Evaluation report on usage and impact of integrating mobile learning with Moodle on learning and teaching across four faculties in HKU

A report in TDG project "Enhancing Teaching and Learning through Integrating Mobile Learning with Learning Management System"

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A) Background

Learning management systems (LMS) are Web 2.0 applications incorporating rich multi-media resources and a variety of educational activities, including providing online platforms for group discussion, uploading course materials, and grading assignments, etc. LMSs have been widely adopted in higher education, offering various tools that support educators' instructional tasks and students' learning activities (Schoonenboom, 2014). Francis and Raftery (2005) defined three levels of LMS usage. The first level is for depositing materials and distributing information. The second is for enhancing teaching and learning by using various tools in LMS for assessment, communication and collaboration. The third and highest level is for supporting fully fledged online courses where much of the learning takes place on the LMS itself. The use of the LMSs for a majority of students was still at the lowest level, i.e., for accessing learning materials and checking course announcements (Carvalho, Areal and Silva, 2011). It was shown that participating in course forums, course chatrooms and taking tests were the less frequently used functionalities. LMS has been primarily used as a repository of contents, assignments and other online resources shared by students and instructors (Susana et al., 2015). In short, the uses of an LMS such as Moodle might not be realized at its full potential.

Following the growing popularity of handheld mobile devices, more staff and students in higher education are in possession of mobile devices such as smartphones. A survey on mobile devices in academic libraries in Hong Kong and Singapore revealed that 93.4% of Hong Kong university students owned a mobile phone, while 61.9% used smartphones to access the Internet (Ang, 2012). Students' use of mobile devices to engage with materials online has become more and more common (Peters, 2007), and previous studies on mobile learning (m-learning) have offered reassuring results on the use of mobile devices for supporting teaching and learning (e.g., Kennedy et al., 2008, Rath et al., 2015). M-learning has also been shown to provide opportunities for building a learning community, interactions and collaboration among students (Donaldson, 2011).

Moodle, an open-source software LMS, has been registered in over 1,800 sites, is present in more than 193 countries, and available in 60 languages around the world (Celik, 2010; Hajjar, 2014). Moodle is also the main LMS adopted in the University. The Moodle installation offers a Mobile Theme, a customized display for browser screens of smartphones. This Mobile Theme is also referred to as 'mobile Moodle' in this report. Except for the display, all functions in Moodle can be accessed through the Mobile Theme. In other words, students can use the Mobile Theme to

view course content, submit assignments and access various Moodle activities including Forums, Choice, Feedback, Quizzes, Wikis, and so on.

Being part of the project titled "Enhancing Teaching and Learning through Integrating with Learning Management System" funded by the Teaching Development Grant, this report aims to evaluate and thus compare the usage and impact of integrating mobile learning with Moodle on learning and teaching across four faculties in HKU.

B) Methods

Participants and Procedures

Nine courses from four different faculties at HKU were involved: Education, Engineering, Humanities and Arts, and Social Sciences. For Education, there were two undergraduate major courses taught by an instructor and two postgraduate-level courses taught by another instructor. For Engineering, the course was a Common Core course co-taught by a professor and five teaching assistants. For Humanities and Arts, there were three elective courses taught by the same instructor from a foreign language department. For Social Sciences, there was a large-size foundation course taught by one instructor.

A mixed method approach was employed for the evaluation, collecting both survey and interview data. Data collection was conducted towards the end of the fall semester of the academic year 2015 – 2016. A total of 316 valid responses were collected from students of the nine courses. These questionnaire responses were collected partially online (n = 71) and partially on paper (n = 245); all administered by the same research staff for the sake of consistency. After collecting the survey data, emails and course Moodle announcements were used to invite survey respondents to participate in follow-up interviews. 26 attended the interviews among which 12 were conducted face-to-face and 14 of them through phone calls. Each interviewee was paid HK$25 for their participation. In addition, after the end of every participating course, each of the nine instructors also took part in an interview to reflect on their design and implementation of LMS activities and pedagogies and how these could enhance teaching and learning. Interviews with students and instructors were used to obtain additional findings to supplement the questionnaire results.

