AC 2007-1348: DEFINE TBT SCORM-BASED TOOL FOR THE REAL-TIME PRODUCTION OF LEARNING OBJECTS IN WBDL

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Define TBT*(Technology base Training) SCORM / based tools for the real-time production of Learning Objects in WBDL

PWUTVU (Power & Water Virtual University), WBDL (web base distance Learning)

Abstract

The first decade of the twenty first century is witnessing the convergence of three strands of development in e-learning which had relatively independent origins during the 1990s.
The first strand is rise of e-learning technology as a recognized industry. This was fostered by the rise of the Internet and the widespread adoption of e-learning software and courses, especially Learning Management Systems such as WebCT and Blackboard in the education sector, and PWUTVU, Click2Learn, and others in corporate training. This strand grew predominantly from software innovation around proprietary e-learning systems which found its way into the wider market through venture capital investment.

The second strand arose from attempts to create open standards for e-learning software and content, driven by specification organizations such as IMS Global Learning Consortium, AICC and ADL, and relevant committees of international standards bodies such as the IEEE LTSC. Despite the potential relevance of these open standards for the proprietary e-learning systems of the first strand, the consistent adoption of e-learning standards by LMS vendors was slow, particularly in the education sector.

There have been exceptions which crossed the boundaries between the strands identified above. However, during the late 1990s the major impact of each strand tended to occur without respect to the others. E-learning technology rose to fame largely without standards or open source software; e-learning standards were initially developed without widespread vendor adoption or open source software examples. While the open source community focused its major efforts at basic infrastructure such as operating systems and web servers, examples such as Moodle[10] provide a SCORM add-in module. User can use some external applications to create SCORM compliant materials for Moodle.

The production of educational multimedia content to be distributed by e-learning systems is growing in every context. The competition among different learning systems, intended as SW platforms, and among different learning/teaching approaches, is essential to the development of the e-learning field. While previous proprietary platforms and existing standards failed to guarantee this competition, the recent definition of SCORM-2006 creates a new scenario. The new standard seems to be sufficiently flexible to support different e-learning approaches and to guarantee content's circulation. In the paper we discuss a real experience to "test on-the-field" the flexibility of the new standard and the portability of SCORM-2006 educational content between experimental test platforms.

Introduction

Continuous training and professional growth are the main foundation of the knowledge economy and current terms for most workers, employees or self-employed. In these last years blended learning has been more and more affirming the integration of traditional face-to-face lessons and distance learning approaches. Private and public companies, universities and institutions answer to these new needs equipping themselves with PWUTVU eLearning environments[1], able to promote the personalized, interactive, collaborative and just-in-time learning.

ELearning environments usually include (almost basic) authoring systems and content management systems for the production and distribution of Learning Objects (LOs in the following of the paper), giving the chance to create collaborative environments to support teachers in managing their relationship with the students (i.e. in assigning tasks, creating discussion groups, etc.) and to define their curricula. Right now the largest parts of these systems are based on proprietary technologies and produce LOs strictly linked to the specific platform.

To overcome this problem, caused by the limitations of the existing standard (like the IEEE 1484.12.1 – 2005)[2], the new SCORM-2006 (SCORM - Sharable Content Object Reference Model made by ADL- Advanced Distributed Learning) is able to represent the full behavior of a learning experience, providing the basis to release the constraint of using LOs with a specific Learning Environment. Moreover, the adoption of the standard allows:

- the student, to easily use content offered by different suppliers of knowledge without changing system ;
- the teacher/tutor, to integrate a course with didactic material created with different authoring systems;
- the content producer to widen its "market";
- the technical operator to reduce/avoid the incompatibilities among several different LMS.

