A New Moodle Supporting Cloud Storage and Social Network Services

Eman Yaser Daraghmi
Department of Applied Computing
Palestine Technical University Khadoori
Tulkarm, Palestine
e.daraghmi@ptuk.edu.ps

Shyan Ming Yuan
Department of Computer Science
National Chaio Tung University
Hsinchu, Taiwan
smyuan@gmail.com

Abstract— **With Moodle, a web based interface that generally supports a wide range of activities including forums, contents, assignments, and much more is provided to assist both the teachers and the students. However, limitations of the file-size acceptable for uploads, weakness in the assessment procedure, complicated task of replacing an existing file, and the lowest visiting rate of the traditional discussion module are some major deficiencies in the traditional Moodle module. Therefore, this paper proposes a new Moodle module that supports cloud storage and the social network services. The module provides a straightforward uploading-function to allow, with only few seconds, uploading several large-size files simultaneously without any restriction on the files-size. The new module also offers an assessment-function to help teachers, without the need to download and save each assignment separately, checking and grading the submitted assignments directly via any web browser. The new proposed module also integrates the Moodle with Facebook to increase the visiting rate of the traditional discussion Moodle module; thus, increasing both the students' motivation to ask questions and the interaction among the students. The usability as well as the performance of the new module were investigated and promising results were obtained.**

Keywords-cloud storage; facebook; moodle; social network services

I. INTRODUCTION

Nowadays, Moodle (Modular Object-Oriented Dynamic Learning Environment) is one of the most popular Learning Management Systems (LMS) that have a significant impact on many aspects of the learning/teaching process. As of June 2015, Moodle had a user base of 83,008 registered and verified sites, serving 70,696,570 users in 7.5 million courses with 1.2 million teachers [1]. In general, there are several official releases of the Moodle that propose new modules and approaches to remedy shortcomings in previous efforts. For example, to reduce the course size and the overall storage requirements for a course site, Moodle released the core 2 repository support to allow Moodle to bring content into Moodle from external repositories [2]. Yet, the Moodle server needs to keep a copy of the uploaded file which still consumes a lot of storage space. Moodle is an open source software;

therefore, this fact together with its modularity and open interfaces allow developers to design new modules, increasing the capabilities of the default Moodle suite. Moodle aims at advancing towards a more interactive learning, self-learning, collaborative learning and teamwork which are increasingly valuable skills in the social network era. Moodle provides a web based interface that generally supports a wide range of activities including forums, contents, assignments, and much more. The Moodle assignment module is one of the important modules that aims at helping teachers to set the course assignments with a description and a due date. Within the specified date, the students are able to submit their assignments to the server. The system records the date of when the students upload their assignments and this function allows teachers to view any late submission. The teacher is then able to download the submitted assignments and give grades with feedbacks. Students are able to view the grades and feedback at any time and location. In the context of Teaching and learning Computer Science courses, such as the Operating Systems course, simulation assignments, programming projects and team works are a great challenge for both teachers and students. Teachers have to assign several appropriate practical exercises and projects to their students for understanding a particular topic better and thus the students' cognitive skill can be increased. However, we still have observed major deficiencies in the traditional Moodle module which lead to several additional problems: limitations of file-size acceptable for uploads, weakness in the assessment procedure, complicated task of replacing an existing file, and the lowest visiting rate of the traditional discussion Moodle module. More specifically, (1) the traditional Moodle limitations of file-size acceptable for uploading these files to the Moodle course page arise a serious challenge for both teachers and students while uploading their large-size files such as uploading a course lecture recorded as high-definition movie or submitting a programming assignment. Consequently, as a solution, first they have to compress those large-size files in order to be able to upload them successfully, that is, additional task for the teacher/students must be performed before performing the uploading process which consumes much time and efforts. Unfortunately, we also have

