

About the Standardization and the Interoperability of E-Learning Resources

George Totkov, Cvetelina Krusteva, Nikolay Baltadzhiev

Abstract: *Providing interoperability by using standards and specifications for e-learning resources is an important element of the virtual learning environments (VLEs). A large number of international organizations develop specifications that provide principles for reaching a common "language" to be used in exchanging resources among the virtual university. In this paper we turn your attention to a method for providing interoperability in different standards. The experiments are carried out in the VLE PeU.*

Key words: *E-Learning Standard, Interoperability in Virtual Learning Environments.*

1. INTRODUCTION

The development of the Internet has growing influence on modern education. New information and communication technologies provide different methods for integration and creation of virtual learning environments (VLEs) which are a fixed part of the new revolution in education. VLEs provide management of the process of learning and the objects and subjects that participate in it, by creation, use and exploitation of various resources – information entities, tests, learning courses, etc.

Together with the improving of the VLEs there must be developed specifications as a means of standardization of electronic learning (e-Learning) resources. By using standards the developers can create coordinated information with which either ELS can work or other developers of this information which is formatted by the appropriate standards. British Standards Institute (BSI) [5] describes a standard as "a published specification that establishes a common language, and contains a technical specification or other precise criteria and is designed to be used consistently, as a rule, a guideline, or a definition".

The e-Learning standards should enable such high-level requirements as [9]:

- *accessibility* – the ability to locate and access instructional components from one remote location and deliver them to many other locations
- *interoperability* – the ability to take instructional components developed in one location with one set of tools or platform and use them in another location with a different set of tools or platform
- *durability* – the ability to withstand technology changes without redesign, reconfiguration or recoding
- *reusability* – the flexibility to incorporate instructional components in multiple applications and contexts

Following an appropriate standard provides an opportunity to different VLEs to exchange learning resources and data. For this purpose it is necessary learning resources from different sources to use uniform structures, to exchange dynamically data with them, to create/have access to integrated data, etc.

The first treatment of the standards named "specification" consists of a combination of basic principles and rules. As a result of a large number of researches and experiments, accredited organizations recognize these specifications as international standards.

2. REVIEW OF THE E-LEARNING STANDARDS

A lot of organizations work on the development of specifications related to electronic education like metadata, information for students and courses, models of the learner, simplicity of contents, outlook of the learning resources, behaviour of the learning resources, operations with databases, etc. The project aims at developing compatible VLEs but unfortunately in some cases such compatibility cannot be found: some specifications are quite general, others are based on early learning computer systems and need to be adapted to the Web applications, etc.

Some of the most important organizations and their actual participations in the development of the VLEs are: AICC, IMS Global Consortium, ADL, IEEE and ARIADNE.

AICC (Aviation Industry Computer-based training Committee) [1] is an international group of technology-based professional learning. It released specification for the interchange of the elements of the virtual course as text, graphics, motion (frame - based), audio and logic (Courseware Interchange).

IMS (Instructional Management System) Global Consortium is a consortium of vendors and implementers which focuses on the development of XML-based specifications. These specifications describe the key characteristics of courses, lessons, assessments, learners and groups. In addition, the XML Specifications and Best Practices Guidelines provide a structure for representing e-Learning metadata. IMS commands the largest number of specifications. The most widely acknowledged IMS specifications are as follows: IMS QTI (Question and Test Interchange), IMS-Metadata and IMS-Content Packaging. IMS QTI [7] describes the structure of e-Learning resources. IMS-Metadata [4] provides means for the description of these learning objects that can be integrated in larger structures, named packages, by using the mechanism of IMS-Content Packaging [3]. The IMS-Metadata standard uses the same element as those in the LOM standard.

