

Framework for Distributed e-Learning Management System

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Abstract- To use a variety of educational contents scattered in internet, this paper proposes concept of distributed e-learning management system. Based on functional role and system flow, this paper designs user interface framework for teacher, students and administrator. The prototype of distributed e-learning management system is also designed by REST (Representational State Transferred) web services.

Index Terms- e-learning, learning management system, user interface design, prototype design

I. INTRODUCTION

Nowadays, technology has developed rapidly and this has enabled the access to communications to expand very fast. For example, Internet technology can be applied in different ways for convenience and also provides faster service in the business, the industrial field, or even the educational field. In particular, the current study which uses the information technology in the educational field is very important. The use of distance learning through the Internet [1] is emerging in order to help in the design [2] or to help teachers as well as students [3]. E-learning system basically consists of three parts; learning management system (LMS), the courseware and “technology” which is the most common part of e-learning. The courseware or learning material via Internet is expanding endlessly and multiple forms of knowledge are spreading in various websites [4] [5].

Organizations developing e-learning or learning contents for students via the Internet are facing significant limitations, since development of contents requires a lot of resources. For example, a teacher who is excellent in a particular field may be in difficulty to find

methods for teaching and also technology for transferring media to students. Besides this, an organizations also requires a series of testing, good evaluation and good learning profile system.

Therefore, this paper proposes learning management system and the development design aims to assist people getting the required virtual data and enhance features of a present learning management system. From those mentioned above, regarding the development of data communication and rapid development of the Internet in the educational field, learning and teaching is affected as well, regarding how to gather data or information to be useful for learning. The second issue is, in the case of service outage, how to keep students access to the data of learning, teaching and courseware on learning management system effectively.

E-learning systems have many issues of critics but one of the most important problem is the learning management system which are developed in various types such as, self-developed program [6] free program (Open source) to assist in development such as Moodle [7] [8] [9]. Although both learning management methods still have problems and limitation of learning management system such as various functions can only be used inside the program only. For example, using the content outside service area is impossible and very limited. In the past, the proposed model [10] used the technology of RSS feed which improved a little bit but this method still have limitations of displaying results in text form only.

The proposed model [11] uses the technology available in the Internet within a scope that has not yet been developed or tested previously by other researchers. In the above research, there are some restrictions on the lessons when taken from the service provider. In the case that the server which attends the requests of LMS is unable to login to the learning & teaching system, the

students will be unable to take lessons from other learning management systems as wanted.

The current learning technology on the standard of IEEE 1484.11 [12] has important elements which are the student's profile, transferring management of learning, evaluation and recommendation. It is difficult for a single learning management system to cover all of these elements. There are many learning materials distributed over the Internet and various ways to analyze students. For their benefit, creating a model for distributed learning and teaching which could work together as a system is sorely needed. Teaching effectively requires information analysis such as learning profile's history, learning behavior, types of media, quality of media and aptitude of the student. The data collection and the learning history of student are very important. In addition, in order to allow students to study effectively is important as well. Learning materials on the Internet expands widely. Knowledge is distributed widely on different websites. Therefore, learning management system and design of e-learning prototype as distributed by using the technology of web service is a way to make it the most effective. Keeping student's profiles which are spread in different places at the host computer as a centralized model (Centralized System) is limited.

In addition, some types of learning may require interaction among students groups. So, student's registration, student's profile and evaluation should be in the distributed system [13][14] as well. Especially, in the case of certificate issuer, authorized company must ensure about the evaluation's control. It is necessary that the test center location should be close to students, in order to facilitate the examination. Also, to assist in learning's guide to achieve competitiveness and develop effectively teaching technique, distributed teaching system is a good approach. [15]

In addition, a framework designed to control learning and teaching has been presented [16] along with managing entire learning systems which will focus on CMS (Content Management system) TMS (Training Management system). The presentation of framework design by using data flow diagram will be able to help managing e-learning. This research [17] will propose a development of e-learning management system by using service oriented architecture (SOA) which will focus on the ability to connect other systems on a different platform. This ability should enable to increase contents into the system and sharing data by using SOAP (Simple Object Access Protocol) and XML connection. Restriction of SOAP in sending each data will be converted documents into WSDL. It must be converted to WSDL document between the source and destination which complicated and take more time. The bad point of

using XML, the language used TAG opened TAG closed that will be too long and not tighten for Source Code in sending and receiving data. Usually, Web Service which uses Protocol SOAP is limited to be used for transferring large quantities of data via the HTTP Protocol. Due to large number of commands in WSDL documents, the system performance will be reduced.

From such problems, the research conducted includes the design of the prototype to illustrate the concept of the development in learning management system as distributed by RESTful web service in solving problems as mentioned above.

II. DISTRIBUTED E-LEARNING MANAGEMENT SYSTEM

A. Overview of Learning Management System

In e-learning system, learning management system is an important component because it requires the study of learning material and other teaching processes. Learning management system is shown in Fig. 1.

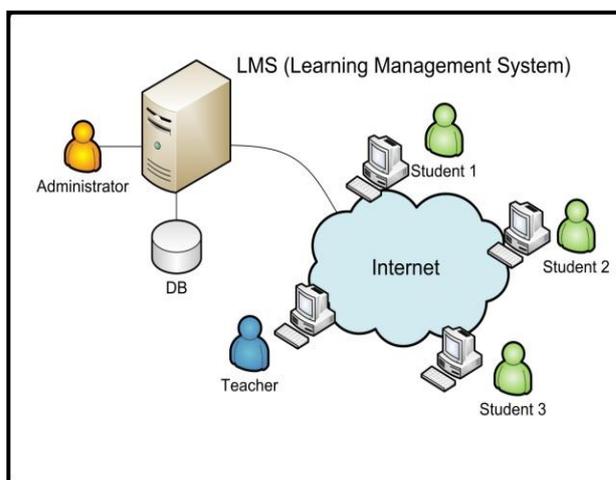


Figure 1. Traditional learning management system

Fig. 1 indicates the process of traditional learning management systems [18] which consists of three parts: administration, teacher and student. Administration is responsible for system management, courseware and other management functions among teachers and students for the whole system. A teacher is responsible for creating courseware into the system for student. A student is responsible for managing assignments and tests. Also, students can choose subjects and tests depending on the service's provider of learning management system. All parts are processed through the server as shown in Fig. 1 Distributed e-learning management system (DLMS) is the learning management system in the form of e-learning. In order to deal with courseware in various subjects between teachers, students, and administrator; this DLMS software which is responsible of learning

management via the Internet, with the ability to gather data of learning material or courseware, data collection of teachers and other important components in e-learning. Normally, traditional learning management system will keep learning materials and other data, such as teacher's data in the single service provider (server). However, this system cannot help gathering or searching data from other service providers of learning management systems. The characteristic of distributed e-learning management system is shown in Fig. 2.

