# Developing SCORM-based Courses for Avicenna Virtual Campus

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**Key words:** Learning object, Learning Standards, SCORM, Pedagogy Model, Educational Technology

Abstract:

*Avicenna Virtual Campus (AVC) is UNESCO-led, multi-cultural EUMEDIS pilot project. It involves partners from sixteen Euro-Mediterranean states. Each partner contributes through a node called Avicenna Knowledge Centre (AKC), which produces e-courses and e-learning objects. For seek of interoperability, partners setup a pedagogical standard to guide the production process of learning objects. Further more, researchers adopted and recommended SCORM as a standard model for structuring learning objects of AVC. At the end, the paper introduces some lessons that have been learned while developing e-courses of the AVC.*

# 1 Introduction

E-learning refers to a computer-enhanced learning. It deals with both technologies and pedagogies using networked and/or multimedia technologies [1]. Multimedia supports an interactive multimedia presentation showing video, sound, animation and images to encourage learning by doing rather than simply reading text about a subject. Further more, e-learning has a computing environment that can support and automate different pedagogical approaches such as instructional design, social-constructivist, cognitive, emotional, behavioral, and contextual models [2]. Technically, it is possible to track, supervise and quiz students and then provide feedbacks; i.e., when the wrong answers are given.

E-learning proved its value in a corporate sector and much of higher education institutes. According to empirical studies, more that seventy percent of US colleges and universities offer online courses [3]. Many have established bricks-and-mortar universities started offering on-line classes. Governmental agencies and universities have formally begun recognizing such online graduate degrees. Too few to mention, Stanford, Penn State, University of Texas, University of Illinois, University of Phoenix, Canadian Virtual University, Michigan Virtual University, African Virtual University and other hundred universities have already had thousands online enrollments and offers a numerous complete degree programs online. On the other hand, some developing countries (e.g., Jordan) has recognized degrees that have partially (i.e., 20%) an online courses in their curriculums.

Avicenna* Virtual Campus, which is funded 80% by the EU, is an ambitious project that aims creating new community of universities, sharing the best practices and pedagogical innovation through a network of E-learning centers across the Mediterranean.


Abu Ali Sina (Avicenna)

Researchers have contributed to produce the first module that includes e-courses of the IT program. Namely, multimedia, web technology & design, simulation, local area networks and Intranet, visual programming, introduction to electronics, digital logic design, programming language C++, and operating systems courses. The contribution was first introduced through Avicenna knowledge Center of Quds Open University (QOU) in Palestine [4].

In addition to the proposed pedagogical model of Avicenna courses, researchers have, of this paper, adopted SCORM model that makes the learning objects interoperable; i.e., they operate across a wide variety of platforms and capable to continue operating under new versions of system software [5].

This paper is organized as follows: Section 2 overviews Avicenna project. Section 3 generally, discusses the e-learning standards. Section 4 handles issues related to produce SCORM compliant learning objects. Section 5 discusses lessons learned while the development phase of the project. Section 6 concludes the work.

## 2 Avicenna Project: An Overview

Avicenna project aims creating new community of universities. The main purpose of this community is to share best practices and pedagogical innovation through a network of E-learning centers across the Mediterranean. It offers the following components:

- A complete multicultural framework for the Open Distance Learning (ODL) of the virtual campus (AVC)
- A virtual library (AVL) [6]
- An Intranet and Quality Assurance (AQUAS System) supported by the UNESCO, which allows the management and quality assurance of the Avicenna project.
- Metadata repository to ease the searching of learning objects that stimulates the cooperation among high education institutions of the Mediterranean region.

Table 1 lists the involved partners, which are sixteen universities from different countries. Each university contributes to Avicenna Campus through a learning center called Avicenna Knowledge Center (AKC). The learning center provides a portal that has a full access to all courses available in Avicenna platform. The portal has an admin page that can be used to define modules, insert new courses, update learning objects,and update users, etc.