ADL (Advanced Distributed Learning) is a US government-sponsored organization that researches and develops specifications to encourage the adoption and advancement of VLEs. The most widely accepted ADL publication is the ADL Shareable Content Object Reference Model (SCORM). SCORM specification combines elements of IEEE, AICC and IMS specifications into a consolidated document that is a specific model of agreement between disparate groups and interests. The SCORM specification [9] is developed in two levels:

SCORM Content Aggregation Model provides technical methods for description of the learning contents that can be recognized, described, integrated into a course or a part of a course, or exchanged between VLEs or data storages. It consists of the following specifications:

- **Content Model** – nomenclature defining the content components of learning experience
- **Meta-data** – a mechanism for describing specific instances of the components of the content model
- **Content Packaging** – defines how to represent the intended behaviour of a learning experience (Content Structure) and how to package e-Learning resources for movement between different environments (Content Packaging)

SCORM Run Time Environment [10] provides e-Learning resources that can be reusable and interoperable across multiple VLEs. There is a common way to start e-Learning resources and a common mechanism for e-Learning resources to communicate with a VLE. SCORM Run Time Environment consists of:

- **Data Model** – a standard set of data elements used to define the information being communicated such as the status of the e-learning resource
- **Launch** – a mechanism that defines a common way for VLE to start Web-based learning resources. The communication protocols are standardized with the use of a common API
- **Communication API** – the communication mechanism for informing the VLEs of the state of the learning resource (e.g., initialized, finished or in an error condition)

IEEE (Institute of Electrical and Electronics Engineers) [2] is an international organization that develops technical standards and recommendations for electrical, electronic, computer and communication systems. The most widely acknowledged IEEE LTSC specification is the Learning Object Metadata (LOM) specification, which defines element groups and elements that describe learning resources. The IMS and ADL both use the

LOM elements and structures in their specifications. The metadata instances that describe the e-Learning resources can be used by various VLEs to create, to arrange, to assess or to exchange e-Learning resources between different environments. Specifications that define the way by which VLEs use a metadata instance for e-Learning resources are not provided by the IEEE organization. In the year 2002 the LOM specification was turned into an IEEE approved standard.

ARIADNE (Alliance of Remote Instructional Authoring & Distribution Networks for Europe) Foundation [6] is a foundation that provides projects for developing the high-education in Europe. The most famous project of this organization is the ARIADNE standard. A completed XML text file can easily be used by VLEs to generate the actual online course, if the VLE is provided with operational access to the electronic pedagogical contents needed for the course and referenced in the XML text file. ARIADNE defines elements that describe metadata for common e-Learning resources but does not define the form of this metadata. ARIADNE submitted an early version of this specification in April'98 to the IEEE LTSC Learning Object Metadata (LOM). Together with a similar specification contributed by the IMS Project, that early ARIADNE version was the basis of the LOM standard. Now ARIADNE is used as a profile of the LOM standard.

Because there are some general features in ELS for describing metadata it is useful to compare ARIADNE and LOM. We should know that this comparison is connected also to the SCORM and IMS Metadata standards because LOM is in their basis. The idea of the figure 1 is to show that for example in the category General of the LOM standard take place 4 elements of the category General (G) of ARIADNE, 3 elements of category Semantics (S) of ARIADNE and 5 new (N) elements are added: 4G+3S+5N.