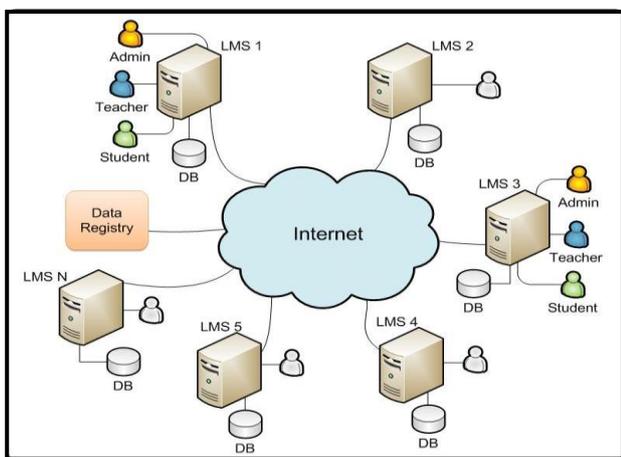


Figure 2. Distributed e-learning management system

Fig. 2 illustrates the concept of distributed e-learning management system, which consists of service providers of learning management system, depending on provider of distributed service. Each provider comprises of an administrator, a teacher and a student. Each user is responsible as traditional LMS user, but students can gather information of learning material from other providers as well. Also, a student is able to select courseware from many service providers. Administrators and teachers are responsible for their own regular LMS, but they also have means to connect with other service providers. Researchers have been presented some parts [19][20] by explaining the principles of the preliminary process in distributed e-learning management system. This research will present how to design a prototype of a distributed e-learning management system.

B. Term Definition

In this part, term definitions used in this research are the following:

LMS : (Learning Management System) means Learning management system which consists of 3 parts; User Interface, Engine and Course content.

$$LMS = User\ Interface + Engine + Course\ content$$

$$LMS_i = User\ Interface_i + Common\ Engine + Course\ content_i$$

Student represents an user that is a student who is able to login into LMS system. A student can process 2 parts which can be searching course content and getting course content.

$$Student_i = Search\ course\ content + Get\ course\ content$$

Teacher represents an user that is a teacher who is able to login into LMS system. A teacher can use 3 processes which can be searching course content, getting course content and managing course

$$Teacher_i = Search\ course\ content + Get\ course\ content + Management\ LMS_i\ course$$

Administrator represents an user that is the entire system administrator. Administrator can use 4 processes, which are searching course content, getting course content, managing course and managing configuration in LMS system.

$$Administrator_i = Search\ course\ content + Get\ course\ content + Management\ LMS_i\ course + LMS_i\ management$$

Course Content means a lesson which is used in e-learning system. Course content consists of topic, lecturer and learning document

$$Course\ Content = Topic + Lecturer + Document$$

They can exist in any LMS.

DLMS: (Distributed e-Learning Management System) means a group of LMS which enables to search for course content across LMS with an algorithm. Each LMS requires to be registered in a system.

$$DLMS = Set\ of\ LMS + Algorithm = \{LMS_1, LMS_2, LMS_3, \dots, LMS_n\}$$

Where the engine is common.

C. Data flow Design

The process of the data flow design is significant, especially the design of the information infrastructure which has been applied in many fields. For example [21] [22], if the data flow design is not in a high-quality form (consistent and no redundancy), it will be difficult to develop or explain the functions.

The general design will be described for the data flow which is explained the process of the system accurately. The data flow design for distributed e-learning management system, further, can be divided into three categories; the group of student, teacher and

administrator. The diagram of the data flow is shown in Fig. 3.

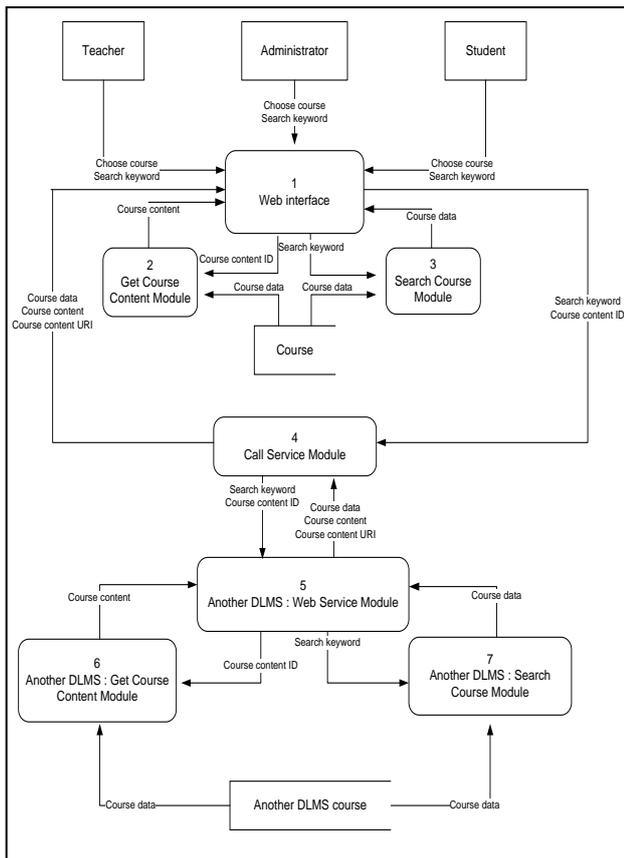


Figure 3. The data flow diagram of the proposed DLMS

The data flow diagram presents the processes for teachers, administrator and students, who can choose the course they want. The system, moreover, is able to search for the course through the web interface (LMS). The process is demonstrated as follows:

- *Web interface* is responsible for the main monitor as the provider of LMS.
- *Searching course module* is responsible for searching the course by receiving the keyword from web interface and then connecting to the data base (Data Store).
- *Getting course content module* is receiving the content ID from keyword in order to search the course content from database the output from.
- *The call service module* is the center function for connecting the DLMS with other systems.
- *Another DLMS: Web services module* is a function that is used to connect to the destination which is required for searching for course contents from the origin DLMS.
- *Another DLMS: Searching course module* is used to search the course by receiving keywords from

the web interface origin and connecting to the data base of the course of the destination DLMS.

The destination DLMS gets course content modules by receiving the content ID from the keywords of origin DLMS, in order to search the course contents from its database.

III. USER INTERFACE STRUCTURE

A. Overview of User Interface

User Interface means the interface between the user for the preparation of data and is used for the interaction with the computer, using graphics, text, or audio in order to enable end users to control the programs running, through a keyboard or mouse. It is upon the designer of user interfaces to choose to connect between the user and software or tools. In the past, there had been research related to design of user interfaces for e-learning systems, such as [23]. This user interface design employs multimedia courseware in order to attract students and increase studying efficiency. This will focus on interesting designs.

In addition, the design of user interface is presented in the aspect of user interface design to enhance service identification [24] in order to improve the service of applications, by means of the technology of service-oriented architecture. This paper presents a design's concept of the prototype. The prototype in distributed e-learning management system must be designed to connect users with user interface. This research will be used to connect a web graphic user interface with form user interface including menu command in connection.

B. Conceptual of users interface design

User interface design has the following important characteristics; simplicity, less complication and user friendly. No moving graphic or text. Not too much different types and colors of text in all of the layouts. Style of graphics, navigation system and color scheme should be similar throughout the system to suit various users, such as students or teachers. Consider the ease of navigation with standard forms and sequences, such as placing controls in the same position of every page. Attractive appearance and preferences of the system must be related to the quality of the elements, such as; the use of color, easy to read text, color compatibility, all these preferences depend on an individual user. The last concern is that the form for filling in relevant data must work properly. Links should be able to direct to actual pages accurately.

C. The design of User interface based on functional role

The design according to the application or functional role is the design which is based on the functions of each user. These are divided into three categories namely, student, teacher and administrator. The detail of the design is shown in Fig. 4.

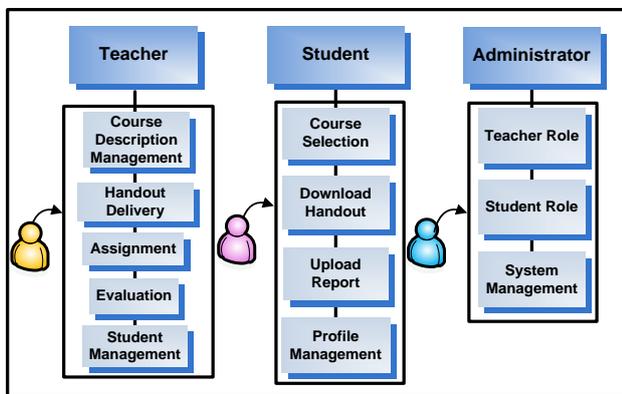


Figure 4. interface structure by functional role.

The Fig. 4 divides the form of presentation per each type of users, which are student, teacher and administrator. Detail of each section as follows:

The functionality for teachers, consists of five sections:

- *Course management section:* Teacher can manage courses in the system, increase or edit a course, etc.
- *Handout section:* Allows students to download data related to the course.
- *Assignment section:* For the teacher to assign homework to students through the DLMS.
- *Evaluation Section:* responsible in managing the evaluation, such as tests.
- *Member management section:* responsible for managing users because teacher would like to manage the list of registered students.

The functionality for students, consists of four sections:

- *Selection course section:* responsible in displaying courses' detail in the learning management system and DLMS which depends on the interest of the students.
- *Download Handout section:* is for students to download documents in e-learning.
- *Upload Report section:* This is for students to submit homework that teachers assign at DLMS system.
- *Profile management section:* responsible in editing personal profile in which only personal details can be edited.

The functionality for administrator, consists of three sections:

- *Teacher role:* The administrator can modify all of teacher roles responsibilities.
- *Student role:* The administrator can modify all of student roles responsibilities.
- *System Management:* The administrator manages all general tasks.

The role of administrator can manage teacher and student sections. In addition, an administrator can perform general management operations of learning and teaching.

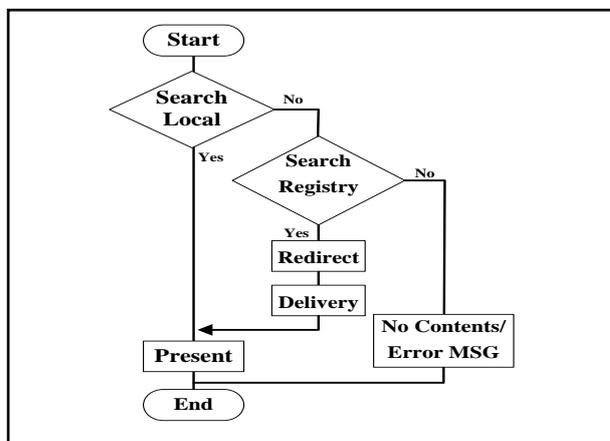


Figure 5. Flow chart of DLMS.

