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A Design and Development of the Learning Contents Management based on the Personalized Online Learning

Dae Hyun Lee[#1], Sae Hong Cho[#2], Yong Kim[*]

[#1] *Department of Knowledge Service & Consulting, Hansung University, Seoul, 02876, Korea*
E-mail : jt@jinotech.com

[#2] *Department of Computer engineering, Hansung University, Seoul, 03087, Korea*
E-mail : chosh@hansung.ac.kr

* *Department of e-learning, Graduate school, Korea National Open University, Seoul, 02876, Korea*
E-mail : dragonknou@knou.ac.kr

***Abstract*— Teaching-learning methods are undergoing rapid transformation in terms of new information and communication technology and in accordance with onset of the 4th Industrial Revolution. The educational environment is being transformed into various forms, with examples being found not only in the existing traditional educational environment, but also in online education and blended learning. Existing online learning (LMS, LCMS) is offered in a limited contents transmission online educational environment, and has been limited but the level of support offered to a learner's personalized learning. This study will overview existing flexible model of contents, suggest possible problems, and attempt to solve these problems. LCMS was designed and realized based on the open source Moodle platform, offering personalized contents to learners. LCMS is composed of the following 3 functions: contents registration of metadata inputted by administrator; search functionality for personalized learner contents; and personalized contents automatically being recommended to learners. As a result of the research, we made online learning environment that can provide customized learning recommendation and self - directed learning by increasing the continuity and efficiency of learning by automatically providing customized online contents to learners. Through this study, the learning of students promises to be effectively initiated by being based on available LCMS functions related to personalized educational contents in online education.**

***Keywords*— Moodle; LMS; LCMS; e-Learning; contents; recommendations.**

I. INTRODUCTION

In accordance with the development of information and communication technology, 21st Century society is being rapidly transformed, and based on this fact, education, society, and culture (among others) are similarly being rapidly transformed. Additionally, the usage of various information devices such as smartphones is accelerating transformations in the form of the educational environment and related contents.

Online learning methods in the field of education have the advantage of being able to be received whenever, wherever, and by whoever, in a self-directed manner across the globe [1] [2]. In addition to this, online learning processes have recently been rapidly increasing, and studies are taking place in order to increase the learner satisfaction and effectiveness levels or these online educational processes [3]. The results of recent studies suggest that online education supports the role of transmitting knowledge to the learner whilst preventing learner failure [4]. In accordance with the development of information and communication, and the online learning supported by online platforms, many studies are taking place to accommodate for this transformation in the educational environment. In order to overcome the limitations of existing online platforms, there is a necessity for the integration of new information and communication technology, and in order to reflect the transforming learning trends, there is also a necessity for considering the constant functional enhancement of the characteristics of user environments relating to online platforms [5][6]. In a recent online learning environment, technology is being used to encode useful information that can track and interpret all movements and clicks [7]. There is also a growing interest in open, interactive educational tools such as games [8].In existing online education, currently in-use contents take forms based on the designated curriculum, and transmit fragmentary contents offered by the teacher. These contents are being offered regardless of the learner's personalized learning correlation (such as their learning needs and interests). Additionally, in existing online education many

Adobe Flash contents which are currently in-use do not support various learning devices (in accordance with suspended technical support of manufacturers) [9]. Following this, many studies are taking place on learning contents management systems (hereafter referred to as LCMS) in order to offer OSMD (One Source Multi Devices) environment support and personalized learning [10].

In this study, the open source learning management system Moodle is used, and LCMS has been designed and realized in the online education environment to offer personalized video contents to learners. Through this, the best possible practices will be suggested based on the learning recommendations and self-directed learning of collective intelligence, which in turn is an expression of personalized contents being offered in accordance with learner interests.

