A Community Cloud-Based Course Management System Using Platform as a Service (PaaS) Model for Higher Educational Institutions

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Abstract—The paper promotes a cloud-based course management system for higher educational institutions. Thru cloud services the student's assignments, examinations and other activities are automatically recorded in a database and immediately the results are evaluated. The system provides timely feedback to the learners regarding their rating. It provides online examination that can randomize questions from the question bank which provides unique set of questions per student. Thus, synchronous automated examination is secured even though there is limited space for the examinees and they are seated closely with each other as they take the exam. The said system was pilot tested to eighty (80) freshmen college students. Based on the result of the survey obtained from the respondents they highly recommend the proposed system. Thus, it can be utilized as an alternative strategy for delivering courses to facilitate resources and services in the classroom.

Index Terms—Cloud-based application, course management system, didactic model, synchronous learning.

I. INTRODUCTION

For more than a decade some educational institutions were implementing eLearning as an alternative strategy for delivering courses to facilitate resources and services in the classroom. They are using software like Learning Management System (LMS) or Course Management System (CMS) to manage the courses offered in the Internet. Ref. [1], [2] according to the survey done by Itmazi and Meg ás there are more than 200 LMS products. They said that Blackboard is one of the leading commercial LMS (or CMS) software packages used by North American and European universities. Nevertheless, the Modular Object-Oriented Dynamic Learning Environment (Moodle) is the most recommended Open Source software (OSS).

Ref. [3] in another study, Beatty and Ulasewicz compared Moodle and Blackboard. Beatty addressed four main issues of comparison such as: 1) interface and usability; 2) discussion forum tool used; 3) assignment posting and sharing among students and 4) the promise of new features. When it comes to author control of posts and in sharing student work she prefers Blackboard. However, for interface ease of use and for the promise of new features she recommends Moodle. She believes most visual learners will appreciate the flexibilities of the Moodle interface.

Consequently, Ulasewicz emphasized that when shifting from a commercial online tool, such as Blackboard, to an alternative online tool, such as Moodle, information technology and instructional design (instructor support services) and faculty advisory committees should be involved.

Ref. [4] "In Japan, the implementation of asynchronous distance learning is not yet fully realized in most distance university even if they are well advanced in technology gadgets". Their students' motivation is different from their Western counterparts because of its education.

Ref. [5] however, UNESCO reports that the Philippines is one of "two dozen countries that devote less than 3 percent of its gross national product to public spending on education. It has had to rely substantially on aid to finance basic education." Ref. [6] apparently, the country receives an average of 20-25 typhoons a year apart from other natural disasters such as landslides and floods. It is a disaster-prone country and those calamities and disasters may greatly affect the Philippine educational system [7].

Thus, Philippine educators should be innovative to bring equal opportunities to an underserved part of the population in terms of broadening access to educational opportunities through Information Communication Technology.

Ref. [8] in our previous work, we developed a project called Network-Mediated Learning System (NMLS) for a Post-Baccalaureate Program in the Polytechnic University of the Philippines. However, it was not fully implemented in 2002 because of the complexity on courseware development and limited university Internet bandwidth.

Consequently, cloud based application is getting popular not only in large companies but also in the academe for eLearning solutions. Ref. [9] this emerging technology has a potential to provide ubiquitous tool and powerful platform which may be used for higher educational institutions. Ref. [10] it provides resources and infrastructure as a source rather than capital expenditure that would mitigate the institution's outlay on information technology resources. Ref. [11] in another study by Reyes, he presents how DROPBOX, a free cloud storage service provider was utilized by the Angeles University Foundation in facilitating the delivery of instructions. It's emphasis is on collaborative works, file synchronizations, file sharing and online submission of laboratory works.

Nonetheless, with the advent of cloud computing, Open Source Software (OSS), ubiquitous gadgets and tools as well as increased Internet bandwidth, we can now design sophisticated instructional software for our students to offer courses using blended learning strategy. As such, the authors

wish to promote a cloud-based CMS for higher educational institutions that can be utilized as an alternative strategy for delivering courses to facilitate resources and services in the classroom.

II. THE COURSE MANAGEMENT SYSTEM (CMS)

A. System Architecture

Currently, the Polytechnic University of the Philippines (PUP) is using Modular Object-Oriented Dynamic Learning Environment (Moodle) to manage and promote online learning. The numbers of users are growing exponentially and the university is anticipating them to grow from 2,800 to 5,000 users with typical daily concurrency of 100 users sustained throughout the day. Users do a massive range of things from quizzes, viewing course content, using glossaries and forums, downloading course materials, watching videos, submitting assignments, etc. Fig. 1 depicts the PUP CMS system architecture. The CMS architecture involved in the delivery of cloud learning services consists of two (2) cloud components communicating with each other. The university is using community cloud to share Platform as a Service (PaaS) to offer online courses. However, for applications the university is utilizing the cloud Software as a Service (SaaS) to access the Internet, the learning portal powered by Moodle and the Google drive applications. It includes operating system, programming language execution environment, databases, and web server. CMS users run their courseware on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers. The PaaS offers the underlying computer and storage resources which scale automatically to match application demand so that the CMS user does not have to allocate resources manually. This architecture aims to facilitate real-time in cloud environments. However, in the business model using software as a service (SaaS), CMS users are provided access to application software and databases. PUP community cloud manages the infrastructure and platforms that run the applications. For instance to avoid the network traffic we allotted 10MB for every activity of each user. If the file that the teacher or student wants to share to the group exceed on the said size, we let them save the file using the google drive then we just provide a portal link so that the users can still view the bulky files. Thus, it eliminates the need to install and run the application on the cloud user's own computers, which simplifies maintenance and support.

