

Design and Implementation of OSMD based Learning Management System for Mobile Learning

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Abstract

As the use of mobile devices expands, a Learning Management System for mobile learning has become necessary. However, as various mobile devices are available and due to the fact that the existing Learning Management Systems have to be utilized, it is not an easy task to design and develop a Mobile Learning Management system for Mobile Learning that can be used in a wide range of devices. In this study, an OSMD-based LMS, utilizing an existing web-based LMS, has been designed and developed that can provide educational services to users with various devices. Through this, user accessibility and utilization of various devices have been improved and also LMS-development cost has been reduced. Through this study, it is expected that an implication is offered to the OSMD-based LMS development for mobile learning that can support various devices.

Keywords: E-Learning, LMS, Mobile Learning, OSMD

1. Introduction

The development of information and communication technology provides not only teaching-learning methodologies but also various learning opportunities to learners. E-learning, which has its root in PCs, has become diversified due to the use of mobile devices such as smartphones.

A Learning Management System (hereinafter LMS), a system that manages learners and delivers content in Internet-based learning, is a system that manages overall activities of learning to improve the capabilities of learners¹. A LMS provides required information to learners, and learning processes and their results and also performs functions of providing convenient registration of courses of contents learners want and access to the content². Thus, as learning is achieved online through LMS,

sufficient support to LMS is essential to improve learning effectiveness³⁻⁶.

In case of Korea, the supply of LMS for e-learning started in the 1990s with universities, corporation and public institutions. Schools started to use LMSs as support tools for lessons and are now being widely used as various services for learners. Early forms of LMS were used as ICT professors-learning tools, using PCs, but currently, their application ranges has widened to cover course-work, credit transfer, certification, and lifelong education. Especially, as information devices which can be used in mobile environment, such as smartphones, etc., have become generalized, they are being developed to be used in mobile devices.

In 2008, the total Korean mobile handset market was 1.2 billion including about 150 million smartphones. At this rate, it is expected that the smartphone market

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will grow to about 3.7 units, about 150% growth, in 2014. Therefore, LMS studies linking mobile devices are required^{7,8}.

In Korea, the new term called “smart learning” is being used to shift the education paradigm to the one based on mobile devices such as Smartphones. Smart Learning can be defined as “mobile digital devices based learning that facilitates information searching and sharing using the Internet and utilization of various application software programs.” From teaching-learning perspective, Smart Learning can be defined as “learner-centered intelligence-customized learning that accepts nomadicity of instructors or learners and allows real-time interactions⁷.

To support smart learning, LMS for mobile learning have to be designed and developed. However, it is not an easy task to provide a LMS that supports various devices learners carry, as various types of devices, OSs, browsers, screen resolutions and sizes are available. In addition, from learners’ points of view, there are instances where it is impossible to learn through devices they have as amounts of information provided by PC-based LMS and mobile device-based LMS are different and differences in UI/UX would also cause inconvenience to learners.

In this paper, One Source Multi Devices(hereinafter OSMD)-based LMS that uses an existing web-based LMS and facilitates learning with various mobiles devices regardless of their characteristics, OSs, web browsers, and screen resolutions is designed and realized. Through this, learners will have opportunities to learn using various information devices they have and schools and educational service providing institutions will be able to provide various educational services.

2. Related Studies

A LMS performs functions of managing learners’ data, providing necessary information and delivering feedback during the learning implementation process of integrated learning online, e-learning^{9,10}. In general, LMS’s functions are divided into three groups, learners, instructors, and administrators, and designed. The suggested functions of these three groups according to characteristics of teaching-learning activities are as follows: Learner’s functions are, in general, functions related to learning activities of learners, interaction functions (email, bulletin board, etc.). Instructor’s functions are teaching support (evaluation, progress check, etc.) functions, interaction functions.

Administrator’s functions are providing and managing contents, information management, statistics, etc^{11–16}.

Studies on LMS being conducted are on methods for increasing convenience such as the learning effectiveness of learners and access to contents, etc., and methods for improving the effective e-learning resources management, etc. In other words, they are about how to design LMS that can achieve effective teaching-learning activities through e-learning and how to improve the quality of management operation through improvements of existing systems. On the area of learning efficiency, the functions on interactions between learners, instructors, learning contents are being emphasized. This is because, individualized learning customized to meet the learner’s characteristics through unlimited interactions between learner and instructor, in addition to learning activities taking place in classroom environment, is possible¹⁷. It has also been suggested by some studies that the more interactions there are through LMS, the higher the learning effectiveness and satisfaction that can be achieved^{18,19}.