II. Materials and Methods

A. A Study Related to e-Learning Standards

In order to procure contents compatibility, LCMS uses the SCORM (Shareable Contents Object Reference Model) standard. SCORM offers standardization standards which enable the sharing and re-usage of online contents and both the compatibility of LMS servers and interaction between online contents systems [11]. Additionally, in order to enable the searching of contents registration, management, and the contents themselves, LOM (Learning Object Metadata) suggests certain standards, while LCMS and the development of contents distribution standards are utilized [12]. For online education services in South Korea, SCORM is the recommended and required standard. If LCMS which has been designed based on SCORM standards is used, then when videos are being viewed, such functions as various learning events, states, progress rates can be measured, and various kinds of useful information can be offered to the learner [13]. The interaction and compatibility of LMS and contents is communicated through API, and the types of API are shown below in Table 1.

TABLE I
SCORM 2004 4th Edition API [14]

No.	Classification	Description
1	Initialize (“”)	bool – Begins a communication session with the LMS
2	Terminate (“”)	bool – Ends a communication session with the LMS
3	GetValue (element : CMI Element)	string – Retrieves a value from the LMS
4	SetValue (element : CMI Element, value : string)	string – Saves a value to the LMS
5	Commit(“”)	bool – Indicates to the LMS that all data should be persisted (not required)
6	GetLastError ( )	CMIErrorCode – Returns the error code that resulted from the last API call
7	GetErrorString (errorCode : CMI Error Code)	string – Returns a short string describing the specified error code
8	Get Diagnostic (errorCode : CMI Error Code)	string – Returns detailed information about the last error that occurred

As shown in <Table 1>, SCORM defines the API communications agreement with the LMS and contents agreement, and information defined by the CMI Data Model supported by SCORM is as follows: versions, comments, completions, credits, entries, exits, interactions, launches, learner information, locations, objectives information, progress, scores, session times, and requests (among others). However, the CMI Data Model is inadequate for supporting personalized learning for students.

In the Korean Education and Research Information Service (a national public organization), the KEM (Korea Educational Metadata) was introduced through national standardized education metadata formation studies, and achieved qualification as the Korea Industrial Standards [12]. KEM version 2.0 was aimed at elementary, middle, and high schools, and KEM version 3.0 is currently utilizing metadata from KEM high school education. KEM 3.0 is the standard for supporting metadata from high school education, and the standards of this metadata are shown below in Table 2.

TABLE II
KEM 3.0 Metadata Standards [15]

No.	Classification	Item Name
1	General	Identifier (Catalog, Entry), Title, Sub Title, Course Number, Language, Description, Table of Contents, Keyword, Coverage, Structure, Aggregation Level,
2	Life Cycle	Version, Status, Contribute (Role, Entity, Data)
3	Meta-Metadata	Identifier (Catalog, Entry), Contribute (Role, Entity, Data), Metadata Scheme, Language
4	Technical	Format, Size, Location, Requirement (Or Composite, Type, Name, Minimum Version, Maximum Version), Installation Remarks, Other Platform Requirement, Duration
5	Educational	Interactivity Type, Learning Resource Type, Interactivity Level, Semantic Density, Intended End User Role, Context, Typical Age Range, Difficulty, Typical Learning Time, Description, Language, Pedagogy (Teaching Method, Environment, Assessment
6	Rights	Cost, Copyright and Other Restrictions, Expiry Date, Description
7	Relation	Kind, Resource (Identifier, Catalog, Entry, Description)
8	Annotation	Entity, Date, Description
9	Classification	Purpose, Taxon Path (Source, Taxon, ID, Entry), Description, Keyword

Through the combination of several metadata elements and vocabulary comparison analysis, KEM is receiving international attention due to the creation of this metadata. However as is shown in <Table 2>, the scope of classifications and item names which have to be defined is too broad, and Flash-based formats are optimized for WBT (Web Based Training), so there is a necessity for further studies relating to online video contents based educational support.

