LePo: An Open-Source Learning Management System with Text Annotation and Content Curation Functions

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Abstract
Web-based Learning Management Systems (LMSs) are widely used in educational institutions mainly because no management cost for native client application and low development cost to adapt the system to multiple client platforms. And the progress in web-related technology makes it possible for web system to implement the functions which were possible only by native application. Based on this situation, we have developed a new web-based LMS named “LePo”. In addition to usual LMS functions like contents and assignments management, LePo has two original functions, Text Annotation (TA) and Content Curation (CC). TA is like a digital sticky. User can put text message on any page in teaching material and set its access level to private or share with the course members. Using CC, user can collect specified part of web contents like text or image from any web pages, pack them with user's original texts and images, organize the contents in display order and share with the course members. Teachers can also put some contents into the student’s contents packages for instructional scaffolding. This CC is intended to be used as a preliminary step before writing a report or making a presentation slide in the classroom and to clarify student’s thoughts with the citations from web pages. We’ve developed LePo with mainly Ruby on Rails and will release it by the Spring of 2017 as open-source software to encourage people to use it for their educational purposes and to share the experiences.

Keywords: web-based learning management system, open-source software, text annotation, content curation, Ruby on Rails

1. Introduction

In recent years, many higher education institutions around the world have introduced web-based learning management system (WBLMS). As a WBLMS that is actually used, it is reported that Blackboard, Moodle, and Canvas are popular for higher education institutions in the United States and Canada, and Moodle, own-developed system, and Blackboard are widely used in those of Japan [1][2]. These WBLMS can be distinguished by whether open source software which shares the source code or not. Moodle and Canvas are representative open source WBLMS. In general, open source WBLMS has merits such as being inexpensive to operate and easy to customize compared to proprietary WBLMS.

Meanwhile, as smart devices equipped with iOS and Android OS become widespread, install-type applications for educational use on these devices are also spreading. Compared with the install-type application, web application has advantages such as neither management cost of installing the application nor development cost to support different OS required, but on the other hand, it had disadvantages like it cannot be used offline and no way to use push notifications from the server. The disadvantage of such a web application is beginning to be solved with the progress of web related technologies such as ServiceWokers in recent years.

2. Purposes

In the present situation where Moodle and Canvas are widely used as representative open-sourced WBLMS, there is no reason for newly developing a WBLMS if only to implement the functions provided by many of the conventional WBLMS, such as viewing digital teaching materials uploaded to the system and evaluating submitted tasks etc. Understanding the current situation like this, the authors set goals to support the following activities efficiently, and independently develop "LePo" [3] (Figure 1.) which is a new web-based LMS.

1. learner centered active learnings
2. various instructional scaffolding activities
3. sharing knowledge about development and operation technology for WBLMS

With regard to goal 1, since activities that learners can actively perform in the system are limited in many conventional WBLMS, it tends to be passive learning using teaching materials or tests prepared by the teacher, except such as bulletin boards activities. As for goal 2, in order to make students' active learning effective, we aim to make teachers able to carry out appropriate scaffolding in various scenes. As for goal 3, to develop the system in cooperation with many developers, we actively utilized the de facto standard open source code and will also make the LePo as open source software. For these goals, Table 1 shows some implemented functions or efforts in the current status. Among them, we will describe some of the functions in the next chapter focusing on functions that are not implemented in existing WBLMS.

And in the actual system construction, we have specifically considered following three points: a. Realization of intuitive user interface, b. Reflection of feedback from students and teachers, c. Utilization of learning resources both inside and outside the system.