noticed that most of the time the uploading process failed because of that file size limitation and these steps must be repeated every time a user has to upload a new file. (2) As known larger files take more time to be completely uploaded to the Moodle server than smaller files; thus, as most of the students, simultaneously, upload their assignment near the assignment deadline, the uploading process becomes a common bottleneck (i.e. some students may claim that they could not upload their assignment because of the system error or the heavily load). This bottleneck arises as the number of assignments required by a course. (3) We also have observed that a common challenge in the assessment procedure arises when teachers perform the evaluation function to grade the submitted assignments and projects. Since Moodle lacks in supporting the web-browsing for the uploaded files, teachers, who wants to grade the students' assignments, have to download all the assignments separately in order to grade and give feedback. This problem becomes more difficult if the student, who submit a large assignment, has compressed the assignment first before the submission (i.e. the compression task is performed because of the files-size limitation), then another task to decompress large size assignments must also be performed by the teachers. Therefore, for groups with a large number of students, this may result in a very time-space-effort consuming task. (4) To modify and replace an uploaded file, a user, first, has to download that file, modify the file and uploaded again to replace the old one. This problem becomes a great challenge especially for students, when they have to modify a submitted assignment that consists of several files since they have to repeat those processes for each file separately. (5) We, finally, have observed that a new challenge arises when a student ask a question using the discussion Moodle module. Since most of the students usually open the Moodle course page to check the new course material, or the new assignments as well as the course announcement, the discussion Moodle module has the lowest visiting rate module among the other Moodle modules. A student who asks a question using discussion Moodle module has to visit the Moodle course page frequently to check the discussion module and find the answer about his question. This process in turn may result, for questions that were posted long time ago, in losing the interest in finding answers to these questions. Therefore, more students feel more comfortable to ask their questions face-to-face or by sending email, this result in decreasing the interaction and the communication among the students who registered the same course.

This paper proposes a new module that supports both the Cloud Storage Services (CSS) and the Social Network Services (SNS) to remedy the shortcomings and cover the limitations in the traditional Moodle module. To alleviate the limitation of the size of files being uploaded and thus improving the uploading process, the assessment procedures as well as the task of replacing an uploaded file. We integrate the Moodle with three of the most cloud storage services: Dropbox, Google drive and SkyDrive. This integration, from one hand, provides a straightforward uploading-function to allow, with only few seconds, uploading several large-size files simultaneously

without any compression task or any restriction on the files-size, and, from the other hand, offers an assessment-function that supports the web browsing of the files being uploaded to assist teachers, without the need to download and save each assignment separately, in checking and grading the submitted assignments directly via any web browser. Another advantage of this integration is that any modification required to be done on a file that was already uploaded can be directly done on the original file without the need to repeat the download/modify/upload procedures to replace the old one. In addition, since SNS such as Facebook plays a significant role in increasing the communication and the interaction between users [3], integrating the Moodle with the SNS, from one hand, will increase the visiting rate of the Moodle discussion module and thus remedy the problems associated with the lowest vesting rate, and, from the other hand, will motivate more students to ask questions as teachers, classmates as well as the students' Facebook friends can also participate in the discussion. In summary, the contribution of this paper are: (1) Improving the Moodle uploading procedure to cover the traditional Moodle module limitations in file-size acceptable for uploads and thus allowing, with only few seconds and one step, uploading not only one file but also several large-size files simultaneously without any restriction on the files-size. (2) Enhancing the Moodle assessment procedure by covering the weakness of supporting web browsing of the uploaded files in order to assist teachers, without the need to download and save each assignment separately, in checking and grading the submitted assignments directly via any web browser which reduces the efforts, time and space consuming while grading the submitted assignments. (3) Increasing the visiting rate of the traditional discussion Moodle module by integrating Moodle with Facebook and thus, increasing both the students' motivation to ask questions and the interaction among the students.

