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SCORM specifications for an emerging world: The linguistic diversity at work

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Summary
With a world wide spreading of eLearning models, techniques and solutions, new challenges of the digital divide are imposing to the emerging countries the need to subscribe to this inevitable global educational process. Many projects, collaborations and initiatives are striving to find out the appropriate solutions to reduce and bridge the e gaps in education through standards definition and implementation.

E-Learning pioneers like the aviation and the military industries were first to set up specifications to harmonize and structure interoperable collaborative systems to exchange content resources and educational procedures through Information and Communication Technologies (ICT). Many specifications and de jure standards appeared to harmonize the e-Learning world context: the Global Learning Consortium developed the Instructional Management Systems (IMS) and the US Department of Defense (DoD) was behind the wide spreading of the Sharable Content Object Reference Model (SCORM). Basically serving Anglo-Saxon communities, these initiatives have progressively gained concern of cultural and academic international structures aware that the cultural and linguistic diversities are to be reinforced through education. The Agency of French Speaking Universities (AUF) is one of the international bodies subscribed to this international e-Learning standardization movement as a relay connector for its partner languages and cultures. One of the major initiatives that the AUF has undertaken in this respect is the assistance to produce standardized educational resources for trainers and learners within the scope of its French speaking partnership areas based on local linguistic and cultural specifications.

This paper illustrates the procedures, outcomes and perspectives of such initiatives related to the AUF experience with SCORM specifications as a leading model in the realm of international eLearning standards.

Keywords: eLearning Standards, Linguistic diversity, multicultural education, competencies, AUF, SCORM

1 Introduction: general overview

It is obvious, nowadays, that e-Learning standards gained a very large universal interest among all categories of actors working within educational, learning and training contexts. The pioneers' era when instances like AICC[1], Ariadne[2], IMS[3] etc. were acting in closed clusters of e-Learning

[1] The Aviation Industry CBT (Computer-Based Training) Committee (AICC) is an international association of technology-based training professionals that develops guidelines for aviation industry in the development, delivery, and evaluation of CBT and related training technologies.
[2] A European Association open to the World, for Knowledge Sharing and Reuse. The core of the ARIADNE infrastructure is a distributed network of learning repositories
3 The mission of the Instructional Management System (IMS) Global Learning Consortium is to support the adoption and use of learning technology worldwide.

elite is somehow obsolete. After two decades of progressive improvements, the e-Learning standardization issue is becoming a strategic component of e-Learning governance and a guarantee of integration within the world wide dynamics of access to knowledge and education for all.

This generalized concern about e-Learning mechanisms and, in a second step, about its standardization procedures, induced a wider concern about the cultural and linguistic diversities in which international potential users and actors could find an obstacle to access and share educational resources and services. International programs like Unesco project "Education for all"(Bikas, 2001) or International Telecommunication Union (ITU) World Summit of Information (ITU, 2005) treating the digital divide, attribute to this linguistic and cultural considerations a key role in solving problems inherent to unequal Information and Communication Technologies (ICT) access and unbalanced Scientific and technical Information (IST) resources between "haves" and "have nots".

Nowadays, an overall consensual e-learning standard is making its way out to be THE common reference model for standardization initiatives. The Sharable Content Object Reference Model (SCORM) is a set of specifications that the Advanced Distributed Learning (ADL) initiative has been tasked by the Department of Defense (DoD) to develop in order to harness the power of information technologies to modernize structured learning. Initially destined to serve learning technologies across the DoD, the vision of the ADL Initiative was to provide access to the highest-quality learning and performance aiding that can be tailored to individual needs and delivered cost-effectively, anytime and anywhere. The model gained wide spreading impact and use; and in 2005 it has been accepted by the Subcommittee 36 (SC36) of the International Organization of Standards (ISO) to be a prototype reference model with multilingual and multicultural adjustments for the future international ISO standard that SC36 is working on since 2000.