On the area of improving the quality of e-learning, there are designing of functions required to manage LMS and applications to new IT environments (e.g. ubiquitous, smart devices, etc.), both about ways to improve the overall quality of e-learning through the use of LMS^{20–24}.

With wide spread of information devices which can be carried by users, mobile learning, when compared to PC-based e-learning, delivers more convenience and higher accessibility. That is, mobile learning, a form of e-learning, refers to learning through a device that is not restricted to locations and movements²⁵. Major mobile devices, operable while being physically moved, are smartphones, smart pads, feature phones, iPod, PDAs, PMPs, MP3 players, etc.

Mobile learning is evolving and transforming the traditional educational way. It introduces a new learning environment due to the emergence of mobile and wireless technologies. It offers a new approach to delivering learning objects into users’ daily lives, although most of the traditional and currently available e-learning system contents are not suitable for m-learning and mobile devices, so new interactive and dynamic content must be produced²⁶.

In other studies on the effectiveness of mobile learning, they pointed out its ability to help learners acquire knowledge regardless of time and place and presented various possibilities to enhance its effectiveness and satisfaction through the use of various features mobile devices have.

For example, through presentation of mobile learning contents, some studies concluded that learning satisfaction and academic achievement levels can be raised^{27,28}. In another study, it was revealed that the awareness of academic use of learners' mobile devices and the collective self-esteem have statistically significant effect on the collaborative-learning attitude²⁹.

However, despite the varied possibilities of mobile learning, presented by the related studies, the important limitation of mobile learning is that it is limited by the hardware and software of the mobile devices. For example, technical considerations for successful mobile learning are safety, security, implementation costs, etc.³⁰.

The results of analysis of preceding studies show that in e-learning, LMS is one of the factors determining the quality of e-learning and users' convenience and accessibility and efficient management of educational resources, effective teaching-learning activities support are all important factors. In particular, from users' convenience and accessibility perspectives, it is deemed that expanding access opportunities for users through support of various devices users have is necessary. In addition, from the perspective of managing e-learning services, it is deemed that economic aspect consideration is necessary.

3. Designing and Implementation

3.1 Designing

The development of the OSMD-based LMS focused on the improvement of effectiveness and accessibility and economic cost savings.

First, improving effectiveness and accessibility. It was designed to support various information devices users (Learners, Instructors, and Administrators) have and provide environment where learning is possible even when the Internet is not available. It is designed to make instructor-learner and learner-learner interactions and learning encouragement anytime and anywhere possible. Also, it was designed to provide a mobile environment in which all the information provided in the web-based LMS is available.

Second, reducing costs. Costs of new development was reduced through the use of an existing web-based LMS. In addition, it was designed to provide convenient and efficient maintenance through support of various information devices with one LMS.

The aim of the OSMD-based LMS is to create a base where users can learn wherever they happen to be with no

restriction on devices, PC, smart devices, etc. and maintain the system with ease. Using a LMS that facilitates learning only in limited places and using an Internet-connect PC, "Main Page" and "My Lecture Page" services was made available in PC and mobile-environment bases. In addition, to improve the user accessibility, "GATE APP" was created and distributed. As users only have to click "GATE APP" once on their mobile devices to access the OSMD-based LMS, the user inconvenience of having to enter the URL themselves has been eliminated. In addition, "GATE APP" provides expandability to interoperate with applications such as "Push Notice", "Certificate", etc. The OSMD-based LMS was developed, through web-standard-based coding, to access IE7.~11, Chrome, Safari, Firefox, etc., regardless of the users' web browser types and characteristics. It was designed, through responsive web design technology of HTML5, to recognize the resolutions of user's browsers and automatically change the screen to portrait and landscape modes and resize images. In addition, in designing the OSMD-based LMS, the use of images and flashes were minimized and a CSS-based design was realized. Through this, web accessibility, web standards, multi-language support functions were provided.