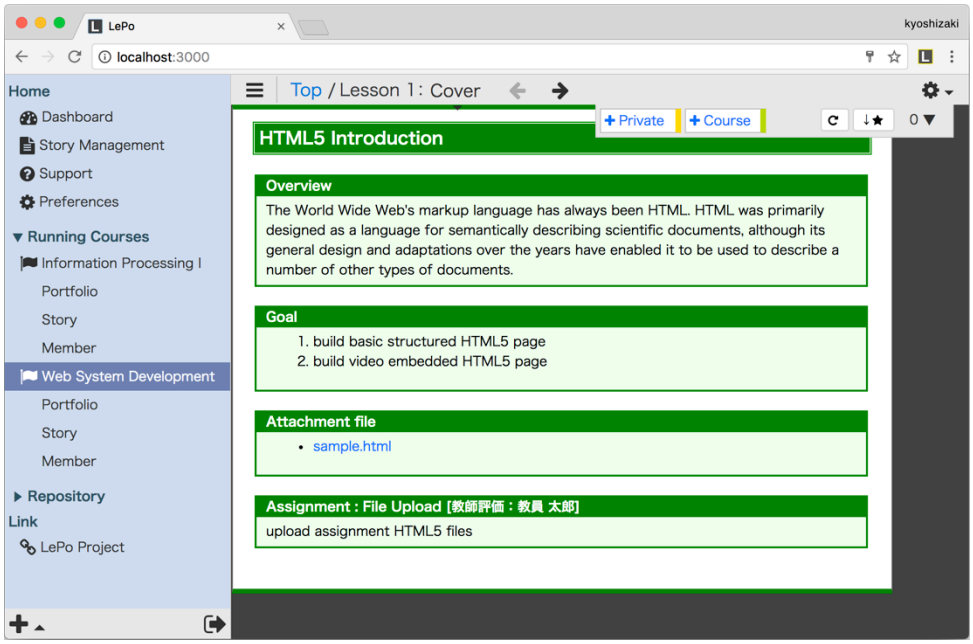

Figure 1: Cover page of sample teaching material

Table 1: Functions or efforts related to goals of LePo

Goal	**Implemented function or effort**
learner centered active learnings	• text annotation • content curation • mutual evaluation of various activities
various instructional scaffolding activities	• shareable text annotation • scaffoldings for content curation • learning objectives and evaluation of achievement degree
sharing knowledge about development and operation technology for WBLMS	• share as open source software • utilization of de facto standard open source code • proactive adoption of new web related technology

Since LePo has been used and improved for several years in the lectures of the university to which the authors belong, it is particularly suited for use in Japanese educational institutions, but its user interface supports both English and Japanese.

3. Main functions

Some representative functions of LePo are outlined below.

3.1. Text annotation

LePo has a "sticky" function as a text annotation tool that allows users to save text and hyperlinks on arbitrary pages of teaching materials (Figure 2). This sticky

function has "private sticky" that only the author can view, and "course sticky" that can be viewed by students and teachers of a specific course. The private sticky is implemented to the system for personal note for learning records. And the course sticky is for teaching

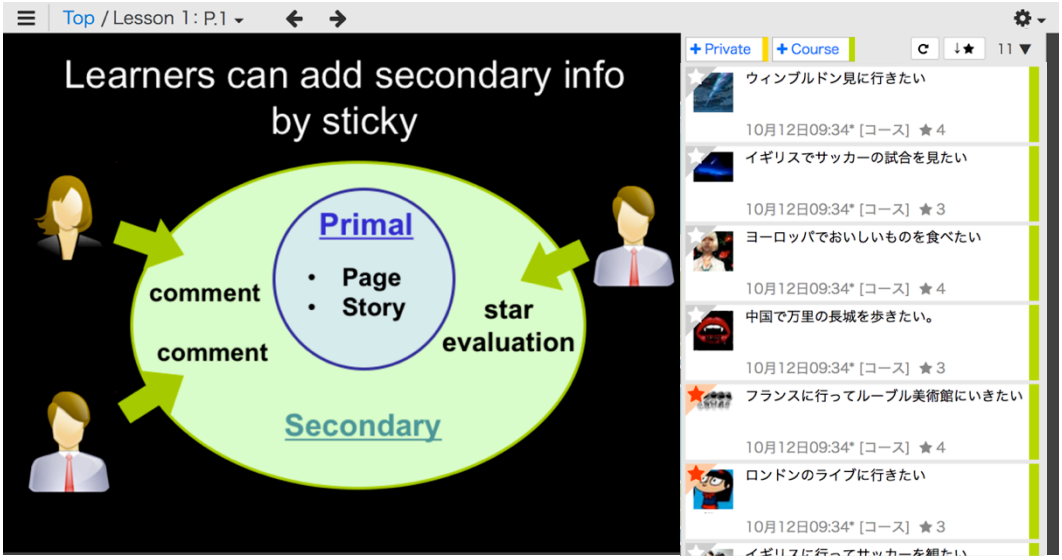

Figure 2: Some stickies on a page in teaching material

among students about the teaching material or for mutual feedback about their annotations [4].