* The project named Avicenna in the honor of Ibn Sina (or Avicenna), 980–1037 AD, the most famous physician, astronomer, mathematician and philosopher of his time [Encyclopedia Britannica, Concise Online Version, 2006]

Table 1: The participating centers in the Avicenna Virtual Campus.

| 1 | Country | University |
|---|---|---|
| 2 | Turkey | METU - Middle East Technical University |
| 3 | Syria | UD - University of Damascus |
| 4 | Palestine | AQ-OU – Al-Quds Open University |
| 5 | Lebanon | LU – Lebanese University |
| 6 | Jordan | Philadelphia University in Amman |
| 7 | Egypt | CU – Cairo University |
| 8 | Tunisia | UVT – Universite Virtulle de Tunis |
| 9 | Algeria | Universite de la Formation Continue |
| 10 | Morocco | ENSIAS – Ecole Superieure d'Informatique et d'Analyse des Systems |
| 11 | Malta | MCST – Malta Council for Science and technology |
| 12 | Spain | UNED - Universidad National de Education a Distancia |
| 13 | UK | NIACE: National Institute of Adult continuing Learning |
| 14 | France | UM- Universite de de la Mediterrannee, Mardelle<br>CNED – Centre National d'enseignement a distance<br>CNAM – Conservatoire National des Arts et Metiers |
| 15 | Italy | NETTUNO – Network per I'Universita Ovunque |
| 16 | Cyprus | UC - University of Cyprus |

Avicenna platform (called Plei@d) is shown in figure 1. The platform was supported by CNAM (Conservatoire National des Arts et Metiers in France). It contains relative information of each course introduced by the campus (including bibliographical material, exercises, tests, etc.).

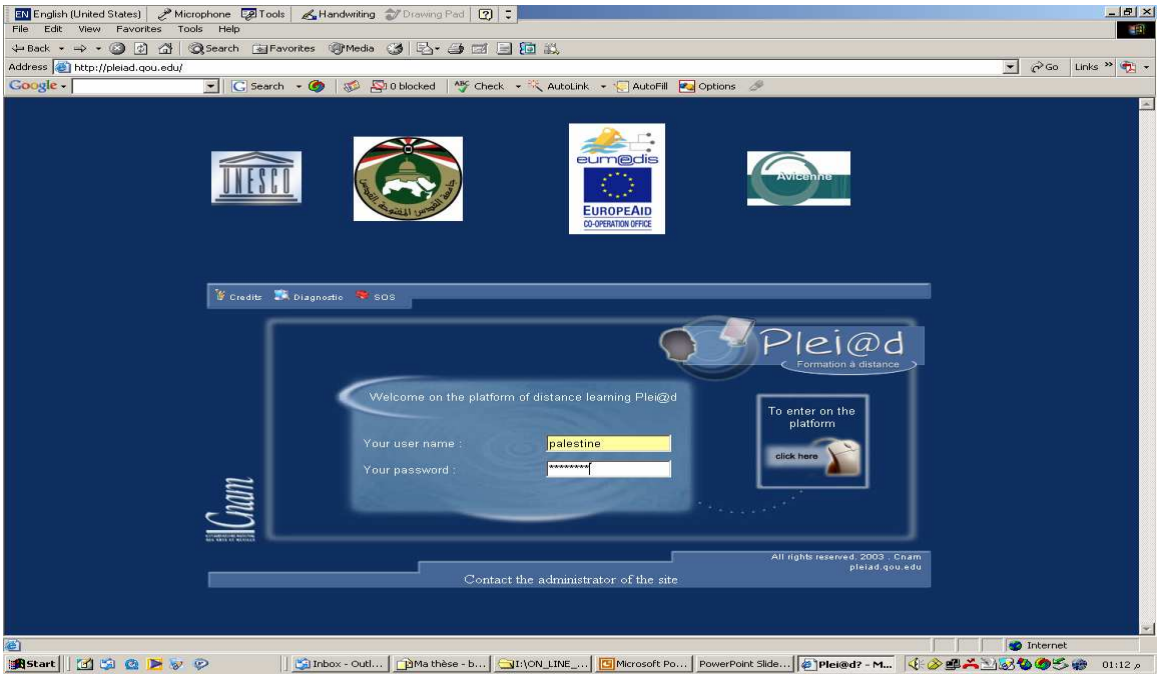


Figure 1: Avicenna platform - Plei@d

A pedagogical standard was setup via collaborations between partners to direct the production process. Partners came to a standard pedagogy [7]. This standard was one of the basic innovations that offered by Avicenna community.

### *2.1 Quds Open University*

The basic teaching model of QoU – Quds Open University is an opened and distanced teaching model. It was an opportunity for QoU to convert its model from an opened and distanced institution into a virtual university through AVC. Therefore, QoU was excited to start its e-learning portal, which later on became a node of ACV, in 2003. The university adopted the in-house development option to save cost and overhead. The used technology for development was an opened source technology (i.e., Java). The first phase of development was funded by UNDP, which includes capacity building and knowledge transfer. The first launch of the portal was issued in May 2004. The portal involves the following systems: Students Information System, Tutor Information System, News and Bulletin Boards that facilitate an easy communication between students and tutors and between the tutors.

