

Implementing Content Packaging Standards

Alenka Kavčič

Faculty of Computer and Information Science
University of Ljubljana
Ljubljana, Slovenia
alenka.kavcic@fri.uni-lj.si

Abstract—The paper deals with the issue of standards and specifications applied to educational digital content. Content packaging has to comply to standards to assure its interoperability and portability, as well as facilitate search and discovery, accessibility, and (re)use. Two most common packaging standards for educational content are described in the paper: already recognized and widely used ADL SCORM, and a newcomer in the field, IMS Common Cartridge, which successfully overcomes some problems of using modern Web technologies in education. We also describe our experience in implementing these standards, the problems, and advantages of using such packaged content.

Keywords—Common Cartridge; content packaging; e-learning; interoperability; SCORM; standards

I. INTRODUCTION

With a widespread use of computers and broadband Internet connections, information and communications technologies have become an important part of the educational process. Consequently, extensive catalogues and large repositories of online learning resources have become available to schools, teachers and students, not only from the commercial providers, but also from teachers in schools. Electronic learning materials are today indispensable part of an educational process, either used in class for enhancing conventional teaching activities (blended learning) or for supporting individual student's work and practice (e-learning).

Electronic content is typically used within a Virtual Learning Environment (VLE) or Learning Management System (LMS), which is designed to support computerized teaching and learning. The content can be used (or created) in one system, discovered and retrieved to another system, and again transported to and reused in the third system. Hence, the creators of the content should also address the interoperability issue by using a suitable format that is completely independent of the VLE, and can be recognized and run under different systems. The only feasible way to accomplish this is by adhering to supported standards, which promise and also deliver such interoperability.

II. DIGITAL CONTENT PACKAGING STANDARDS

The need for content accessibility, reusability, durability, and exchange urged the development of common formats and procedures for content packaging and content description.

Various standards and specifications for content exchange have therefore emerged.

A pioneering work in this area was carried out in 1993 by Aviation Industry Computer-based Training Committee (AICC) in its CMI Guidelines for Interoperability [1], which defined interfaces and rules for interoperability between Computer-Based Training content and Computer Managed Instruction (CMI) systems. The guidelines thus proposed the format for describing the course, its structure, and its dynamic behaviour (unit sequencing), but they didn't address the packaging mechanism to enable its portability. The latter was proposed in a separate AICC Packaging Specification [2] that described precise course package structure in a zip file.

A. ADL SCORM

A well known and accepted standardised format for digital learning content is SCORM (Shareable Content Object Reference Model) [3] from Advance Distributed Learning (ADL) initiative. SCORM is a set of technical standards and specifications that regulate the development, packaging and delivery of educational content, as well as its interaction with the VLE.

Portability and reusability of educational material in SCORM is ensured by its proper organization into content packages (zip files) and description of this organization in manifests (XML files). The content is broken into Sharable Content Objects (SCO), which are reusable learning objects of a standardised form. SCOs are used as building blocks to create content packages and are assembled in packages together with their delivery instructions. A separate description of the package is provided in the manifest file that declares the content of the package and the locations of SCOs. Beside the content aggregation model, the specification also covers the interaction with the VLE. It defines an application programming interface (API) and data model for enabling communications between learning content and the system. Furthermore, SCORM supports sequencing, which is strictly separated from the content. A set of rules specifying the order, in which SCOs are to be delivered, is treated directly on the level of VLE.

The main disadvantage of SCORM is its obsolete model that was designed years ago for self-paced computer-based learning and training [4]. It therefore lacks support for modern educational technologies, such as immersive learning environments (e.g. simulations, games, virtual worlds),

collaboration tools (e.g. wiki, chat, forum, social networks), or various Web-based learning activities.

B. IMS Common Cartridge

This gap in standardisation and interoperability support in the area of educational technologies of the new generation was addressed by IMS Global Learning Consortium (GLC) [5], which develops interoperability standards for distributed learning and facilitates their adoption practice. Its Common Cartridge [4] specifications were released in October 2008.

Common Cartridge (CC) is a set of open standards that enable strict interoperability between content and systems, support flexibility in the type of digital content (content can be also applications), and sustain distributed content (and applications) [4]. The main purpose of CC is not to replace SCORM [6], but to enhance the educational scenarios with advanced approaches to assessment, collaboration tools, modern learning environments, Web services, and content authorisation, for which SCORM was just not intended [7]. CC was developed specifically to sustain interactive and collaborative learning situations, typically guided by a teacher [4]. Although the specification can be used to assist self-paced online learning, its main focus is on blended learning.

