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# Personalized Interactive e-Learning System using Expanded SCORM

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**Abstract:** In this paper, we propose an e-Learning system that can accomplish the following two goals; personalization and interactivity. First of all, the system support personalized learning environment and allows learners to participate in their learning. This system can register and inquire for courses using personalized function and provide statistics on progress rate, by contents and learning type. Useful statistics and link registration can be retrieved in real time. Second, the system implements real-time interactive video contents that are usable both teachers-learners and learners-learners in video lectures. These new bidirectional learning components are suitable for maximizing the learning effects. These interactive video contents are compatible with standard web-based learning system and maintain the information consistency. We accomplished this by expanding the standard for the sharable content object reference model (SCORM) currently used in building the learning management system (LMS) and the learning content management system (LCMS). This new components can be easily fit into the existing system. Moreover in video-lectures, this system can attach various functions in real-time that learners can make a true interactive learning environment.

**Keywords:** SCORM, Personalized Learning, Interactive Learning, Real-time Contents, LMS/LCMS

## 1 Introduction

The enormous advantages of e-Learning encompass the low expenses and the availability of education to everybody, regardless of time and place. The current e-Learning integrates various information technologies such as computer graphics, virtual reality, network, game, vision, and mobility with learning systems [1,2]. Learners, contents, and platforms are the three components of e-Learning which is used for self-development, human resource development (HRD), and lifelong education.

The introduction of Web 2.0 has brought many changes to the e-Learning environment [3,4]. The concepts of Web 2.0 cover the expansion of a social networking service (SNS) and the use of blogs or podcasts in the field of education [1]. These trends require e-Learning environment based on a user-centered learning management system (LMS) and learning contents management system (LCMS). The new e-Learning concept is more cooperative than the existing e-Learning; it allows learners to participate in during learning period. In this way, e-Learning 2.0 equipped with the function of SNS is spreading steadily in the existing e-Learning environment. This trend also diversifies the contents of e-Learning and makes it possible to personalized contents.

Some of the new trends expected in e-Learning are social learning, rapid learning, and mobile learning [1]. Analyzed through such changes and forecast of the e-Learning paradigm, the existing passive learning environment based on videos and flashes is very inadequate for supporting real-time interaction. Changes in the e-Learning paradigm suggest the necessity to develop technologies for real-time and high interactivity that enhance the learners satisfaction and maximize the efficiency of learning at the same time. This requires an existing video-based environment which only provides the unidirectional education to be evolved into a real-time interactive bidirectional learning environment. In other

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words, a personalized learning environment and a direct interactivity between teacher-learner are important learning components in these new trends.

Another new trend for this e-Learning is changing from passive learning to active learning through users participation, sharing, and social networking [5,6]. With the emergence of the new trend of education environment, e-Learning has caught the attention of people around the world. It is spotlighted as a new knowledge industry, as it is expected to make substantial achievements in HRD. At present, numerous investments and efforts are being made in the development of e-Learning technologies, and many studies are being conducted on new technologies for the next generation of e-Learning [6].

**Table 1.** Representative e-Learning 2.0 services. In international e-Learning markets, new online services are spreading rapidly because they pursue sharing and openness rather than monopoly[1].

| Service | Contents |
|---|---|
| elgg | "*http://elgg.org/*" is an open source system that provides personal blogs, file storages, RSS readers, etc. |
| edublogs | "*http://edublogs.org/*" is a blog-based e-Learning service that provides functions such as automatic storage, automatic spelling check, and convenient upload of files and images. |
| DIGIfication | "*http://www.digication.com/*" is an online classroom service through which students submit assignments online and teachers manage students. |
| Wikispaces | "*http://www.wikispaces.com/*" is a Wiki-based e-Learning service that is easy to edit and update and allows free exchange of opinions. |
| ChinesePod | "*http://chinesepod.com/*" is a Chinese language learning site using podcasting, RSS and blogs, through which learners can participate in discussions and have bidirectional learning and multimedia learning. |
| | "*http://www.dickinson.edu/*" forms language learning communities so that language learners find native speaker partners in overseas and practice conversations through Skype. |

In order to overcome the existing passive environment of e-Learning 1.0 in response to trends in the age of e-Learning 2.0, we propose the base of learning environment suitable for e-Learning 2.0 that has emerged from Web 2.0. In this paper, we develop an e-Learning system that can accommodate the following two goals; personalization and interactivity.