This can also guarantee interoperability, scalability, large reuse and accessibility to the content at the same time. However the production process of high-quality multimedia-rich LOs can become very long and expensive, due to the need of creating all the required media data and metadata, to integrate them and to test the conformity of the resulting LOs to the standard. We believe this is one reason why most LOs are mainly based on text and images, with basic navigation structures. An alternative is to “video-record” high-quality lessons performed by good teachers, and to transform them into effective LOs. However this approach has two main shortcomings:

- As reported by many authors, the manipulation of large video files (several hours) can be time-expensive and complex from the technical point of view;
- Digital video, audio and animations are not indexed by search engines. Hence, searching and retrieving operations of audio/video content can be ineffective and time consuming.

To solve these problems many tools have been proposed by various authors. Among them, SCX 2006 (Scorm Compliant X-Presenter 2006) has been created with the aim to separate the learning content (indexed video) from the specific systems used to create it (X-Presenter).

With SCX2006, the indexed video can be exported in SCORM 2006 – compliant format and imported in other Learning Management Systems (LMSs in the following). The main considerations regarding Learning Objects and the SCORM 2006 standard are presented in section 2. In section 3 we describe SCX 2006. Validation is presented in section 4. In section 5 we present our conclusion and future works.

Background

Distance learning, multimedia technologies and the continuous growth of the Web have caused the proliferation of tools and technologies to support the learning content development process and the use of both on-line and off-line (CD & DVD) didactic content. This created a strong need of standards for the creation, distribution and share of Learning Objects. The LO is defined in IEEE 1484.12.1 -2005 as "any entity, in electronic or not electronic form, used for didactics, education or training." Such a LO is a self-contained element, that can be distributed through any eLearning system. Providing LOs standardization allows sharing content among users and among systems with consequent economic and temporal savings.

In order to guarantee the interoperability and reuse of LOs, several international initiatives have been developed. Among all we remind ADL (Advanced Distributed Learning), promoted at the beginning of 1997 by the US Department of Defence and the White House Office of Science and Technology to develop SCORM (Shareable Content Object Reference Model). The aim of SCORM is to define a reference model for assembling Shareable Content Objects (SCO) to answer the specific user needs. SCORM integrates all the most accredited specifications about American and International eLearning standard (AICC, IMS, IEEE and Microsoft LRN, as well as ARIADNE -Alliance Remote of Instructional Authoring and Distribution Networks in Europe[3,4]). The authors of SCORM-2006 tried to harmonize all the main specifications and standards to define the interrelationship of content objects, data models and protocols and to promote the content sharing across systems.
The three official books of SCORM 2006 define[5]

- the guidelines for the identification and aggregation of elementary content inside a structured didactic context ("Content Aggregation Model" (CAM) 1.3) [6],
- the specific techniques to describe functions libraries that LMSs must support to interact with the SCO ("Run-time Environment" RTE) 1.3) [7]
- the specifications to define sequencing information and behaviors that enable SCORM 2006 content to reproduce standard Cognitive Behavioral Therapy (CBT), thus removing sequencing logic from the delivery environment ("Sequencing and Navigation" (SN) 1.3)[8]. This is the very novelty of SCORM 2006 with respect of the previous version of the same standard.

Today, most market authoring tools (like Reload Editor 1.3, Macromedia L5 SCORM Producer, DDLS NETg Learning Studio and Sample Connect) are still compliant with SCORM 1.2, but to our knowledge there are very few professional tools compliant with the new SCORM 2006 standard (like the Macromedia Captivate – published in February '05 - that supports both SCORM 1.2 and SCORM 2006).

In this paper our attention is focused on the LO structure in order to permit packaging and exchanges from LMS to LMS. Therefore we concentrate on the Content Aggregation Model (CAM)[8] and the related aspects of Content Model, Meta-data and Content Packaging.

