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# E-Learning technology standard promotion activities in Japan<sup>\*</sup>

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**Abstract:** Open technology and open standards play important roles in the progress of e-Learning. Japanese e-Learning industry, being aware of this importance, has paid a lot of attention and made various efforts to disseminate open technology and open standards in e-Learning. Among these efforts, e-Learning Consortium Japan, a group of Japanese e-Learning providers and user institutes, has implemented and operated several programs to facilitate e-Learning technology standards promotion in terms of technical resource development and engineers' skill development. This paper describes such programs including development of software modules for SCORM implementation and SCORM engineer certification program.

**Key words:** open technology; e-Learning standards; SCORM; e-Learning consortium Japan

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## 日本对数字化学习技术标准的推动

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**摘要:** 日本数字化学习行业认识到开放技术和开放标准的重要性,因此一直在努力推广它们;由供应商和用户机构联合成立的“日本数字化学习联盟”(e-Learning Consortium Japan)已经实施了一些项目,以推动数字化学习技术与开发的标准化工作.本文主要介绍,该联盟为实现“内容共享对象参考模型”(Sharable Content Object Reference Model, SCORM)标准方案而开展的软件模块开发项目和 SCORM 工程师认证项目.

**关键词:** 开放技术; 数字化学习标准; SCORM; 日本数字化学习联盟

## 0 Introduction

Technology standardization has had a significant impact on industry. This impact has

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resulted in the particularly rapid growth of the information and communication technology (ICT) industry over the past 50 years. A system consisting of modules connected by standardized interfaces can be quickly improved in terms of performance and functionality because the modules can be enhanced independently without losing system consistency. Moreover, open standards facilitate market entry by module providers because they can develop product modules without the need for detailed knowledge of the whole system—they simply need knowledge of the standardized interface. This promotes competition among vendors, pushing them to pursue innovations leading to higher performance, more cost effective products.

Since e-Learning has inherited the characteristics of ICT, technology standardizations have had the same impact on the growth of e-Learning. This has been well recognized since the early stages of the development of e-Learning. Several organizations concerned with e-Learning standards, including the AICC, IMS, ADL, IEEE LTSC, and ISO/IEC JTC1 SC 36, were established from 1998 to 2000 (Nakabayashi, 2009).

Considerable efforts synchronized with these activities have been made in Japan to promote e-Learning standards and open source software, as exemplified by the development and promotion of the Sharable Content Object Reference Model (SCORM) (Advanced Distributed Learning 2006) introduced by the government and corporate sector in 2000. Mutual benefits to stakeholders, including system vendors and customers, have been emphasized through these practices as being the most important factor in the promotion of e-Learning standards.

This paper describes Japanese activities to promote the SCORM specifications in terms of support for system development and engineer skill development programs. It also discusses the key factors for the successful promotion of standards.

## 1 System module development for SCORM

The importance of e-Learning standards in Japan has been recognized from the early stages in the adoption of e-Learning. Considerable efforts have been made by the government and corporate sector since 2000 to promote e-Learning standards, especially SCORM. This section describes the activities concerning system module development such as the SCORM RTE module, the SCORM 2004 sequencing engine. Several system modules have been developed based on the SCORM 1.2 and SCORM 2004 specifications. Most of them are available as open source software. They were developed to minimize system development costs and interoperability problems by providing well-tested reference modules that can be integrated into commercial systems. Some of these developments are described in the following subsections.

### 1.1 Interface modules for SCORM 1.2

Several interface modules were developed in 2001 to support implementation of a learning management system (LMS), authoring tool, and content compliant with both SCORM 1.2 and the AICC (Aviation Industry CBT Committee) CMI (Computer Managed

Instruction) specifications. One of them is a course-structure-handling module intended for integration into a courseware-authoring tool. This module can work with both manifest files for SCORM and CSF files for AICC CMI. A pair of modules, one for servers and another for browsers, has been developed to implement the API adapter of a SCORM-compliant LMS. The HACP protocol has been used for communication between the server-side and browser-side modules so that they can handle AICC CMI specifications as well. Another module has been provided to help content developers implement sharable content objects (SCOs) containing typical test questions.