First, we design the LMS Web site that supports personalized learning environment and allows learners to direct their learning in Chapter2. This LMS can register and inquire for courses (using a personalized function), and provide statistics on progress rate by contents and by learning type. Useful statistics and link registration can be retrieved in real time. We accomplished this by expanding the sharable content object reference model (SCORM) standard which is currently used in building LMS/LCMS [7,8,9]. We will discuss continuously about expanding the SCORM standard in Chapter3.

Second, in Chapter4, we implement real-time interactive video contents that are usable for both teachers-learners and learners-learners in video lectures. These new bidirectional learning components maximize the learning effects. These interactive video contents are compatible with the standard LMS Web site and maintain the information equally. These new components can easily fit into the existing system. Moreover, in video-lectures, this system can attach the various functions required for learners to make use of interactive learning environment in real-time.

## 2 Personalized e-Learning System

For the most of existing video-based an e-Learning systems, it is hard to measure the learners progress accurately. Moreover, real time is insufficient in contents operation, and there is a limitation in providing interactive components in contents. Although, there are also problems in the volume or availability of video contents, these shortcomings impair the functions or effects of e-Learning. Therefore, the operation of video contents can restrict the operation of learning courses [9].

In order to overcome these e-Learning limitations, this chapter proposes a personalized e-Learning system to respond to the users need. Personal e-Learning environments are well adapted to the life-long learning needs of our current IT-based society. They provide the required flexibility that each user wants, especially as users adapt tools to a particular context [6]. Therefore, we design and expand a standard based on SCORM so that new bidirectional components can be added to existing video lecture systems. In addition, we implement LMS/LCMS that maximizes the effect of learning through supporting real-time interactive video contents.

### *2.1 System Flow Diagram*

The flow diagram for proposed method is described in "Figure 1". The Web page and learning window (video contents) of LMS/LCMS are built on the Internet and flash video (FLEX) installable to all users (e.g., teachers, learners, and administrators), for the efficient expression of e-Learning 2.0 functions. This system is implemented using the expanded SCORM standard so that a running video content may be interlocked with LMS/LCMS and executed with the required actions.

Lastly, learning components with various functions are implemented for real-time interaction during a video lecture. Consequently, video contents can be organized, as shown in "Figure 1". As video contents such as real-time chatting and discussion, Q&A and bulletin board are implemented based on the expanded standard. Users can gain new learning effects by clicking the desired icons in the interactive learning environment. This system enriches the traditional learning environments by providing the nature of learning contents for each learner.

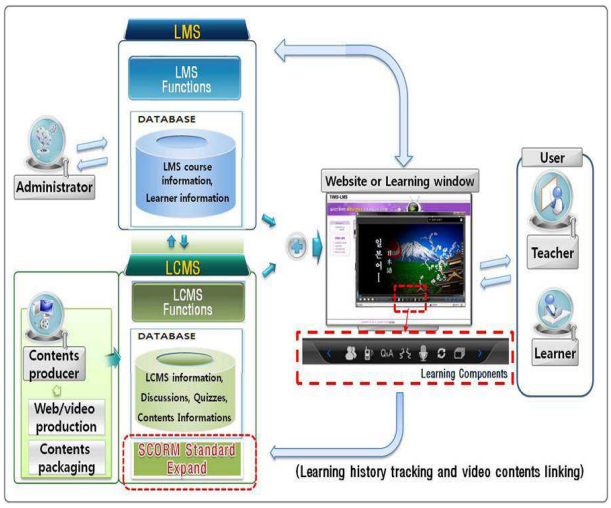


**Fig. 1:** Personalized interactive e-Learning environment in real time.

## *2.2 Standard for Linking Web Services*

Basically, LMS/LCMS is serviced based on the Web [10]. For the personalized e-Learning environment, the link Web service should be modified accordingly. For this reason, we design a new standard for linking Web services, as shown in ”Figure 2”. When a user logs in the LMS-based Web site and calls the learning window, information on the learner and the learners learning history in LMS should be connected to and should communicate with contents information in the LCMS. Moreover, the XML schema should be designed so that when the learning window (video lecture) is executed, it is connected to tasks such as discussion, quiz, and learning history tracking that appear between LMS/LCMS and videos.

We define standard information for linking between course information in LMS, and course and learner information in LCMS. The standard shows the information necessary for linking, related to the LMS course, learner, bulletin board, and discussion in order to support real-time interaction when the video player imports contents.