II. BACKGROUND AND RELATED WORK

Over the past years, Cloud Storage Service has become popular in the world [4]. Cloud Storage Services not only provide security online file systems but also allow sharing files easy [5]. Users can install desktop application and access Cloud Storage files by dragging and dropping the files into their Cloud Storage folder. Once a user access his/her Cloud Storage files, other computers which also installed the desktop application and links to user's account will synchronize automatically. These types of service are different from the traditional client/server or peer to peer, which only store the files in the storage, has attracted a vast number of Internet users. In the November, 2012, Dropbox has announced that it has reached 100 million users and 1 billion files saved per day. Several studies have proposed new Moodle modules that provide better support for the Moodle assignments module that require teamwork and subsequent processing [6,7]. The authors in [8] proposed an intermediate system called JAssess which is developed to provide a handy way to manage the submission of students' Java programming exercises from Moodle, as well as grading them semi-automatically including

compiling and running the programs, as well as giving marks and feedbacks. Within this system, teachers and students interact with the Moodle system to upload and download Java programming assignments. Teachers are able to evaluate the programs without the need to log out of the Moodle system. Gutiérrez et al [9] proposed a Moodle module that gives support to the practical content of a basic computer organization course. This module goes beyond the mere hosting of resources and assignments. It makes use of an automatic checking and verification engine that works on the VHDL designs submitted by the students. The module automatically keeps up to date information about their state, and significantly reduces the overload that a continuous assessment demands to the teacher.

III. METHOD

To achieve the objectives of this research, we have developed a new Moodle module that integrates Moodle, from one hand, with three of the most popular Cloud Storage Services CSS (i.e. file hosting service) Dropbox [10], Google drive [11] and SkyDrive [12] and, from the other hand, with the most popular SNS, Facebook [13]. The integration between Moodle and CSS offers cloud storage, file synchronization, and client software advantages. CSS offers a free account with a set storage size and allows users to download a special folder on each of their computers. CSS automatically synchronizes the folder content to their servers; therefore, it appears to the user as the same folder (with the same contents) regardless of which computer he/she is used to view it. Files placed in this folder also are accessible through a website and mobile phone applications. Moreover, CSS are safe and secure; thus, even if the user computer crashes, his stuff is always safe in CSS and can be restored in a snap. Moreover, integrating Moodle with Facebook can increase the students' motivation, satisfaction, and interaction among them. Our proposed Moodle module provides three main functions to achieve our goals (see Fig. 1). Following subsections illustrate the functions of our proposed module in details.
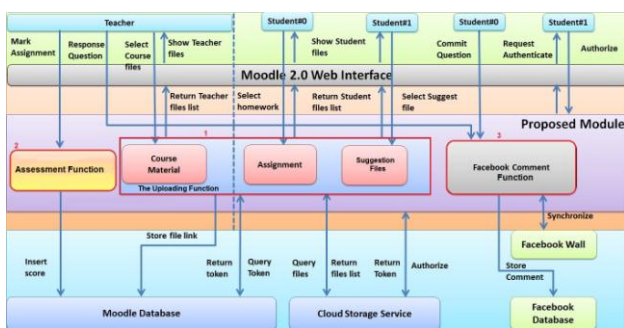

Figure 1.   Overview of the proposed Moodle module

A. The Uploading Function

The uploading function is responsible for covering the file-size limitation in the traditional Moodle module by allowing uploading, in addition to the small-size files, large-size files

without any delay or network failure. This function reduces the storage space needs to store large size-files, and thus decreases the time required to upload those files. As a result, the proposed function, from one hand, reduces the students' and the teachers' efforts when uploading large-size files, and, from the other hand, avoids the bottleneck case that arises when many students uploads several large-size files simultaneously. Practically, this function assists teachers in uploading the course material even a recorded lecture saved as a high definition movie, as well as helps students in submitting and uploading their assignments even large-size ones. In addition, students can use this function to upload some suggestion files such as references books to help other students in completing their assignments or some tips saved as a high definition movie which in turn increases the interaction and the communication among the students. Fig.2 illustrates the concept of the uploading function.
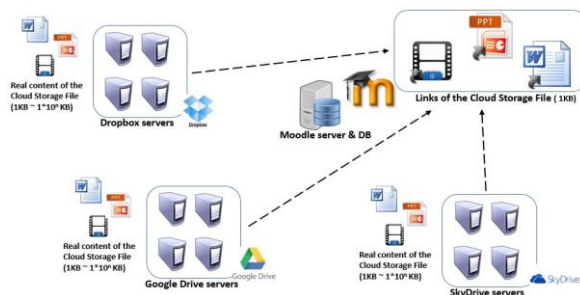

Figure 2.   The concept of the Uploading function

Our proposed Moodle module by integrates the Moodle with the cloud storage services manages and easiest the uploading function. The cloud storage services offer a free account for a user (students and teachers) with a set of storage size, allow users to download a special cloud storage folder on his computer, and allow the user to access these services through a desktop folder, a website and mobile phone applications.

