SHAPING THE COOCOON: A MODEL FOR WRAPPING LEARNING CONTENTS ON AN E-LEARNING PLATFORM

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ABSTRACT
In disentangling edges and interpretation about the concept of learning object, pedagogists and computer scientists are still crossing their swords. Flexibility is opposed to standardization (i.e. strictness), context independence faces to portability, learning intent to accessibility and, finally, aggregation and granularity are not explicitly issued yet. Despite the widespread acceptance of standards, such as SCORM IMS Content Packaging, and of Learning Content management Systems, principles and practices in wrapping or splitting learning contents are not univocally ruled. Another complexity level arises from the wide use of platform tools done by users with the latest generations of LOs. The association between tools and content is addressed by Learning Content Management Systems (LCMS) in many different ways, trying to find a balance between flexibility and standardization issues. This paper presents a new model, called CoCOON (COnten t Case Organizer for Objects Nesting), based on well-known IEEE and IMS standards, to manage complex aggregation mechanisms among LOs and to provide many association levels to relate LOs and platform tools. The model has been tested by implementing extensions and modules to an open source LCMS (ATutor) and implementing a whole course to be used in a Master Degree.

KEYWORDS
E-learning, Learning object, Granularity, Learning Content Management System

1. INTRODUCTION

Applying pedagogy – or, exactly, doing didactics - on the distance-learning context, at the state of the art, implies a long series of assumptions and conventions, in order to equally meet technological issues and learning instances.

Digital learning materials are designed and implemented around basic entities, which generally refers to the concept of Learning Object (LO), as a conceptually indivisible, exhaustive, reusable and portable wrapper for potential learners (Wiley, 2000). Literature about e-learning and, specifically, about LOs, is widely addressed to some further definitions shaped around general principles such as flexibility, learning intent and context-independence (Polsani, 2003; Balatsoukas 2008). Unfortunately, standards in charge of identifying and describing LOs, such as SCORM IMS Content Packaging (IMS, 2001), partially characterize their structure and composite nature (Metros, 2005; Knight, 2005), without explicitly stating rules about their level
of aggregation or granularity. Hence, interoperable exchange of packed contents can be seriously restricted because of a latent vagueness of edges and connections among (potential) atomic units. Researches introduced several solutions to clarify the above hinted specifications gaps, by addressing methodological issues (Polsani, 2003) or by introducing technological artifacts, both in terms of model expressiveness and of implementation logic (Verbert, 2004). Two different process approaches in designing LOs synthesize trends in facing LOs boundaries: on one side, each LO is conceived as a small collection of raw data and information; on the other side it is identified once an aggregation level for contents has been stated. Indeed, the former conception is revealed by the content models themselves, while the latter one arises within learning technology standardization communities, corporate training departments and among individual researchers. As an example, the IEEE LTSC LOM standard (IEEE, 2002) supports the notion that any aggregation level may be regarded as a learning object.

Beyond theoretical reasons to specify learning resources aggregation, there are evident motivations, bounded to the LOs access via platforms in charge of managing them. The very first step to access any content (from enrolling to a course to sharing some comments on a forum with other students) is, obviously, having a clear link between such content (as a target) and the tool to access it. Platform dependent customizations for resources aggregation can only apparently solve access capabilities because content may be excluded from portability or reuse.

An outreach solution that addresses the tool-content association is Common Cartridge (CC) (IMS, 2008), a set of open standards which enable strict interoperability between content and systems. They also support great flexibility as it concerns to the type of digital content - which can actually be applications - and to the place where such content is located (content and applications in a Common Cartridge can be distributed). Starting from a real case study, we present our solution to trade off instances coming from didactics issues and universality requirements with flexibility characteristics and technological constraints.

Our work tries to fit the design of a real university course (Multimedia Systems, 10 Italian credits) into one of the standard packaging definition proposed by IMS (IMS, 2001; ADL, 2004; CAM 2004). The course, devised in blended learning, is structured into 4 main on line modules, corresponding to 30 hours of lectures and related on line activities. Each module is composed by a set of lectures, each one related to a specific subject and corresponding to 2 hours of work (including all auto-evaluations and on line practices). Such a course could be structured into LOs by using a wide range of strategies. Extremes of this range are:

1. Creating a whole LO, containing all materials and activities corresponding to the 30 hours of lectures. Obviously the reuse of such an LO is conditioned to a new identical edition of the same course because as a standard content, it could not be divided into components to be partially used. At the same time, this approach practically simplifies the real upload of content into platforms, which usually recognize each LO as a course and associate class authentication policies and tools to it.

2. Creating an LO for each single lecture. On one hand, this strategy permits a large reuse of contents and specific lectures could be included into different courses. On the other hand, the design of the course as a whole is lost, the upload procedure becomes long and complex and concept represented by modules and courses are lost as well. Some platforms present such a plethora of LOs as a sequence of unstructured courses and give a partial support to associate tools to multiple LOs.

Let us notice that (1) and (2) actually represent the instances we disclosed here about aggregation and granularity of learning content.