Ref. [12] the cloud architecture can be considered as the best solution to store a huge volume of files which was also used in video-based teaching strategy in the University of Sharjah.

B. System Features

Moodle has a feature that captures and stores in the database the log-on history of all participants. For anonymity, we used dummy student number (see Fig. 2) as a sample. But, in the actual output the system will display the full name of the student.

The professor as soon as granted a system administration rights can manage the log-in of registered users, monitor learner activities and results. It provides report such as User's Activity Report per Log and User Activity Outline. Then, he

can analyze the IP Address used, the lessons opened, learner's frequency of viewing and downloading the course contents. In addition, he can keep an eye on the participant's online activities and his actions, the date, the time and the duration he explored them. For this reason, it will be easy for the professor to closely monitor the individual performance of each student and give him timely feedback on how to improve his learning experience.
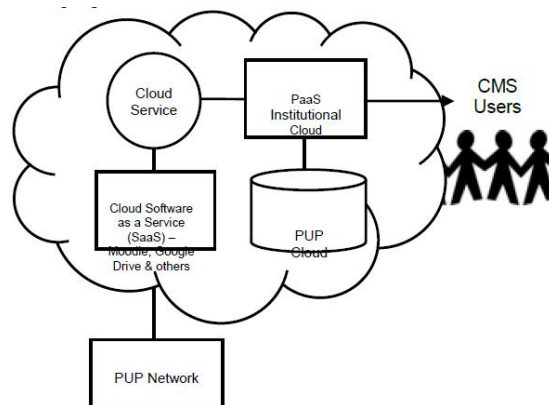

Fig. 1. PUP CMS system architecture.

Fig. 2. Sample activity report of the student using the instructional software.

Another feature of the CMS is Electronic Communication system. It is composed of news forums, web blogs, Real Simple Syndication (RSS), audio/video-casting, e-mails, bulletin board systems and discussion rooms. It presents some methods for guiding the learners through courses, such as starting a particular discussion through online chat rooms. In addition, it also permits the students to post their messages in the bulletin boards. Discussion rooms has a mechanism that enables learners to search and review previous messages. Users are allowed to give their own comments regarding the discussions. The system was also designed to let the user view all participants in the discussion. By using the discussion forums tool, the RSS feeds can be activated. The users can simply post messages with media files as attachments then it will be delivered as podcasts in the RSS. On the other hand, anybody who is not part of the course will not be given any access to the system.

The system can also integrate or link to reference materials such as course guides or online academic papers. It can generate reports regarding the online behavior of the participant with regards to his activities while exploring the courseware. Therefore, the professor can easily monitor and analyze the performance of his student based on the frequency of his access to the website.

C. Practice Tests and Online Examination

To better assess the participant's knowledge about the topic presented, there is also practice tests and online examination. The result then is automatically evaluated and recorded in the database which provides timely and frequent feedback about the learner's progress. The questionnaires may be randomized from the test question data bank so each student can have different set every time he will attempt to take the test. The selection of items will depend on the number of questionnaire saved by the professor in the system. This feature is helpful in conducting assessment test or giving reinforcement exercises because it offers several attempts until the participant master the subject matter. The question bank feature allows a professor to create, preview, and edit questions in a database of question categories. The questions in a category can be added to a Quiz or to a lesson activity via an export process.

Ref. [13] moodle has a number of different formats that can be used to import questions into Question bank categories and as lesson question pages. These include some proprietary quiz software formats, as well as text files and Moodle formats. Also, it is possible to import questions from a file on your network/computer or from a file that has been saved or uploaded into file that has been saved or uploaded into your course files. The most common is the GIFT format which allows someone to use a text editor to write multiple-choice, true or false, short answer, matching missing word and numerical questions in a simple format that can be imported. The GIFT format is also an export file format available in Question bank. The format has been developed within the Moodle Community but other software may support it to a greater or lesser degree. When creating a large numbers of questions, GIFT can provide a quick way of bulk loading questions either into a question category, or into a Lesson. Sometimes it is easier proofing questions in a question category by viewing them in a GIFT file.

D. Book Module

The Book module makes it easy to create multi-page resources with a book-like format. Previously created websites can be imported directly into the Book module. It can be printed entirely or by chapter. It allows you to have main chapters and sub chapters. You can link to choices, forums etc., from within a book to make it more interactive. Also, Flash movies and other multimedia may be integrated in a book.