### 1.2 SCORM 2004 sequencing engine

Development of a sequencing engine was started in 2002 on the basis of an early version of the IMS simple sequencing specifications and the SCORM 1.3 specifications. The latest version of the sequencing engine was designed on the basis of SCORM 2004 2nd Edition (Nakabayashi, et al, 2006).

The sequencing engine consists of three functional modules. The sequencing module, the primary part of the sequencing engine, implements the SCORM 2004 sequencing specifications, which are implemented as a Java class. The run-time environment (RTE) module and application programming interface (API) module together implement the SCORM 2004 RTE and navigation specifications. The RTE module is on the server, and the API module is on the browser. They communicate using HTTP. The API module provides the API adapter functionality defined in the SCORM RTE specifications. The API module is invoked every time an SCO is launched, and it communicates with the RTE module during SCO execution. The RTE module is implemented as a Java object that is instantiated for each leaf activity. The RTE module object updates and stores runtime data elements exchanged with the associated SCO.

The sequencing engine has several utility functions. One is a sequencing trace log recording function that helps content developers debug course content with complicated sequencing rules. Another function is a GUI customization function that enables LMS and content vendors to customize the GUI of the sequencing engine by simply modifying an external definition file.

The sequencing engine has been open to the public as open source software since 2004, and more than 1 500 copies have been distributed. The engine is used in several commercial LMS and e-Learning services.

### 1.3 Extensible learner adaptive architecture

One of the big problem of traditional learner adaptive system including SCORM 2004 is the lack of extensibility. Most existing learner-adaptive systems have usually been designed to implement a certain single learner-adaptive strategy without any consideration being given to support multiple learner-adaptive strategies or even to extend a single implemented strategy. Without such a framework for extending functions, it would be difficult to add new functions that could improve the effectiveness of learning. This is because new-

ly added functions may conflict with those towards executing existing learning content by leading to a damage of the reliable behavior of this content. In addition, it would take too long for standardization organizations to authorize extensions of functions to existing standard specifications. It is thus very difficult to achieve both content-system interoperability and system-function extensibility in conventional learner-adaptive systems.

To overcome this problem, new learning-system architecture has been proposed aiming at achieving the goals of both extending learner-adaptive functions and making learning content interoperable (Nakabayashi, et al, 2010). To achieve this goal, the proposed architecture introduces the concept of a “courseware object”, which is a program module that is used to implement various educational functionalities. This architecture allows for the incremental extensions of functions by adding new courseware objects. Since the existing functions are not affected, this ensures that existing content will always work properly.

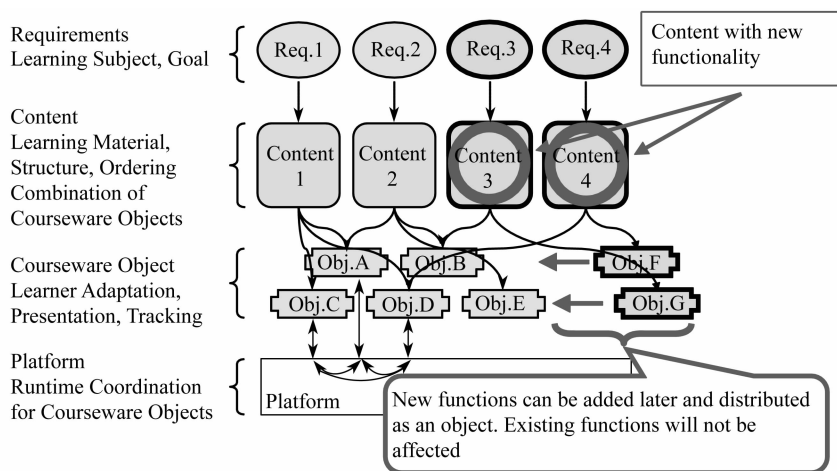


Fig. 1 Configuration of the extensible learner-adaptive system using courseware object

As shown in Fig. 1, in the proposed architecture, the courseware object is clearly separated from the platform. It is possible to incrementally extend functions with this configuration by adding new courseware objects. Since this addition does not affect functions previously implemented with existing courseware objects, existing content always works properly. Moreover, courseware objects can be distributed with content, thus enabling existing platforms to be immediately updated for newly developed functionalities. This eliminates the long time lags that result from conducting standard authorization processes and installing platform updates.