Also, as a function to feed back to the stickies from the user, a star evaluation function was implemented. This is a function that allows a star to be added when a course sticky reader evaluates the sticky as important. The user can sort the stickies in a page by the number of stars. And by automatically extracting course stickies with many given stars and show the star ranking on the place the student surely sees when using the system, LePo promotes sharing of the contents described on the stickies.

3.2. Content curation

The information on the web page is widely distributed on internet with various media format such as text, images, and movies. The work of gathering these information and organizing them into a composition with its own context is generally called content curation. We thought that content curation function was effective for investigative learning using web pages, so implemented the function to LePo considering the following three points: 1) record of metadata such as citation source URL, 2) sharing and mutual evaluation for deliverable of curation among students, 3) instructional scaffoldings for deliverable of curation by teachers [5].

In order to gather some contents on the web to LePo, it is necessary to register the bookmarklet or browser extension provided by the system in user's browser as preparation. Next, the user selects certain text in the arbitrary web page by the mouse, and operates it with the bookmarklet or browser extension. By this operation, both selected information and related metadata are collected to LePo. With the same kind of operation, user can collect not only text but also various information in the web page such as images (Table 2). Since the collected information is displayed in the

system together with the hyperlink to the web page of the collection source, the context of the collected information at the source page can be easily confirmed (Figure 3). In addition, it is possible to construct contents packages which constitute the contents gathered in the system together with the user's own contents. This contents package is called "story"

Table 2: collectable web contents

collectable web contents
texts, images, YouTube & TED videos, Scratch programs

Figure 3: content curation operation with bookmarklet or web browser extension

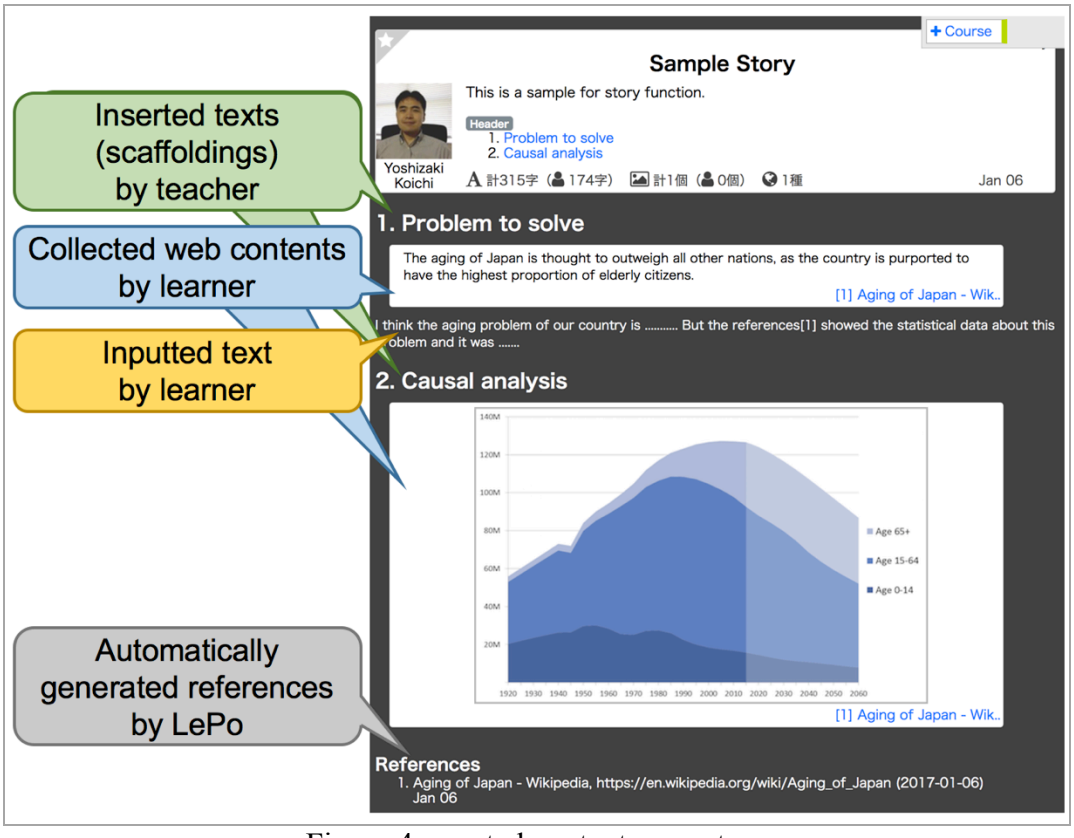

Figure 4: curated contents as a story

in LePo as a deliverable of curation. This function is intended to be used as a preliminary step before writing a report or making a presentation slide in the classroom and to clarify student's thoughts with the citations from web pages [5].

