Preface

Educational technology is a key interdisciplinary area. The main aim of educational technology is the support of teachers and students with computer tools in order to complete their tasks faster, more accurately and more efficiently. Various tools and techniques for supporting teaching and learning have been proposed and implemented over the years and especially with the advancement of Web technologies. The development of applications and tools for e-learning is complicated due to the heterogeneity of the user aims and the development approaches and the dynamic behaviour of users which the tools needs to accommodate. As the e-learning industry continues to expand every day, and the methods and tools necessary to create and maintain content and infrastructure applications become more complicated, there is an inherent need for these applications to interoperate and exchange data in order to better support the needs of learners and educators.

The Advanced Distributed Learning initiative (ADL – www.adlnet.gov) defines a set of abilities for e-learning tools and technologies. These abilities are reusability, accessibility, interoperability, adaptability, durability, and affordability. The IEEE (Institute of Electrical and Electronics Engineers - http://www.ieee.org) defines interoperability as the ability of two or more systems or components to exchange information and to use the information that has been exchanged. In e-learning the ability of tools to interoperate is of crucial importance as it will allow systems of diverse educational aims to work together, re-using the learning data and the accumulated knowledge about learners. This will eventually reduce the maintenance costs and the efforts of the educational content providers and will allow the development of more complete and adaptable interactive learning environments.

To increase the ability of educational hypermedia applications to re-use the learning data, several organizations are working to develop learning standards. CETIS (Centre for Educational Technology Interoperability Standards - http://www.cetis.ac.uk) states that standard ways of describing educational materials are needed so that they can be easily searched for and located (http://www.cetis.ac.uk/static/standards.html). Learning standards refer to the standardization of XML structures which are used to describe various aspects of the learning procedure.

The following organizations and committees have been involved in developing the best known standards:

- ADL - Advanced Distributed Learning Project (http://www.adlnet.gov)
- AICC - Aviation Industry Computer-Based Training Committee (http://www.aicc.org)
- ARIADNE - Alliance of Remote Instructional Authoring and Distribution Networks for Europe (http://www.ariadne-eu.org)
- CEN - European Committee for Standardisation (http://www.cen.eu)
These organizations and consortiums have developed, among others, XML standards for e-lessons, user profiles, e-portfolios, testing data and metadata. Standards are generally developed to promote interoperability between otherwise competing implementations.

One of the most well known learning standards for coding learning data is Sharable Content Object Reference Model (SCORM - http://www.adlnet.gov/Technologies/scorm/). SCORM is an XML-based framework used to define and access information about learning objects so they can be easily shared among different learning management systems (LMSs). SCORM was developed in response to a United States Department of Defense (DoD) initiative to promote standardization in e-learning.

The IMS Question and Test Interoperability (IMS QTI - http://www.imsglobal.org/question/) specification describes an XML based technical format for the coding and exchange of assessment content from individual questions through to complete tests. IMS QTI, or simply QTI, structures material into assessments, sections, and items and provides support for adaptive items.

The IEEE’s Public and Private Information (IEEE PAPI – http://jtc1sc36.org/doc/36N0186.pdf) for Learners XML standard is a data interchange specification that describes learner information for communication among cooperating systems. The IMS Learner Information Package (IMS LIP - http://www.imsglobal.org/profiles) is based on a data model that describes those characteristics of a learner needed for the general purposes of recording and managing learning-related history, goals, and accomplishments of learners.

IMS Learning Design (IMS LD - http://www.imsglobal.org/learningdesign/) is a specification which enables the modelling of learning processes. The specification can be likened to a stage-play where people act in different roles. These roles work towards specific objectives by performing learning and/or support activities. The activities are conducted within an environment consisting of learning objects and services. This specification is used to model entire educational activities where several people and educational activities are involved.

The Dublin Core (http://dublincore.org/) metadata is a standard for cross-domain information resource description. Dublin Core was standardised by ISO in 2003. The semantics of Dublin Core have been established by an international, cross-disciplinary group of professionals from librarianship, computer science, text encoding, the museum community, and other related fields of scholarship and practice.

IEEE Learning Object Metadata (IEEE LOM - http://www.ieeeltsc.org/standards/1484-12-1-2002) is a data model encoded in XML, used to describe a learning object and similar digital resources used to support learning. The purpose of learning object metadata is to support the reusability of learning objects, to aid discoverability, and to facilitate their interoperability, usually in the context of online learning management systems.

IMS Simple Sequencing (IMS SS - http://www.imsglobal.org/simplesequencing) defines a method for sequencing discrete learning activities in a consistent way. Initially some researchers considered IMS SS as a simple adaptive learning system itself, but currently most of its features have been integrated into other standards such as IMS LD and IMS QTI.

More standards for metadata and for packaging or sharing learning and testing data exist. The development and diffusion of e-learning standards raised new research questions related to how they can be
efficiently utilized in order to increase the reusability and syntactic interoperability of learning content. Pedagogy and content quality related issues in interoperable tools are also important.

