Towards Management of Interoperable Learning Objects

Tanko Ishaya
The University of Hull, UK

INTRODUCTION

Developments in the Internet and the World Wide Web (WWW) technologies have led to an evolving trend in Electronic learning (e-learning). E-learning is now one of the most fast growing trends in computing and higher education (Ishaya & Wood, 2005) and certainly becoming a dominant way of learning in workplace settings across other organizations (Mungania, 2003). From its initial roots as an information-sharing tool, the Web has seen an exponential growth into a myriad of applications, ranging from very serious e-business to pure leisure environments. Likewise, research into technology support for education has quickly recognized the potential and possibilities for using the Web as a learning tool (Ishaya, Jenkins, & Goussios, 2002). Thus, the Web technology is now an established medium for promoting student learning, and today there are a great many online learning materials, tutorials, and courses supported by different learning tools with varying levels of complexity. It can be observed that there are many colleges and universities, each of which teaches certain concepts based on defined principles that remain constant from institution to institution. This results in thousands of similar descriptions of the same concept. This means that institutions spend a lot of resources producing multiple versions of the same learning objects that could be shared at much lower cost.

The Internet is a ubiquitous supporting environment for sharing of learning materials. As a consequence, many institutions take advantage of the Internet to provide online courses (Ishaya et al., 2002; Jack, Bonk, & Jacobs, 2002; Manouselis, Panagiotou, Psichidou, & Sampson, 2002). Many other agencies have started offering smaller and more portable learning materials defined as learning objects (Harris, 1999; POMETEUS, 2002).

Common standards for metadata, learning objects, and services are mandatory for the success of Web-based learning, which is why the creation of such standards for learning objects and related standards has being one of focus for research and development within the past few years. This includes the creation of accredited standards from the IEEE Learning Technology Standards Committee (LTSC) for Learning Object Metadata (LOM), Sharable Content Object Reference Model (SCORM), Instructional Management System (IMS), and so on. All these metadata models define how learning materials can be described in an interoperable way. There have also been intensive developments in the area of e-learning technology and the wide variety of learning environments from many different vendors (e.g., Sakai, Moodle, and Blackboard). While most of these approaches provide a means for describing, sharing, and reusing resources, the concept of interoperability and heterogeneous access to content chunks is yet to be fully achieved. This results in thousands of similar descriptions of the same concept, even within the same learning management system (LMS), and because these concepts may have been defined using different standards, they are not interoperable.

What is required therefore is a mechanism and infrastructure for supporting a interoperable system of individual components that can be assembled by mixing and matching content from multiple sources to satisfy individual learner's requirements. See Wood and Ishaya (2005) for a personality-based approach for building learner profiles.

The purpose of this article is to examine current approaches used in managing learning objects and suggests the use of ontologies within the domain of e-learning for effective management of interoperable learning objects. In the next section, a background to this article is presented; the current state of e-learning metadata standards is examined and a brief overview of the semantic Web evolution in the relation to e-learning technology development is given. In the third section, the author discusses the driving force behind the need for effective management of interoperability of learning objects. In the fourth section, the article presents e-learning ontologies as the state of the art

way of managing interoperable learning objects. The fifth section concludes the article with suggestions for further research.

BACKGROUND

The background to this article is based on two different disciplines: developments in Web-based educational systems and the evolving vision of the Semantic Web by Berners-Lee, Henler, and Lassila (2001).

Web-Based Educational Systems

Electronic learning (e-learning) has been defined as a special kind of technology-based learning (Anderson, 2000; Gerhard & Mayr, 2002). E-learning systems and tools bring geographically dispersed teams together for learning across great distances. It is now one of the fastest growing trends in computing and higher education. Gerhard and Mayr (2002) identified three major trends as internalization; commercialization and modularization; and virtualization. These trends are driven by the convenience, flexibility, and time-saving benefits it offers to learners. It is a cost-effective method of increasing learning opportunities on a global scale. Advocates of e-learning claim innumerable advantages ranging from technological issues and didactics to convenience for students and faculty (Gerhard & Mayr, 2002; Hamid, 2002). These result in tremendous time and cost savings, greatly decreased travel requirements, and faster and better learning experiences. These systems are made possible from the field of collaborative computing (Ishaya et al., 2002), encompassing the use of computers to support coordination and cooperation of two or more people who attempt to perform a task or solve a problem together. All these seem a promise towards changing how people will be educated and they might acquire knowledge.

In order to support increasing demand for Web-based educational applications, a number of virtual learning environments (VLEs) and managed learning environments (MLEs) have since been launched on the market. These VLEs (e.g., Blackboard and WebCT) are a new generation of authoring tools that combine content management facilities with a number of computer mediated communication (CMC) facilities, as well as teaching and learning tools. VLEs are learning management software systems that synthesize the functionality of computer-mediated communications software (e-mail, bulletin boards, newsgroups, etc.) and online methods of delivering course materials. They "have been in use in the higher education sector for several years" and are growing in popularity (MacColl, 2001, p. 227). VLEs began on client software platforms but the majority of new products are being developed with Web platforms (MacColl, 2001). This is due to the expense of client software and the ease of providing personal computers with Web browsers. Furthermore, using the Web as a platform allows easier integration of links to external, Web-based resources.

Alongside evolutionary representation formats for interoperability, many metadata standards have also merged for describing e-learning resources. Among others are LOM, SCORM, and the Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE) Instructional Management System (IMS). All those metadata models define how learning materials can be described in an interoperable way. The IEEE Learning Object Metadata standard developed by the IEEE Learning Technology Standards Committee in 1997 is the first multipart standard for learning object metadata consisting of:

- **The IEEE 1484.12.1:** IEEE Standard for Learning Object Metadata. This standard specifies the syntax and semantics of Learning Object Metadata, defined as the attributes required to fully and adequately describe a learning object.
- **The IEEE 1484.12.2:** Standard for ISO/IEC 11404 binding for learning object metadata data model.
- **The IEEE 1484.12.3:** Standard for XML binding for learning object metadata data model.
- **The IEEE 1484.12.4:** Standard for resource description framework (RDF) binding for learning object metadata data model.

This standard specifies a conceptual data schema that defines the structure of a metadata instances for a learning object.

The LOM standards focus on the minimal set of attributes needed to allow these learning objects to be managed, located, and evaluated. Relevant attributes of learning objects to be described include type of object, author, owner, terms of distribution, and format (http://ltsc.ieee.org/wg12/). Where applicable, LOM may also include pedagogical attributes such as teach-