Unlike the traditional Moodle module, where uploading files of different sizes and formats requires performing the compressing task for large-size files and then performing the uploading procedure when the user is online through the Moodle course page for each file separately, that means to upload 10 large-size files, a user has to perform, first, the compressing task 10 times and then the uploading procedure 10 time as well (totally, 20 steps are required). In contrast, to upload several files at a time using the proposed Moodle module, for example 10 large-files, a user has to perform only two steps; first, creating a folder in the cloud storage folder to drop the 10 files into it, and then a user has to go to the Moodle course page to link the created folder with the Moodle course page (totally, only 2 steps are required). Note that, by using our new Moodle module, no more compression tasks are needed even for large-size files. Moreover, the second step to upload files using our module is required only once during the course, at the first time of using our proposed module, that is, to upload additional files, for example 100 files, the user only has to perform one step to drop that 100 files into the created

folder without the need to visit the Moodle course page again and the cloud storage services automatically synchronizes the folder contents. Our proposed Moodle module allows the user to upload the files in the go. Since the cloud storage services are accessible through a desktop folder, a website and mobile phone applications, a user can drop the file using his phone or iPad, even the device is offline, and the changes of the folder content will synchronized automatically when the device comes back online without the need to any additional efforts by the user. Fig.3 shows the sequence chart of uploading a file using our proposed module.
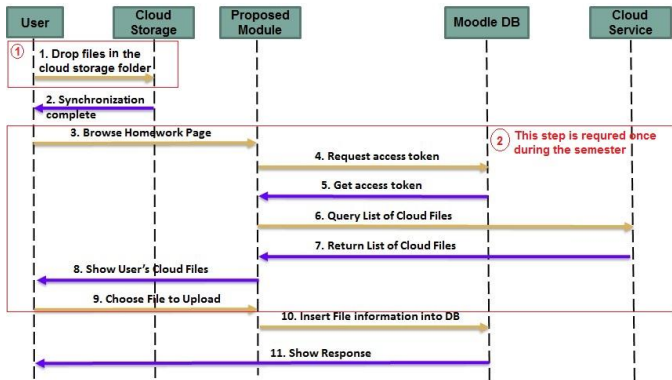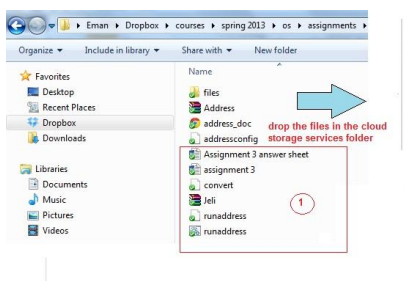

Figure 3. The sequence chart of uploading a file using our module

Moreover, unlike the traditional Moodle module, where modifying a submitted file requires, first, downloading the old file to modify it and then upload it again to replace the existing one. For example, if a student, who have already submitted his programming assignment that consists of 10 files, has to modify the submitted assignment, then the student has by using the traditional Moodle module to download each file separately to modify and then submit each modified file again to replace the existing old one. In contrast, by using our proposed Moodle module, a user (student) can directly open the old file from his cloud storage folder to modify that file and then the existing old file will be updated automatically without the need to visit the Moodle course page to download and replace. Fig.4. shows the steps of uploading files using our proposed Moodle module.

Figure 4. The steps of Uploading files using our Moodle module

B. The Assessment Function

The assessment function aims at helping teachers to evaluate the students' assignments by giving grades and writing feedbacks without the need to download each assignment individually as shown in Fig.5. This function keeps updating the last modification time of the uploaded assignments' files, and stores that time in the Moodle database to help teachers in identifying assignments that are submitted in time and the delayed ones.