The Agency of French Speaking Universities (AUF) which is an international network of more than 635 universities and research institutions having French as one of their working languages, has been aware since the beginning of SCORM future impact on the international e-Learning standards. It anticipated its implementation and contributes as a liaison member at ISO/SC36 to be one of the stakeholders that strive to deal with the e-gaps in education, training and research through multilingual and multicultural standards definition. It is currently conducting projects on basis of equal chances, bilateral cooperation and mutual recognition of each partner's cultural and linguistic peculiarities in the educational context.

2 AUF e-Learning framework

One of AUF concerns is to put forward an Information and Communication Technologies (ICT) competencies reference model for the definition of professional profiles and the appropriate trainings associated to them. Since few years ago, AUF has been developing a reference frame of ICT training capacities that fit with its French-speaking and multilingual partnerships policies.

The competencies reference frame is built upon 4 priority themes:

1. Information and Communication Technologies for a basic use of Internet (an axis treating digital documents editing, collaborative working tools and communities of learning);
2. Interconnection of systems and networks;
3. Information systems;
4. Educational technologies.

Among the expected objectives of AUF, while implementing this reference frame of competencies, we can mention:

1. Visibility of the learners' progression in their respective educational processes and their appropriation of the mechanisms that help them acquire competencies;

2. The use of a common vocabulary in the field of ICT between the trainers and learners using the collaborative environments.

These two issues synthesize the wide spectrum of AUF involvements in e-Learning resources and services in connection with its French speaking academic and research partnerships. This also justifies its current strategy to be aligned on the practices and the recommendations of e-Learning through international standards.

Two core activities are conducted by AUF to reinforce its commitment in this educational choice.

1. On the one hand, the implementation of *Transfer®* Learning Management System (LMS), a centralized educational Learning System (AUF, a) to provide a set of free educational materials and services around its ICT competency reference model (AUF, b).

2. On the other hand, AUF is sponsoring decentralized series of specialized workshops about education, e-Learning and standardization in developing French speaking countries (AUF, c).

Although starting as limited and free initiatives, without strong standards conformity, these both experiences are nowadays submitted to a large effort of synchronization with up-to-date standards and recommendations.