Students can download relevant teaching material from within the online workspace. Mobile SMS features are integrated with the portal to facilitate information delivery to students such as grades and other important news.

Continuing growth of the university, which has more than 40,000 users who often simultaneously use the system, and the ever-increasing number of students (users) has imposes extra burden on the portal.

During the fall semester of 2005, around 25827 students; 1467 tutors used the portal; 400 MB of documents were sent by tutors to the students; 17818 SMS were sent by the portal to the students.

# 3 e-Learning standards

Nowadays, over 2.5 million people have access to online courses which are being taught by over 100,000 faculties at a place and a time of their convenience. [8]. However, such online courses and learning resources are widely world replicated with a high degree of overlapping. Since Internet is a standard and global system, it is believed that it is possible to globalize the learning courses and resources to a coherent global learning content management system.

Web services, for example, provide data and services to other applications via standard Web formats (HTTP, HTML, XML, etc), with no need to know how the web service itself, which are implemented. In service-oriented applications, web services are building blocks in the programming model. E.g., Microsoft .NET technology.

Most of the current e-courses and learning objects are not standard components. Hence, they are not capable to support future distributed e-learning applications, because they based on non-standard technologies like COM objects, DLL-files, registry settings, INI-files.

Therefore, initiatives have been launched to investigate and develop specifications to encourage the adoption and advancement of e-learning era. Some to mention are:

- Advanced Distributed Learning – ADL [9]
- Aviation Industry CBT Committee – AICC [10]
- Institute of Electrical and Electronic Engineers/Learning Object Metadata – IEEE-LOM [11]
- Instructional management Systems – IMS [12]

- Alliance of Remote Instructional Authoring and Distribution Networks for Europe - ARIADNE [13].

The main objective of these initiatives is the subjects and their ability to fulfill the teaching needs thus are generally available.

# 4 Developing SCORM Compliant Learning Objects

SCORM aims to standardize materials of e-learning environments, in particularly creating or re-using Learning Objects. The other functional requirements of SCORM are [14]:

- Accessibility: Authorized authors can access learning objects and deliver them to other locations.
- Adaptability: To adapt learning objects according to individual and organizational needs.
- Affordability: To provide affordable solutions for delivering learning objects in less time and cost.
- Durability: To produce learning objects that can sustain for a longer period with minimal cost of redesign, reconfiguration or recoding.
- Interoperability: Being able to operate in any other platform.
- Reusability: To reuse learning objects in multiple applications and contexts.

To fit the above-mentioned requirements, learning objects should be self-contained units that are properly semi-structured and stored in an XML file. Therefore, the sequence of learning objects should be integrated together in a file that is accessible to any other e-learning centers in the AVC network.

To produce SCORM compliant (or so-called scormify) learning objects, authors have to follow certain guidelines and procedures. Further, they have to follow strict naming standards of SCORM like Asset, SCO, Learning object, etc.

Figure 2 shows the structure of the whole module of teaching material. It consists of many modules containing an arbitrary number of tags, called items, used to denote the corresponding sessions, resources, evaluation within the teaching material. Each item can be also tagged with activity metadata, which can be used to easily discover and reuse the activity within the learning object repository.

Based on the concept of learning objects and the SCORM content packaging scheme, teaching materials can be structured by organizing the learning objects according to teaching strategies, students' learning abilities, and overall evaluations.