It was designed, through recognition of user devices, to use PC learning screens in PCs and mobile-dedicated learning screens in mobile devices. It was developed to send and receive teaching-learning activity information such as learning progress of each learner in PCs and mobile devices. In addition, to enable learning where an Internet connection is not available, it was designed to be able to download video contents and carry out with learning at a place where an Internet connection is not available, then once an Internet connection is available, the teaching-learning activity information can be stored in the server so the information can be updated. It was designed so all the functions of PC-based LMS can also be used in the mobile devices. The most typical functions by users are as follows:

Users are divided into learner, instructor, administrator, and super administrator groups. Once a super administrator opens, through processes of degree set up, curriculum set up, and contents registration, an online course, then learners, after course registration, can proceed with learning and assessment. Learning information and grades of learners are statistically summarized and provided to the instructor, operation administrator, and super administrator. Based on this information,

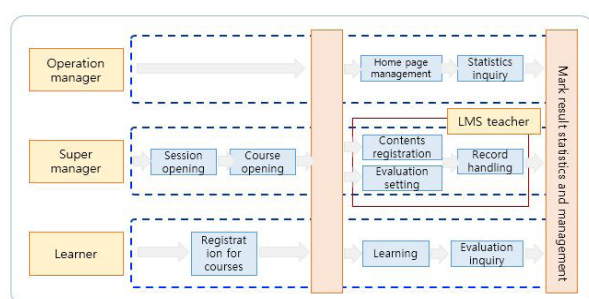


Figure 1. OSMD LMS basic operating flow.

activities such as learning encouragement, counseling and interaction are carried out.

User groups access the system through login authentication or SSO. Users can receive personalized services from the OSMD LMS through group's rights and personal information. The OSMD-based LMS supports learner function, instructor function, and operator/administrator function and supports systematic management of contents using LCMS, learning screen (PC, mobile) functions. In addition, it supports linking with the backbone system and 3rd party solution through API data communications. All these functions are managed through an integrated management system.

Main features for learners and instructors are divided into "My Page" and "Lecture Room". The "My Page" feature, applying to all learners and instructors, facilitates communications functions such as memo, and 1:1 counseling and also management of lecture-related information such as courses taken, course registration, grade-objection registration. Functions such as lecture information, courses taken, grading, course management, etc. are incorporated in the design of the "Lecture Room" feature for learners. Functions such as lecture information, courses progress, grading, lecture room management, etc. are

incorporated in the design of the "Lecture Room" feature for instructors.

Main features for administrators are basic information management, user management, curriculum management, lecture management, homepage management, etc. The basic information management function manages the basic data for the management of educational matters. The user management function manages learners and instructors using the LMS. The curriculum management function manages not only all the curriculums operated by the university but also activities taking place in each course. The course operation management function manages the evaluation of learners including course registration.

LMS, as learning, through web or mobile devices, which offer convenience to learners and an ability to carry out self-directed learning program, are being developed with emphasis on the learning abilities, learning activities, and learning delivery of learners. Recently, attention has been placed on the standardization and reusability of contents, and models integrated with LCMS (Learning Contents Management System) are being generalized. Therefore, an emphasis was made to reflect above in the design of the LMS.

3.2 LMS Realization and Application

An OSMD-based LMS that can be used in PCs and mobile devices has been realized. The resolution for PCs is 1366 * 768 and resolution for mobile devices is 2048 * 1536. Users access PCs and mobile devices using identical URL but PC and mobile device screen displays are different as shown in Figure 3. For mobile devices, the function that optimize the screen use by automatically switching, through pivot function of the screen, from portrait mode to landscape mode, and vice versa, was included also.

The OSMD-based LMS supports a function that can change the words and sentences on the screen into other languages to retain multi-language expandability. As shown in Figure 4, when the administrator enters a chosen language (words and sentences), the language of the screen automatically is changed.

In addition, the OSMD-based LMS automatically recognizes learner devices and provides a suitable learning screen.

The learning screen on PC provides WBT, authoring tools, videos, documents, URLs, Forums, Discussions, contents of test (quizzes), etc. The "Common Cartridge",

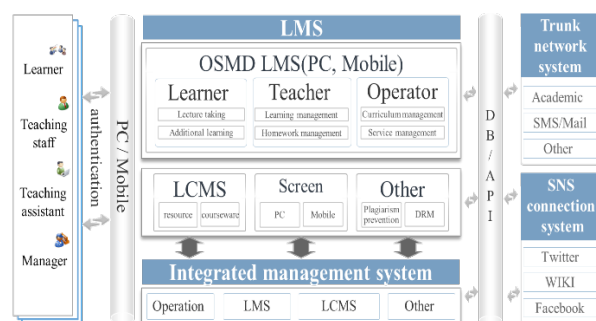


Figure 2. OSMD LMS configuration.