Like SCORM, CC builds on IMS Content Packaging [8] specification, yet adds support for IMS Question and Test Interoperability (IMS QTI) [9] and IMS Learning Tools Interoperability (IMS LTI) [10]. Content Packaging standard takes care of the package composition and thus enables the portability of the learning material. As in SCORM, all files are gathered in one zip file. A manifest file, which describes the content and the package organization, is also added to the archive. IMS QTI standard describes the way of integrating interactive tests into the learning material. CC supports only a subset of QTI, including five types of the most popular quizzes: true/false questions, multiple choice questions (single answer and multiple answers), fill-in-the-blank quizzes, and essay. All quizzes are described in an XML file, holding all necessary data: quiz type, its content, all possible answers, correct answers, feedbacks, grading, etc. IMS LTI standard supports integration of learning content with VLE services, as well as with other Web services. The content can be enriched with collaboration tools (chat, forum, wiki, etc.) that are part of any VLE, or with external Web services (e.g. Google Maps or e-books). If the external service is not free and/or needs an access authorisation, LTI enables automatic authorisation, either on the level of the package or the VLE user. The accessing services are detailed in an XML file, which is described in the manifest and included in the package.

A CC package depends on VLE to interpret and display its content. Thus, the environment is responsible for correct rendering of the content and its execution, including QTI quizzes and LTI services. The look and feel of the package content depends on the environment and integrates with the uniform appearance of the system, yet the standard functionality of the content is always assured. Because VLE takes care of the content execution, content delivery can be adapted to a particular user and their rights (e.g. access to the

quiz solutions is restricted to teachers only). Besides, quizzes can be automatically graded and results recorded in the VLE.

III. CONTENT PACKAGING PROCEDURE

For comfortable and efficient work with packages (both, SCORM and CC) we need a set of tools that facilitate their construction, editing, validating, and playing. We examined various tools that assist in this process [11], and decided on a workflow best suited to the needs of a teacher.

The lifecycle of a package with educational content can be divided into four stages:

- development of the educational content,
- packaging the content,
- validating the package, and
- using (playing) the package.

Before we can start with the packaging, the educational materials have to be created. The most convenient is to use an ordinary Web content (HTML files with associated styles and JavaScripts, applets, pictures, video, animations, and other media files). There are many authoring tools available for creating such content, or for exporting the existing content into Web-based format.

The support for the navigation through the content is not part of the content itself and is dealt with separately. This way the content is free of navigation buttons and links and can be used independently, reused in other contexts, or delivered to the user in an arbitrary order.

A. Packaging

Packaging ensures the creation of the manifest file, in which the content and its organization are described, and the compilation of all files into one single zip file.

When creating a SCORM package, HTML files might have to be supplemented with API calls to guarantee the needed communication with VLE.

Common Cartridge packages can be enriched with three types of activities: forums, external Web links, and quizzes (QTI questions). All activities are described in XML files, which are also added to the package (with corresponding entries in the manifest file).

A use of appropriate packaging tools is recommended as they assist in the process.

1) *SCORM Tools*: For many years, SCORM has been the only standard for educational content that was really widely used. Consequently, many tools exist that facilitate creation of SCORM packages [11]. Some authoring tools include “Export to SCORM” feature (e.g. eXe Learning, MOS Solo, Learning Essentials 2.0 for Microsoft Office), while other editors focus on package creation (e.g. Reload Editor). Our tool of choice was Reload Editor [12], because it is already quite mature, powerful, user friendly and easy to use, yet freely available and platform independent.

TABLE I. COMPARISON OF DIFFERENT TYPES OF PACKAGES

| | Zipped Web material | SCORM package | CC package |
|-----------------------------|---|--|--|
| format | zip file | zip file | zip file |
| portability | yes, but deployment can be difficult | yes | yes |
| metadata | no | yes, included in manifest file | yes, included in manifest file |
| organization description | indirectly in external index file | manifest file | manifest file |
| navigation | external index file (complex preparation) | described in manifest file | described in manifest file |
| deployment | unzip, play in browser; difficult in VLE | needs player; simple import to VLE | needs player; import to VLE |
| construction (creation) | simple, except the index file (navigation) | easy with suitable tools; good existing tools | easy, but the tools have to be improved |
| adapt/modify/(re)use in VLE | yes, but depends on deployment in VLE | invariable, cannot be changed once deployed | yes, the content can be changed, adapted, partially deleted, or new content can be added |
| integration with VLE | no | partly | completely |
| intended learning scenario | various | good for self-studying, not suitable in blended learning environment | collaborative learning and social component of learning (blended learning scenario) |
| remarks | although Web content can be wrapped up to create a package, which greatly improves the content's portability, such package lacks proper metadata description, which is essential for content search and discovery; using such packages in VLEs is also problematic, as a lot of knowledge and manual work is needed for proper deployment | package depends on the execution environment, with which the package interacts through API calls; because the package also controls the navigation, sequencing, and the look and feel of the presented content, it looks and behaves similarly regardless of the particular execution environment; no support for modern learning technologies | there is no direct interaction with VLE (no API calls for control over sequencing and results); the package has integrated support for QTI assessment and services (through LTI); the package is integrated into its execution environment - its navigation, look and feel, and delivery of the content vary on the system (VLE) can include forums, quizzes, or other activities |