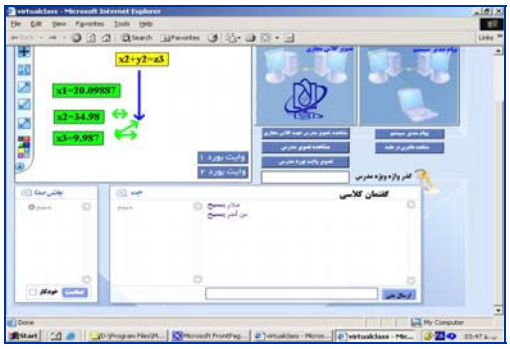
SCX 2004: SCORM 2004-Compliant X-Presenter

SCX 2004 is based on X-Presenter[9], an authoring tool for real-time creation of LOs starting from live lessons, lectures and conferences. X-Presenter has been developed by a joint effort of the University of Lecce and Alba Project s.r.l.. X-Presenter allows the real-time production of multimedia content which combines two synchronous video streams (a primary and a secondary video stream, respectively used for the speaker and for supporting materials, like slides etc.) with a hierarchical index (i.e.a table of contents) hyper-linked to the various topics/subtopics in the video sequence. The index is created during the lesson/lecture, at recording time. Distinctive characteristics of X-Presenter are:

- the ability to effectively support the most common "training/teaching situations";
- the very simple and intuitive way to organize video content into topics and subtopics;
- the possibility of linking appropriate comments, bibliographic references and other materials (doc, pdf, ppt, xml, html,..) to the indexed video.
- the ability to create hyperlinks between textual elements (topics/subtopics, textual summaries etc., that are indexed and retrieved also by normal search engines), and the audio/video streams;
- the ability to play the indexed video in standard browsers, like the Microsoft Explorer or the Real Player, without requiring specific plug-in or extensions.

X-Presenter has been used both in educational context and in conferences and meetings for on-line and off-line (CD, DVD) distribution of "Video Proceedings". It has also been used in face-to-face classes of executives, who used the Video Proceedings as learning support.

In the following we describe the functionality and technical structure of X-Presenter and of the SCX 2004 extension. X-Presenter is made up of two distinct modules: X-Author (Fig.1), which is the authoring environment where video lessons are recorded, indexed and annotated, and X-Player to run the hyperlinked video applications created with X-Author.



E whiteboard

Chat unit

Fig 1. X-Author: main interface

SCX 2004 is an X-Author extension designed to bridge the gap between the creation of indexed video and the creation of SCORM 2004-compliant LOs based on that indexed video.

Fig. 2 shows the scenario of use of SCX 2004: the content developer uses X-Author to produce his/her video-based learning object, which is stored in a LO Repository with a proprietary format. SCX 2004 is able to transform the LOs in a SCORM 2004 compliant format by adding packaging information and all the required Metadata.

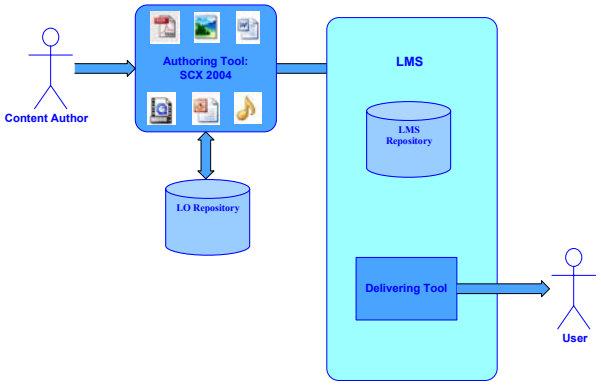


Figure 2. The scenario of SCX 2004

The LO so produced is available to be imported in any SCORM 2005-compliant LMS to produce on-line courses. In our scenario the LMS is a server-based environment for the management and the delivering of learning content.

Implementation aspects

SCX 2004 has been developed in Microsoft Visual Basic.NET, to create both the Resource Package and Content Aggregation Package as defined by SCORM 2004. Multimedia content produced with other tools (Web pages, images, flash animations, text files, etc.) can be easily added to the indexed video created by X-Presenter.