## *2.3 Designing Personalization Module*

For the personalized an e-Learning system, we design standards for learning history and progress rate by measuring modules, as shown in ”Figure 3”. The existing LMS measures the learners progress rate using only the learning hours. In order to overcome the shortcoming, we design new logic that calculates the learners participation rate based on the proposed designs and calculate the progress rate by tracking learning history using actual learning hours. The progress rate that measures process involves actual learning hours, participation in quizzes, and participation in supplementary learning. In addition, the rate can be changed by contents producers. With this, we define a database structure that allows the efficient management of learning history, and design the XML schema for communication between LCMS and learning history which is the learners response to video contents.

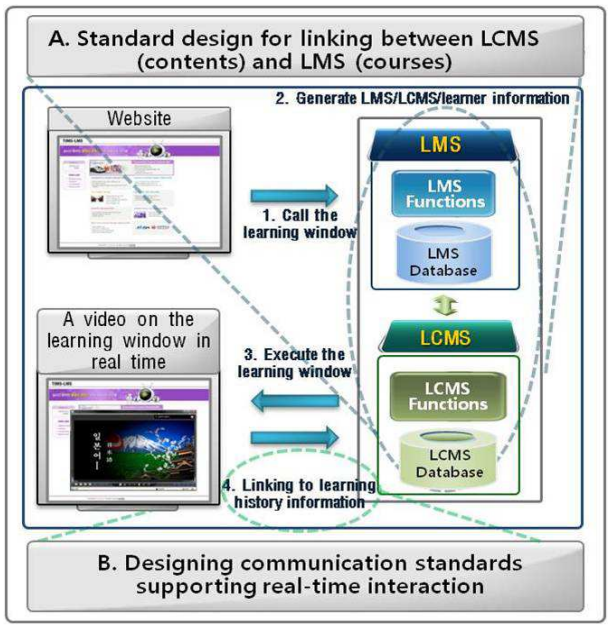


**Fig. 2:** Standardized idea architecture for Web service connection.

The standard database structure for managing learners learning history is designed for data connecting between LCMS and LMS courses, between learner information in LMS and LCMS, and between learning history and quizzes/ supplementary learning materials.

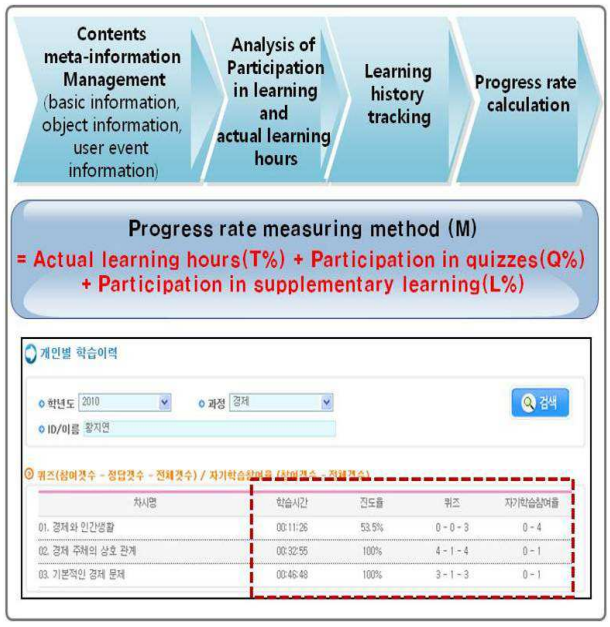


**Fig. 3:** Standardized idea architecture of learning record and progress measurement module.

## 3 LMS and LCMS using Expanded SCORM

In this chapter, we expand the SCORM to accomplish the newly proposed personalized learning environment for the user. In order to connect LCMS, which was developed based on the SCORM standard to real-time video contents, we design a new XML-type standard by expanding the existing SCORM standard, as shown in "Figure 4". Using the designed expanded XML schema, contents (lectures) developers produce contents. The produced contents are packed, parsed, and stored in the database. In this study, we define these processes and then expand the standard so that video contents can be connected to (communicate with) interactive components (e.g., chatting, discussion, quizzes, and learning materials) through LCMS.

The manifest XML defined in SCORM is described as four layers: metadata, organizations, resources, and sequencing. This study expands the metadata and organization tags into new structures in order to support the packaging of interactive video contents in real time [7, 11].

When the LCMS packages contents, it ports contents using the database (contents information) based on import modules (upload /unzip module, parsing module, and data process module). At that time, it builds the contents by packaging import modules through LCMS. Three import modules are packaging module, XML file parsing module, and database storage module.

The expanded SCORM shows the information defined for linking LCMS to interactive learning components (e.g., discussion, quizzes, and supplementary learning materials) in video contents running online in real time.