Instruments

This study used a questionnaire that asked about students' experience of using Moodle through computer and mobile access of the selected courses. Prior to filling in the questionnaire, students were reminded that they should base their responses on the use of Moodle in the particular course, instead of using Moodle in general. The questionnaire asked students to report their frequency of using different categories of Moodle activities via computer and mobile access, with multiple-choice responses in a 7-point Likert scale, from 1 ("never") to 7 ("several times a day"). Regarding the student interviews, a semi-structured interview protocol was designed to elicit students' further elaboration on their Moodle usage experience and opinions. It contained questions such as "Why would you (not) access Moodle of this course with your mobile device?". For the teacher interviews, another semi-structured interview protocol was developed, comprising questions such as "What did you do to encourage your students to use Moodle of your courses?".

C) Results

Questionnaire responses

Table 1 shows the statistics of students' self-reported usage of Moodle via mobile phones. Access to learning resources was the most frequent activity, while collaborating with other students was the least frequent.

Moodle uses	N	Minimum	Maximum	Mean	Std. Deviation
accessing resources	316	1	7	3.86	1.586
submitting assignments	316	1	7	2.31	1.697
taking tests	315	1	7	2.33	1.622
Interaction	315	1	7	2.26	1.583
collaboration	316	1	7	2.17	1.573

Table 1. Descriptive statistics of frequency of Moodle usage via mobile phones (1 – "never", 2 – "Once a month or less", 3 – "Once every 2 weeks", 4 – "1-2 times a week", 5 – "3-6 times a week", 6 – "Once every day", and 7 – "Several times a day")

Statistics across disciplines (represented by Faculty) are presented in Table 2. In each discipline, similar to overall results, resource access was still the most frequently accessed Moodle use. This implies that students from all disciplines mostly used their mobile devices for obtaining learning resources rather than other uses. As the data are in the ordinal scale, the non-parametric Kruskal-Wallis test was used to compare the usage frequencies of mobile Moodle across disciplines. Statistically significant differences across disciplines were found in all five Moodle uses (Table 2).

Moodle uses		Humanities and Arts	Education	Social Science	Engineering	Sig. Kruskal-Wallis
accessing resources	N	56	94	72	94	.000**
	Mean	4.14	4.01	3.15	4.09	
	Median	4.00	4.00	3.00	4.00	
	SD	1.50	1.76	1.37	4.46	
submitting assignments	N	56	94	72	94	.000**
	Mean	2.34	2.09	1.56	3.06	
	Median	1.00	1.00	1.00	3.00	
	SD	1.83	1.69	1.20	1.67	
taking tests	N	56	94	71	94	.000**
	Mean	2.18	2.04	1.48	3.35	
	Median	1.00	1.00	1.00	4.00	
	SD	1.72	1.49	1.08	1.53	
interaction	N	56	94	72	93	.000**
	Mean	2.25	2.30	1.54	2.78	
	Median	2.00	2.00	1.00	2.00	
	SD	1.64	1.56	1.20	1.64	
collaboration	N	56	94	72	94	.000**
	Mean	2.20	2.13	1.53	2.70	
	Median	1.00	1.00	1.00	2.00	
	SD	1.72	1.60	1.17	1.57	

** indicates significance level at $p < 0.01$.

Table 2. Statistics of frequency of Moodle usage via mobile phones across disciplines

A follow-up pairwise comparison reveals that there existed significant differences between results from the Social Sciences course and those from the Engineering course in all the five categories of Moodle usage. Comparing results of the two disciplines, Engineering students' frequencies of Moodle usage via mobile phones for the four non-repository uses (i.e., assignment submission, test-taking, interaction, collaboration) were all higher than Social Science students. Another significance was identified in the frequency of using mobile Moodle for taking tests between the Engineering course and Education courses.