Unlike the traditional Moodle module, where a teacher who needs to evaluate the students' assignments has to download separately each assignment to grade and give feedback (Note that by using the traditional Moodle module and because of the file-size limitations, students have to compress their large-size assignments before submitting; therefore, a teacher, in this case, needs also to decompress the assignments first before grading them). For example, to evaluate 100 assignments, 100 download tasks must be performed. On the other hand, our proposed module allows teachers to grade the assignments without the need to perform the downloading task by only clicking on the submitted assignment link to browse that assignment directly via any web browser to check, grade and give feedback. Since our proposed module only stores the link of the folder contains the submitted assignments and not the real files, our module, from one hand, easily retrieves the assignment from the cloud server and browses the assignment via any web browser without the need to download that file every time the teacher needs to check, and, from the other hand, saves the storage space required to store the downloaded assignments. Fig.6 shows the sequence chart of evaluating a student assignment.

Figure 5. The steps of the provided assessment function

Moreover, unlike the traditional Moodle module, where a teacher is restricted with the device in which the assignments were downloaded, our proposed Moodle module, because it support web-browsing, allows the teachers to grade the assignments "on the go" using their PC, laptop, mobile, iPad, etc. without any restriction with using the device in which the assignments were downloaded.
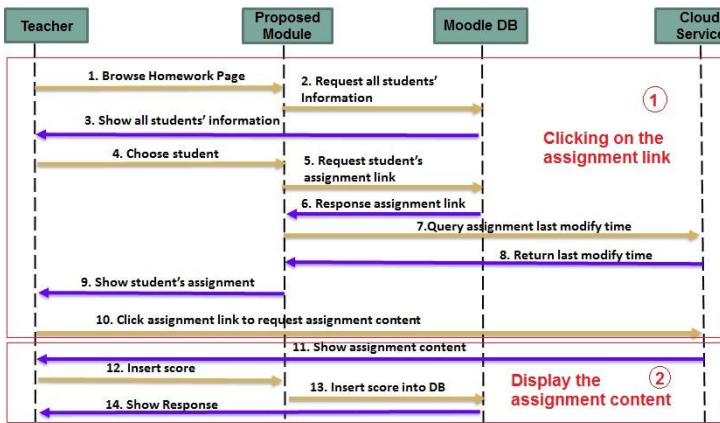
Figure 6.   The sequence chart of evaluating the student assignment

C.   The Facebook-Comments Function

Since we observed that the traditional Moodle discussion module has the lowest rate among the other Moodle modules, we have developed the Facebook-comments function that integrates Facebook with the traditional Moodle module in order to, from one hand, motivate more students to ask questions and to increase the interaction as well as the communication among the students, and, from the other hand, increase the visiting rate of the Discussion Forum Moodle module.

The original Moodle Discussion Forum module is a Moodle module that is separated from the Moodle Assignment module. A student who asks questions about the course, such as questions about the assignments or the exam time, has to leave a message in the Moodle Discussion Forum module. We observed that most of the students pay little attention to the Moodle Discussion Forum and more attention to the course announcements or the assignments announcements as students visit the Moodle Discussion Forum module only if they left questions there; thus, no interaction is happening between students. Consequently, to attract the students viewing other students' questions, our proposed module displays the question about a related topic below the announcement of that topic. For example, if a student asks a question related to the assignment 2, then the question will be appeared below the assignment 2 announcement. Our module also allows the students to publish their questions in their Facebook Activity Feed. Fig. 7 shows a screenshot of the Facebook-comments function. As a result, the interaction among the students will be increased as viewing the questions below the announcement motivate others to answer those questions without the need to visit the Discussion Forum module. Moreover, any question/answer being asked/responded to/from teachers/students will be synchronized to the user Facebook account and thus teachers/students will receive a Facebook notification if any user has posted/ "replied or answered" the question. In other words, if a student asks a question about the assignment via the Facebook-comments function and someone answers it, then the student will get a notification via his Facebook account. Additionally, allowing the students who ask questions using the Facebook-comments function to publish their question to their Facebook account Activity Feed creates more and more interaction since the student Facebook friends, including those who do not register the course can see the questions via Facebook, comment and response. Fig.8. shows the scenario of asking questions via the Moodle Facebook comments function. Technically, integrating the Moodle with Facebook has additional advantage of saving more storage space since all of the comments will be stored in the Facebook database.