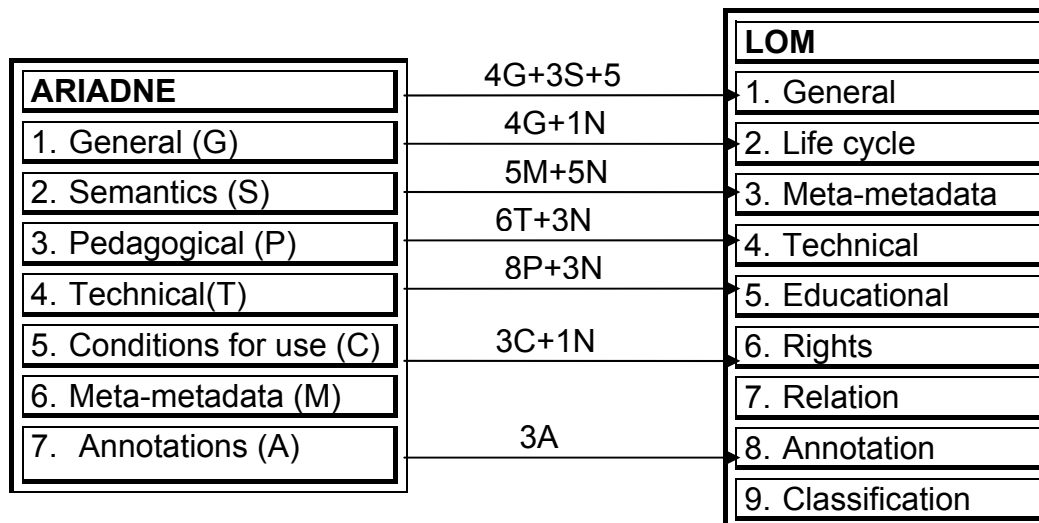


Figure 1. Comparison between ARIADNE and LOM

The ARIADNE standard groups his own data elements in 7 categories – General, Semantics of the resources, Pedagogical, Technical, Conditions for use, Meta-metadata and Annotations, but the other standards consist of 9 categories for metadata description – General, Life cycle, Meta-metadata, Technical, Educational, Rights, Relation, Annotation and Classification.

3. ABOUT PROVIDING INTEROPERABILITY OF E-LEARNING RESOURCES

The corresponding ELS need to be observed for providing interoperability by using standards and specifications for e-Learning resources. Unfortunately in many practical developments this requirement is not kept. The main reason according to us is related to the large number of ELS and the large number of the categories, characteristics and parameters that have to be supported by the concrete VLE. The support and the following of con-

create ELS make the development of a VLE more expensive. So the suggestion of automatic methods and sources for providing interoperability for e-Learning resources during the observing of definite ELS is extremely pressing.

VLE PeU 2.0 [8, 11, 12] experiments in two directions are planned for providing interoperability of e-Learning resources (objects – information units and tests, and subjects – learners, authors, teachers, administrators and guests). The first one is related to the providing of interoperability of e-Learning resources between online and offline versions of VLE PeU. For this purpose all resources that have to be exchanged are transforming in an intermediate XML file. During the experiments in the second direction after the adapting of the standard to the VLE database (DB), the e-Learning resources (all or part of them) are saved as an XML file. This provides possibility to transfer them to a database of another VLE. This process is shown in Fig 2.

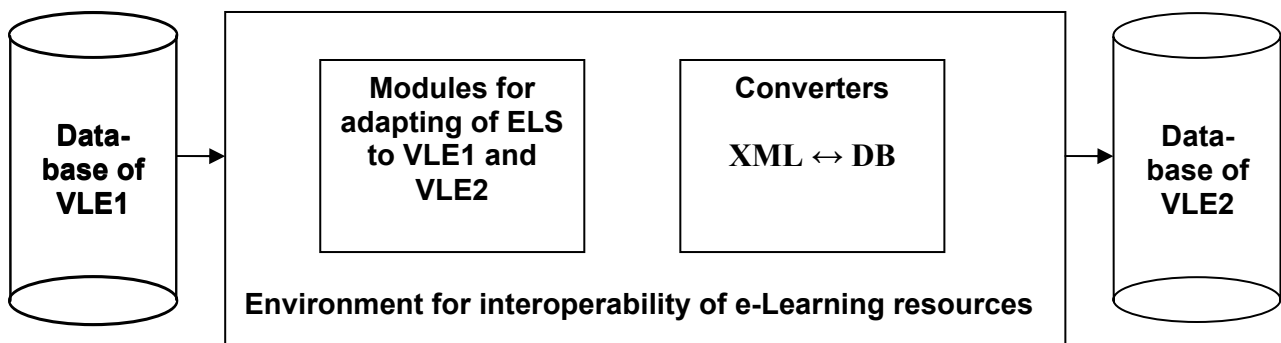


Figure 2. Providing interoperability of e-Learning resources between VLEs

The formation of an environment for interoperability of e-Learning resources between VLEs runs through two stages – the creation of the modules for ELS adapting of ELS to VLE1 and VLE2 and the development of converters for transforming the e-learning resources into the adapted standard.