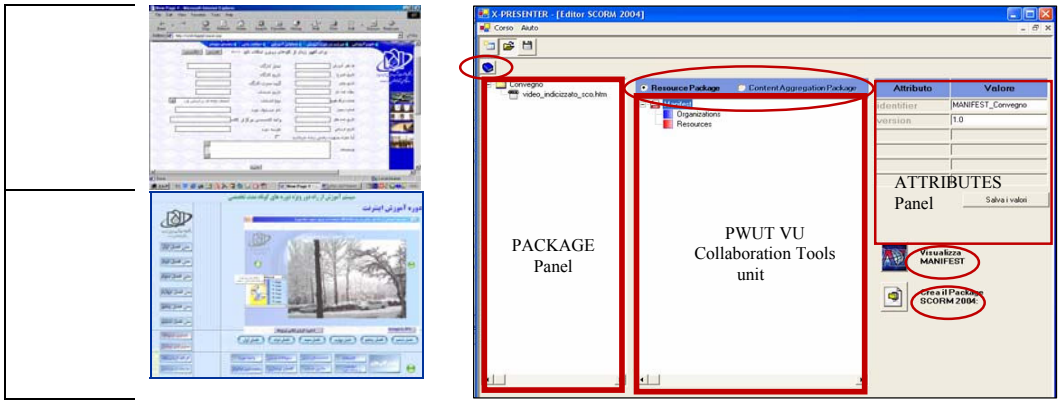


Figure 3. The main interface of SCX 2004

The main interface of SCX 2004, shown in fig. 3, is organized in three panels:

– the **Package Panel:** describing the main content to build the LO;

– the **Manifest Panel:** describing the structure of the Manifest (Metadata, Organizations and Resources), that describes all content, its organization and the resources contained in the content package;
– the **Attributes Panel:** visualizing the attribute values of the selected item in the Manifest panel and allowing to modify them, if possible.

The user allows to insert new content in the Exportation Package Directory and to update the Manifest through "drag and drop" operation.
The user can choose to build the package with Assets or SCO.
At the end it is possible to choose the kind of package:
– Content Aggregation Package, which is a structured content. In this case the Manifest will be opportunely modified to create an Organization Package.
– Resource Package, which is a set of Assets and SCO without a structure.
Besides, the user can add meta-data to the package, using a form to write the Aggregation Metadata (conforming to standard IEEE 1484.12.1 - 2002 (LOM)).
The process ends with the creation of the ".zip file" package.

Validation

To verify the content conformity to SCORM 2004 we used the Conformance Test Suite v. 1.3.2 realized by ADL, with positive results. The Suite includes both software for conformity test and procedures and documents for self-testing about SCO, meta-data, Manifest, Resource Package and Content Aggregation Package. The last step of the validation has been the creation of a sample LO to be import in the "Sample RTE 1.3.2", a sample LMS produced by ADL for test purpose. After a preliminary verification of conformity, made automatically by the tool, the package has correctly imported the LO and reproduced all the desired behaviours and navigation structures, as shown in fig 4.

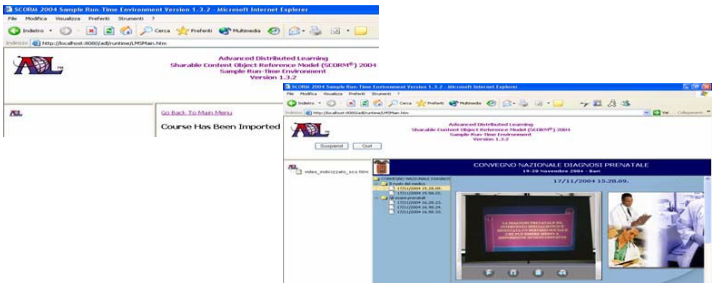


Figure 4. Sample Learning Object encapsulating an indexed-video lesson

History of the Subject of Project: PWUTVU Project

With respect to the urgent need developing countries to educational substructure and lack of conformity of population growth and educational possibilities on Web basis, with full facilities in simulation of educational environment and multimedia via providing software systems that would match the speed of data transfer for existing networks.