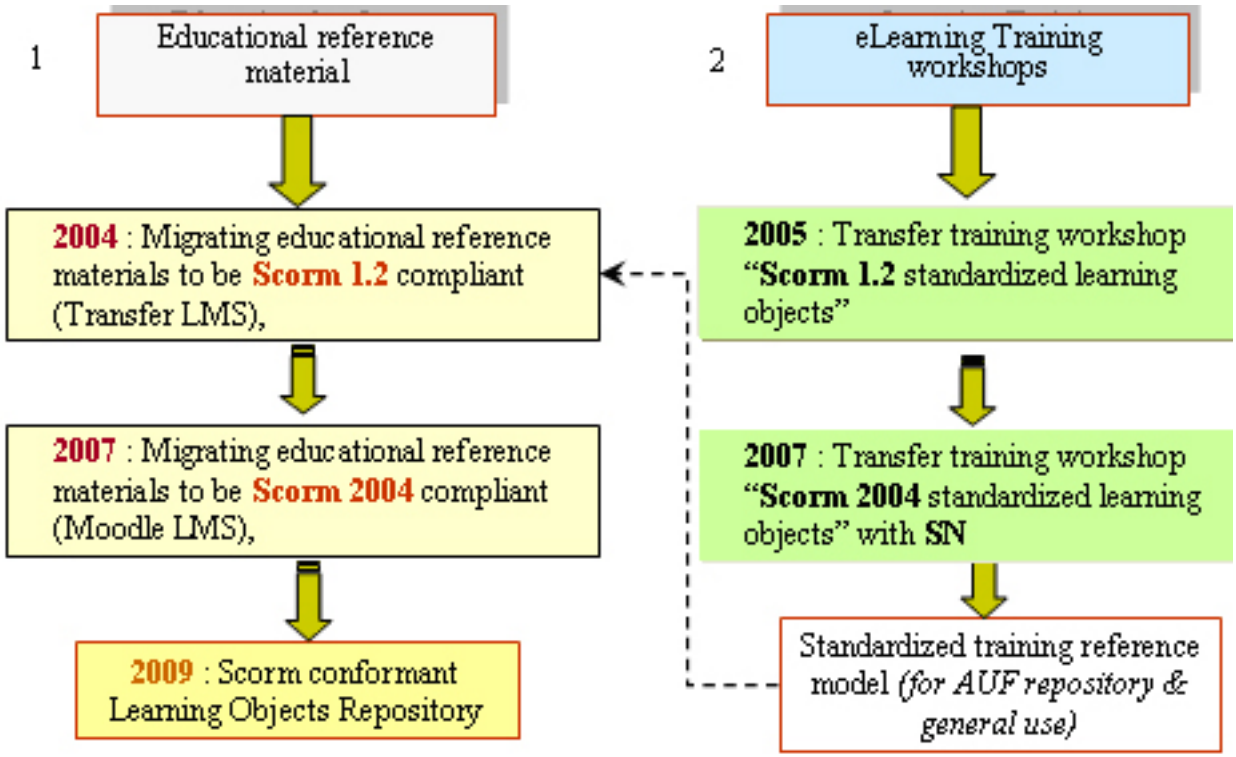

***Fig. 1** : AUF e-Learning strategy*

3 *Transfer®* Learning Management System

The *Transfer®* platform, developed as an open source system under GNU[4] license, is designed to provide a framework of integrated training services and resources in which the educational standardization requirements of e-Learning cope with those of the most relevant world specifications like AICC and IMS (Singh, 2000). The objective is to reach on the long term, a level of compatibility with the current standards largely inspired from IMS specifications (Grant et al., 2005) like: Accessibility (Accommodation), Competency definition (RDCEO[5]), Content packaging (IMS-CP), Digital repositories (Open Archives Initiative model), Enterprise, Enterprise services, Learner Information Profile (IMS-LIP), Learning Design (IMS-LD), Metadata (IEEE LOM[6]), Question and test interoperability, Simple sequencing (IMS-SS), Vocabulary exchange definition (VDEX[7]).

3.1 Planning standardization priorities

In this respect, and in order to achieve advanced standardization stages of its reference frame of competencies, AUF established a set of priority levels dealing with the different components of its information and educational supporting systems, on basis of a logic ordering of fundamentals dictated by the nature of the on-line educational processes and the stakes that AUF has to deal with. These priorities can be summarized as follow:

a. Ongoing achievements

1. Drafting and structuring *Transfer®* Workshops contents on basis of structured learning objects granularity (IMS organization compliant),
2. Their referencing and indexing by standardized metadata (IEEE-LOM compliant),
3. Their use on basis of standardized adaptive sequencing (Scorm-SN/IMS-SS compliant)
4. Their delivery in the forms of content aggregation packages (IMS-CP compliant),
5. Their interoperability between various Learning Management Systems (AICC/IMS compliant).

b. Short terms objectives

1. Design of standardized educational contents (IMS-LD compliant),
2. Definition of competencies, particularly those of Tutors (RDCEO compliant),
3. Creation of standardized educational resources repositories (OAI and Cordra compliant),

c. Long terms objectives

1. User information: “Passeport TIC” (IMS-LIP compliant),
2. Common multilingual vocabulary definition (VDEX compliant).

Success of such objectives is intended to be the result of an international dynamics that implies contribution to international standardization activities and e-Learning worldwide governance initiatives. It also implies implication of worldwide French speaking partners in developed and developing countries to reinforce the cultural and linguistic diversities to which AUF devotes a large activity program in its educational strategy.

4 GNU, a recursive acronym for “GNU's Not Unix”, was launched in 1984 to develop a complete Unix-like operating system which is free software.
5 The Reusable Definition of Competency or Educational Objective (RDCEO) specification provides a means to create common understandings of competencies that appear as part of a learning or career plan, as learning pre-requisites, or as learning outcomes
6 Learning Object Metadata (LOM), created by the Institute of Electrical and Electronics Engineers (IEEE), defines element groups and elements that describe learning resources.
7 IMS Vocabulary Definition Exchange (VDEX) specification defines a grammar for the exchange of simple machine-readable lists of values, or terms, together with information that may aid a human being in understanding the meaning or applicability of the various terms.