Following the recent introduction of SCORM, studies have been taking place on the standards of Tincan, API, IMS, and Caliper in order to be able to offer personalized content for learners, however as the version is in its early stages, references are in a state of incompletion. An explanation of Tincan API, IMS, and Caliper is shown below in Table 3.

TABLE III
TINCAN API, IMS CALIPER STANDARD [16], [17]

No.	Classification	Item Name
1	Tincan API	Tin Can was created to allow you to track more information about the learning behaviour of users than was previously available
2	IMS Caliper	Caliper Analytics enables institutions to collect learning data from digital resources to better understand and visualize learning activity and product usage data, and present this information to students, instructors, and advisors in meaningful ways to help inform them

B. A Study Relating to the Open Source Learning Platform: Moodle

In the online environment, the functions of learning management platforms are important for the effective implementation of learning [5][6]. Moodle (short for Module object oriented developmental learning environment) is an open source LMS, and is the LMS platform which is based on constructivist learning theory, and is the most widely used LMS platform in the world [18]. The Moodle learning management system supports various educational engineering designs through course-wear design and a wide range of plugins [18]. However, the Moodle learning management system has no functions for contents registration or management, and only registers individual contents based on plugins and manages only simple click items. There is a necessity for separate LCMS for the support of the following items in Moodle: online contents registration, history management, re-usage, searching, and personalized learning support. By recent learning analysis/recommendation standards, the interworking data of the recently highlighted IMS Caliper, ADL, and Tincan API is being supported, but as this is in its early stages, references are currently in an inadequate state. <Image 1> is a diagram of how learning resources are utilized in Moodle.

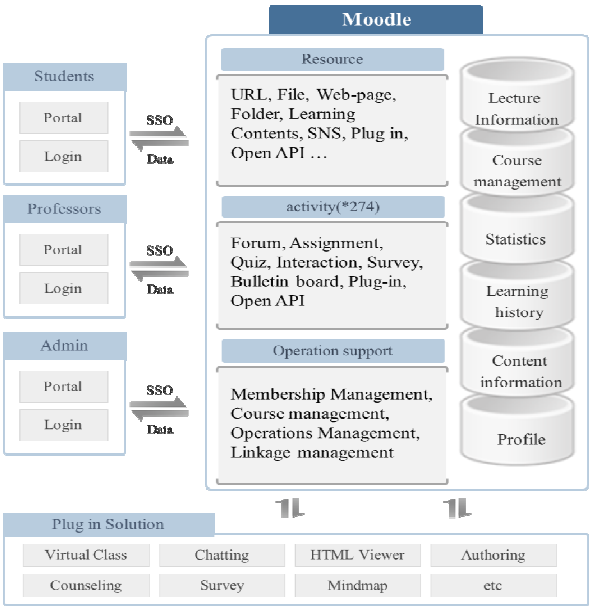

Fig. 1 Moodle Learning Resources Utilization Diagram

In figure 1, the Moodle platform has LCMS as an internal load, and although it is able to utilize Open API, Retained Content, and Learning Activity in plugin formats, it does not support individual management through contents resourcing.

Fig. 2 Activities and resources in Moodle

In figure 2, shows the addition of activities and resources in Moodle. All learning resources are managed for each resource.

C. A Study Relating to LCMS

By utilizing the information network system, the attendance, progress, and evaluation results are managed as a Learning Management System (LMS) which supports the possibility of a learner's independent learning. The LCMS is a system which manages all contents relating to students [19], [13]. Recently, a combined model of the learning management system and LCMS has been becoming generalized [10].

The LCMS is also able to support features such as contents registration, modification, editing, and

configuration management, and generally supports the systematic management of contents.

D. Issues from Related Studies

The Moodle platform has the advantages of being able to utilize various kinds of learning activities and connect to external learning resources, but it has the issue of not having a process for student history or learning resource management.

SCORM's 2004 version no longer offers further standard regulations, and is unable to offer standardization which reflects the most recent educational trends. In order to reflect these recent educational trends, ADL is initiating studies on the differing standards of Tincan API [13].