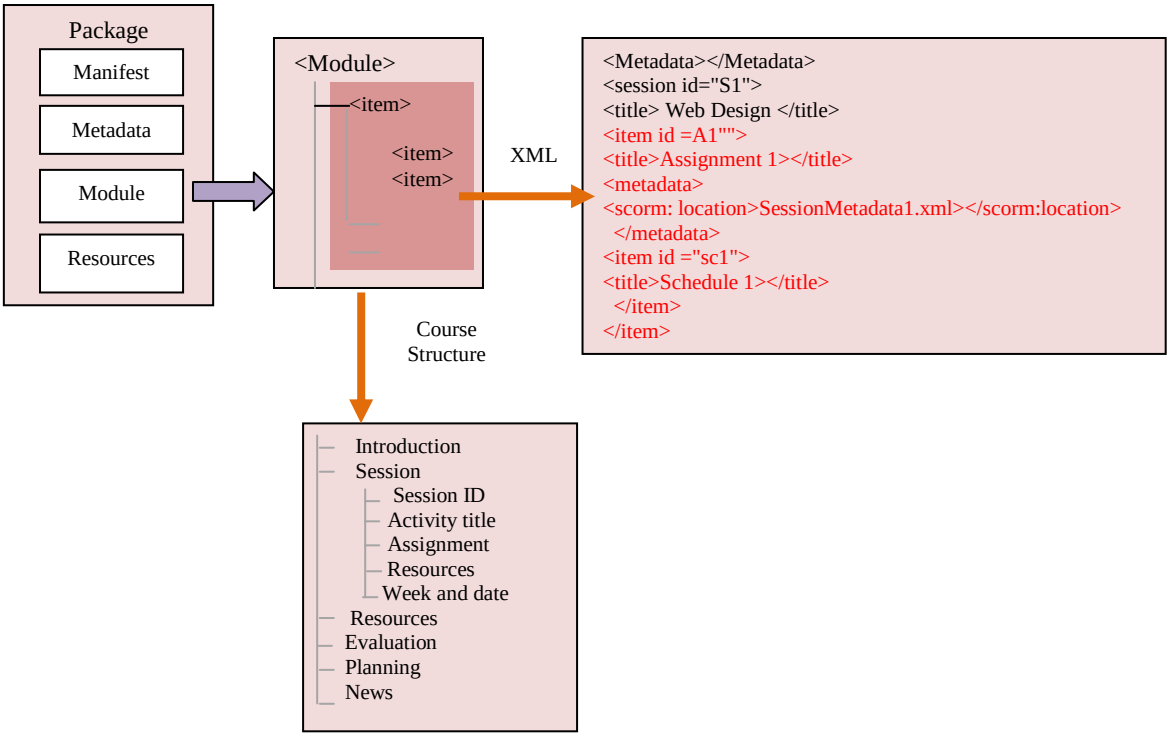


Figure 2: SCORM Content packaging scope and corresponding structure of teaching materials

One XML file can hold all information shown in figure 2. It describes the content structure through given metadata and saved in the same folder with the other shared learning objects. To ensure interoperability, JavaScript functions stored in web pages of the client machine can help in finding SCORM API and running other SCORM functions. Due to bandwidth limitation, packages of learning objects should be compressed in a file, which is named Package Interchange File (PIF). SCORM recommends that content packages be created as PIFs. The PIF files should be conformant with RFC, and in the format of PKZip (.zip) that is conformant to RFC1951 [14]. Thus, the learning portal may compress all content packages into a zip file and be accessible to users.

However, the content packaging scheme that defines teaching material packages consist of the following parts, which are illustrated in figure 3:

1- Introduction: This part includes welcome, overview, learning outcomes, and previous knowledge. Welcome part involves photo or video of the professor, his/her name, faculty name, and a link to his/her personal website. Overview introduces brief presentation of the educational unit. Learning outcomes present the main outputs or general objectives of the educational unit. Finally, previous knowledge consists of a brief recall of the basic notions which follow up the educational unit contents.
2- Sessions: This is the most important part, since it has been managing assignment, activities and resources through a concrete period of time. It is considered as a guideline of the students' study. As shown in figure 3, sessions involve assignments, resources, activities, and solved exercises. Assignments are the main work that a student can send to the tutor. Assignments may be uploaded after or during the percentile sessions. Resources are references that a student should study. Activities are

linked to a content that are used to clarify difficult concepts or to show a multimedia presentation. Also, it might include simulations to be manipulated by students. Finally, solved exercises include the solution of the introduced exercises.

3- Resources: This part includes references that are required for the final exam. In addition to the bibliography, web site addresses, glossary, other documents (CD's, video, etc) or materials that might not be required for the course evaluation.