The first stage during the development is the formation of modules with a possibility to adapt a standard (in which e-Learning resources to be transformed) to the VLE1 and VLE2 DBs. For each of the described standards (ARIADNE, LOM, SCORM, IMS) a table is made. In every table the corresponding procedure is pointed out (for insertion or extraction of VLE1 and VLE2 e-Learning resources). This is shown on Fig. 3.

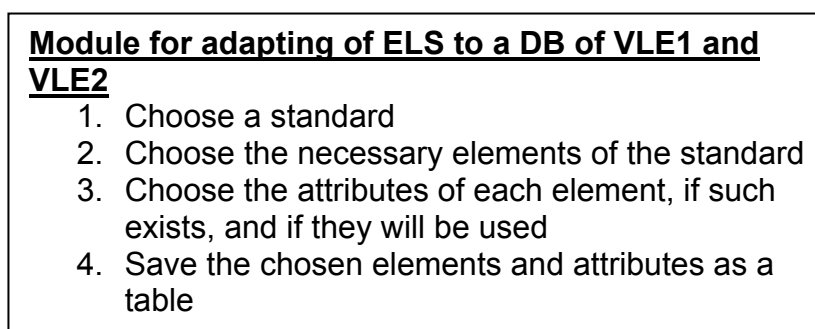


Figure 3. A module for adapting the ELS to the VLE

The module gives possibility to the user to choose the necessary standard for the application and then its specific elements. If an element has its own attributes they are chosen too. In this way a list with the necessary elements is presented as a table.

The second stage is related to the formation of converters that provides a possibility for insertion and extraction of a list of learning resources in XML format. A form is filled in for each of the elements and the information from the form is transferred to the corresponding function for the extraction/insertion of data (Fig 4).