Figure 7.   Screenshot of the Facebook-comments function
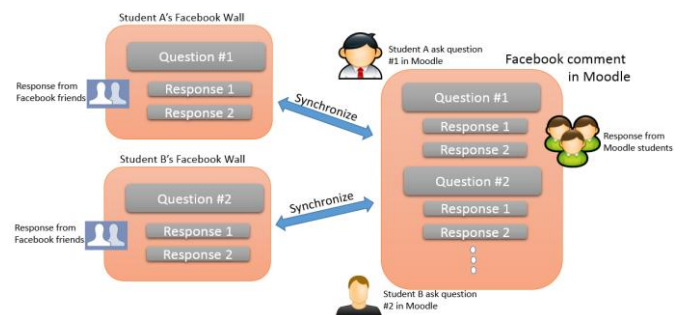

Figure 8.   The scenario of asking questions via the Moodle Facebook comments function

IV.   EXPERIMENTS

A.   Assignments overview

When teaching a course on operating systems, it is normal practice to demonstrate several operating systems topics such as process concurrency, process scheduling, and memory management. For example, one of the required assignments allows a student to run a simulator that helps to experiment with various process scheduling algorithms on a collection of processes and to compare such statistics as throughput and waiting time. Therefore, supported algorithms by this

simulator include First-Come/First-Served, Shortest Job First (actually shortest remaining CPU burst time first), and Round Robin. The CPU and I/O bursts of the processes are described by probability distributions, but it is possible for the student to choose the seed so that the same processes can be used to test different algorithms. The simulator is a Java application that can be run on any platform supporting a modern Java runtime system. The simulator produces log files in HTML format that include tables of data as well as graphs and Gantt charts. In general, a student, for each assignment, has to create, first, a configuration file describing the basic properties of the simulator, create an experiment which consists of a number of experimental runs, run the simulator on this experiment, log the results and, finally, send the related files along with the log file back to the responsible teaching assistant.

Participants: Sample and data collection

To test the proposed Moodle module, a study was conducted using a sample consisted of a set of 159 students and 6 teaching assistants (n=159+6=165), in the department of computer science of National Chaio Tung University, Taiwan, who registered or assisted in teaching the operating system course over one semester from February 2014 through June 2015. Students had to complete three practical assignments and upload it using our proposed module during this course. Regarding the demographic characteristics, the sample included 50 females (30.3%) and 115 males (69.7%). The average age was 25.22 years with ages ranging from 20 to 30 years and a standard deviation of 4.589.Regarding the educational level, the sample consisted of 12 (7.2%) undergraduate students, 95 master students (57.58%) and 58 (35.15%) PhD students. Regarding the participants practical experience, the sample consisted of 108 students who have previous experience with cloud storage services, 95 students who have experience with Moodle, 51 students who have not previous experience with cloud storage services, and 64 students who have no experience with Moodle. Moreover, the sample consisted of 5 teaching assistants who have previous experience with cloud storage services, 3 teaching assistants who have experience with Moodle, 1 teaching assistants who have not previous experience with cloud storage services, and 3 teaching assistants who have not experience with Moodle.

The experiment Procedure

At the beginning of the course, the students were introduced to both the teaching platform, including our proposed Moodle module and the course practical assignments, including a sample simulation tool. Our proposed Moodle module provided three significant functions, for both teachers and students, to upload the course material by teachers/ teaching assistants, submit the assignments by students, evaluate the assignments along with a way to increase the communication and the interaction among students during the semester when the operating system course was taught.