Figure 3. Main screen.

the standard for IMS GLC, "QTI" and "SCORM 2004" standards were incorporated into its development. The mobile device learning screen supports MP4-based video learning in the iOS, Android, and Window-based OS, and resolutions of Smartphones, Smart Pads. Main features of mobile device learning screen are progress management, bookmarks, A-B repeat, contents DRM, text-material view, chapter function, continued viewing, attachment function, and gesture volume control function.

Regardless of whether a user uses a PC or a mobile device, data related to teaching-learning activities, such as learning progress, etc., are synchronized through API data communications.

The OSMD-based LMS provides LCMS for efficient management of contents. Learning contents are divided into for web and mobile services, for web services, and for mobile services to be managed separately. This is to provide efficient management depending on the use of contents.

4. Findings

To measure the effects of the OSMD-based LMS, FGI (Focus Group Interview) was performed on all the system



Figure 5. Learning screen.

operations personnel. The operations personnel is divided into learning system, contents, user failure process and persons in charge of all disciplines were interviewed. The results of interviews revealed that the effects of the OSMD-based LMS are as follows:

- Cost reduction through the use of an existing system
- Increase in user satisfaction due to multi-device supports.
- Increase in work efficiency due to convenience arising from multi-device supports.
- Increase in external perception through establishment and utilization of Smart Campus.
- Following issues were pointed out as needing to be further supplemented.
- Not all OSMD-based LMS screens are optimized on Smart devices and poses UI/UX compatibility issues
- Decrease in efficiency of management arising from the fact that PC and mobile contents use different formats.
- Separate systems for supporting different mobile devices, such as mobile contents player, Wowza Media Server, etc., and their management are needed.

System operators indicated that the OSMD-based LMS was in general superior than existing LMS on areas such as user satisfaction, work efficiency, recognition of system. However, the following shortcomings need to be further supplemented: The OSMD-based LMS is not able to optimize all screens. The increased management demand due to increase in the mobile use of the system. Separate contents need to be developed and managed as the existing contents do not simultaneously support PC and Mobile devices.

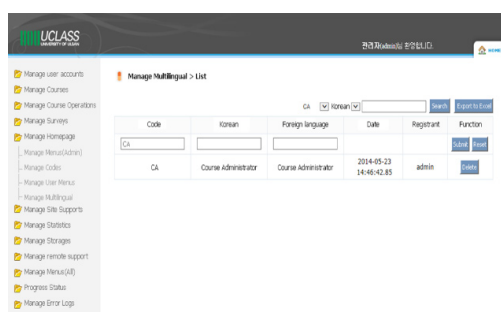


Figure 4. Multi-language set up feature.

5. Conclusion and Recommendations

It is expected that wide use of mobile devices, such as smartphones, will provide a variety of educational opportunities to learners and instructors. However, various devices such as iPhones, iPads, and Android smartphones could rather be hindrances when providing educational services. As learners and instructors wish to carry out teaching-learning activities using the devices they have, from the perspective of providing educational services, their needs have to be addressed.

The OSMD-based LMS developed in this study is able to handle various devices users have. As the system was designed to operate in mobile environments while taking full advantage of the existing web-based LMS, the user accessibility and economic feasibility were improved. The device utilization showed improvements: For system administrators, speed and convenience of management, and for users, accessibility of information.

When a new OSMD-based LMS is designed and developed in future, several issues that need to be considered are as follows:

First, mobile UI/UX should be taken into consideration during the initial design and development stages. In this study, OSMD-based LMS was materialized after establishing an existing web-based LMS and accordingly all subsequent screens are not optimized for the mobile LMS. If OSMD-based LMS was taken into consideration at the initial design stage of LMS, mobile UI/UX would have been reflected on all functions.

Second, optimized LMS functions in mobile environments have to be enhanced. The currently used LMSs for mobile learning have been realized after partially modifying existing web-based LMSs. The OSMD-based LMS developed in this study, despite its intent to realize optimized function, e-test function was excluded. To realize an e-test (online test) function on mobile devices is not yet possible because of contents distribution, cheating prevention, and network issues.

Third, the requirements of final end users, learners and instructors, should be sufficiently understood. Applying the methods that can improve the educational effects from the perspectives of the end users, learners and instructors, a more complete system will result.

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