When students enter the system, they can find data by searching the database in the DLMS system. After finding the data, then the data will be presented directly to students. If such a system cannot find the data, it will search in the services registry instead. After finding the data, it will redirect and present data to the students. In case of not finding data in the Service Registry, the system will display “No Content” and “Error” when error occurs.

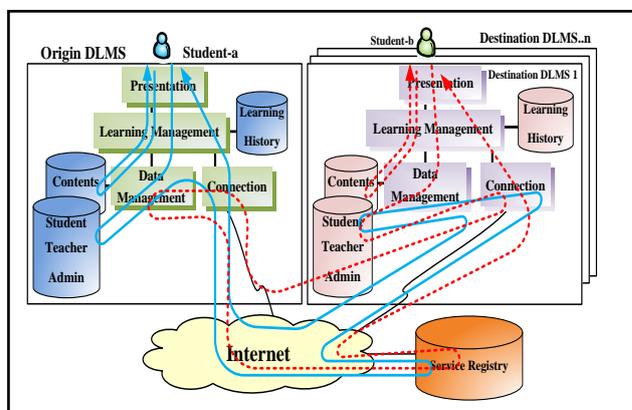


Figure 6. System flow for DLMS

- *Presentation:* The data presented to users.
- *Learning Management section:* refers to all learning management that is responsible for managing the functions of teachers and students.

- *Learning History section:* The DB has the ability to collect students' records.
- *Data Management section:* Dealing with the database of students, teachers, admins and all contents.
- *Connection:* whose responsibility is connecting with other DLMS through the Internet.
- *Service Registry section:* is responsible for providing data in the registry such as Course, Teacher Data, etc. and services registry will connect to any DLMS.

From Fig. 6, we assume four scenarios as follow:

Scenario 1: Student a, assumes to enter the system of origin DLMS to search the data of a subject called MIS which first step is searching the local database. Once the needed data is found, the system will display results back to the student a. But, in case of no data found, it will search in the service registry and display results to the student including sending a message to the student.

Scenario 2: Student b, assumes to enter the system of destination DLMS to search the data of multimedia. The first step is an attempt to find data in the local database. Once the data is found, the system will display the data to student b. If not, it will search the service registry further. Once found, data will be displayed to student b, and messages will be sent to the student.

Scenario 3: Student a, b, n, assuming to enter a DLMS system a, b, n searching for a multimedia subject and finding each subject of multimedia at local database and 5 DLMS together with local database getting in total 6 multimedia subjects. Student can choose to study multimedia subject at each DLMS. (DLMS original or DLMS destination depend on the usage of the student, if the user entered the DLMS which it is used; DLMS original. DLMS destination is a destination which display information student would like to search and equal to a searched subject).

Scenario 4: student a, b, n assuming to enter DLMS a, b, n searching each multimedia subject which can determine that we need to search only local database of DLMS (Original DLMS) or other DLMS (Destination DLMS)

D. Design of process and framework

Research of RESTful web service will make a process of a distributed learning in an e-learning system to be more efficient and faster when compared with the use of a web service as SOAP [25]. Transferring data uses JSON (Java Script Object Notation). This method is compact and faster than XML Base [26]. Previously, we presented a data flow design for DLMS [27]. In further research, we will test the performance of DLMS model

by comparing between the uses of duplicate with pointer and between web service with SOAP and RESTful. RESTful is representational state transferred as architected form by media distribution [28] [29]. The basic idea is the use of standard HTTP and XML to exchange data as simple as possible. The idea will use HTTP Get to request XML file and update by using XML Put. This idea will be different from SOAP. The process used a written language and quite complicated. The process of RESTful will be shown in Fig. 7.

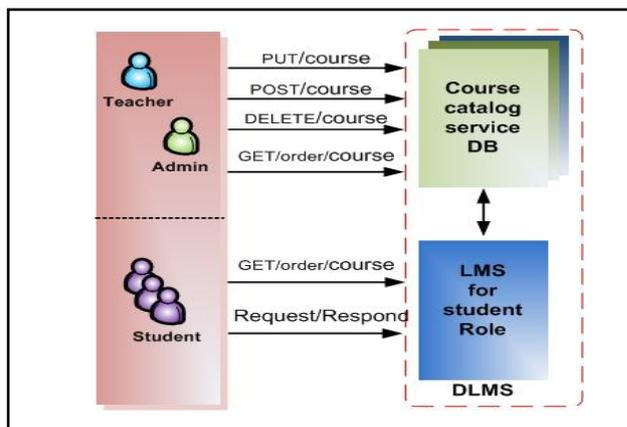


Figure 7. Framework RESTful service for DLMS

This Fig. 7 shows a framework of RESTful Web service for DLMS in order to transfer data of REST in request/response on basic and simple HTTP commands. GET is used for retrieving data for being displayed. POST means sending data from a form or application in order to enter data. PUT means transferring data from a form or application in order to correct data. DELETE means delete data which will be quick, easy and not complicated when compared with Web services SOAP [21].

In the example of searching courses for students, GET course command is used, to request and display the desired subject to students. The process for teachers will be able to enter new data in each subject by means of POST course, and modifying data by using PUT course. Admin's processes will be able to execute every function such as, GET, PUT, DELETE and POST.

E. Example of REST

Restful concept Fig. 8 shows an example of a concept in basic process of Restful Web service by using HTTP protocol for helping in request and response. The process is shown as Fig. 8.

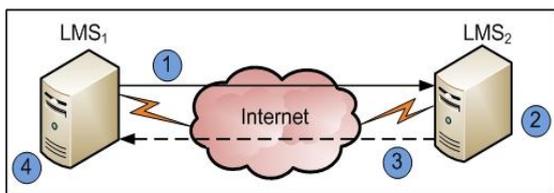


Figure. 8 Example of RESTful concept

- Step 1: LMS₁ requests a service from LMS₂. When LMS₁ requests to receive a service by sending Request services LMS₂. And using URL of LMS₂ which is already Registered by using HTTP GET method.
- Step 2: When LMS₂ gets a request service, it will calculate the command which received from LMS₁.
- Step 3: When LMS₂ is already processed will send a result back to LMS₁. The data which is sent will need an Encoding, such as XML or JSON.
- Step 4: When LMS₁ received data, it will decode data and display to user.

