

## Interoperability of Educational Systems - Editorial of Special Issue

### Daniel Olmedilla

L3S Research Center and Hannover University, Deutscher Pavillon, Expo plaza 1, D-30539 Hannover, Germany  
Tel: +49 511 762.9741  
olmedilla@l3s.de

### Nobuo Saito

Keio University - Shonan Fujisawa Campus, Keio Research Institute at SFC, 5322 Endo, Fujisawa, Japan  
Tel: +81 466 47 5049  
nobuo.saito@w3.org

### Bernd Simon

Vienna University of Economics and Business Administration, Institute of Information Systems & New Media  
Augasse 2-6, A-1090 Vienna, Austria  
Tel: +43 1 31336 4443  
bsimon@wu-wien.ac.at

## Why a Special Issue on Interoperability of Educational Systems?

Interoperability - defined as the capability of different systems to share functionalities or data - has become a hot topic for educational technologists. From the educational point of view the increasing attention for interoperability research has been driven, for example, by

- the desire to collaborate on the development of content (maybe stored in multiple systems),
- the need for making content accessible in or via various systems (re-use),
- cross-organisational, collaborative learning and teaching,
- sharing of assessment data for the purpose of effective personalization of learning environments.

Economical motivations for interoperability include:

- securing investments in content development,
- making designs of learning environments exchangeable (good practices),
- increasing the user value of the systems provided by integrating components of other systems,
- allowing specialisation in the field, so that vendors can focus on particular aspects of the educational value chain (e.g., content creation, assessment, skill management).

From the information systems (IS) design point of view interoperability is required in order to

- break up the technological isolation of learning management systems and alike by fully integrating them in a company's IT infrastructure,
- get access to crucial data stored in legacy systems,
- integrate business process-driven solutions with learning management,
- reduce time for and costs of system integration by providing reference specifications.

National and international standardization consortia, such as ISO, IEEE, ADL, AACE, CEN/ISSS, HR-XML, IMS, or DIN, sometimes accompanied by research projects have produced an overwhelming number of standards and specifications. The sometimes even competing work is still heavily discussed in the field. At this stage of a global discussion process, not all answers have been provided yet. Many of us working in the field of the technology-enhanced learning have been frequently confronted with issues such as: what are the use cases or pedagogical models standards such as SCORM, LOM, or QTI have been designed for? Can the specifications help to fulfil the requirements of learning environments or system integration projects? What about industry adoption - have they reached a critical mass and if so, is an outstanding ability to solve a particular problem driving the adoption or are other forces driving the process?

Motivated by the pedagogical, technological, and IS design driven need for interoperability, on the one hand, and the still ongoing discussion about specifications and standards, on the other, this special issue is devoted to give an overview about and advance current state-of-the art of interoperability research.

## **Some Metrics on the Call for Contributions to this Special Issue**

This special issue has followed up a workshop held in conjunction with the 14th International World Wide Web Conference (WWW2005), May 10-14, 2005, in Chiba (Japan). Supported by the workshop the call for contributions has attracted 38 papers in total, from which 33 of them went into the review process (5 had to be rejected at an early stage, because of a lack of relevancy to the special issue). Each paper was reviewed by a minimum of two reviewers. In total 85 reviews were collected in a double-blind review process. Finally, four papers were accepted for leading with an acceptance rate of 11%. Each accepted paper was assigned to a responsible editor in order to ensure that reviewer's comments were interpreted in the most beneficial way.

## **In this Special Issue**

The issue is composed of five articles covering interoperability-related topics including the authoring of learning material using metadata and improvement of reusability, protocols for the exchange of such metadata, extensions to standard specifications for inclusion of new features in Learning Management Systems in a common way, and integration of cross-domain technologies and standards for learning.

Aroyo et al. claim in "Interoperability in Personalized Adaptive Learning" (accepting Editor: Nobuo Saito) that interoperability plays a crucial role in adaptive technologies. They discuss state-of-the art and main challenges of interoperability specifications. Based on an enhanced Adaptive Hypermedia Application Model they model systems that support distributed user profiling in the context of interconnected educational repositories.

Kassahun et al. (accepting editor: Daniel Olmedilla) extends the current SCORM standard in order to support author-defined data for learning objects which require the management of state information. "Providing Author-Defined State Data Storage to Learning Objects" describes such an extension and a plug-in, DBLink, that implements it.

Di Nitto et al. discuss in "Supporting Interoperability and Reusability of Learning Objects: The Virtual Campus Approach" (accepting editor: Bernd Simon) strengths and weaknesses of the latest SCORM specification. Based on their experiences in the Virtual Campus project they propose specific extensions to SCORM's metadata and sequencing specifications. They claim that reusability of learning objects can be increased by intruding attributes such as supervision mode, access modality or learning objective. The relationships they propose for connecting learning objects in a learning flow shall provide enhanced capabilities for instructional designers to model effective learning environments.

"Spinning Interoperable Applications for Teaching & Learning using the Simple Query Interface", by Van Assche et al. (accepting Editor: Nobuo Saito), describe the Simple Query Interface, a protocol intended to provide an universal interoperability layer for the search and exchange of resource's metadata. Authors discuss the technical details of the interface and provide several case studies as a proof of its applicability.

## **Conclusions**

The papers received to this call for contributions gave a clear sign that interoperability will still remain to be a hot topic of research in the forthcoming years. The standards and specifications currently available seem to solve only a small piece of the big puzzle. Issues such as how to describe learning resources best for re-use are still not fully resolved while completely new topics such as connecting business processes with learning, for example via re-usable competency definitions, arise while technology enhanced learning disseminates in corporate environments.

So it remains clear that the seamless development of high quality content and making it accessible in a smart way is still a vision that requires a lot of research to be performed. However, the authors of the above papers have made their contributions to bring this ultimate goal one step closer.

## **Acknowledgements**

Special thanks to our reviewers who have provided relevant and detailed comments to the authors of all papers submitted and helped us in the selection process:

Allyn Radford, Ambjörn Naeve, Andreas Pinterits, Arthur Stutt, Bill Blackmon, Daniel R. Rehak, David Massart, Eric Roberts, Erik Duval, Frans Van Assche, Hiroaki Chiyokura, Hiroshi Komatsuwaga, Hiroshi Makoshi, Jan Brase, John Toews, John Williams, Juan Quemada, Keiko Okawa, Kinshuk, Kinya Tamaki, Lora Aroyo, Lorna M. Campbell, Makiko Miwa, Marek Hatala, Martin Dzubor, Massimo Marchiori, Matthew J. Dovey, Michael Sintek, Mitsuru Ikeda, Nobuyau Makoshi, Norm Friesen, Oleg Liber, Peter Dolog, Peter Spyns, Peter van Rosmalen, Pythagoras Karampiperis, Rob Koper, Ruimin Shen, Seok-Choon Lew, Simos Retalis, Stefano Ceri, Uwe Zdun and Wayne Hodgins.