3.3. Others

3.3.1. learning objectives and evaluation of achievement level

When proceeding active learning in an educational institution, it is desirable to clearly show the objectives of learning and also conduct self-assessment or teacher evaluation for the objectives by small steps. In LePo, learning objectives and tasks should be explicitly set to each of the teaching materials [6], ant the tasks set for the teaching materials and allocated scores for the objectives are used for quantitative evaluation for the degree of achievement based on the objectives of the teaching material.

In each lesson, it is possible to record and evaluate the degree of achievement of learning without registering a teaching material to LePo, and using only the learning objectives, tasks, and achievement evaluation functions. Based on the fact that LePo also has aspects as an e-portfolio system, we have named LePo from Learning Portfolio.

3.3.2. Push notification

Until recently, it was technically impossible to send a push notification from a web system to a device such as a smartphone. Therefore, in the conventional WBLMS, there was only a way to use a different system such as e-mail when sending some information from the server to a user who is not logged into the system. This situation is beginning to change as several web browsers, such as the Chrome browser, implement ServiceWorkers technology [10]. One of the author and his co-workers have developed message notification function using ServiceWorkers and PushAPI for LePo. Using this function, users who aren't logged into the system can also receive information [11]. In the present status, LePo sends push notification to student when his/her task is evaluated by the course teacher. This function works only with chrome browser on Windows, Mac, and Android (NOT iOS) devices.

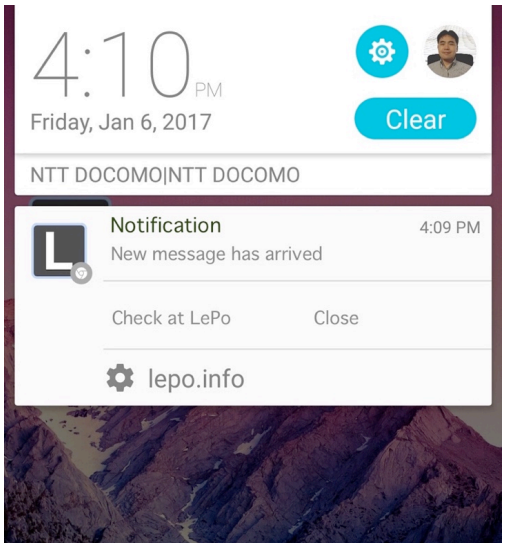

Figure 5: Push notification message from LePo

4. Development and Operation

4.1. Development

LePo is a web application developed mainly using Ruby on Rails 5 [7]. LePo is a SPA (Single-Page Application) which all information updates in the application are accomplished with Ajax, so the information in the page is promptly updated. LePo's page design adopts Bootstrap framework [8] and font-awesome icon [9]. According to the former, responsive design which adapts to small screen sizes of smartphones, and he latter, vector type icon design which does not deteriorate image quality even when enlarged, were realized.

LePo is under development and still a beta version period, but practical evaluations have already done through several classes targeting university students. Regarding open source, we plan to release it on GitHub by the Spring of 2017.

4.2. Operation

Currently, as an operation environment of LePo, practical evaluation is performed using nginx as the web server, Unicorn as the Rails server, and MySQL as the database. Note that when using the function to send Push notification to the device registered by the user [11], it is necessary to separately use FCM (Firebase Cloud Messaging) [12].

5. Conclusion

In this research, LePo, a new web-based learning management system (WBLMS) has been developed mainly assuming use in the educational institutions. The main goals of the system are to support following activities: 1) learner centered active learnings, 2) various instructional scaffolding activities, 3) sharing knowledge about development and operation technology for WBLMS. Though it is still on a beta version status, LePo implements a function not found in conventional LMSs, such as text annotation and content curation function. In order to make this Web-based LMS more effective, we are planning to make it open source software by the Spring of 2017.

Acknowledgments

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