The teaching assistants provide the students with a very precise description of the assignment, documentation about the simulation tool, and user-manual about the functions provided by our Moodle module. Moreover, the students were provided with a precise description of the cloud storage services supported by our module, Dropbox, Google drive, and SkyDrive, that will assist the students in submitting their assignments along with all the assignments related files without consuming their time and efforts. Each student who registered the operating system course in the time of the experiment was asked to create a free cloud storage service account. In fact, most of the students had an account before registering the course. In the Moodle course page, they find the full specification and objectives, the deadline, and a description of the documentation to generate. In addition, students who have questions were encouraged to ask their questions using the proposed Facebook-comments function offered by our proposed module. At the end of the semester, a system usability questionnaire was developed and administered to participants in the classroom. All students who registered/assisted in teaching the operating system course completed and returned the questionnaires. Before carrying out the survey, all participants received instructions. The activity was performed by respondents with the support of, at least, one teaching assistant to assist respondents during the process and, in case of need, further explain questions and procedure.

V. RESULTS AND DISCUSSIONS

A. Usability Evaluation

The principal factors proposed by [14, 15] were used for designing a questionnaire to evaluate the usability of the proposed Moodle module along with its three main functions. The questionnaire consisted of 10 questions based on factors of appeal, ease of use, content, ease of learning and support. The questions are listed in table 1 with 6 (0–5) agreement degrees ranging from "strongly disagree" to "strongly agree". This questionnaire was used to survey the 165 participants who registered or assisted in teaching the operating system course over one semester from February 2014 through June 2015.

TABLE I. QUESTIONS INCLUDED IN THE SYSTEM USABILITY QUESTIONNAIRE

Category	Questionnaire questions	Average degrees of Agreement
Appeal	1. I am willing to use the new Moodle module frequently.	4.32
Ease of use	2. I can easily find the buttons that I need every time.	4.21
Ease of use	3. This new Moodle module is easy to use. Thus, I don't need professional to help when I use the module functions.	4.25
Content	4. All the functionalities are well-integrated in this module.	4.11
Content	5. The new module motivate me to interact and communicate with the students.	4.33
Content	6. I prefer asking questions using the Facebook-comments function rather than using the traditional Moodle module.	4.13
Content	7. The uploading function provided by the proposed module are more convenient and faster than the traditional Moodle module.	4.57
Content	8. The assessment function provided by the proposed module are more convenient and faster than the traditional Moodle module. (for the Teaching assistants only)	4.44
Performance	9. The functions provide by the proposed module are straight-forward.	4.31
Ease of learning	10. Most people can learn how to use the new Moodle module very quickly.	4.22
Support	11. The system can do what I thought it could do.	4.48
Support	12. I feel very confident of using the system	4.49
Support	13. The new proposed Moodle module saves my effort and time.	4.52
Support	14. The assessment function saves my time. (for the Teaching assistants only)	4.32

The advantages of using the cloud storage services (CSS) and the social network services (SNS) led us to infer that the integration between the Moodle LMS and both the CSS and SNS services would support the traditional Moodle module features and cover the traditional Moodle weaknesses, lack and limitations. The findings were consistent with our hypothesis. Table 1 shows that the overall degree of agreement was satisfactory and the highest average degree of agreement appears in questions 7, 11, 12 and 13. These results indicated that the uploading function provided by our proposed Moodle module helps both teachers and students to easily complete the uploading task as well as saves their effort and time. The importance of our proposed module appears when a user has to upload several large-size files to the Moodle course page. Since the student or the teacher, who has to upload several files to the Moodle course page, can create a folder in the cloud storage service folder and link it (i.e. first time to use the function, once during the semester) with the Moodle course page to drop those files into it. Thus, any addition, deletion, or modification on the folder content automatically gets synchronized. Moreover, if any work is conducted on the linked folder while the device was offline, then changes will synchronize automatically when the device comes back online. In other words, no need to visit the Moodle course page every time a student/a teacher needs to upload a new file, delete a file or replace an existing one which save the user time and effort.

Moreover, results implied that the proposed module was easy to use, and the participants did not require professional help when using the proposed Moodle module since participants, in fact, were highly familiar with the traditional Moodle module and the proposed Moodle module functions were straight forward. Also, the reason behind these results was that the responsible teaching assistant had taught the other teaching assistants how to use the new Moodle module and the students were provided a very precise description about the new module and its functions.