The present volume aims at promoting the discussion and presenting specific solutions for increasing the interoperability of future standalone and Web based educational hypermedia tools. Further, the role of learning standards and the issues arising from their deployment are investigated. The ultimate goal of the publication is to be a scholarly edition, suitable for practitioners and researchers in the area of educational technology with a focus on content reusability and interoperability.

With respect to our open call for the present handbook, 72 proposals were submitted and after a double blind review process by at least 2 reviewers, 25 articles were selected for inclusion in this volume, based on their relevance, clarity of presentation of the research issues, and diversity of topics. The selected chapters negotiate technical issues related to the efficient deployment of e-learning standards and interoperability and present evaluation studies which critically review the importance of e-learning specifications. Some of the studies deal with metadata or issues such as pedagogy and quality in interoperable systems.

Chapter 1, by Yongwu Miao, Jo Boon, Marcel van der Klink, Peter Sloep and Rob Koper, presents a combined use of IMS QTI and IMS LD. The combined system is able to support interoperability and reusability of emerging forms of assessment, such as self assessment for example.

Next, Chapter 2, written by Onjira Sitthisak and Lester Gilbert, aims at illustrating some affordances of machine-processable competency statements. Such competency statements are supported by ontologies and taxonomies of competency. Machine processing can offer interoperable and reusable resources and applications that are pedagogically effective for e-learning and assessment. The generated questions are expressed in the IMS Question and Test Interoperability specification (IMS QTI) to enable interoperability.

Vladimir Tomberg and Mart Laanpere in Chapter 3, discuss some of the issues involved in developing online testing of learning outcomes. The research is focused on the changes and implementation scenarios of the latest versions of IMS QTI. The chapter pays special attention to the increasing trend of using Web 2.0 technology in education, especially Mash-up Personal Learning Environments and their impact on the architectural.

Chapter 4, by Michael Piotrowski, focuses on the reusability and sustainability of electronic tests and presents the IMS QTI specification. The main aim of the chapter is to investigate whether this specification improves the interoperability among testing systems and the shareability of the data.

Chapter 5 by Bernard Blandin, Geoffrey Frank, Simone Laughton, and Kenji Hirata describes how the needs for interoperability in exchanging competency information have been addressed so far and then discusses the issues related to the exchange of competency information across systems.

Sergio Gutiérrez-Santos in Chapter 6, studies the problem of adaptive sequencing which is about finding the optimum sequence of learning resources with respect to the special characteristics, goals, needs, and background of learners. This chapter reviews the two specifications most relevant for the standard expression of adapted sequencings: IMS Simple Sequencing and IMS Learning Design. The strong and weak points of each specification are highlighted, showing their implications on adaptive sequencing interoperability.

An extended study by O.C. Santos, J.G. Boticario, E. Raffenne, J. Granado, A. Rodriguez-Ascaso and E. Gutierrez y Restrepo is presented in Chapter 7. This chapter introduces a standards-based and adaptive framework whose main objective is to adapt user interfaces, content and learning environment to learners’ needs, including potential disabilities. The framework is intended to be general and to that
end it is implemented in terms of an open architecture, which aims at providing services for Accessible Lifelong Learning.

Stephen Marshall in Chapter 8, presents the e-learning Maturity Model which provides a standard that guides professionals and organizations in assessing their e-learning capability, but also complements with quality enhancement and feasibility elements that support reflection, prioritization of resources and guide personal and organizational development of e-learning.

The research reported in Chapter 9 by Helen Farley, explores some of the issues associated with using the IMS LD specification for learning designs in virtual worlds such as Second Life and multi-player online role playing games such as World of Warcraft. The main issues relate to the inadequate description of collaborative activities and the inability to alter the design ‘on-the-fly’ in response to learner inputs. Some possible solutions to these problems are considered.

The following Chapter 10, written by Steve Green, outlines the problems associated with inclusive e-learning and the role that user profiles and an adaptation service can have to support personalization. The chapter introduces the idea of an Adaptable Personal Learning Environment (APLE) and looks at how one component, the Transformation, Augmentation and Substitution Service (TASS), can be formally specified using Prolog. The compliance with standards like IMS ACCLIP and ACCMD is identified. The chapter also considers issues of IMS and SCORM content packaging, learner information profiles and the JISC definitions for a Personal Learning Environment, all within the context of inclusive e-Learning support.

Chapter 11 by Francisco Arcos and Pablo Ortega uses SCORM in learning objects to manage a course in Moodle for the students of English. The purpose of the chapter is to give an account of the problems and solutions encountered by using SCORM in Moodle and to explain the guiding aims of a framework for language teaching.