Additionally, it has proved extremely difficult to find cases of CMI Data suggested by SCORM 2004 being utilized. It has also been difficult to find cases of LOM and KEM Metadata being utilized in contents management, which presents problems when attempting to reflect recent online educational trends, and suggest standards for offering personalized learning.

III. Results and Discussion

A. Design Strategy

In order to support personalized online learning, the main functions of LCMS have been composed of 3 modules: contents registration, management, and recommendations. The functions supporting this are defined in the Main Function Statement defined below in Table 4.

TABLE IV
LCMS Main Function Statement

No.	Classification	Description
1	Share Range Designated Function	Organizations, special recipients, shared function link support
2	Notice and Series Function	Top exposure functions of the contents manager's motivation Continual replay function for compiling similar contents into a group
3	Classification Tag Modification Function	Modification of dictionary-defined tags and improved search accuracy functions for contents exposure Defined tag modification functions for the keyword searches of users
4	Process Sharing Designated Function	Option of whether to designate functions for shared use of clip type contents (in MOOC subjects etc.)
5	Classification System Modification Function	Defining large/middle/small classifications and systematic contents management functions
6	Exposure Control Function	Internal sharing, option whether to use video, exposure control functions according to designated contents expiry date URL, external exposure functions through embed codes, designated automatic/manual thumbnail functions

The online contents shown in Table 4 were constructed with capabilities which exposed personalized individuals in accordance with the affiliations and vocations of learners. Learners are offered personalized contents classified by his/her interests and affiliations in accordance with the contents classification system defined in the dictionary, and designs were made with the capabilities to refresh different contents.

The main functions of LCMS were designed as follows: designated sharing range functions able to share contents to particular subjects, notification series functions able to continuously offer special contents exposure and similar contents, classification tag modification functions able to improve keyword searches, process sharing designated functions able to be used and connect clip type contents with other processes, classification system modification contents able to systematically manage contents, exposure control functions able to control contents exposure.

The LCMS table design, based on personalized online learning, is shown below in Table 5.

TABLE V
LCMS Table Statement for Personalized Online Learning

No.	Table Name	Table Description
1	tb_lmsmedia_contents	About video content
2	tb_lmsmedia_files	About video content files
3	tb_lmsmedia_revision	History of video content changes
4	tb_lmsmedia_thumbs	Video content thumbnail information
5	tb_lmsmedia_captions	Video content Subtitle information
6	tb_lmsmedia_captions_revision	History of video content subtitles change
7	tb_lmsmedia_corps	Video sharing target corporation
8	tb_lmsmedia_users	Video Shared with and Organized
9	tb_lmsmedia_groups	Video Series Group
10	tb_lmsmedia_playtime	Video progress log information
11	tb_lmsmedia_track	Video progress information
12	tb_lmsmedia_satisfaction	About video satisfaction scores
13	tb_lmsmedia_comments	About video comments

The design table of LCMS personalized online learning shown in Table 5 was composed of 13 items: about video contents, about video contents files, history of video contents changes, video contents thumbnail information, video contents subtitle information, history of video contents subtitles change, video sharing target corporation, video shared with and organized, video series group, video progress log information, video progress information, about video satisfaction scores, and about video comments. Personalized content was offered through: gathering video contents data for the realization of personalized online learning, defining types of similar contents, defining the 'sharing subjects' of contents, contents log, initiation,

satisfaction, and comment data. The structure of the Moodle system is shown in < Image 3>.