To overcome strategies limits, we have designed a novel approach to LOs composition and organization, called CoCOON (COntent Case Organizer for Objects Nesting), with the aim to offer an effective support to content flexibility and, contemporaneously, to address reusability issues by ensuring compliance to main standards. Contents, which are built as standard SCORM LOs, are aggregated into containers and organized in a hierarchical structure rooted as a course, composed by modules obtained by aggregating sub-modules. Each level of the hierarchy can (potentially) be associated to all the platform tool and the top level (representing the course) can be related to classroom tools and access/authentication mechanisms. In order to verify the feasibility of our approach with all the different actors involved in the e-learning process, we have implemented and uploaded the entire blended e-learning course described above, which was used during the last quarter (march 2009-june 2009). We used a customized version of a well-know open source e-learning platform, ATutor (ATRC, 2009), tailored to support the Common Cartridge standard and to host and provide to users CoCOON compliant content.
The reminder of this paper is organized as follows. Section 2 presents the CoCOON model and proposes some examples of use, while section 3 shows our case study scenario, describing the content architecture, its deployment and the e-learning platform setup. Section 4 presents some final considerations.

2. THE COCOON MODEL

The CoCOON model is designed to represent complexity of university courses, which may be divided into modules and sub-modules, arguments and sub-arguments and, finally, lectures. The model assumes the lecture to be an atomic learning element, designed and implemented as a LO (in compliance with SCORM/IMS Content Packaging). Each lecture can be associated to:

- specific tools, i.e. a wiki to collaboratively compose an hypermedia, a pool to collect students’ preferences, one or more auto-evaluation tests.
- Specific access prerogatives, so that only some groups or single users can manage or benefit it. As an instance: a certain lecture could be co-tutored by an external expert, or it could be accessed by a suitable class of learners.

The association between an occurrence of atomic learning element (called lecture 1), its tools and access prerogatives is depicted in the following Figure 1.

Figure 1. Association between an occurrence of atomic learning element, its tools and access prerogatives.

![Diagram](lecture1-tools-access)

Both these issues are simply addressed by using the IMS Common Cartridge standard to specify tools association, access and authentication prerogatives. Finally, lectures are structured in complete compliance with well known specifications, ensuring both re-use and retrieve of learning contents at this granularity level. It is worth noticing that an atomic learning element, can be identified in each course structure, inside or outside the academic scope of our work.

In order to provide a formal definition, we state that an atomic learning element is a LO which is built in compliance with SCORM/IMS Content Packaging (IMS, 2001) and is associated to a set of tools and access prerogatives in conformance to IMS Common Cartridge (IMS, 2008).

Lectures have to be composed into higher level structures, up to the complete deployment of the whole course. The simplest course structure is represented by a flat ordered sequence of lectures. Such a course is a learning container, filled with a sequence of atomic learning elements. The course is obviously associated to

- specific tools, i.e. a community forum or tool, a calendar to schedule on-site lectures and other temporizared activities, a general bibliography and/or a glossary.
- Main access prerogatives, such as professor/tutor credentials, student access and authentication mechanisms.

Figure 2 shows a course (named course A) composed by a simple sequence of lectures (called lecture 1, lecture 2, …, lecture n). Lectures are sometimes associated to local tools or access prerogatives, while a global set of tools and access prerogatives is associated to the whole course A.

Note that the course, in conjunction with its access prerogatives and tools, also maps the concept of class.

Figure 2. A learning container (course A) built as a sequence of atomic learning elements (lecture1, …, lecture n).
This course example shows a learning container structured as a flat sequence of atomic learning contents. As an obvious generalization, learning containers can include both atomic learning contents and learning containers as well, so as to generate hierarchical structures which can model more complex course architectures.

Formally, a learning container is a sequence of atomic content elements and content containers, associated to a set of tools and access prerogatives.

A more complex example is shown in the following Figure 3: a course \( (\text{course } i) \) is composed by three sub-elements:
1. an atomic learning content, i.e. a lecture to introduce the course and its contents. This specific introductive lecture is not associated to tools or access capabilities.
2. two modules (called module A and module B respectively), assigned to different tutors and, as a consequence, associated to two different sets of access prerogatives.

As a didactical strategy, tools are associated to each lecture (except for the introduction) and to the whole course, as community and course related tools.

Figure 3. A learning container \( (\text{course } i) \) containing both sub-learning containers and an atomic learning element.

It's worth noticing that the CoCOON model can be used to describe more complex course architectures, both to be used inside the university scope and outside it. It fully addresses the goal of reuse at the base level of atomic learning content. As an open issue, we leaved the reuse of the whole course or parts of it that is not effectively supported by available standards yet.

3. THE SMEL SCENARIO

The CoCOON model has been used to design and implement a whole university course used as scenario, both to verify effectiveness of our approach during the design process and to evaluate technological issues related to e-learning standards and platforms. The deployed course is Multimedia Systems, a 10 Italian credits class part of the Master degree in E-learning (Università, 2009); in the following the course is named SMel (in Italian “Sistemi Multimediali e-Learning”). This course is devised in blended learning, structured into 4 main on line modules, which are subdivided into 30 lectures. The CoCOON based deployment of the course is presented in Section 3.1. Once built the 30 LOs corresponding to the lectures, we modified an Open
Source e-learning platform, ATutor, to host and deliver our content. The main issues related to implementing the model on a real Learning Content Management System (LCMS) are presented in section 3.2.