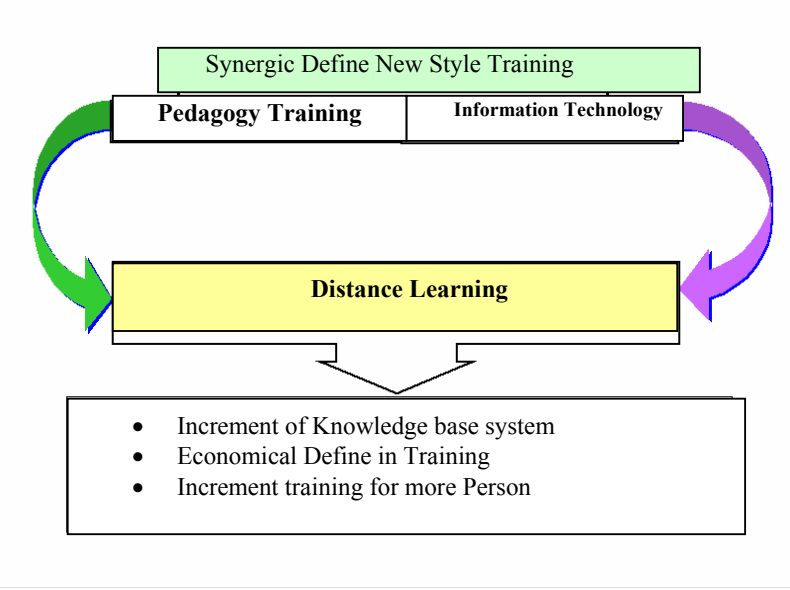
Work that has been performed:

I have implemented the remote education system software with full facilities in order to provide the needs mentioned above. The system consists of two general sections:

1. Procedure of education affairs (registration, schedule, tests….)
2. Education section (simulation of class environment, mass media via aggregated synchronized multi-media)

The mentioned software has vast facilities in providing educational courses, particularly holding specialized courses for on-the-job-training for employees, and being analyzed and initially designed based on the SCORM electronic education standards.

A- To lower need to establish educational spaces and at the same time, to obtain quantity development in education facilities
B- Better use of professors and specialists in each profession
C- Decrease in the education per capita costs with respect to the centralized use of educational facilitlies
D- Saving in costs and loss of time for in-bound and out-bound trips (trainers and instructors of the course)
E- Decrease in depreciation of educational inputs and lowering welfare costs (accommodation, food, reception)
F- Decrease in expenses of seminars and conferences
G- Standardization of contents of educational courses and tests, optimized use of educational equipment in relation with computer and optimized use of the trainees' times in participating in education course



Social reasons for implementing software for remote education system

The global declaration of higher education made at UNESCO's 1998 world meeting in Paris states that the higher education institute should be of the first institutes that would benefit from potential allowances and facilities of information and communication technology, in this line to establish modern educational environment to coordinate information era and to determine abstract education systems.

The significant point is that in the developing countries, or undeveloped countries:

- The social substructure facilities, education system is a part of it- it grows in arithmetic multiplication (in best status)
- In these societies, the population grows in geometrical multiplication
- This lack of conformity leads to social and individual abnormalities, for, non-distribution of social sources occurs and as a result, class struggles would lead to structural challenges.

Reasons for using multimedia tools in remote education system

This is a case study, research by Authors

- **The trainees learn 1060 items they read**
- **The trainees learn 2060 items they hear**
- **The trainees learn 3060 items they see**
- **The trainees learn 5060 items they see and hear**
- **The trainees learn 7060 items they experience**
- **The trainees learn 9560 items they teach others**

These figures are compared to a few education points (of 1600 cases); however, the above-mentioned subjects are a case study in explaining status of educational technology.