F. Simulation of the framework

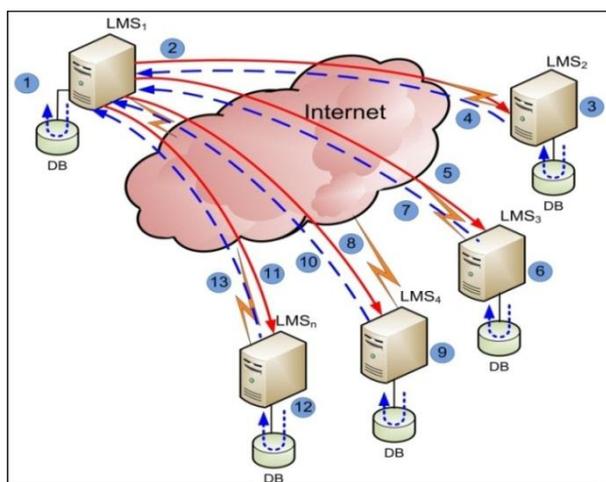


Figure 9. Simulation of system processing.

Assuming the simulation of the process, for example, a student would like to find some courses. Specifically, finding the course of Java, the following is the process that the student performs on LMS₁

- Number 1. First step begins with LMS₁ finding the course of Java in the system which will be ready to use as LMS₁.
- Number 2. LMS₁ will send a request for searching course content to LMS₂.
- Number 3. LMS₂ will process a request of searching for course content at LMS₁.
- Number 4. LMS₂ response a result to LMS₁

- Number 5. Meanwhile, LMS₁ will send a request for searching course content to LMS₃.
- Number 6. LMS₃ will process a request of searching for course content at LMS₁.
- Number 7. LMS₃ response a result to LMS₁.
- Number 8. Meanwhile, LMS₁ will send a request for searching course content to LMS₄.
- Number 9. LMS₄ will process a request of searching for course content at LMS₁ request.
- Number 10. LMS₄ response a result to LMS₁.

The system will continue this process until all the number of registered URLs are completed. In each system can be both requester and response, depending on the way that user uses. When user uses LMS₁, other LMS will be responded data back to LMS₁.

G. Example of Coding Algorithm

The Example of Code in processing for Searching course content. This process will use function switch case in order to check a condition. The search algorithm is shown on Fig. 10.

```

$returnResult = array("success" => 0);
switch($_GET["method"]){
case "searchcourse":
global $SYSTEM_URL;
$keyword = $_GET["keyword"];
$data = Course::search($keyword);
if(is_array($data)){
    foreach($data as $row){
        $tData["cou_id"] = $row["cou_id"];
        $tData["cou_name"] = $row["cou_name"];
        $tData["cou_credit"] = $row["cou_credit"];
        $tData["ownerUrl"] = $SYSTEM_URL;
        $returnData[] = $tData;
    }
    $returnResult["success"] = 1;
    $returnResult["data"] = $returnData;
}
break;

```

Figure 10. Example of Searching Course content Algorithm

When the value of Parameter Method is equal to Search course, the system will search each topic by receiving a value of Parameter Keyword in searching. This search will use Searching Method from Class file which is called Class Course. And if each topic is found, Searching Method will send a value back as an Array.

When receiving each topic as an Array, it will take a loop in order to increase data of RESTful Web service URL within the system for URL (Uniform resource Location) for retrieving data of each topic later. Then,

setting a value of Array of each subject for return a result Array, and put a return result Array to Encode as JSON Object. Then send a value back to the requestor.

```

case "getcourse":
global $SYSTEM_FOLDER, $SYSTEM_URL;
$callServiceType = $_GET["callservicetype"];
$courseId = $_GET["courseid"];
if(in_array($callServiceType,
ServiceTypes::getAllServiceTypes())){
$result = Course::getCourse($courseId);
if($result){
if($callServiceType ==
ServiceTypes::POINTER){ $data["ownerUrl"] =
$SYSTEM_URL;
$data["url"] = Util::getRootURL()."/".$SYSTEM_FOLDER.
"/?p=course_content&id=$courseId";
$returnResult["data"] = array($data);
}
}else{
$data["cou_id"] = $result[0]["cou_id"];
$data["cou_name"] = $result[0]["cou_name"];
$data["cou_credit"] = $result[0]["cou_credit"];
$data["cou_content"] = $result[0]["cou_content"];
$data["ownerUrl"] = $SYSTEM_URL;
$images = Image::getCourseImage($courseId);
if($images){
for($i = 0; $i < count($images); ++$i){
$images[$i]["ownerUrl"] = $SYSTEM_URL; }
$data["images"] = $images; }
$returnResult["data"] = array($data); }
$returnResult["success"] = 1; } }break;
    
```

Figure 11. Example of Get Course content Algorithm.

If Parameter Method is equal to getting course, the system will send a value of each topic by referring from a value of Course ID. According to receiving Parameter Course ID, Parameter Call Service Type will have 2 values; Pointer or Duplicate. By retrieving data of each topic from Getting course Method of Class file, which is called Class course. When getting each topic, a value of Call Service Type will be equal to the Pointer. The system will set a data of RESTful Web services URL and URL of each topic for displaying data as Pointer.