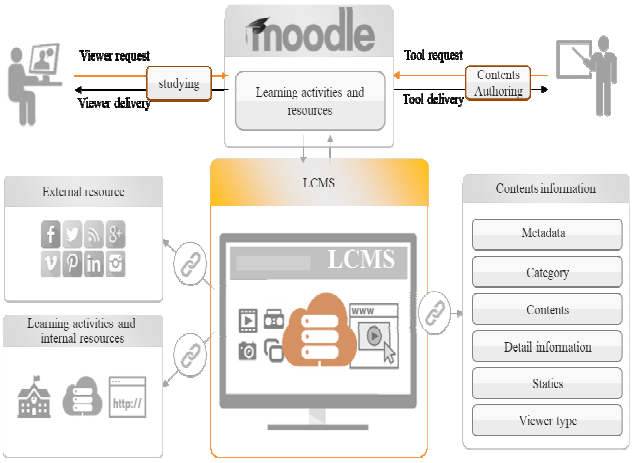

Fig. 3 Moodle system configuration diagram

In figure 3, external resources and internal resources can be managed in LCMS and metadata management is supported.

B. Realization and Application

The realization of LCMS for the initiation of personalized online learning was constructed of the following 3 main functions: contents registration, contents search, and contents recommendation/ learning. Figure 4 shows the contents registration screen for the initiation of personalized online learning.

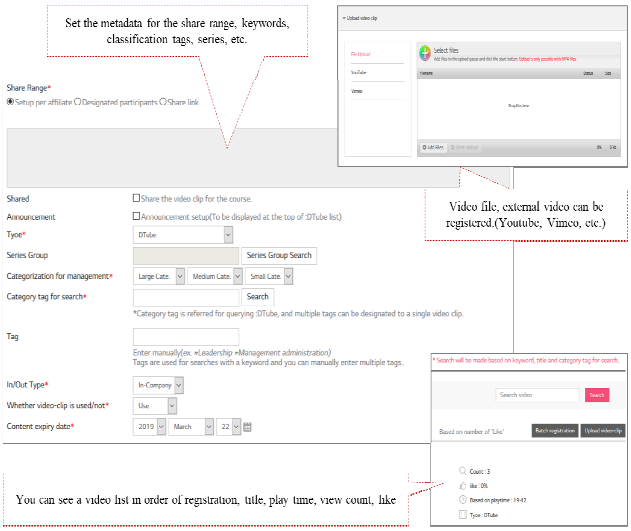

Fig. 4 Contents Registration Screen

In figure 4, the site manager inputs data about: contents sharing range when registering contents, whether to share, whether to notify, service subject classification, series group, administrative classification system, searchable classification tags, tags, user differentiation, whether to use video, and contents expiry date. Additionally, contents registration is made possible for contents able to be used internally, and externally (e.g. Youtube and Vimeo). Registered contents are refreshed according to the learner's title, playing time, refresh order, and recommendation order.

The content data refreshed and learned by learners is saved based on evaluation related to learning satisfaction, and using this data as a base, personalized learning is used and offered in the learning searches of other learners. Figure 5 is a learner's contents searching screen.

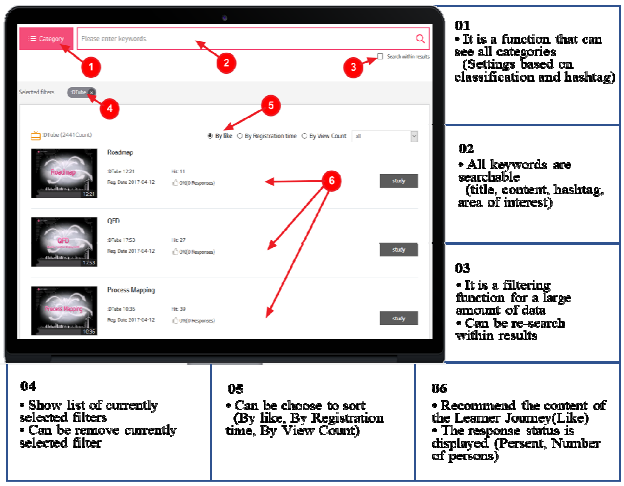

Fig. 5 Contents Refresh Function

Figure 5 shows how learners can rapidly and easily search for personalized contents through contents refresh functions, initiating the process of learning. Learners are offered the following: category refreshing based on hashtags, titles, content, hashtags, keyword searches using interest ranges etc., re-browsing functions within results, filter management, column criteria options (number of recommendations, registration time criteria), contents recommendations, and applicant information (percent, number of applicants). Figure 6 shows a screen of the personalized online contents offered to learners.