2) *Common Cartridge Tools*: A relative novelty of the standard is reflected also in the availability of tools [11]. Many of them are still in beta releases, not fully compliant with the standard, and/or lacking some essential functionality (e.g. eXe Learning, MIR Common Cartridge System, Learning Components IDE). The situation is more optimistic with the commercial tools, like SoftChalk V6. We decided on Common Cartridge Builder [13]. Although this open source tool still lacks much needed functionality, it is very intuitive, easy to use, and is platform independent. Yet we had to make some changes in the created manifest file to ensure its validation.

There is also a good alternative way to obtain a Common Cartridge package: it can be automatically converted from a SCORM package using an appropriate conversion tool. One of such tools is freely available SCORM2CC [14].

B. Validating

The correctness of the created package and its compliance with the standard can be checked with the validation tools.

1) *SCORM Validators*: ADL provides a set of validation tools ADL SCORM Test Suite that can be freely downloaded from their Web site. Alternatively, some online validators are also available (e.g. Rustici Software SCORM Cloud) [11].

2) *Common Cartridge Validators*: The most convenient and easiest option is online Common Cartridge Validator [15], which was also our validator of choice. The tool is still in experimental use, but works fine and is easy to use. We just have to be aware of its limitations, faults, and possible workarounds. The other option [11] is a standalone IMS Common Cartridge Test Tool, which is an excellent tool, but is currently available to IMS GLC members only.

C. Playing

Packaged content cannot be used efficiently without a suitable player that can interpret the manifest file and correctly display the appropriate content. The player is also responsible for the navigation support within the content.

1) *SCORM Players*: There are some online players available (e.g. Icodeon SCORM Player or Rustici Software SCORM Cloud), whereas Reload SCORM Player can be used offline as a standalone application [11].

2) *Common Cartridge Players*: Online players include Icodeon Common Cartridge Platform, MIR Common Cartridge System, Learning Components Player (for CC), and there is also a standalone alternative MOS Player [11].

A packaged content is usually used directly in a VLE, as most of them support all major standards. SCORM import is already available in all main systems, while an integrated support for Common Cartridge is included in their latest versions (e.g. Moodle, ATutor, Sakai, Blackboard).

IV. COMPARISON OF THE PACKAGES

Starting from the educational Web content, we have constructed three different types of packages that correspond to one learning object: zipped Web-based material, SCORM package, and CC package. Each has its advantages and weaknesses, and is suitable for a specific learning situation. Their comparison is summarized in Table I.

V. ASPECT PROJECT AND RELATED WORK

Project *ASPECT: Adopting Standards and Specifications for Educational Content* [16], is a Best Practice Network supported by the European Commission's eContentplus

programme. The project has three main objectives: to analyse and compare different standards and specifications in terms of their relevance to a range of learning resources; to check the effect of their implementation on enhancing the interoperability of educational resources; and to establish best practices for combining existing specifications into complete solutions.

Within the project, we searched for efficient ways of preparing educational content, including the tools to facilitate this process, and went through the whole process of package creation while preparing a demo cartridge. Our experience was shared with teachers at the workshop “From Web Documents to Educational Packages”, which was held in Ljubljana at CoLoS 2010 Summer School [17]. The participants learned about the various tools used in the process of package creation, with special attention to its usage and differences in the two standards, SCORM and CC. Since SCORM standard is already quite common in educational domain, the main focus was on introduction of the CC standard and its advantages in some educational scenarios.

A group of 6 teachers, all with previous experiences with SCORM, actively participated in the workshop. Together we created one demo package, as both SCORM and CC package (providing step by step instructions). Then the participants gained experience with packaging while individually preparing their own packages from their learning materials. Ten SCORM and nineteen CC packages were prepared altogether at the workshop. Their content included HTML pages, forums, external links to other resources, QTI quizzes, lesson plans, and collaborative tools.