3.2 Choosing SCORM as a reference model

Once the development of educational contents for the 4 training above-mentioned topics of the competencies reference frame has been completed (10 workshops, 71 sessions between 2005 and 2006, 1006 learners, 22 French-speaking countries), AUF undertook a standardization process of these training resources putting as a fundamental goal to make them "RAID" qualified (Reusable, Accessible, Interoperable, Durable) among and by all its French speaking partners. Considering its widely admitted added values (Masie, et al., 2002), the Scorm reference model was selected to be the solution for this initiative.

A SCORM 1.2 compliant upgrading has been applied to the Transfer® Learning Management System to make concrete the above mentioned category of ongoing objectives: using a Scorm Contents Aggregation Model (CAM) with Scorm Sequencing and Navigation (Scorm SN), applying a Scorm Runtime Environment (RTE) and using a Scorm derived metadata model. In other words, the Content Aggregation Model defines the common way how to create and structure educational contents that could be accessed using a set of predefined rules of sequencing and navigation within a standardized runtime environment built on interoperable Application Programming Interfaces (API). Metadata are descriptive data that helps tagging in uniform and stable way information that is stored and exchanged within an information system. In doing this, metadata plays a role in providing context and allowing easy structuring, access, retrieval and understanding of the information over time and through changes in technology.

A minimal application profile, which is a subset of metadata elements extracted from a more general metadata reference model, has been defined using Scorm compliant metadata elements. Some extra-SCORM data elements have been appended to respond to particular AUF system needs (Responsible, execution type). Choosing a reduced metadata model, was under constraint of providing easy to use metadata categories in comprehensive taxonomy for the large educational French speaking communities, which is still unprepared to these new trend of contents tagging forms.

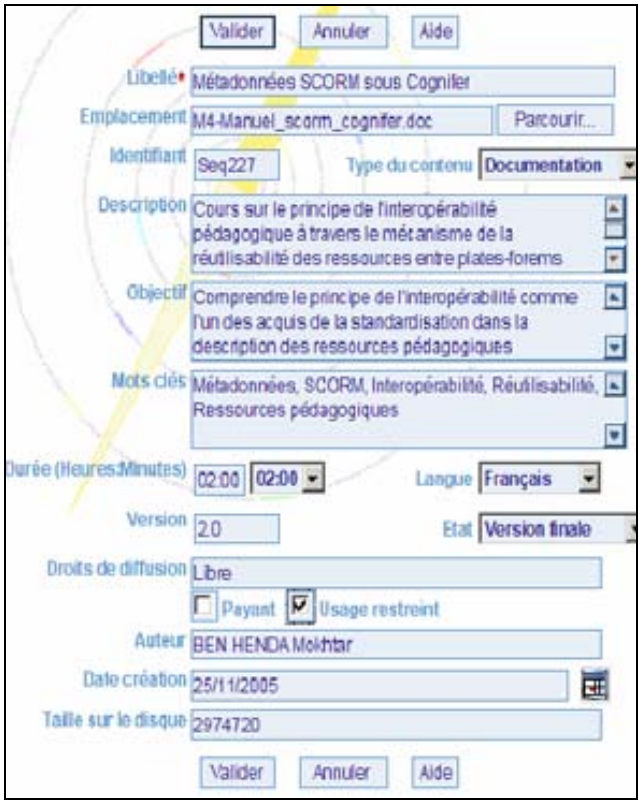

Fig. 2 : Learning Object Metadata elements

Nowadays, the entire *Transfer®* competencies educational reference is standardized on this basis. The next steps, as stated in short terms objectives, are standardization of learning design processes and creation of standardized educational resources repositories conform to Open Archives Initiative protocols[8] and Cordra[9] system architecture (Jerez et al., 2006).

