Educational Technology Standards in Focus

Michael O'Dea
York St. John University, UK

INTRODUCTION

Educational technology standards, or learning technology standards, as they are also known, have become an increasingly important area of multimedia technology and e-learning over the past decade. These standards have been developed and refined, and have grown to encompass wider aspects of e-learning as the discipline has matured. The scope and reach of e-learning and technology-enhanced systems has increased as a result of this maturing of the discipline.

The "holy grail" of e-learning is to enable individualized, flexible, adaptive learning environments that support different learning models or pedagogical approaches to any Internet-enabled user, that these environments should also integrate into the wider MIS/student records system of the teaching institution, and that they should be cost-effective to develop, maintain, and update. The level of functionality of the current systems certainly has not gotten to this level yet, but there have been a number of big improvements made recently in certain of these areas, in particular, in how to make it less time-consuming to develop, more cost-effective, and interoperable. Educational Technology Standards have been in the forefront of these developments.

The learning technology standardization process is leading the research effort in Web-based education. Standardization is needed for two main reasons: (1) educational resources are defined, structured, and presented using various formats; and (2) functional modules embedded in a particular learning system cannot be reused by another system in a straightforward way (Anido-Rifon, Fernandez-Iglesias, Llamas-Nistal, Caeiro-Rodriguez, & Santos-Gago, 2001).

In this article, the main Educational Technology Standards will be presented, notably, LOM, SCORM, and OKI; their uses and coverage will be outlined; their shortcomings will be discussed; and the current areas of research will be reviewed.

LEARNING OBJECTS AND LEARNING OBJECT METADATA

The fundamental concept upon which virtually all current educational technology standards and specifications have been developed is reusable chunks of information. These have variously been termed *knowledge objects*, *content objects,* and most commonly, *learning objects*. These small self-contained objects of knowledge offer the basic ability to enable reuse of content, modularised development of applications, and standardisation between environments.

Learning objects (LO) and the very closely-related learning object metadata (LOM) specifications have become the base level standard for learning technology, effectively the de facto standard for creating learning content. The IEEE describe them as "*Any entity, digital or non-digital, which can be used, reused, and referenced during technology-supported learning*" (IEEE, 2001).

The key concept behind the LO is that they are designed to be reused, but along with this, that they can be easily delivered via a variety of media, particularly the Web, to enable any number of people to access and use them simultaneously. In this way, they provide a means for efficient development of a large amount of computer-based, interactive, multimedia instruction. Examples of Learning Objects include: multimedia content, instructional content, instructional software, software tools, learning objectives, persons, organizations, or events. On their own, LOs are of limited use. In practice, if they are used to implement any of the operations outlined above or if e-learning systems such as virtual learning environments (VLE) or learning content management systems (LCMS) are employed to implement them and present them to e-learners, they require additional information attached to them. In this context, they also need to have the ability to communicate with the Learning System that organises and manages them. In addition, to enable more complete reuse, each LO has information attached to it that describes its contents to enable easy exchange

and searchability through search engines. This information is termed *metadata* or, more specifically, learning object metadata (LOM).

LOM is a standardised set of metadata attached to a learning object that describes its contents. These metadata (data about data) descriptions can describe a number of different characteristics of the LO. Indeed, the sheer number of different requirements placed on the LOM by the different potential uses of LOs has led to the development of a number of different LOM specifications, each differing slightly, but significantly, in terms of the metadata they specify and provide. The basic LOM specification is set out in the IEEE LTSC (Learning Technology Standards Committee). This is based on the Dublin Core metadata schema and specifies a set of 47 metadata elements, in nine categories (General, Lifecycle, Meta-metadata, Technical, Educational, Rights, Relation, Annotation, and Classification). These categories and elements have been selected to describe the most important aspects of a LO, in order to enable reuse and interoperability. However, the IEEE standard is not the only LOM specification that has been developed. Most of the other main specifications are based on the IEEE standard, but tend to add additional metadata elements and dispense with others. Examples include ARIADNE, CanCore, UK LOM Core, Vetadata, and SingCore.

To be useable, metadata has to be attached to the LOs. It is important to note that the original IEEE LOM specification, LTSC 1484.12.1, specified the metadata elements and attributes only; it did not specify how the metadata was to be represented or attached to the LOs. So, in theory, it is possible to express LOM metadata in a wide variety of formats; for example, text and HTML are options. In practice, the IEEE specification has implemented two methods for this to be done, in RDF or XML. These formats are considered to be of most use in enabling the implementation of LOs within VLEs, LCMSs, and to search engines. These were specified by IEEEE in LTSC 1484.12.3 and 1484.12.4, respectively, in 2002. See Nilsson, Palmer, and Brase (2003) for a detailed exposition of the developments of these implementations. The XML binding of LOM defines the structure of the LOM metadata, while the RDF binding provides a semantic definition. The XML binding is best suited to enable reuse and interoperability of the LO, while the RDF binding is intended to enable more effective search and retrieval of the LO. In other words, each has a specific and complementary use.

THE LEARNING TECHNOLOGY STANDARDS

When the various different educational technology standards are considered, it can be found that there are many different standards, many supporting and working in conjunction with others, some overlapping with others, and some competing with others. However, ADL's SCORM (ADL, 2001) and OKI (OKI, 2004) are generally considered to be the most significant of the standards, as they are wide-ranging standards that focus on enabling all aspects of VLE and MLE functionality.

In this article, SCORM and OKI will be discussed first; then other standards that provide specific functions or services will be considered. This article will focus mainly on the IMS and IEEE standards, as these are the most prevalent. It will also be noted that these standards tend to operate within the SCORM environment, and it makes sense to show, as this article is intended as a review of the technologies, how standards combine to enable the full range of functions and facilities within learning environments.

General Standards

SCORM (shareable content object reference model) and OKI (Open Knowledge Initiative) are general standards that operate at an "enterprise level", that is, they are standards or specifications that focus on enabling VLE, MLE, and LMS operation, integration, and development. Their raison d'etre at this level is to enable interoperability and reusability of resources, within and between these systems.

At the design level, standards such as SCORM or OKI can enable interoperability and reusability using two different conceptual models: interface-based or model-based. Interface-based models aim to provide common interfaces to systems; typically they focus on providing services between systems to enable interaction between components or exchange of data and provide interoperability at a component level. Model-based systems aim to specify common data models that can be used by all of the elements within a system and those communicating with a system. These systems focus on providing interoperability at a data level.

SCORM is both a model-based and an interface-based model, while OKI is built upon an interface-based model.