from that of a sage on a stage to a guide on the side does not appear accurate today, nor is it evident that teachers should always and only be guides as opposed to sages.

While we have learned much about learning and instruction on account of new technologies, there is much that we do not know. Moreover, it is important to retain a humble attitude with regard to the technologies that we help to create. The basic question in our work is this: What will come from we are doing and are likely to do in the next few years? The basic answer is that we do not know. We hope that we can contribute to the personal and intellectual growth of others and help people better understand their worlds.

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