In the participating courses, students used both computer and mobile access to Moodle. Table 3 presents the statistics of frequencies of Moodle usage via mobile phones and that via computer. To compare the statistics of frequencies via both modes of access, Mann-Whitney U tests were carried out for questionnaire results from each discipline. A statistically significant difference here implies that one mode of access was more frequently adopted than the other, while a lack of significant difference can be interpreted in two ways: either both modes were frequently used or neither mode was frequent. The general trend is that computer access outweighed mobile access in terms of Moodle access frequencies for all Moodle uses. In particular, there was a significant difference between frequencies of the two means of access for all Moodle uses in the results from Education courses. Students were more inclined to use their computer to access Moodle for different uses than using their mobile phones.

Moodle uses		**Humanities and Arts**			**Education**			**Social Science**			**Engineering**		
		Computer	**Mobile Access**	***p***	**Computer**	**Mobile Access**	***p***	**Computer**	**Mobile Access**	***p***	**Computer**	**Mobile Access**	***p***
accessing resources	N	55	56	.020*	94	94	.000**	72	72	.000**	94	94	.027*
	Mean	4.80	4.14		5.53	4.01		4.50	3.15		4.66	4.09	
	Median	5.00	4.00		5.00	4.00		4.00	3.00		4.00	4.00	
	SD	1.22	1.50		1.08	1.76		1.02	1.37		.979	4.46	
submitting assignments	N	56	56	.000**	94	94	.000**	72	72	.000**	94	94	.000**
	Mean	3.57	2.34		4.10	2.09		2.31	1.56		4.30	3.06	
	Median	3.00	1.00		4.00	1.00		2.00	1.00		4.00	3.00	
	SD	1.52	1.83		4.42	1.69		1.47	1.20		.993	1.67	
taking tests	N	56	56	.005**	94	94	.000**	72	71	.037*	93	94	.000**
	Mean	2.95	2.18		2.87	2.04		1.83	4.48		4.31	3.35	
	Median	3.00	1.00		2.00	1.00		1.00	1.00		4.30	4.00	
	SD	1.71	1.72		1.59	1.49		1.31	1.080		.932	1.53	
interaction	N	56	56	.003**	94	94	.000**	72	72	.074	94	93	.198
	Mean	2.96	2.25		3.81	2.30		1.76	1.54		3.06	2.78	
	Median	3.00	2.00		4.00	2.00		1.00	1.00		3.00	2.00	
	SD	1.54	1.64		1.37	1.56		1.25	1.20		1.57	1.64	
collaboration	N	56	56	.121	94	94	.000**	72	72	..342	94	94	.001**
	Mean	2.59	2.20		3.56	2.13		1.71	1.53		3.53	2.70	
	Median	2.00	1.00		4.00	1.00		1.00	1.00		4.00	2.00	
	SD	1.75	1.72		1.38	1.60		1.27	1.17		1.52	1.57	

* indicates significance at $0.01 < p < 0.05$ and ** indicates significance level at $p < 0.01$.

Table 3. Comparison of statistics of Moodle usage frequency between means of access

Themes from interviews

Twenty-three out of the twenty-six (88.5%) interviewed students responded that they used their mobile phones to access the Moodle page of courses. Table 4 presents the several representative quotes from students' responses in interviews, categorized by the different uses of Moodle through mobile access. Students tended to opt for resource access when they used Moodle with their mobile phones, where they usually 'viewed' certain general information (e.g. announcements posted by the instructor, course syllabus) or retrieved learning materials (e.g. 'reviewing' lecture content). As for other uses, participation in forums and doing online quizzes were the two frequently mentioned Moodle activities via mobile access. However, some students did not prefer using mobile access to Moodle for such uses mainly due to slow 'loading' or difficulty in 'typing words'. Aside from forum participation and test-taking, students would access Moodle using their mobile devices to check for information related to assignments (e.g. deadlines, location for assignment submission) and quizzes (e.g. test coverage).

