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ORIGINAL ARTICLE

A general model of learning design objects

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Abstract Previous research on the development of learning objects has targeted either learners, as consumers of these objects, or instructors, as designers who reuse these objects in building new online courses. There is currently an urgent need for the sharing and reuse of both theoretical knowledge (literature reviews) and practical knowledge (best practice) in learning design. The primary aim of this paper is to develop a strategy for constructing a more powerful set of learning objects targeted at supporting instructors in designing their curricula. A key challenge in this work is the definition of a new class of learning design objects that combine two types of knowledge: (1) reusable knowledge, consisting of theoretical and practical information on education design, and (2) knowledge of reuse, which is necessary to describe the reusable knowledge using an extended learning object metadata language. In addition, we introduce a general model of learning design object repositories based on the Unified Modeling Language, and a learning design support framework is proposed based on the repository model. Finally, a first prototype is developed to provide a subjective evaluation of the new framework.

1. Introduction

Over the last few decades, information technologies have come to play an increasingly central role in classroom learning. The ability of instructors to design intensive technology courses that enhance the learning process is therefore the key to success in educating the youth of today. Several studies have focused on the pedagogical aspects of technologically intensive courses, but insufficient support has been provided in the area of curriculum design. The release of the Instructional Management Systems Learning Design (IMS-LD) specification is indicative of a directional shift in e-learning. The IMS-LD has many pedagogical benefits compared to earlier open specifications for e-learning. However, it is not straightforward for instructors to understand and work with (Griffiths and Blat, 2005), and the usability issue poses a major challenge for instructors who are not highly qualified as instructional designers. Instructors must master the IMS-LD specification and authoring tools before they can begin to design high quality courses. In addition, they require the means to express their effective teaching practices as learning designs in a uniform way and share them through web-based repositories (Sampson et al., 2011).

There is a current trend toward using learning design (LD) as a means of sharing best teaching practices. For a literature review on the subject, we refer the reader to (Beetham and Sharpe, 2007). However, LDs can only be shared if the

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representation provides all the information necessary for instructors to understand them, for example, the details of each learning activity, the associated learning and support tasks and the required resources (Conole, 2008). In other words, the sharing of LDs requires tools and strategies to facilitate their transparent communication between humans and machines (Sampson et al., 2011).

In this work, we propose a new approach to the representation and qualification of LDs to facilitate their reuse within LD repositories. Our approach is based on the concept of a learning design object (LDO) that includes two types of knowledge: reusable knowledge and knowledge of reuse.

The remainder of the paper is organized as follows. Sections 2 and 3 review the concepts of LOs and LDs, and Section 4 introduces the problem statement. Section 5 provides an overview of related work. In Section 6, we present our main contribution, the definition of an LDO, and a class diagram of the model is also proposed. A learning design support framework based on the LDO model is presented in Section 7, along with a subjective evaluation of a first prototype. The final Section concludes the paper and suggests directions for future work.

2. Learning objects

Various researchers have attempted to define an LO as an entity or particular type of artifact and have inevitably failed in the attempt to provide a definition that is both broad enough to include all that an LO might be and specific enough to reject what it is not (Parrish, 2004). In (Hodgins and Duval, 2002), an LO is defined as any digital or non-digital entity that may be used for learning, education or training. In (Grace et al., 2008), LOs are defined as building blocks that can be combined in a virtually infinite number of ways to construct collections that may be referred to as lessons, modules, courses, or curricula. LOs can be as small as an explanatory paragraph or as large as a complete tutorial and can be presented through a variety of media, including text, graphics, animations, audio and video.

The utility of LOs to instructors as designers can be illustrated through the following three examples: (1) an instructor discovers a concept with which his students frequently struggle and seeks a better way to explain the concept; (2) an instructor requires a reusable assignment covering a new topic in his course; or (3) in a course on software requirements, the instructor may wish to provide real-world examples to make the course more attractive and practical. Let us assume that an extensive collection of illustrative software requirement categories (data requirements, functional requirements, etc.) and styles (data dictionaries, entity-relationship diagrams, dataflow diagrams, etc.) is available. The instructor can save substantial effort and expense by reusing the same examples of software requirements from this collection.

(Parrish, 2004) takes a critical look at the proposed benefits of LOs in the published literature, particularly in terms of their scalability and adaptability. He also discusses the difficulty of defining the term LO and the limitations of metaphors used to describe the concept. He concludes that rather than attempting to define LOs as entities or particular artifacts, the following approaches may be more useful:

- viewing LOs as processes or strategies, such as object-oriented instructional design (OOID). OOID is a strategy for designing digital learning content and activities as discrete, addressable, and adaptable units to achieve fine-grained accessibility and improved reusability.
- using LOs to support active learning strategies (case-based learning, problem-based learning, generative learning, collaborative learning, etc.) rather than treating them as collections of static lessons. In this way, LOs can provide stimuli and support for students as they practice complex tasks rather than simply presenting a deterministic outcome.

LOs were developed to address the need for high-quality and reusable educational fragments that are organized in an accessible manner. These objects help to solve the problem of costly reproduction of instructional materials for e-learning courses. The decision on which LOs to include in a given course can be made in advance by the instructor or spontaneously by the student (adaptive learning). There are now abundant LOs available on the web. However, standard web search queries for LOs often return a prohibitively large number of results. It is more convenient to obtain instructional materials such as exams, exercises, and quizzes from repositories.

It is already viable to reuse, share, and freely interchange LOs via the World Wide Web. The leading Open Educational Resources (OER) movement and other international initiatives have highlighted the importance of sharing and reusing LOs among teaching communities (Caswell et al., 2009). LOs and their metadata are therefore organized, classified and stored in learning object repositories (LORs) (McGreal, 2004). In recent years, a number of interactive and user-friendly web-based LORs, such as Ariadne[1], Merlot[2], Maricopa[3], and Careo[4], have been developed worldwide in various disciplines. However, despite the extensive development of LORs, their impact on teaching practices in the classroom has been rather limited. According to (Sampson et al., 2011), this limited impact may be due to a lack of systematic mechanisms for connecting LOs with their educational contexts.

3. Learning design

The IMS-LD (Koper et al., 2003) is an open standard that is used to code a wide variety of digital courses, known as units of learning (UoLs), in a formal, semantic, interoperable and machine-readable fashion. The IMS-LD supports a wide range of modern pedagogical approaches such as active learning, collaborative learning, adaptive learning, and competency-based learning (Koper and Manderveld, 2004; Koper and Olivier, 2004).

In (Koper and Olivier, 2004), LD is defined as the description of the teaching process following a specific pedagogical approach that addresses specific learning objectives for a particular audience in a particular discipline. Fig. 1 illustrates the relations among the UoL, learning model, domain model, and theories of learning and instruction. The UoL is the result of LD. The learning model describes how students learn based on various learning theories. The domain model describes

[1] www.ariadne-eu.org
[2] www.merlot.org
[3] http://www.mcli.dist.maricopa.edu/
[4] http://www.careo.org