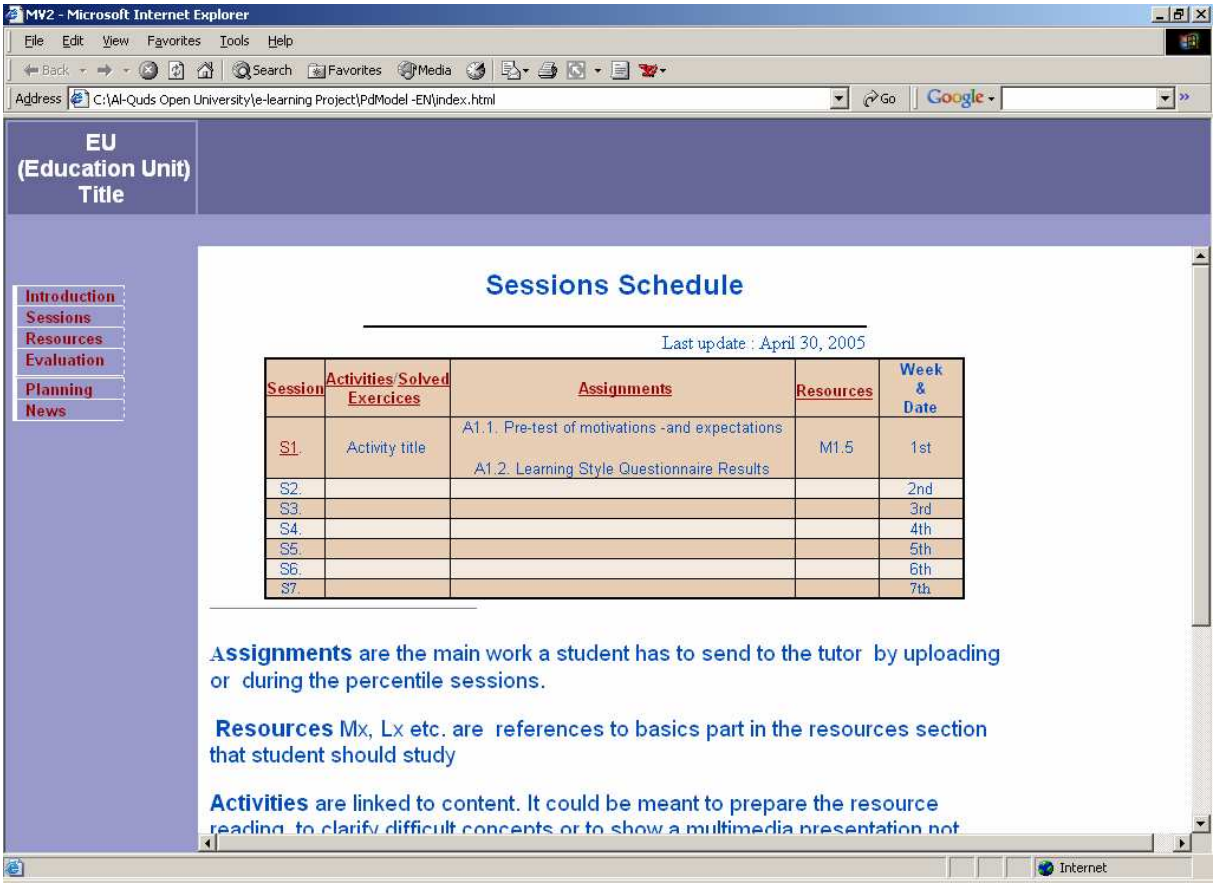


Figure 3: The Proposed course structure

4- Evaluation: This part contains pretest, assignments, previous final exams and course assessments. Pretest is an assessment activities which is presented to verify the acquirement of the previous knowledge. Assignments include all the application exercises that students prepare during the sessions. Previous final exams show the previous exams with detailed solutions. Finally, course assessment includes students' opinions of the different aspects of the course: contents, organization, tutor, global satisfaction, etc.
5- Planning: this schedules the educational unit timetable and deadlines, credits/hours, presentable sessions, final exams, and chats.
6- News: This part presents information with regard to the changes that affected the web site. The tutor will suggest a systematic visit of this item.
7- Last update: This part is used to indicate the last date for each component; it is necessary to tag the last update in a visible area of the page.

As per multimedia presentation and teaching materials, partners decided to use SMIL (Synchronized Multimedia Integration Language.) for developing teaching materials that will also be organized as learning objects. SMIL describes audiovisual presentations that produce television-style content to the web. It is a text-based markup language used to describe the temporal, positional, and interactive behavior of a multimedia presentation. It is a free and

opened source. Typically, there are five steps for producing SMIL streaming clips shown in figure 4:

1- Store video clips on a server
2- Lay out a presentation
3- Control and time a presentation
4- Stream different presentations to different viewers.
5- Display/Add special effects


Figure 4: Regions of SMIL clip ran using RealPlayer

# 5 Lessons learned

This section will discuss some challenges and lessons that were learned throughout the development process of e-courses in AVC.