3.1 Contents architecture and deployment

SMeL contents are structured into an introduction to Digital Multimedia (built as a single lecture) and three main modules respectively on Images & Colors, Audio and Video, Networked Multimedia. Each of these modules is sub-structured into a set of lectures. Figure 4 shows the home page of SMeL that clearly presents the first level of substructures, while Figure 5 presents the home page of the Images & Colours module. It’s worth noticing that CoCOON simply models the course structure into a three level tree (course, module, lecture). After the complete listing of course components and subcomponents, the hierarchical structure has been completed by specifying tools and access strategies as follows. A single group of access prerogatives is associated to the whole course together with a file storage tool, a forum tool, a news board tool, a statistic tool to track students progresses and, finally, a wiki to support cooperative activities. As Figure 5 shows, modules are not associated to any tool. Finally, some lectures containing cooperative activities are directly associated to a forum discussion or a wiki page. We decided to refer to the course forum and wiki, simply opening a working area for each lecture to centralize all new contents into course tools. Using a new forum or wiki for each lecture was considered too dispersive.

While a set of prototypic LOs were etched in English, the whole course was implemented in Italian to meet law requirements.

Figure 4. The SMeL course home page: the user (here the instructor is logged in) see the list of sub content corresponding to the four modules which compose the course.

Figure 5. The Images & Colours module home page.
3.2 Platform setup

The 30 single LOs were uploaded on a modified version of a well-known e-learning LCMS, ATutor. Several reasons have driven the choice to use ATutor to deploy our tests. First of all we considered its accessibility and compliance to W3C and e-learning standard as a fundamental issue. Secondly, we are involved in the implementation of a Common Cartridge module for ATutor and the availability of this specific feature is an essential element to completely build a CoCOON-based learning environment.

Each LOs is imported on ATutor as an internal structure called “Course”, associated to all the platform tools. ATutor “Courses” can be aggregated into “Categories” in a two levels structure. These settings are obviously inadequate to host SMeL, fundamentally due to two aspects:

1. The two levels structure is not enough to contain the three levels of SMeL and, more generally, to support the creation of an unspecified hierarchical structure. To overcome this limit, we defined a new data structure based on existing data tables that works as a learning container, as it is defined in Section 2. Beside this improvement, a set of additional functionalities were developed to support the effective management of the resulting hierarchy. As an example, the subscription done by users was originally limited to ATutor “Courses” (i.e. to each of our lectures). In order to avoid multiple enrollments, we consider the subscription to a learning container as done to all its descendant in the hierarchy.

2. Tools are associated to the lowest level (called “Course” in ATutor, but corresponding to our lecture) of the hierarchy. To overcome this limit we decided to associate tools also to the new data structure representing the learning container.

After these deep modification to ATutor functionalities a new issue arose, related to tools scope. The distribution of tools over the hierarchy is not truly effective whenever their utilizations are related to content structure. A significant example is the statistic tool, which tracks students progresses in terms of visited pages and auto-evaluations. The conventional ATutor tool works on a single ATutor “Course” and a radical modification is needed to let it operate on the global SMeL content. Specifically, we implemented a new statistic tool which shows the whole activity of a specific user, as shown in the following Figure 6. This tool is associated to the top level (our course, i.e. the whole SMeL content) and reports all progresses of a user structured on the basis of lectures and associated modules.

Figure 6. The Statics Tool showing all lectures and related modules visited by a specific user
4. CONCLUSION

Granularity of LOs is still an open issue, complicated by the wide use of cooperative tools done by new e-learning 2.0 activities. The need to maintain conformance with standards contends against flexibility and, more generally, capability to fit complex situations. In this paper we presented a simple model (called CoCOON) based on the idea to define a reusable atomic granularity (in our scenario, associated to a university lecture) and compose each grain into a hierarchy of ad hoc structures. Atomic contents are built as LOs, in conformance to main standards, specifically the IMS SCORM Content Packaging (ADL, 2004). We shown the feasibility of our approach through a real case study, an e-learning course, part of a Master Degree, deployed during the last quarter (March 2009-June 2009). To complete our work we start a study on how to provide partial or global conformance to standard also to hierarchical structures. In particular, we are working on the idea to use Common Cartridge functionalities to create associations between different LOs, also using URI (Uniform Resource Identifier) or other universal identifiers.

While the hierarchical structure fits completely our design needs, the implementation of the model inside a real e-learning platform is still under development. Main tools of the LCMS have to be adapted to the structured contents and the management (import/export, editing) of Common Cartridge compliant content is into a test phase. Our work is available (in Italian) at the following address: http://sm.polocesena.unibo.it (previously contacting the authors via e-mail, to obtain credentials).

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