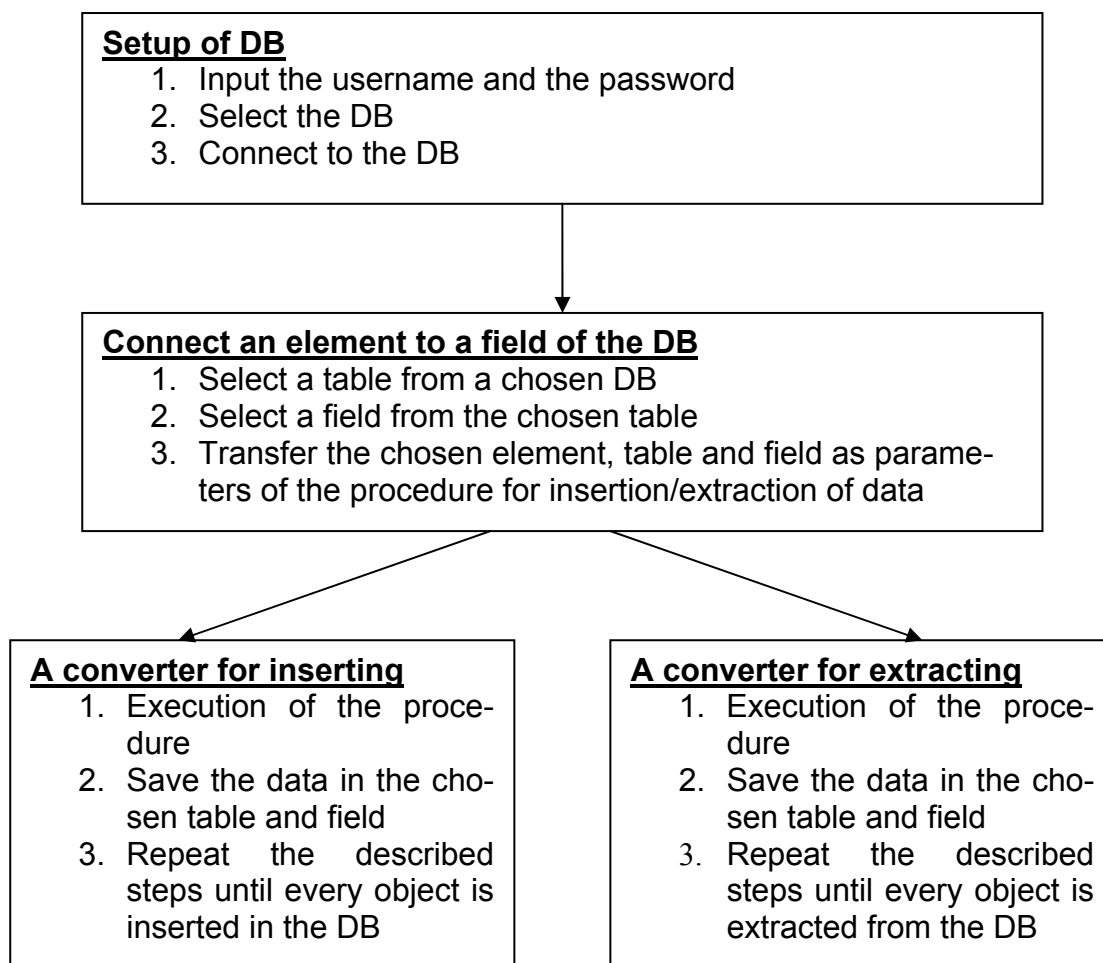


Figure 4. *The second stage of the development of the environment for interoperability*

At the beginning, after an identification of the user, we choose the DB with which we will work. On the next stage we point out the arguments of the procedures - elements, tables, fields of the table of the selected DB, etc. If the converter is for insertion the e-Learning standards in a VLE DB, the corresponding procedures are executed and the results are inserted in the DB. If the converter is for extracting the e-Learning resources in a VLE DB and for transforming them in the adapted standards, the results in the corresponding XML file are ordered as follows: <element> value </element>.

4. CONCLUSION

The ELS are an important element during the development of the modern VLEs. The usage of the standards in the VLEs provides an excellent structure of the description of the learning resources, virtual courses and their participants together with the design of the VLEs. The basic purpose for future experiments is the description of other modules of the VLEs like: models of students, data for groups of students, design of the learning resources, etc. The development of these purposes will create an integrated environment for data exchange between VLEs.

REFERENCES

- [1] AICC Guidelines and Recommendations (AGRs), <http://www.aicc.org/>, 2004
- [2] Hodgins, W., IEEE Standard for Learning Object Metadata, <http://ltsc.ieee.org/>.
- [3] IMS Content Packaging, <http://imglobal.org>.
- [4] IMS Meta-data Specification, <http://imglobal.org>.
- [5] International Standards Online, <http://www.iso-standards-international.com>.

[6] Leuven K. U., ARIADNE Educational Metadata Recommendation - v3. 2, <http://www.ariadne-eu.org/>.

[7] Smith C., E. Shepherd, L. Brewer, S. Lay, IMS Question & Test Interoperability: An Overview, <http://www.imsglobal.org/>, 2002.

[8] Somova E., Tools system for design, creation and support of virtual learning environments, Ph. D. Thesis, Sofia, 2003 (in Bulgarian).

[9] The SCORM Overview, <http://www.adlnet.org/>, 2004.

[10] The SCORM Run-Time Environment, <http://www.adlnet.org/>, 2004.

[11] Totkov G., E. Somova, A Planning Model with Resources in e-Learning, International Journal "Information Theories & Applications", vol. 10, No 2, p. 218-226.

[12] Totkov G., Virtual Learning Environments: Towards New Generations, Int. Conf. on Computer Systems and Technologies, Compsystech'2003, P.2-1–P.2-9.

ABOUT THE AUTHORS

Assoc. Prof. Dr. George Totkov, PU "Paisii Hilendarski", Dept. "Computer Science", Phone: +359 32 628 672, E-mail: totkov@pu.acad.bg

Cvetelina Krusteva, PU "Paisii Hilendarski", Phone: +359 32 678 024, E-mail: cvetelina_krusteva@abv.bg

Nikolay Baltadzhiev, PU "Paisii Hilendarski", Phone: +359 32 235 465, E-mail: nikolay_baltadjiev@abv.bg