Standardization in computer-based education

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ABSTRACT

This paper presents the state of the art and current trends in the standardization of computer-based education, including recent approaches like virtual learning or distributed education. Equipment, communication protocols, multimedia content and formats, description and representation of educational resources, organizations, modeling languages and management issues are some of the key areas in this standardization process. The main institutions participating in the process and their roles are also identified. This survey may serve as a reference for the researcher or practitioner in this field.

Contents

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1. Introduction

Many institutions take advantage of advances in Multimedia, Networking and Software Engineering to offer training products and services at all levels. Educational systems and resources proliferate, and a need for standardization becomes apparent.

In general, standardization is concerned with the solution of two problems: interoperability and reusability. Interoperability is related to the ability of being able to work together and communicate, and reusability is concerned with the possibility of exploiting a resource in several systems according to its original purpose, as conceived by its designer. On the one hand, interoperability is supported by the specification of common interfaces and protocols, including models for the messages exchanged. On the other hand, common data models contribute to solve the reusability problem.

Although considerable progress has been made in e-learning standardization, educational standards and specifications remain largely impenetrable for practitioners not directly involved in standardization activities. For example, in a study performed in Spain with expert lecturers in engineering education [1], only 44% claimed to know of some e-learning standard, such as LOM, IMS-CP, IMS-QTI, SCORM, IMS-LD, IMS-LIP and DC, all of them discussed in this paper, and the percentage of teachers who used them was even lower. The same study, extended this time to worldwide experts [2], reported an even smaller percentage of e-learning standard knowledge (33.56%) and usage.

Moreover, there are some e-learning functionalities and aspects for which different standards and specifications overlap [3], while there are other functionalities and aspects having very limited coverage by present standards and specifications. An effort to achieve a full coverage of e-learning by standards or specifications is still to be done in order to increase their usage.

Thus, the chasm between standards' organizations and the educational community prevents the actual potential and benefits of a standard-based approach to be fully exploited, as standards and specifications should both map to and be influenced by their actual application in schools. In other words, the educational community should be aware of the existence of standards and, in turn, standards should contribute to solve actual problems encountered by practitioners in the educational community. Awareness will speed up a life cycle where candidate standards will be eventually discarded or generally adopted, depending on their ability to address real situations in actual educational settings.

This paper offers a survey on the current state of the art of the standardization of educational systems, identifying the key aspects of this process, the main institutions involved, and future trends.

The many standards, specifications and reference models introduced here are discussed from the perspective of technological interoperability among systems. Our aim is to assist practitioners and academics who wish to identify the best alternatives to share data and communicate among technology-based educational systems, or more specifically, to enable the technological interoperability among services and data from heterogeneous sources and systems in the education and learning field. The analysis of the semantic interoperability of individual elements or the analysis of semantic interoperability within a specific context, a complex task on its own, would justify a specific survey and is therefore outside the scope of this article. On the other side, there are some contributions discussing current standardization work related to semantics, including semantic interoperability issues [4], that complements the content of this article.

Fig. 1 represents a typical computer-mediated educational scenario. A learner wants to enrich his or her competences in a given field. For this, the learner contacts an institution providing education and selects a course from the portfolio of that institution according to the learner's preferences and profile. In turn, the course is composed of learning material produced by experts and other content providers. Besides, mediation elements – repositories, directories, searching facilities, etc. – operate to assist both learners to locate the best option among several education providers, and education providers to locate the best content to construct their courses.

For the sake of clarification, we will use this scenario as a reference model for e-learning, to illustrate where standardization initiatives discussed along the paper intend to contribute. Note that other e-learning scenarios are possible – e.g., autonomous learning – and some of the actors identified might not be present in some settings — e.g., the use of self-produced content in a given educational institution will not
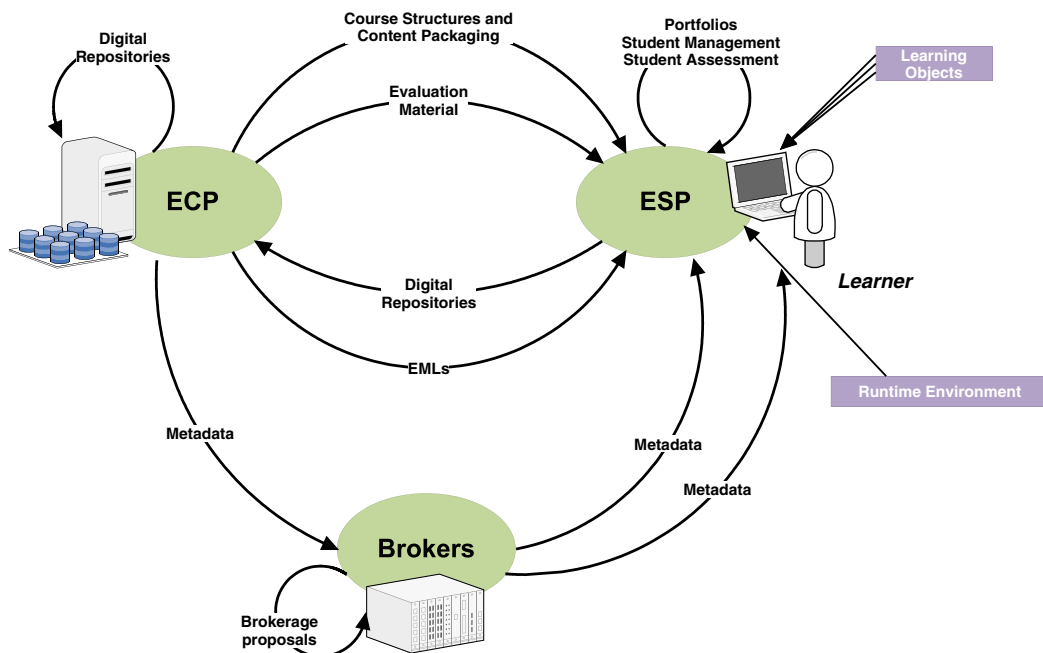

Fig. 1. Standardized information flow in e-learning scenarios.