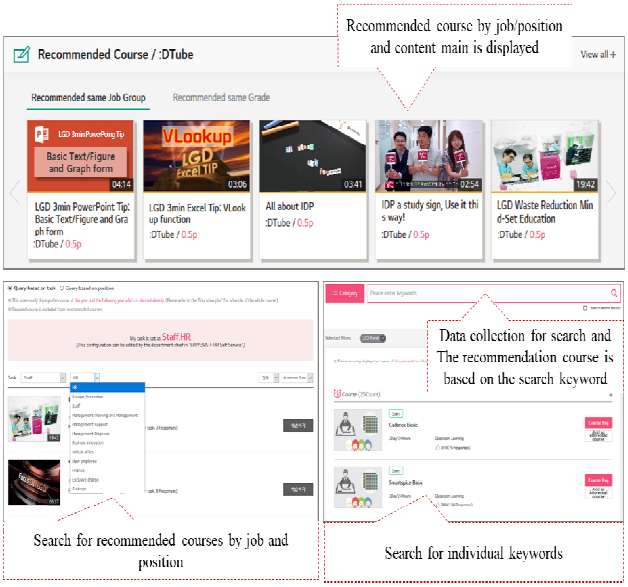

Fig. 6 Offered Functions of Personalized contents

Upon connecting to the system and logging in, learners are offered the recommended process online contents data shown in figure 6. Recommended online contents are extended by identical duty and rank recommendations, and

offer contents-related information based on the top thumbnails. Information offered by thumbnails displays learning titles, learning time, categories, and mileage values. Additionally, learners are able to search for job/rank recommended lectures outside of their recommended learning, and are also able to search for relevant content through keyword searches. If recommended lectures are studied through this method, learners are offered a series of separate learning contents connected by similar content subjects.

IV. Conclusions

In order to offer personalized learning support in line with rapidly improving educational trends (in the context of improving information and communication and the 4th industrial revolution), this study seeks to understand the flexible model of existing contents and suggest and solve possible problems related to this. Inadequate functions to support learning analysis and personalized learning are present in the metadata of the existing online contents flexible models SCORM and KEM, and availability is also inadequate in current online education. Additionally, in order to support personalized learning, current studies are taking place on early versions of Tincan API and IMS Caliper, and there is a necessity for further studies relating to availability in online education. In order to offer personalized online contents, LCMS was designed and realized, and this study seeks to make improvements based upon the points outlined below.

First: analyzing necessary standards, items, and functions in SCORM, KEM, and Moodle contents management, suggesting possible implications, reestablish LCMS functions to enable personalized learning, and suggesting a capable environment for personalized online learning.

Second: offering an easily available and rapidly searchable environment to learners for personalized contents, automatically offering learning (and related contents) in a series format, and increasing learning connectivity and efficiency.

Third: using the personal data of learners to offer online contents relevant to their vocation and rank, offering personalized online contents to different learners based on learning history (such as number of recommendations), and suggesting the best practice solutions of personalized online learning able to both recommend personalized and self-directed learning.

The suggested personalized online learning in this study was specifically initiated in the area of contents-centered LCMS, and was lacking in terms of the learner's learning history, learning results, and connectivity with learning satisfaction. There is a necessity for further technical and instructional studies to initiate personalized learning, using AI (machine learning), and 'big data' (which has recently received much attention), along with the learning patterns, learning results, activity history, and personal information of learners.

The basis for this study can be considered as applicable design and development 'base line data' for the personalized online learning support of the learning management system (LMS) and learning contents management system.

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