Chapter 12 by Andreas Alexopoulos, Georgia Solomou, Dimitrios Koutsomitropoulos and Theodore Papatheodorou, presents the basic characteristics of some educational metadata schemata and application profiles with a focus on IEEE LOM standard. The study shows how the IEEE LOM metadata set can be incorporated in the default DSpace’s qualified Dublin Core metadata schema. The authors document a potential LOM to Dublin Core metadata mapping and reveal potential advantages of such an approach. Further, they propose an ontological model for the repository’s metadata, taking into account the educational characteristics of resources.

Chapter 13 reported by Kate Taylor looks at how XML technologies can interchange information with the help of new intelligent resources such as the OpenMind project that are beginning to model the world around us. Advances in these areas pave the way for more automatic acquisition of knowledge from existing texts using specialized tools to provide a basic semantic understanding of the material and promote interoperability.

Dimitris N. Kanellopoulos in Chapter 14 presents a localisation-aware semantic e-learning approach to integrate multilingual content provision, learning process and learner personality in an integrated semantic e-learning framework. An architecture for supporting localisation of e-learning content is proposed and a basis for further development of automatic localisation services that will be able to reason on top of such an explicit infrastructure is presented.

Chapter 15, by Marta R. Ariza, Antonio Quesada, offers a brief overview of the main ideas underlying the learning object (LO) paradigm, with special emphasis placed on pedagogical aspects. Requirements for the interoperability and reusability of learning objects (LOs) are discussed, with attention drawn to the need of developing new metadata models to fully benefit from this approach.
In Chapter 16 by Barbara Vagiati the efforts to harmonize MPEG-7 and SCORM are discussed. In particular a model for the interoperability between these standards is developed. The MPEG-7 provides a standardized set of technologies for describing multimedia content, while SCORM is a collection of specifications for developing, organizing and delivering instructional content. The proposed model concerns the semantic mapping between the different elements of these standards.

Ricardo J. Rejas-Muslera, Alvaro J. García-Tejedor, and Olga Peñalba Rodríguez in Chapter 17 present an overview of Open Educational Resources (OER) in e-learning, focusing on technical issues, mainly standards and socio-economic and legal questions. The OER’s role in education, especially for e-learning performance is considered.

Chapter 18 by Natalia I. Hughson deals with the fundamental principles of interoperability of complex and dynamic global education systems. The contemporary approaches to systems theory, entropy and autopoetic theory, social system theory, sociocybernetics, the strengths and limitations of these approaches, and their potential applications in education are examined.

M. C. Mora-Aguilar and J. L. Sancho-Brú in Chapter 19 focus on e-assessment tools. In particular, diagnostic and formative e-assessments implemented on a Moodle-based VLE environment has been introduced in different subjects. The benefits and the underlying problems of their approach are described here.

Chapter 20 by Carmen Bao and José María Castresana starts with a brief background to worldwide standardization activities in the field of educational technologies as means of enhancing the accessibility, interoperability, durability, reusability and efficiency of e-learning resources. Then it presents a possible framework, which helps to reconcile different data models, by e-learning systems and learning standards and standardization process.

In Chapter 21, Marta Fuentes Agustí, Margarida Romero Velasco and María José Hernández Serrano, offers a review of the e-learning possibilities and criteria, based on several analyses carried out by on higher educational settings. Based on the learner cantered perspective, this chapter proposes some criteria for assuring the quality in higher education e-learning contexts, mainly based on three categories: psycho-pedagogical utility, usability and accessibility.

Chapter 22 by Lilyana Nacheva-Skopalik presents the importance of providing high quality e-learning and the need to apply the requirements of the standards from ISO 9000 series for continual improvement of the quality management systems in education. The work applies the main principles for multiple criteria decision making. An approach for satisfaction measurement is developed which uses weighting coefficients as qualitative valuation of the importance of the quality characteristics.

John Milne and Gordon Suddaby in Chapter 23 introduce the e-Learning Guidelines for New Zealand and show how organisations have used them. It presents some of the benefits of the guidelines as well as the limitations and discusses how these limitations may be managed. The guidelines allow organisations to share their e-learning knowledge and experiences.

Brian Nolan and Lorraine Leeson in Chapter 24 present the efforts of two institutes who have partnered to create a unique e-learning environment based on MOODLE for teaching Sign Languages to deaf people. The work discusses the aspects of sign languages that can best be supported and assessed online and the decisions regarding annotation and mark-up standards for sign languages. It also presents a corpus utilized within digital learning objects in a MOODLE environment and the architecture of the developed tools.

The final Chapter 25 by Olugbemiga T. Ekundayo and Francis Tuluri focus on learners and learning management describing some of its implications for pedagogy. Their Chapter describes contemporary
definitions of LMSs and proposes a comprehensive definition of LMS. Then it classifies various tools according to current applications in the industry and it also describes resource poor environments and discusses some problems in resource poor settings.

The above studies discuss technical issues related to the topic of interoperability and learning standards and more theoretical topics related to the designing and acceptance by educators of interoperable and semantic learning applications. Overall, the handbook attempts to provide alternative views on related subjects and to bring closer technologists and educators.

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