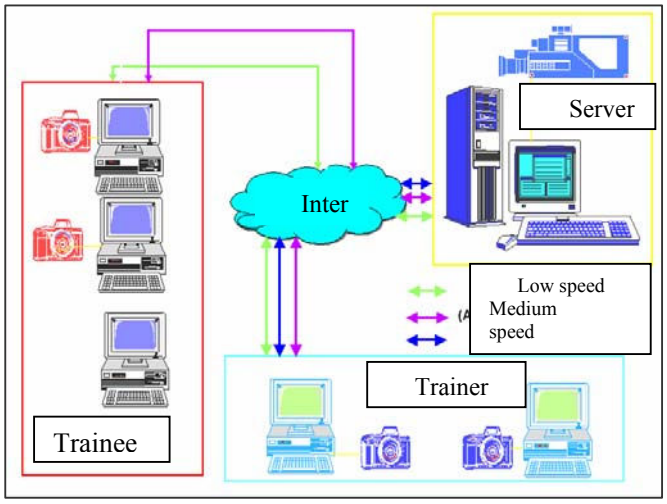
9) Main advantages of implemented remote education system

- Decrease in the need to establish educational spaces and at the same time, quantity development of education
- Better use of professionals and specialists of each field as well as lowering educational cost per capita with due respect to centralized use of educational facilities
- Saving in time and costs for in-bound and out-bound trips (instructors and lecturers of educational courses)
- To decrease depreciation of educational inputs, and to lower welfare costs (accommodation, food and reception)
- Standardization of the contents of educational courses and tests
- Generalization of education issue for large regions, which lack any educational facilities.

10)Relative advantages of implemented remote education system

- A dynamic software environment by 100 thousands lines of source code for the operator and server, for presenting short term specialized courses. The software system has been designed on SCORM standard base; thus, it is possible to communicate with different types of data base in this field.
- The application layer of the system has the ability to conform to any real time data base-Oracle & etc).
- The system has been designed in a way to enable different work groups (including ten work team) including trainees, trainers, managerial forces, supervision and staff agents) to gather in the place and perform their activities
- To offer education courses including simulation of all educational, class and lab institutes in form of presenting synchronized course; in addition, the possibility to make non-synchronized educational course archives has been incorporated.
- The administrative layer of the system is ways that make it possible to have a remote control in activities on the system via main server.
- The production method, transmission, multi-media section renovation and Collaboration & Comm. are designed in a way to enable live (same time) communication with least volume of data transmission. This is possible with the use of Vector Base for the Bitmap Base servers.

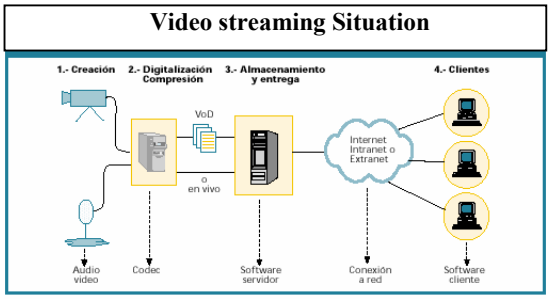
Dynamic educational planning in the form of educational calendar of all courses together with their syllabus and topics is the main specifications of implemented remote control education system software. The educational management system (including all educational category) includes visual and sound transmission of the lecturer via a powerful data bank (in form of an abstract class) the learner's side, educational environments, such as electronic whiteboards, etc, possibility of holding abstract labs and abstract visits, , possibility of holding scientific conferences and educational staff sessions, dynamic informative system, possibility to using electronic sources and libraries as well as other facilities of a full educational system, mechanism of supervision and evaluation of an overall system along with statistical summarized information, use of electronic education calendar and course brochures with the possibility of searching, possibility to hold highly secure test and financial system, payment for the course in form of credit card or bank voucher, monitoring system and input of independent Persian information from the platform and the type of synchronized admission of more than 1000 educational users at one time via the operating system and possibility to holding several numbers of courses at the same time or in different times during one session, remote central administration of the system, using a vector graphic base for user in the educational multimedia to increase the power of system