However, when implementing such upgrading and introducing an innovative standardized layer to its educational and training projects, AUF is aiming at a higher objective: to endorse local governance and stewardship of these new standardized issues in French speaking countries and partners communities. Thus, it would play its intermediary role, which defines its core educational mission as a consortium of hundreds of French speaking universities in the world. This explains its commitment to set up the second solution of training national trainers in order to put forward its policy of technology transfer between North and South.

4 *Transfer®* training workshops on and by e-Learning standards

Within the series of its 10 *Transfer®* workshops covering various aspects of Information and Communication Technologies and education, AUF has defined a *Transfer®* workshop specific to the "standardized design of interoperable learning objects" targeting a development of competencies around essential skills like use of metadata, handling the general Scorm environment, producing IMS aggregation packages, handling interoperability functions of Scorm/Aicc/Ims compliant LMS, and validation of contents and Scorm certification.

4.1 *Transfer®* workshop about e-Learning standards: the basics of Scorm

The workshop is constructed around 5 topics combining theoretical basics and practical productions of learning objects:

1. General introduction to standardized metadata models and XML documents10,
2. General overview about e-Learning standards and their implementation,
3. Presentation of SCORM environment :
    a. Content Aggregation Model (CAM)
    b. Run Time Environment (RTE)
    c. Test Suite: ADL test suite is the only automated and common method developers have of determining if their content is SCORM conformant. The ADL Test suite is also a solid aide for developers gaining an understanding of SCORM and becoming comfortable with producing SCORM conformant content
    d. Certification
4. Scorm Sequencing and navigation
5. Interoperable Content Packages between LMS : Ganesha, Moodle, Transfer®

As a first training experience with learners arriving with classical assumptions of linear and monolithic one-bloc learning resources, the objectives of this first basic version of the Scorm workshop is to:

- Sensitize with the advantages of the standardization of learning resources,
- Encourage use of educational metadata when creating educational resources,
- Draw attention on the benefits of interoperability obtained through standards,

8 The Open Archives initiative-Metadata Protocol Harvesting (OAI-MPH) is one of the most exciting new developments in the area of information dissemination in that it facilitates the interoperability of repositories, allowing them to contribute to a larger global system.

9 an open, standards-based model for how to design and implement software systems for the purposes of discovery, sharing and reuse of (learning) content through the establishment of interoperable federations of (learning) content repositories

10 Extensible Markup Language (XML) documents are widely used as containers for the exchange and storage of arbitrary data in today's systems.

- Train on handling authoring tools for tagging Assets, Sharable Content Objects (SCOs) and producing organizations of XML based e-Learning standardized contents (Using Reload),
- Train on using SCORM compliant learning resources and environments (LMS) on basis of mentioned RAID criterions.
- Train on validation of Scorm contents using ADL Test Suite.

Three sessions of *Transfer®* 2.3 workshop have been already organized during 2006, two of them were in Tunisia and one was in Madagascar, registering totally 36 participants from 07 African countries. Three others have been conducted in 2007 in Lebanon, Syria and Burkina Faso.

4.2 Learner-oriented evaluation of Scorm applications

Transfer® workshops are characterized by a final evaluation process performed by the learners themselves about their appreciations, difficulties and ways of considering the upgrading of any workshop they attend. Evaluation criteria are fixed through a common template concerning the agenda, the resources distributed, the pedagogical objectives and methods, the trainers' qualifications and the added value they may acquire following the training session.

Transfer® workshop 2.3 about Scorm standards has consequently been submitted to this evaluation in order to consider the extents at which a second versioning is required to reach better performances.

Remarks have been generally formulated around the following issues:

Metadata complexity

Being rarely used to deal with metadata in electronic documents editing, learners find some redundancy in using so long application profiles and metadata forms to fulfill. The role of metadata for indexing and searching in an e-Learning system remains confusing to them. Taxonomies of some metadata categories and elements, when using Learning Object Metadata standards (LOM), remain also barely apprehended. Some of these are, for instance, the recurrent data element "Catalog" appearing with 1.1.1 and 3.1.1 then 7.2.1.1 items, the "entry" data element 3.1.2 and the data element 9.2 "Taxon path".