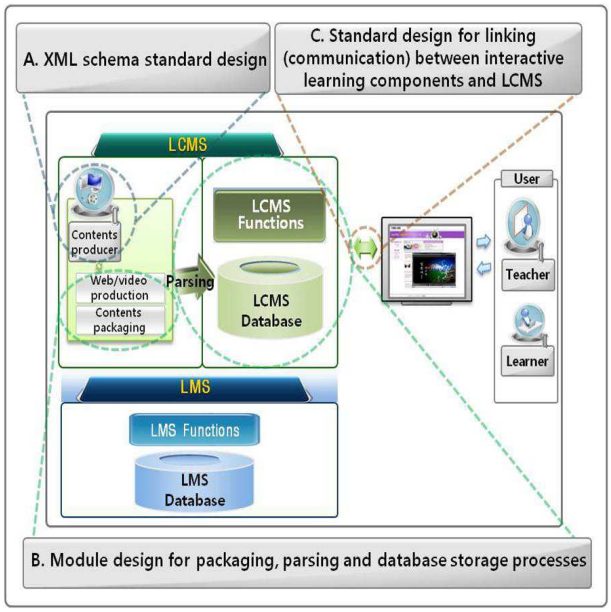


**Fig. 4:** XML standardized idea architecture based on expanded SCORM.

## 4 Real-time Interactive e-Learning System

### *4.1 System Structure and Implementation*

The proposed system accommodates real-time communication between users (e.g., teachers-learners, learners-learners) through chatting, replies, or bidirectional information exchange, and provides viewing information on all interactive components available. For this part, we propose a platform for video contents operation by implementing a contents linking system that overcomes the shortcomings and limitations of existing LMS/LCMS.

As shown in "Figure 5", bidirectional learning components (video contents) implemented through linking between LMS and LCMS support the learning environment that is personalized in the video learning window. This window provides various functions including progress rate management and learning event support; and enables interactive learning through real-time edition and distribution. Such a system environment maximizes the effect of learning, and may become a new technology of e-Learning 2.0 paradigm that efficiently expresses technological functions based on the expanded SCORM [9].

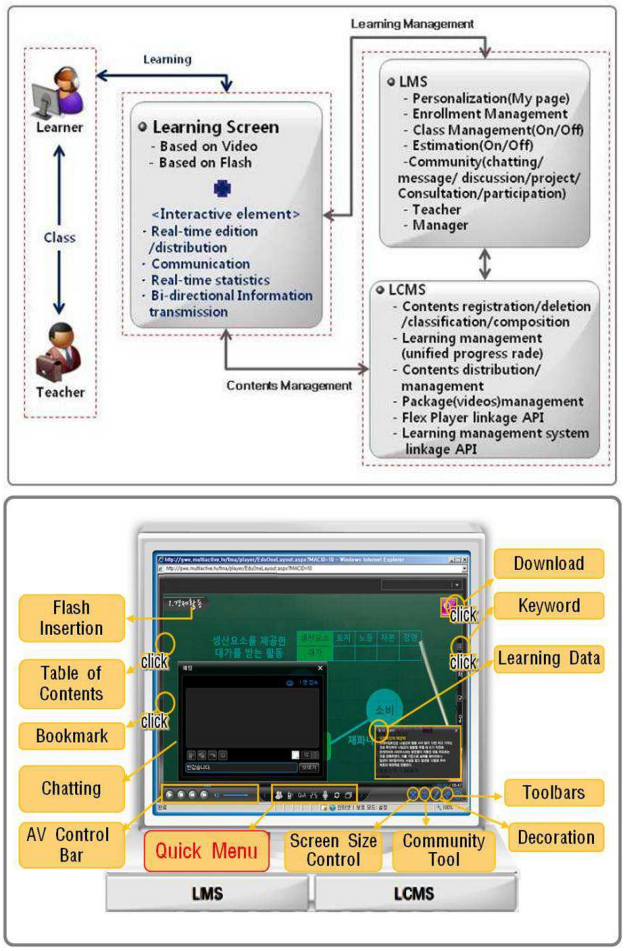


**Fig. 5:** Schematic diagram of system functions and video contents (interactive learning components).

The system was built by AJAX, which is Web 2.0 technology, based on aspect-oriented programming (AOP). The general architecture, which is independent from the platform, was built on J2EE and implemented so that all services can be provided through a Web browser; thus, learners can access all services at any time and in any place [9].

## *4.2 Various Real-Time Interactive Components*

### 4.2.1 Real-Time Edition and Distribution

This component allows real-time edition of contents and immediate sharing among all users using the editing function. This function provides video learning contents services based on Web 2.0, which can be edited and executed on the Web. Moreover, contents (texts, images, flashes, sounds, and videos) can be edited, added, deleted, or updated through online cooperation between teachers and learners, and contents can be tested and distributed freely (see "Figure 6").