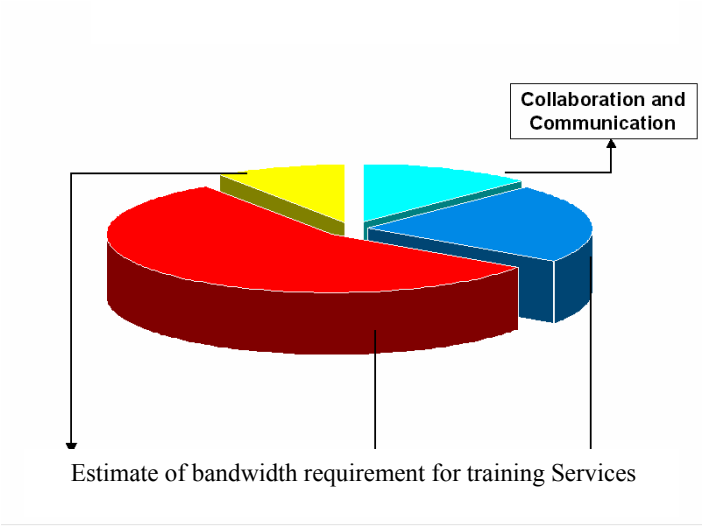


Situation for training partner

11) Software implementation technology:

1. Use of UML tools production system with RUP method
2. Use of RDBMS powerful substructure
3. Use of ASP technology for developing WEB layer
4. Use of VBS language for server side processes and JSP language for operator side processes
5. Use of special techniques for improving system safety
6. Use of Active X technology to improve system efficiency
7. Use of Applications made by Action Script for educational tools
8. Use of special server for vector multimedia facilities
9. Use of vector animation technology for user layer





Estimate of bandwidth requirement for training Services

Conclusion

E-Learning and Distance Learning require us to re-think several aspects of the production and distribution of virtual content to make it more effective.
X-Presenter represents a interesting trade-off among production costs, effectiveness, portability and interoperability of Learning Objects.
SCX 2004 turns X-Presenter in a user-friendly SCORM-compliant tool, that satisfies the following requirements:

- production of multimedia content at low cost;
- interoperability. Learning content can be used in all location with different tool sets or platforms because content is independent of the LMS used to run it;
- reuse of didactic content.
- durability of didactic content. Learning content should not need to be significantly redesigned, reconfigured or reprogrammed to keep up with the evolution of technology;

The future developments of SCX 2004 go to the development of the “Sequencing and Navigation” functionalities as defined by SCORM 2004, in order to better define the learning experience of the user.

References

[1]. Ramin Sadeghi The author is charge of distance learning Software; he has developed a distance learning software program in power and Water University of Technology Idea -ramin71@gmail.com

[2]- Ramin Sadeghi Ph.D. Thesis and Ms.c Thesis 2000-2005

http://www.pwut.ac.ir

[3]-Ramin Sadeghi Research on Web based Distanced Learning FA Magazine nov.2005- ramin71@gmail.com
http://www.faa.ir

[4]- Paul T. Jaeger, Kim. M. Thompson – e-Government around the world: Lessons, Challenges, and Future directions – Florida State Univ. School of Information Studies. Information Use Management and Policy Institute
http://pwut.ac.ir

[5] IMS Global Learning Consortium: IMS Meta-data Best Practice Guide for IEEE 1484.12.1-2002 Standard for Learning Object Metadata, Version 1.3 Public Draft
http://www.imsglobal.org/metadata/mdv1p3pd/imsmd_bestv1p3pd.html (Revision: 2005)

[6]. http://www.adlnet.com

[7]. http://www.macie.com

[8]. http://learnwise.aadlcolab.org: An Introduction to ADL and the SCORM

[9]. http://www.adlnet.com: SCORM Content Aggregation Model v. 1.3, Advanced Distributed Learning (2005)

[10]. http://www.adlnet.com: SCORM Run-Time Environment v. 1.3, Advanced Distributed Learning (2005)

[11]. http://www.adlnet.com: SCORM Sequencing and Navigation v. 1.3, Advanced Distributed Learning (2005)

[12]. M. Bochicchio, A. Longo, G. Caldarazzo: X-Presenter: a tool for video-based hypermedia. AVI 2007. Gallipoli, Italt, May 25-28, 2006

[13]. Moodle website, http://moodle.org/