In short, we can summarize the learners' difficulties handling metadata as follows:

- Superfluous taxonomy (i.e. 1.1.1 "Catalog", 2.3.2 "Entry", 9.2 "Taxon path"),
- Subjective (unqualifiedly) data elements (i.e. 4.7 "Duration", 2.2 "Status")
- Unnecessary data elements (depending of each)
- Accessibility to controlled lists of vocabulary data types (i.e. 3.1.1 "Catalog", 3.1.2 "Entry")
- Complex data elements (i.e. 3.2.2 "Entity", 4.1 "Format", 9.2.2 "Taxon,")

Granularity

Beginners with Scorm standards generally face the challenge of migrating from a classical cognitive schema of linear learning contents structuring to a Scorm-compliant learning model. Largely used to one bloc and linear data contents, learners find it relatively difficult to understand the real scope of Scorm learning items like Assets, SCOs and Learning Objects. Three issues are usually discussed in this respect.

- First, the ambiguous conditions when an Asset could be considered as a SCO or a SCO could be taken as an Asset in a content aggregation is sometimes confusing for learners.

- Second, the high level semantic autonomy of a SCO, that makes it reusable in different learning contexts, goes beyond the linearity constraints that classical course contents impose on the intrinsic sequential and semantic ordering between all their components. The fact that an asset is taken as a semantically neutral component in an IMS organization, contradicts the thematic dependency that it inherits in a classical course construction.
- Third, the prohibition of any physical links (hyperlinks) or logical ties (cross-references) between SCOs (prohibition necessary for SCOs reusability), constitutes another crucial change for learners by comparison to the deeply rooted cognitive schemas they inherited about course contents structuring.

Using authoring tool

Transfer® workshop 2.3 is mainly based on Reload authoring tools to produce and test Scorm compliant learning packages. Although originating a large world consensus as a reliable authoring tool, Reload Editor offers a relatively complicated interface for Scorm grass root users mainly those who did not follow any ICT previous trainings. Yet, the Java software solution of Reload tools constitutes a draw back problem for implementing the editing environment on some users' machines. An XML web based solution would have been of better impact for larger dissemination and use.

LMS Interoperability

Interoperability of Scorm content aggregations is demonstrated and tested through three different Learning Management Systems: AUF *Transfer®* LMS, Moodle LMS and Ganesha LMS. The strategy is to create a Scorm compliant aggregation package using Reload editor and to export it in-between the three of them. One of the recurrent problems in these experiments is the reproducing of IMS sub-manifest nodes in a large package when migrating from one LMS to another. This puts forward the interoperability problem between LMS that should be better addressed by LMS developers. This is one of the forthcoming upgrading features that AUF is planning for its LMS environment. Upgrading to Scorm 2004 is also another quality criteria among all those related to IMS compliant specifications.

4.3 Evolution towards a Learning Design approach

AUF strategy today is to encourage local duplication of this first version of the SCORM workshop by national trainers who attended one of the three mentioned sessions, and work on a second version where Scorm advanced functions and specifications would be introduced.

AUF is working today to restructure this workshop so it could be merged with a previously designed workshop exclusively dedicated to Web based educational contents development without strong emphasis on standards. The issue will be that two complementary standardization workshops will be tied consequently to each other, the first one (Workshop 3.3) will be about Scorm compliant Web based XML learning objects and repositories, and the second one (Workshop 2.3) will cover IMS-LD compliant learning design using IMS Sequencing and Navigation specifications.

The result would be a quality upgrading of the impact that standardization workshops would have on the local final users involving them to further disseminate standardized e-Learning resources and services.