**Fig. 6:** Real-time edition and distribution functions.

### 4.2.2 Communication

The communication component provides functions such as real-time chatting, replies, discussion, bidirectional information exchange (file transmission, see "Figure 7"), and Q&A. This function enables one-to-one communication with an online tutor. It provides a communication channel for conversation between a tutor and a learner who are connected, and they can use functions such as file transmission and walkie-talkie while talking through the screen. In addition, we can implement a real-time function (see "Figure 7") in which a tutor can immediately send a message or a material to multiple learners attending the class.


**Fig. 7:** Communication function (file transmission).

### 4.2.3 Real-Time Statistics

This component provides a real-time view of useful statistics on videos such as view, edition, recommendation, and link registration. These functions also provide useful statistics to users by analyzing the learners participation in various interactive components that are included in learning contents and participation in quizzes and discussions. Such statistics can be used to correct inadequacies in existing video contents and manage the learners progress rate and actual learning hours (see "Figure 8").

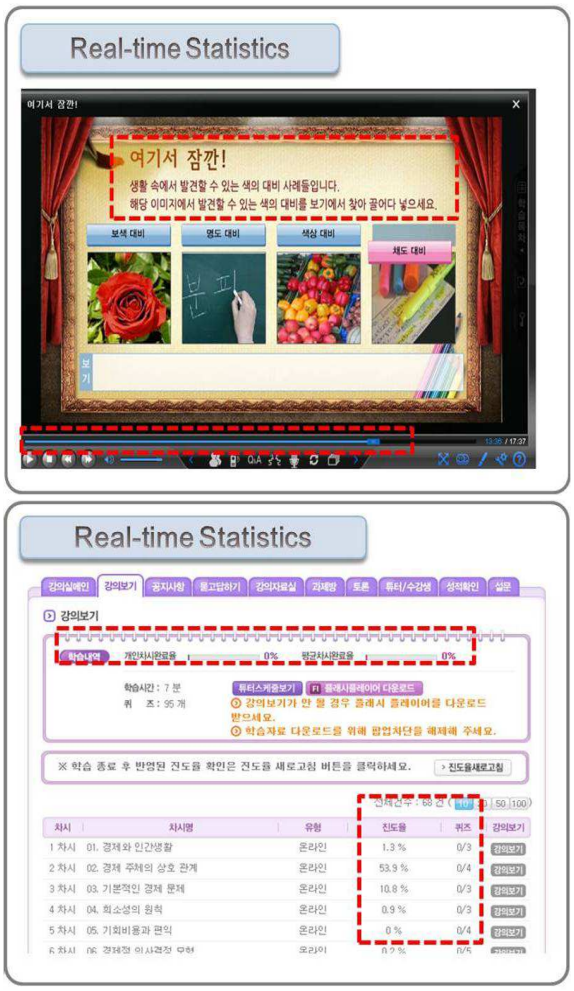


**Fig. 8:** Real-time statistics function.

## 5 Conclusion

We proposed an e-Learning system that accomplished the following two goals; personalization and interactivity. Changes in the e-Learning market triggered by the emergence of Web 2.0 have a very important meaning as learners participation began to be recognized as a new factor of competition [1]. In e-Learning 2.0 as well, learner-centered interactive components are being spotlighted.

With this background, this study expanded the existing SCORM standard model to be ready for the real-time learning environment [7]. Such a video contents linking system provides a platform for video contents operation, and solves problems in the existing learning environment.

The learning events of various functions, which are designed based on the expanded SCORM standard allow users to monitor the learners state of learning and progress rate, hence provide various types of personalized information. Furthermore, by using real-time edition and distribution functions for editing contents and sharing them among all users in real time, users can create user-centered e-Learning 2.0 environment. This way, collaborative real-time LMS/LCMS as a contents linking system can enhance the efficiency and effectiveness of learning and can be utilized as a learner-centered and customized learning environment.

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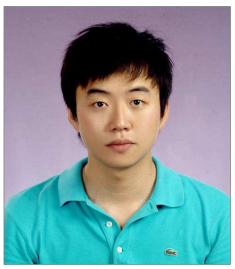

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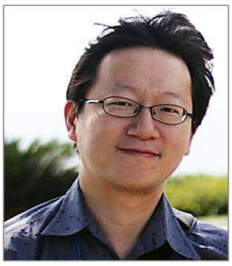

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