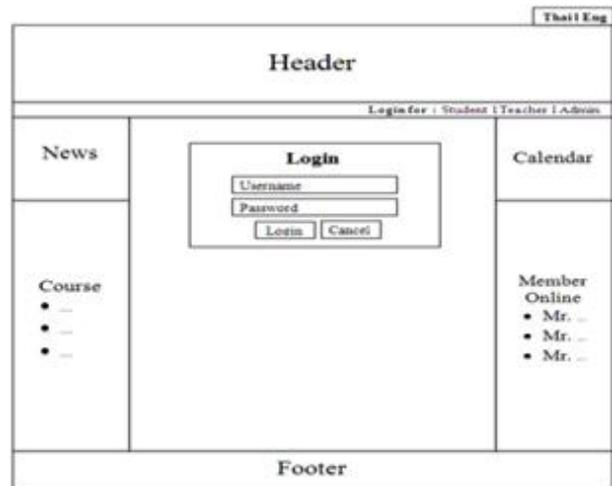
If Call Service Type is equal to Duplicate, it will increase data of RESTful Web services URL and Figure data for each topic. To display picture data from Getting Course Image Method of Class file which is call Image Class file.

Picture data of each topic will send a value back from Getting course Image Method as an Array. Then, it will bring an Array of picture data to check in a loop in order

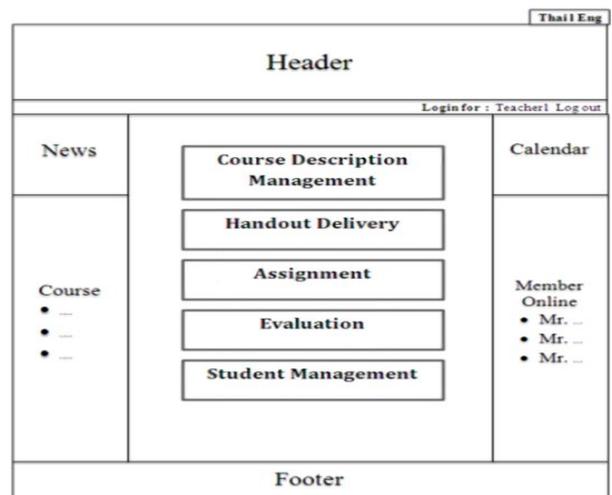
to increase data of RESTful Web services URL and set a value of Array of all pictures for Array of each topics. The last step, an Array will bring data of each topic as Pointer and Duplicate to set a value for returning result Array. In order to enter Encode as JSON Object and will send value back to requestor.

H. The design of layout

The design of layout is based on the functions and applications that allows each user to easily understand and easy to use. The structure is shown in Figure 12.

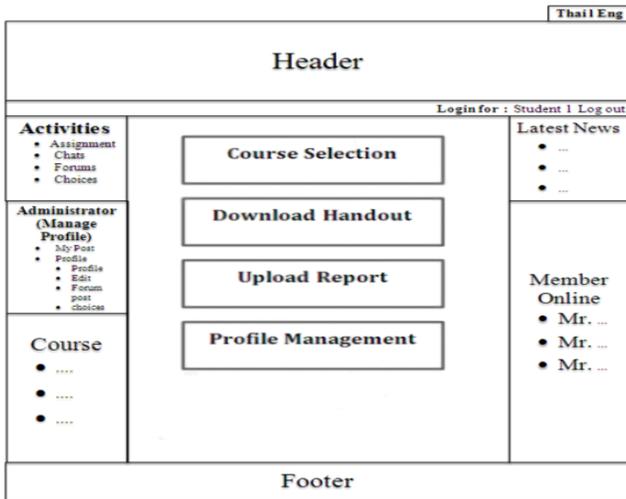


(a) Main page

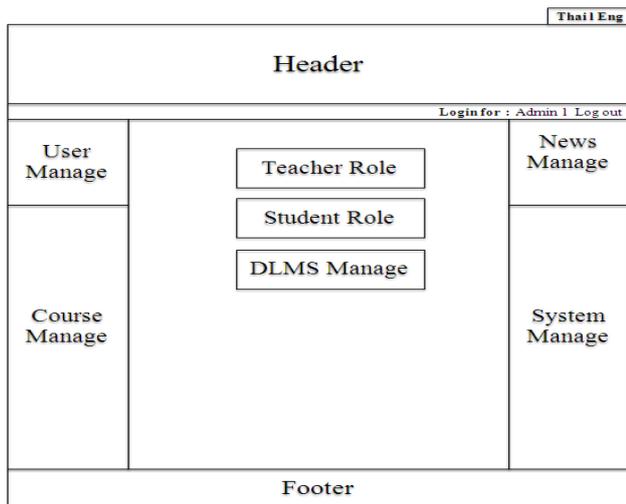


(b) Teacher sections

Fig. 12 (a) shows the design of the layout in the main page when logging in to the system. This section shows the detail of online user, update news and choices between LMS and DLMS. Fig. 12 (b) shows the design of the layout in teacher sections which consist of course description management, handout delivery, students' assignment, evaluation and students' management.



(c) Student sections



(d) Administrator sections

Figure 12. Layout and design of each user

Fig. 12 (c) shows the design of layout in student sections which consist of management of course selection, download handout, upload report and profile management. Fig. 12 (d) shows the design of the layout for the administrator, which consists of functions of teacher and students that can be managed, so the design of the layout should cover all sections.

1. Demonstration of DLMS

We define a case for demonstration. There are 3 DLMSs as follow: 1) A Junior High school DLMS uses 10 plants course contents. 2) B Junior High school DLMS uses 10 animals course contents. 3) C Junior High school DLMS uses 10 earth course contents. The detail is show in Fig. 13.

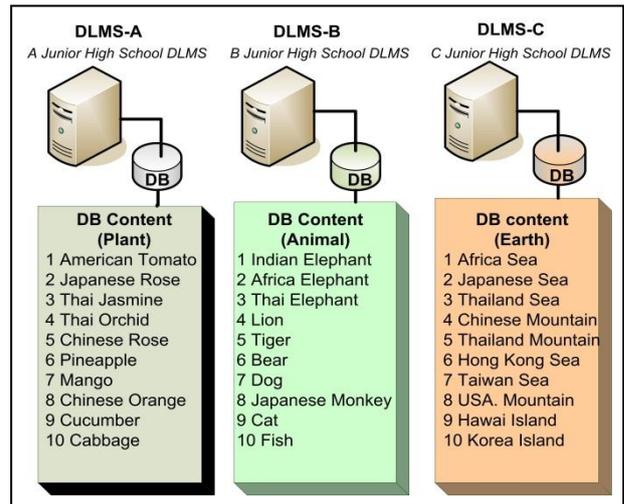


Figure 13. Digital course content for each DLMS.