This delocalization process of e-Learning standards towards emerging countries has been planned by AUF to reach a second quality level by affording validated educational and training materials and developing local competencies in order to strengthen local expertise and appropriation of standardization issues. This will certainly encourage wide spreading of standards implementation, local governance and adaptive stewardship of e-Learning standards to local cultural and linguistic needs.

5 Scorm & I18n: challenging the linguistic and cultural diversity

Digital linguistic diversity is yet a worldwide concrete matter of fact. Internationalization (I18N) and Localization (L10n) of digital resources, applications and services are nowadays of common use owing to multi-byte characters coding sets like Unicode and its derived UTF-8 coding format (Dieter & Shanmugam, 2001). Starting from the core definition of its mission and partnerships policy, AUF has adopted the principles of I18n to reinforce and help partner languages to integrate rapidly the information age and the ICT revolution. One of its initiatives in this respect is to upgrade its working spaces and resources to a multilingual framework where partner languages could find their own linguistic and cultural requirements for a balanced multilingual partnership. Experimental multilingual versioning of its LMS working space is on the way to become the official solution with integrated IMS compliant multilingual resources and services.

Yet, some experiments have been conducted to test the extents at which existing IMS resources and Scorm specifications could comply with multilingual course content aggregations. Experimental e-Learning workspaces, similar to AUF *Transfer®* LMS, have been tested to produce multilingual IMS compliant aggregation packages and to run them within multilingual Scorm based learning environments.

***Fig. 3**: Multilingual Content Aggregations*

The relevant fact in these experiments is that the multilingual encoding is no more limited to content materials, but the whole LMS is compliant with internationalization and localization global specifications regarding automated language detection for interface adaptation (i.e. directionality swapping), appropriate characters' glyphs rendering and adapted linguistic command based menus and instructions. Arabic language has been chosen as an experimental language considering its both complexity levels of character glyphs rendering and right to left directionality. The result has been outstanding at level of Content Aggregation Model (CAM) and metadata editing, Sequencing and Navigation (S/N) and Run Time Environment (RTE) Application Programming Interfaces (APIs).

Trying to put this multicultural and multilingual technological issue at a higher level of systems interoperability concern, the AUF effort is structured around a three step strategy as dictated by any digital information system layers: multilingual characters encoding, multilingual software Application Programming Interfaces (API) including system menus and dialogue messages, contents management including multilingual data indexing, retrieval and dissemination.

As mentioned before, the first challenge of multilingual characters encoding has been already overcome through international standards like Unicode. Data input is no more an obstacle for any software application conformant with Unicode multi-byte encoding character set.

The second issue, relevant with multilingual application programming interfaces, is currently considered in AUF projects through several initiatives to reinforce current Learning Management Systems and authoring tools with linguistic extensions coping with AUF partners' languages. The A6 Media Company[11] that has developed *Transfer®* LMS for AUF, is producing multilingual versioning of its educational tools for a wide range of languages. A Tunisian team of computer science students is also working on the localization of Reload authoring tools. This experience, still at its first steps, aims at a full linguistic and cultural adaptation of Reload software, the internationally recognized authoring and delivery tool of Scorm compliant educational resources. Localization process is targeting software windows bi-directionality, menu based commands, editing templates, localized calendar and currency use. Since Reload is an open source software, this initiative is expected to help duplicate localization and translation of this kind of applications and reinforce awareness about standardized learning resources in linguistic environments other than Latin language based areas.

Fig. 4 : *Reload localization*

An alternative project is on the way since September 2007 to migrate all the e-Learning resources and processes of AUF educational activity onto Moodle Learning Management System[12]. Being a free Open source application software, Moodle has been developed in more that 75 languages and upgraded to Scorm and IMS specifications ensuring an interoperability criterion with all Scorm compliant content resources in the world. AUF goal is to afford collaborative educational environment for its partners to develop and exchanges content materials and educational processes without linguistic constraints.