Results demonstrated that the Facebook-comments function, which integrates the Facebook social network service with the Moodle and display the questions below the related course announcement, motivate students to ask questions, increase the interaction and the communication between the students. Using the Facebook, from one hand, helps the teachers to easily observe the questions being asked by the students as any posted question on the Moodle course page will appear to the teacher as a Facebook notification and, from the other hand, helps the student who asked that question to notice the response as any posted response about the question will also appear to the student as a Facebook notification. In other words, no need to keep visiting the Moodle course page to check any question/response. Another advantage of our proposed function is allowing the students to publish their questions on their wall or timeline which in turn gives the opportunity for the student's friends to participate with the discussion. Moreover, since the students focus on the course announcements when visiting the Moodle course page, we have observed that providing the questions related one course announcement below that announcement, such as an exam announcement, attracts and motivates more students to participate on the discussion as the question will appear to them directly without the need to visit the traditional discussion Moodle module.

The questionnaire contains some questions that only appeared to the teacher and the teaching assistants to evaluate the assessment function. Results showed the teaching assistants were satisfied with the assessment function to grade the students' assignments and give feedback. These results were

not surprised as the proposed function provided by our Moodle module covers the lack of the traditional Moodle module in supporting web-browsing. Therefore, this function assists the teachers to grade the assignments directly via any web browser without the need to upload each assignment separately which, from one hand, saves their efforts and time in downloading each assignment separately, and, from the other hand, allows them to grade the assignments "on the go" using their PC, laptop, mobile, iPad, etc. without restrict them on using the device in which the assignments were downloaded.

B. Storage-Space comparison

A storage-space comparison between our proposed new Moodle module and the traditional Moodle module is shown in Table 2. In order to store only the assignments for students who registered the operating system course excluding lecture slides, recorded lectures, etc., 56.88 MB (Megabyte) are totally needed via the traditional Moodle module while only 1.27 MB are needed by using our proposed new Moodle module. In other words, using our proposed new Moodle module saves at least 55.61 MB storage-space (97.77% storage-space will be saved).

TABLE II.   STORAGE-SPACE COMPARISON

Assignments	Storage Space for Traditional Module(MB)	Storage Space for Proposed Module(MB)	Saved Storage Space (MB)
HW1	10.06	0.53	9.95
HW2	29.71	0.29	29.42
HW3	17.11	0.45	16.66
Total	56.88	1.27	55.61

Table 3 shows the number of courses offered at National Taiwan University over 10 years, from 2003 through 2012, with the storage space that can be saved each year by using our proposed new Moodle module. As shown in column 3 of table 3, our proposed new Moodle module has the capability to save at least 1 TB (Terabyte) storage-space every year. Note that, 1 Terabyte is equal to 1048576 Megabyte.

TABLE III.   COURSE COUNT OF NATIONAL TAIWAN UNIVERSITY AND STORAGE SAVED

Course Count of National Taiwan University		
Year	Course Count	Saved (GB)
2003	17,526	981
2004	18,708	1048
2005	18,807	1053
2006	19,312	1081
2007	19,773	1107
2008	19,999	1120
2009	20,497	1148
2010	20,928	1172
2011	21,117	1183
2012	21,202	1187

VI.   CONCLUSION

In this paper, we proposed a new Moodle module that integrates the traditional Moodle module with three of the most popular cloud storage services, Dropbox, Google drive and SkyDrive, and the Facebook social network service to cover its weakness and limitations. The new Moodle module provides three main functions that are: the uploading function, the evaluation function and the Facebook- comments function. The module provides a straightforward uploading-function to allow, with only few seconds, uploading several large-size files simultaneously without any restriction on the files-size. The new module also offers an assessment-function that supports the web browsing of the files being uploaded to assist teachers, without the need to download and save each assignment separately, in checking and grading the submitted assignments directly via any web browser. The new proposed module also integrates the Moodle with Facebook to increase the visiting rate of the traditional discussion Moodle module; thus, increasing both the students' motivation to ask questions and the interaction among the students. The usability as well as the performance of the new module were investigated and promising results were obtained.

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