For next step, we assume that student-1 wants to query and study for Japanese digital course content in B Junior High School DLMS. Student-1 uses Japanese keyword for query. First student-1 login in B Junior High school DLMS. Then student-1 chooses local radio button (Fig. 14 (a)). The result by local LMS is illustrated on Fig. 14 (b) and Fig. 14 (c).

Anyway, student-1 choose DLMS radio button (Fig. 14 (d)). The result of using DLMS is illustrated on Fig. 14 (e) and Fig. 14 (f). Fig. 14 is shown below;

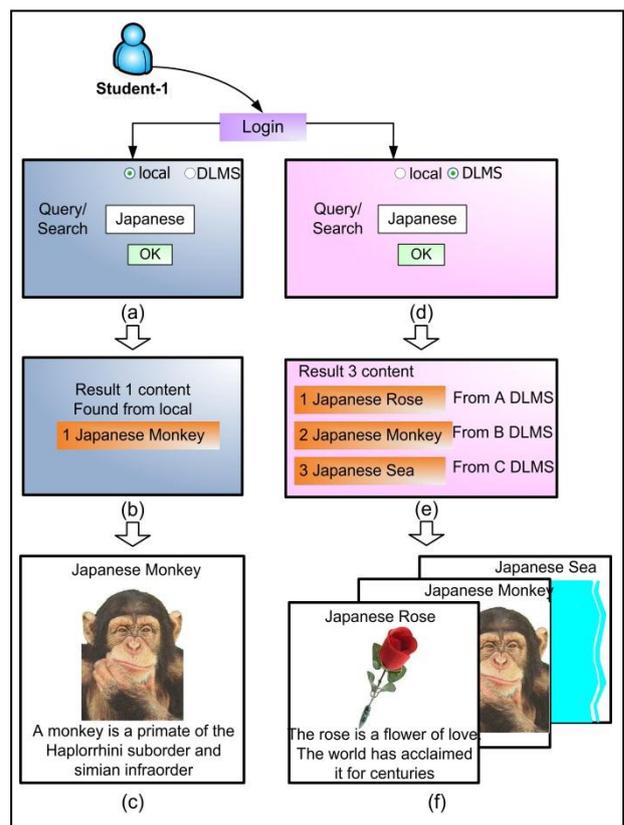


Figure 14. The demonstration of DLMS.

From Fig. 14 the demonstration of DLMS is a comparison between using local DLMS with DLMS. The result of demonstration is in case of student-1 choosing local DLMS, the result will be Japanese monkey digital course content, because of B Junior High school DLMS has only Japanese monkey digital course content. The step illustrates on Fig. 14 (a), (b), (c).

The result of this demonstration is in case of student-1 choosing DLMS. The result will be Japanese monkey (From local), Japanese rose (From A Junior High school DLMS), and Japanese sea (From C Junior High school DLMS) digital course content. Because of DLMS for proposed ideals in this paper, it can search crossing DLMS. The step illustrates on Fig. 14 (d), (e), (f).

IV. AN APPLICATION FOR JAPANESE SCIENCE DIGITAL CONTENT SHARING

A. Experimental evaluation of framework system.

This section will be applied a framework together with Japanese science digital content sharing. Some of the digital content from Japanese science will be tested for sharing. In the past, sharing course content would be in a social network service with maturity level for science teacher. [30] In order to support Japanese teacher with knowledge sharing on digital content usage.

In additional, the design of knowledge-network for Japanese science teacher has been presented [31] to support knowledge sharing among science teachers on ICT. This paper has proposed a knowledge-network of SNS (Social network service) based on stickiness. Three factors will be as follows; 1) Relationship 2) Reputation 3) Personalization. However, only [30] and [31] can support Japanese science teacher, however students studying and searching for digital content across several DLMS is not supported. Detail of the experiments is showed as follows: The experiment will use 3 DLMS which consists of; 1) A Junior High School DLMS 2) B Junior High School DLMS 3) C Junior High School DLMS. We used 4 scenarios in course contents of plant, animal, earth, Japanese weather, and human body. Each scenario will be used for each student, teacher and administrator. Student will use 2 different scenarios.

B. The result of evaluation.

Scenario-1: We define a case in a scenario experiment. There are 3 DLMSs as follow: 1) A Junior High School DLMS uses plant course content. 2) B Junior High School DLMS uses animal course content. 3) C Junior High School DLMS uses earth course content. We assume that student 1 wants to search and study for animal course content in A Junior High school DLMS.

Use case of student: Login, searching course content and getting course content.

TABLE I. RESULT OF SCENARIO-1 TESTING.

Step	Test Action	Expected Results	Pass	Fail
1	Login in A DLMS	Login successfully	✓	-
2	Select button of local and search animal course	No animal course content.	✓	-
3	Select button of DLMS and search animal course	Find animal course content (That mean from B DLMS)	✓	-
4	Get course content	They can be access for animal course content from B DLMS.	✓	-

From Table I, scenario-1 is an experiment for student which consists of Login, searching and getting course content. The result is passed in all test actions.

Scenario-2: We define a case in a scenario experiment. There are 3 DLMSs as follow: 1) A Junior High School DLMS uses plant course content. 2) B Junior High School DLMS uses animal course content. 3) C Junior High School DLMS uses earth course content. We assume that teacher1 wants to search and study for earth course content in A Junior High school DLMS. Then, they add human body course content and they revise human body course content in A Junior High school DLMS.

Use case of teacher: Login, searching course content, getting course content, adding course content, and editing course content.

TABLE II. RESULT OF SCENARIO-2 TESTING.