The third issue addressing multilingual contents management is basically constructed upon multilingual indexing techniques and resources. Multilingual retrieval and delivery are strongly dependant of indexing quality and semantic analysis. This is the most complicated task that AUF is actually challenging to afford semantically based educational multilingual solutions. With the Web 2.0 services and even the upcoming Web 3.0 services, semantic networks are an inevitable alternative for e-Learning applications (Berners-Lee, 2007). This challenge goes through development of specialized ontologies and semantic networks which results a very heavy burden when addressing multidisciplinary contents. Yet, only few disciplines like medicine have developed specialized ontologies and semantic networks (Simonet, Patriarche, Bechlioulis 2006). Still very recent and then rare in use throughout the Web, the Ontology Web Language (OWL), designed by the World Wide Web Consortium (W3C) in 2004, has not yet accomplished its major task to develop "*standard representation formalisms that will allow*

[11] A6 Media is a French private enterprise specialized in developing educational tools. http://www.a6.fr/
[12] Moodle is a course management system (CMS) - a free, Open Source software package designed using sound pedagogical principles, to help educators create effective online learning communities. http://moodle.org/

ontologies to be published on the Web and be shared by different computer applications" (Androutsopoulos, Kallonis, Karkaletsis, 2005). AUF initiative in this respect has started by the compilation of a standardized vocabulary list as the basic for a multilingual e-Learning ontology. A standardized list of e-Learning vocabulary, referenced ISO 2382-36, is being converted into as many languages as possible with validation processes from authoritative bodies in partner countries. Already standardized in English and French, this list has been translated into Korean and Arabic languages and is in the final process of its validation by Korean and Arabic specialized institutions. Work is actually conducted to convert it also into other Asian and African languages. The goal is to produce a multilingual ontology which will serve all AUF partners while collaborating through standardized e-Learning environments without any language problems.

6 Conclusion

No more doubt that standards constitute a worldwide challenge for the future educational systems and policies. The linguistic and cultural diversities, being one of the world's most emphasized issues to deal with the digital divide, they have to be considered with as much care as possible not only to disseminate content resources and technical solutions for emerging countries, but also to train local skills in order to produce appropriate resources and tools based on their proper needs and requirements. This requires much more implication of indigenous human resources in software engineering, computerized applications development, educational contents modeling and definition and local expertise training and education.

ADL initiative to forward the Scorm development to an international stewardship is a valuable initiative for an international governance of e-Learning standards. Being largely disseminated as an e-Learning reference model, Scorm would certainly enhance the universal dynamics for more concrete e-Learning systems interoperability. The foundation of the LETSI international non-profit federation in March 2007 will certainly promote e-Learning and enable innovation in learning technologies[13].

Some recommendations are however compulsory for the forthcoming evolution of e-Learning standards:

- *End-user oriented solutions*: the old questioning of adapting technologies to users or vice versa should be settled definitely to be user based solutions. It is recommended that in using standards, users are not evidently concerned by standards script coding or complicated set-up interfaces. Intelligent systems should replace users adapting their inputs to the required output standardized formats. Back office layers and routines are to be implemented to take over this function.
- *XML Web-based solutions*: for some users, sophisticated plug-ins (i.e. Java) could constitute problems of computer systems set-up requirements. Web based XML resources are today a more easy solution to handle. The future of the Web 3.0 services is built upon XML standards.
- *Free software solutions*: any e-Learning solution should be open source and put free for the large world community. Appropriate and commercial solutions have demonstrated restrictive dissemination among low income communities and have induced large gaps of mutual conformity which is very critical for worldwide e-Learning systems interoperability.

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Citation instruction

Ben Henda, Mokhtar (2008). SCORM specifications for an emerging world: The linguistic diversity at work. eLearning Papers, Nº 7. ISSN 1887-1542. www.elearningpapers.eu

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Edition and production

Name of the publication: eLearning Papers
ISSN: 1887-1542
Edited by: P.A.U. Education, S.L.
Postal address: C/ Muntaner 262, 3º, 08021 Barcelona, Spain
Telephone: +34 933 670 400
Email: editorial@elearningeuropa.info
Internet: www.elearningpapers.eu