We decided to test our packages in Moodle [18], as this LMS is widely used in Slovenian schools and teachers are already familiar with it. Besides, the support for Common Cartridge is integrated in the latest release and performs satisfactorily, although it is still in an experimental phase.

The participants were already aware of the limitations of SCORM packages and were all excited by the ease of use of CC packages, especially in the context of their integration into VLE, reuse and possibilities of modification. Since CC cartridge blends as a native content in Moodle, as shown in Fig. 1, you can easily edit, add, remove and alter the content.

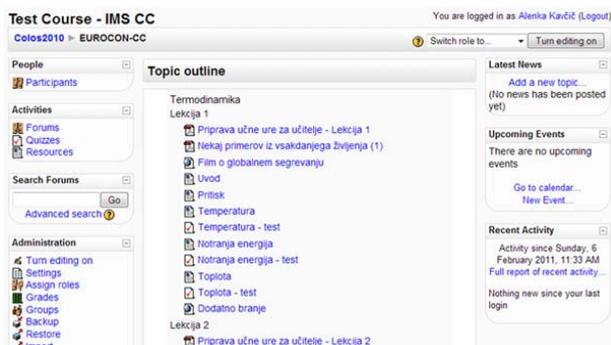


Figure 1. IMS Common Cartridge on Thermodynamics in Moodle

General feedback from the participating teachers was very positive towards the new standards, but the main obstacle remained: the lack of suitable tools for creating CC packages.

VI. CONCLUSION

The issue of standards for educational content is very important, as implementation of standards positively affects content interoperability, portability, and exchange, as well as search and discovery, accessibility, durability, and (re)use. Existing older standards (e.g. SCORM) are widespread, but fail to cover modern educational approaches, while newer standards (e.g. Common Cartridge), despite of better concepts, are still not adequately adopted in practice.

One of the problems with adoption of new standards is also lack of suitable tools that would embrace all novelties and features of the standard, and facilitate the preparation of educational packages. The tools available at the moment are just not adequate and lots of work has to be done manually (i.e. by editing XML files directly), which demands good practical knowledge of the standard. But with time, the tools will become more mature and tested in practice, and will eventually support comfortable work with packages in all development phases.

ACKNOWLEDGMENT

The work presented in this paper is partially supported by the European Community eContentplus programme - project ASPECT: Adopting Standards and Specifications for Educational Content (Grant agreement number ECP-2007-EDU-417008). The author is solely responsible for the content of this paper. It does not represent the opinion of the European Community and the European Community is not responsible for any use that might be made of information contained therein.

REFERENCES

- [1] AICC, “CMI guidelines for interoperability,” 2004. Online: <http://www.aicc.org/docs/tech/cmi001v4.pdf>
- [2] AICC, “AICC packaging specification,” 2006. <http://www.aicc.org/docs/tech/cmi012v1.pdf>
- [3] Advanced Distributed Learning, SCORM. <http://www.adlnet.gov/Technologies/scorm/default.aspx>
- [4] IMS GLC, IMS Common Cartridge specification. <http://www.imsproject.org/cc/index.html>
- [5] IMS Global Learning Consortium. <http://www.imsglobal.org/>
- [6] I. Dahn, “Common Cartridge is not SCORM: a note,” ASPECT Project Internal document, 2009.
- [7] V. Gonzalez-Barbone and L. Anido-Rifon, “From SCORM to Common Cartridge: A step forward,” *Journal Computers & Education*, Vol. 54 Issue 1, pp.88-102, January 2010.
- [8] IMS GLC, IMS Content Packaging specification. <http://www.imsglobal.org/content/packaging/index.html>
- [9] IMS GLC, IMS Question and Test Interoperability specification. <http://www.imsglobal.org/question/index.html>
- [10] IMS GLC, Basic Learning Tools Interoperability. <http://www.imsglobal.org/lti/index.html>
- [11] ASPECT project, IMS Common Cartridge & SCORM Demonstrator. <http://aspect-project.com/node/40>
- [12] RELOAD project. <http://www.reload.ac.uk>
- [13] Learning Components. <http://www.learningcomponents.com>
- [14] CodePlex, Scorm2CC. <http://www.codeplex.com/scorm2cc>
- [15] IMS GLC, Common Cartridge Validator. <http://validator.imsglobal.org/>
- [16] ASPECT project. <http://aspect-project.org/>
- [17] CoLoS 2010 Summer School (in Slovenian). http://colos.fri.uni-lj.si/SUMMER_SCHOOL_2010/
- [18] Moodle Community. <http://moodle.org/>