## *5.1 Managing e-Learning Project*

To maximize the potential of ICT in learning, it needs a diverse developing team that involves programmers, graphic artists, writers, instructional designers, videographers, animators,

subject matter experts and quality controllers. Each of which has a specific set of tasks and duties to be accomplished. Integrating this diverse group of specialists into a cohesive unit can be challenging. Often, the missing part is an effective leadership and project management. In other words, besides technical and subject matter experts, Avicenna project needs project managers with a strong leadership that can bond the developing group of the diversed talent. Further, project managers have to manage the work, tasks, and communication within the team. They should allocate resources and estimate the costs.

### *5.2 Estimating the Cost of e-Learning Products*

The estimation of product's cost is directly related to the availability of specific requirements. Therefore, lack of specific requirements leads to inaccurate cost estimation. Since e-learning is still an emerged trend, sometimes it would be difficult to have detailed requirements from the clients [15]. In Avicenna project, requirements for the adaptation of effective e-learning within Arabic cultures and languages were not clear. Consequently, developers asked how much it would cost to produce a learning object. In e-learning development, the most appropriate unit for cost must be at the level of a learning object. Developers are able to produce PowerPoint slides with slight animation. However, they might consider this as the minimal effort spent for developing an e-learning module. Accordingly, the cost of the development will be much less if using advanced multimedia presentation using Flashes, DHTML, Picture Animation, Videoing and SMIL.

Avicenna authors, who are professors, can earn much more in developing Instructor-Led Teaching (ILT) rather than Technology-Based Teaching (TBT).

### *5.3 Bandwidth Limitations*

One of the important issues that have been discussed in the preliminary phase of the project is the bandwidth limitation. The main challenge that has been faced in Avicenna project is that most of the students are using dialup services. To realize the problem, transferring a video file with 680Mbyte size might need 54 hours using Modem of 28.8 Kbps speed. While transferring the same file needs only 0.5 second using OC-192c of 9.5Gbps speed.

However, in Avicenna project, some strategies were proposed to alleviate the limitation of the bandwidth. One of these, for example, is encoding video files by using Real Media (RM) format. RM uses streaming technology to transfer live video and audio over the Internet. RM is able to sharpen video images at any Internet connection speed, which makes it popular with Video and real shows. Therefore, about 85% of audio/video files on the Internet use the RM format. Further, RM compression has reduced the standard of the video size file to a considerable size in respect of the original one[16].

Real Producer tool [16] is used as an encoding software convert video/audio files into RM format. Further, the tool has been used as video cutter to slice video clips into sequences.

Another technique that used to overcome the bandwidth limitation is compressing the SMIL file itself by using WinZIP compression [17].

# 6 Conclusion

In this paper, an overview of the Avicenna project has been introduced. About sixteen partners have participated in the award celebration that has been held in Paris 2006. In this celebration, Quds Open University (QoU) had an Award for its outstanding contributions and its high quality e-courses that have been deployed into Avicenna Virtual University.

The criteria that have been chosen based on the variety of multimedia, homogeneity, reusability and standardization of the deployed courses. A Pedagogical standard was setup via collaborations between partners to guide the production process. While production, researchers have learned much in developing standard pedagogies for online courses.
For standardization, researchers have suggested SCORM as a standard for structuring the teaching materials, related technical issues have been elaborated at certain length, the main objective is to introduce guidelines to partners the know-how of publishing online courses into Avicenna virtual campus.
This paper presented some lessons learned from this project. First: a project manager of the e-learning project should have sufficient skills to manage the diversity nature of the e-learning development team. Second: developing e-learning project is expensive. A formula should be proposed to estimate the accurate cost of the project. Third: there is a bandwidth limitation that creates a tradeoff between download speed and effective e-learning. It is recommended to use RM with compression schemes suggested in SCORM to resolve the issue of bandwidth. The quality of the developed courses depends on the standard technology used in addition to the efforts (manpower) made by the author(s). Authors need to stick to some production standards including international standards such as SCORM with a certain margin of expandability.
However, recently most of authoring tools are able to export content packages as “SCORM compliant”. Authors can accomplish this feature by selecting a checkbox in the export menu. Consequently, the tool creates the sharable content objects as html files, and generates the related and dependent files (images, multimedia and SMIL files). All information will be stored in an XML file.
In Avicenna project, there are some open issues that must be handled such as copyright terms and agreements of learning objects.

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