Interoperable Learning Objects Management

Tanko Ishaya
The University of Hull, UK

INTRODUCTION

The sharing and reuse of digital information has been an important computing concern since the early 1960s. With the advent of the World Wide Web (from now on referred to as the Web), these concerns have become even more central to the effective use of distributed information resources. From its initial roots as an information-sharing tool, the Web has seen exponential growth in a myriad of applications, ranging from very serious e-business to pure leisure environments. Likewise, research into technology support for education has quickly recognised the potential and possibilities for using the Web as a learning tool (Ishaya, Jenkins, & Goussios, 2002). Thus, 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 a much lower cost. The Internet is a ubiquitous supporting environment for the sharing of learning materials. As a consequence, many institutions take advantage of the Internet to provide online courses (Ishaya et al.; Jack, Bonk, & Jacobs, 2002; Manouselis, Panagiotu, Psichidou, & Sampson, 2002). Many other agencies have started offering smaller and more portable learning materials defined as learning objects (Harris, 1999; PROMETEUS, 2002). While there are many initiatives for standardising learning technologies (Anido, Fernandez, Caeiro, Santos, Rodriguez, & Llamas, 2002) that will enable reuse and interoperability, there is still a need for the effective management, extraction, and assembling of relevant learning objects for end-user satisfaction.

What is required, therefore, is a mechanism and infrastructure for supporting a centralized system of individual components that can be assembled according to learners' requirements.

The purpose of this paper is to examine current approaches used in managing learning objects and to suggest the use of ontologies within the domain of e-learning for effective management of interoperable learning objects. In the next section, a background of this paper is presented. The current state of e-learning metadata standards is examined and a brief overview of the semantic-Web evolution in relation to e-learning technology development is given. Then, the paper discusses the driving force behind the need for effective management of interoperability of learning objects. Next, the paper presents e-learning ontologies as the state-of-the-art way of managing interoperable learning objects. Finally, the paper concludes with further research.

BACKGROUND

The background of this paper is based on two different disciplines: developments in Web-based educational systems and the evolving vision of the semantic Web by Berners-Lee et al. (2001).

Web-Based Educational Systems

Electronic 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 identified three major trends as internalization, commercialization and modularization, and virtualization. These trends are

driven by the convenience, flexibility, and time-saving benefits e-learning 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 the 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 by the field of collaborative computing (Ishaya et al., 2002), encompassing the use of computers to support the coordination and cooperation of two or more people who attempt to perform a task or solve a problem together. All these seem a promise toward changing how people will be educated and how they might acquire knowledge.

In order to support the 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 combines 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). 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 the 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. Amongst others are learning-object metadata (LOM), the shareable content object reference model (SCORM), the Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE), and the Instructional Management System (IMS).

All these metadata models define how learning materials can be described in an interoperable way. The IEEE LOM standard, developed by the IEEE Learning Technology Standards Committee (LTSC) in 1997, is the first multipart standard for learning object metadata consisting of the following.

- **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.
- **IEEE 1484.12.2:** Standard for ISO/IEC 11404 Binding for Learning Object Metadata Data Model.
- **IEEE 1484.12.3:** Standard for XML Binding for Learning Object Metadata Data Model.
- **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 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 the 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 teaching or interaction style, grade level, mastery level, and prerequisites. It is possible for any given learning object to have more than one set of learning-object metadata. LTSC expects these standards to conform to, integrate with, or reference existing open standards and work in related areas. 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.