E. Online Assignment Submission

The system has provision for online assignment submission which is different from the usual e-group session because only the professor can see the submitted files by the students. The teacher can monitor the date and time when the files submitted. It has provision for setting a deadline of submission and give penalty for late submission. Once the student submits the file, the system will display the difference of number of days and hours from the expected schedule by the teacher.

The professor can give a comment or grade which can be viewed by the respective student. For this reason, it will be easy for the professor to closely monitor the individual performance of each student and give him timely feedback on how to improve his learning experience.

III. RESEARCH METHODS AND TECHNIQUES

The study explores the concepts, theories, methodologies and technologies in designing online course wares for the universities. The study then presents the general requirements and issues in designing and deploying course content in ubiquitous learning. The authors explored the available software tools, the existing hardware and infrastructure to develop the prototype. Afterward, they collaborate with the school administrators and educators then conduct an action research with the community of learners by applying the new system.

At the start of a semester, the authors gathered the digital course modules that are being developed and utilized by the professors. They worked together with the professors to create instructional software by converting the original materials into diverse formats. Then, at the end of the semester, a survey was conducted to the students for the validation of the efficacy of the proposed system.

To test its effectiveness, a pilot test was done on June 2013 to October 2013. The participants were eighty (80) freshmen college students of the College of Computer and Information Sciences of the Polytechnic University of the Philippines. (PUP). They were enrolled in the Information Technology Fundamentals class for First Semester 2013.

IV. RESULTS AND DISCUSSIONS

While the goal of this study is to design a community cloud-based course management system using Platform as a Service (PaaS) model for higher educational institutions, we designed questionnaires which evaluated the efficacy of the system. The said questionnaires were formulated based on the National Standards of Quality for Online by North American Council for Online Learning (NACOL). The first part of the questionnaires gathered the technology profile of the participants to know the user's technical readiness for the system. Conversely, the second part consists of questions that evaluated the system into five categories such as system features, system functionality, structure/form of prototype, student's attitude towards the use of computer and their opinion on Online Examination as they access the program. For the questions on system features the users recommend it. This category obtains the highest Average Weighted Score (AWS) of 4.14 with a descriptive rating of Agree. The respondents found that the system can shut out access from people who are not part of the course. It provides online submission of assignments and online examination where the result can be evaluated by the professor then recorded in the database. This is an indication of an effective integration management that should be maintained by the system. Generally, the system's rating is commendable as it offers the features it can provide to its users.

Based on the summary of responses on system functionality all eight questions were rated AGREE by the respondents. Question# 7 got the highest AWS (4.34) among all other questions. This indicate the versatility of the proposed system when it comes to system functionality as it

gives opportunity to the users to recapitulate, retrieve and interact with the system whenever the user desires to. The ratings on this category exhibit the capability of the system to develop independent learning among the users and at the same time to reach out and provide effective learning to distant users.

Based on the summary of responses on the structure/format of the system prototype most questions were rated as AGREE. This signifies the user-friendliness of the system through its very effective and well-designed format and structure. This is an indication that the use of texts, photographs and graphics and video were helpful to convey the course content. The ratings on this table measure the effective performance of the system when it comes to technicality.

With regards to the participants opinion on the attitude towards the use of computer as they access the program it got an AWS of 4.065 which is the second to the lowest rate in the group but its descriptive rating is Agree. Based on the summary of responses all the questions got a fulfilling rating. It shows that that the system can enrich the learning experience of the participants with little assistance from anybody which develops independent learning for the distant learners.

The last question category was well evaluated by the users. According to the respondents thru Online examination they can devote more time in analyzing their answer instead of writing. They were exempted from the tedious written examination. For them, online examination is a better approach because students can utilize advance technology to have a better result. In addition, they can go over with the exam on their own comprehension pace and they can answer the questions during the exam more correctly. Also, they can easily go back to the item/question where they skipped and type the appropriate answer. Thus, they can review the item/question they did not comprehend initially. On the other hand, for professors they can save time on checking papers because the system can instantly display the exam result, it can save paper cost and provide timely feedback to both professors and students.

Overall the users were satisfied and recommend the use of the proposed system as a strategy on deploying courses in blended learning environment.

V. CONCLUSION AND FUTURE WORKS

The paper introduces a cloud-based didactic model using course management system for higher educational institutions. It re-engineers the conventional learning approaches through creative, innovative, and cost-effective learning delivery channels. It utilizes ubiquitous computing technology which offers new experiences, useful knowledge, and sustainable growth in the field of education. In the future, the authors will extend the work on using the appropriate tools and resources for the design, development and distribution of educational dynamic learning materials. It is recommended that continuous reorientation and training should be conducted to all the university stakeholders (students, professors, staff, administrators and course creators) on data conversion of the existing digital course materials for the successful implementation of the Course Management System (CMS).

For future works, the authors will implement CMS to both undergraduate and graduate programs of the university. It will be integrated to the Student Information System (SIS) to better facilitate the students' performance and monitor their scholastic records.

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