Step	Test Action	Expected Results	Pass	Fail
1	Login in A DLMS	Login successfully	✓	-
2	Select button "local" and search earth course.	No earth course content.	✓	-
3	Select button "DLMS" and search earth course.	Find earth course content (That means from C DLMS)	✓	-
4	Get course content	They can be accessed for earth course content from B DLMS.	✓	-
5	Add human body course content in A DLMS.	Human body course content is on A DLMS.	✓	-
6	Revise human body course content by add on some picture to A DLMS.	Some picture has changed in human body course content.	✓	-

From Table II, scenario-2 is an experiment for teacher which consists of Login, searching, Getting, Adding and Editing course content. The result is passed in all test actions.

Scenario-3: We define a case in a scenario experiment. There are 3 DLMSs as follow: 1) A Junior High School DLMS uses plant course content. 2) B Junior High School DLMS uses animal course content. 3) C Junior High School DLMS uses earth course content. We assume that administrator 1 wants to search and study animal course content in A Junior High school DLMS. Then, they add Japanese weather course contents and they revise Japanese weather course contents in A Junior High school DLMS. In additional, they can add new student user, new teacher user, and configuring system.

Use case of administrator: Login, searching course content, Getting course content, Adding course content, Editing course content, Adding student user, Adding Teacher user, and Configuring system.

TABLE III.
RESULT OF SCENARIO-3 TESTING.

Step	Test Action	Expected Results	Pass	Fail
1	Login in A DLMS	Login successfully	✓	-
2	Select button "local" and search animal course.	No animal course content.	✓	-
3	Select button "DLMS" and search animal course	Find animal course content (That mean from B DLMS)	✓	-
4	Get course contents	They can be accessed for animal course content from B DLMS.	✓	-
5	Add Japanese weather course content in A DLMS.	Japanese weather course content is on A DLMS.	✓	-
6	Revise Japanese weather course content by adding on some picture in A DLMS.	Some picture has changed in Japanese weather course content. (A DLMS)	✓	-
7	Add new student user in A DLMS.	Add new student user successfully	✓	-
8	Add new teacher user in A DLMS.	Add new teacher user successfully	✓	-
9	Configuring system such as URL DLMS remove from registration.	URL DLMS remove successfully	✓	-

From Table III, Scenario-3 is an experiment for administrator which consists of Login, searching, Getting, Adding, Editing, Adding student user, Adding Teacher user, and Configuring system. The result is passed in all test actions.

Scenario-4: We define a case in a scenario experiment. There are 3 DLMSs as follow: 1) A Junior High school DLMS uses plant, Japanese weather, and human body course content. 2) B Junior High school DLMS uses animal course content. 3) C Junior High school DLMS uses earth course content. We assume that

student 2 wants to search and study plant, earth, animal, Japanese weather, and human body course contents in C Junior High school DLMS.

Use case of student 2: Login, Searching course content, Getting course content.

TABLE IV.
RESULT OF SCENARIO-4 TESTING.

Step	Test Action	Expected Results	Pass	Fail
1	Login in C DLMS	Login successfully	✓	-
2	Select button of "Local" search course content Search plant, earth, animal, Japanese weather, and human body.	Find earth course content only.(From itself DLMS)	✓	-
3	Get course content	They can be access for earth course content from itself DLMS.	✓	-
4	Select button of DLMS search course content and search plant, earth, animal, Japanese weather, and human body.	-Find earth course content (from itself DLMS) -Find plant, Japanese weather, and human body course content (from A DLMS) -Find animal course content (from B DLMS)	✓	-
5	Get course content	They can be accessed for plant, earth, animal, Japanese weather, and human body course content from C DLMS.	✓	-

From Table IV, Scenario-4 is an experiment for student which consists of Login, searching, and getting course content. But this experiment has many digital course contents and searching across DLMS, the result will be passed in all test actions.

In conclusion, all 4 scenarios were tested with different users, DLMS and different purposes. The result is all test actions passed. This means that the development of the framework in this experiment is effective and can be applied in other DLMS.

V. DISCUSSION

This paper has proposed a design of Prototype system for DLMS using RESTful web service. Previous research has proposed a development of e-learning management system by using service oriented architecture (SOA) which will focus on the ability to connect other systems on a different platform. This ability should enable to increase contents into the system and sharing data by using SOAP (Simple Object Access Protocol) and XML

connection. Restriction of SOAP in sending each data will be converted documents into WSDL. It must be converted to WSDL document between the source and destination which complicated and take more time. Usually, Web Service which uses Protocol SOAP is limited to be used for transferring large quantities of data via the HTTP Protocol. Due to large number of commands in WSDL documents, the system performance will be reduced.

The highlight of this research is able to find each subject across LMS. The design of GUI is clear and easy for users. Also, transfer data is faster than a typical Web services (SOAP) [21]. The weak point for this research is that the Prototypes design of DLMS which has not yet tested and compared to transfer data between SOAP and RESTful. Although, transferring data is faster and easier than the designs using a Web service (SOAP). The security of data is still not as good as it could be, due to the lack of standard support.

This research focuses on the search for subjects that can be connected with the current system and other registered DLMS. So, when students search for each subject, the subjects displayed will be from many DLMS and also the ones stored in the local DB as well.

In further research, we will test the performance of the DLMS model. Comparing data retrieving by duplicates with pointer and comparing Web service SOAP with RESTful Web service in order to identify the most effective further applications.

VI. CONCLUSION

This paper has presented a user interface based on functional role and system flow. Method which we have proposed is a framework of the distributed e-learning management system by using RESTful web services. This research can help solving problems of traditional learning management system which failed to work effectively with the limitation of data in only a single server. In case a failure occurs, the service will not available including data and learning material in the server will be unable to use, as well.

In addition, this paper also suggested an idea to develop the model of Prototype as presented and tested for performance, and to reduce defects thus increasing the overall efficiency.

This research has focused on the design of a prototype which is designed by duties of users, design of layout, design of graphic user interface, design of the connection in each DLMS, and scenario for operation of the model. A method for exchanging and registering each subject between each DLMS on the system has been proposed.

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