The trial implementation showed that several learner-adaptive functionalities including the full functionality of SCORM 2004 specifications and their extensions can be successfully implemented on the proposed architecture.

## 2 SCORM engineer program

Conformance programs dealing with learning management systems and content have

been conducted since 2003 in Japan. After each conformance test, there are periodic follow-up activities in which LMS vendors and content vendors get together to check whether their products work together. This promotes the sharing of experiences with and knowledge of interoperability issues in the e-Learning community.

A unique program for engineers' skill development is the SCORM engineer certification program, which is the former the SCORM assessor program started as a conformance activity. The original motivation for this program was to improve the technical skills of content developers. These developers come from various fields such as multimedia design and instructional design, so they are not necessarily sufficiently skilled to deal with interoperability issues related to the SCORM specifications. Thus, in this program, skilled SCORM engineers, rather than products, are certified. As certified assessors, they can conduct the SCORM 1.2 content conformance test. The candidates attend a two-day lecture and go through the certification test. In 2010, the program was updated as SCORM engineer certification program which not only deals with skills necessary for SCORM 1.2 but also SCORM 2004. When the program started in 2004, there were 16 certified engineers, and currently it is 109 as of August 2011. Tab. 1 indicates the engineer skill set for certification.

Tab. 1 Skills set for SCORM engineer certification

Knowledge about assessor program	Knowledge about SCORM application
Program purpose	Content development
Assessor responsibilities and authority	Content test
Content conformance procedure	Typical interoperability issues and solutions
Content registration procedure	
Interoperability problem management	
Assessor community purpose	
Knowledge about SCORM specifications	Knowledge about related fields
General	Industrial product standardization
Content aggregation	e-learning product standardization
Run-time environment	Internet communication protocols
Sequencing	Client-side programming
Navigation	Basic computer knowledge
Conformance requirements	Server-side programming

Tab. 2~4 indicate some questionnaire survey results conducted in year 2011 to investigate the SCORM promotion status. Tab. 2 indicates that 80% of the SCORM users are using or considering using SCORM 2004. Tab. 3 indicates that SCORM users are using SCORM not only for ready-made content for which interoperability is essential, but also order-made and in-house content. Some of the users answers that "we created more than 1,000 content in the past", or "we are creating more than 100 content per year". These results seem to indicate that SCORM is employed not only for ready-made content distribution but to standardize content design and authoring process. Tab. 4 indicates that most of the users implement their content on multiple-types of LMSs. Some uses more than 10 types of LMS. This shows that they fully exploit the advantage of content-LMS interoper-

ability established by SCORM.

Tab. 2 Version of SCORM specification being used ( $n = 45$ )

SCORM 1.2 only	9	(20%)
Currently SCORM 1.2, SCORM 2004 in the future	18	(40%)
Both SCORM 1.2 and 2004	16	(36%)
SCORM 2004 only	2	(4%)

Tab. 3 Number of developed content by content type ( $n = 45$ )

# of developed content Type	0	1~5	6~10	11~20	21~50	51~	N. A.
Ready-made	14	2	4	0	5	12	8
Order-made	7	3	3	4	6	14	8
In-house	14	7	3	1	4	9	7

Tab. 4 Number of LMS used ( $n = 45$ )

1	2~3	4~5	6~9	10~	N. A.
17	17	5	2	2	2

### 3 Conclusion

This paper described several activities to promote e-Learning standards especially SCORM specification in Japan. These activities include software module development to support implementation of SCORM 1.2 and SCORM 2004 compliant system as well as extensible learner adaptive architecture aiming to establish both interoperability and function extensibility. Another activity is related to the engineers' technical skill development. The number of certified engineers has increased more than 100 in the last seven years. This wide acceptance of the program is not only because of the technical reasons—content developers holding certification can achieve the respect of customers as trustworthy engineers. This mechanism benefits engineers, their companies, and their customers. Thus promotion of standards should be conducted not only from technical view point but various stakeholders view point.

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