Themes	Quotes from interviewees
Resource access using Mobile Moodle	"*Sometimes, when I received a text message [from a friend] that the teacher has posted new **announcements** about assignments and I would then use my [mobile] phone to access Moodle.*" "*I would use the mobile phone to access Moodle when I am going to school or going home, for **reviewing the lecture content** or preparing for class.*" "*When we needed to look at each other's work or to **check the course syllabus**, [we would use mobile access to Moodle]. These tasks were fast.*" "*Normally, I would use mobile access [to Moodle] for **viewing information** but not for working.*"
Other uses of Moodle via mobile access	"*[I would seldom use mobile access to work on an assessment task on Moodle] unless the task is simple, for example, doing an **online MC quiz**.*" "*I was able to do [online] **quizzes** [using mobile access to Moodle] and it was really time-efficient.*" "*When there is a **forum task** and there is not enough time, my classmates would work on it using their mobile during transportation.*"

Table 4. Themes from Interviews with Students

Students were divided as to their preference towards using mobile access to Moodle for uses other than accessing resources. Nonetheless, most of them in general expressed negative opinions about using mobile phones when accessing Moodle. Table 5 displays various aspects of limitations brought about by mobile access to Moodle, generalized from students' comments.

When asked the circumstances under which mobile access to Moodle would be used, a majority of students associated their responses first with computer access, either using their own personal laptop computers or the desktop computers on campus. They would use their mobile phones to access Moodle when computer access was not available. For instance, when they did not have their

laptop computer for various reasons (e.g., too heavy to bring along), they would resort to mobile access since they always carried their mobile devices with them. If they brought their laptop but it was troublesome, not feasible or even impossible to use it in certain situations (e.g. during transportation), they would then find mobile access to Moodle useful and convenient. Desktop computers were available for temporary usage on different locations of the campus, such as the library and classrooms. An example was that the Education students attended lessons in classrooms equipped with computers. According to the interviewed students, mobile access to Moodle would come in handy when these on-campus computers were occupied. Generally, students treated mobile access to Moodle as a back-up option to computer access.

Aspects of Limitations	Issues reflected in students' comments
Moodle display	• Low reliability of access due to mobile display of Moodle page (i.e., Mobile Theme of Moodle) • Too many columns on Moodle page
Device	• Limited mobile storage for downloading large-size files (e.g. notes, PowerPoint Slides, etc.)
Usability	• Small phone screen leading to difficulty of pressing buttons • Small keyboard increasing risk of accidentally quitting Moodle
Functionality	• Browser version causing inconvenience compared to native App • Failure of command execution in certain Moodle activities (e.g. posting a comment on a forum) • Need to log-in repeatedly after refreshing

Table 5. Limitations of mobile access to Moodle

D) Discussion

Findings from both the survey and interviews indicate that students used their mobile phones to access Moodle for accessing learning resources more frequently than for other uses (e.g. interaction, collaboration). This reflects that the use of mobile access to Moodle remained at the lowest level of LMS usage as suggested by Francis and Raftery (2005). Moreover, depositing learning materials is the most popular usage of Moodle across courses in this study, similar to the prominent LMS feature 'Content' reported in Antonenko et al. (2013). This indicates that the potential of Moodle usage was only realized in terms of the increased access to course content but not in other aspects (Mullinix & McCurry, 2003). For instance, students accessed Moodle using their mobile devices to download and read online learning materials when they were commuting to and from campus or when computer access was not available. They also viewed general course-related information on their mobile under the same circumstances.

Considering the result that computer access was preferred over mobile access, this implies that possessing a smartphone did not necessarily mean students would access Moodle frequently via mobile access. Moreover, limitations arising from the device itself and various usability issues still curbed students' usage of mobile access to Moodle for resource access, such as the failure to

download learning materials despite good Internet connections, and inconvenience of reading the whole PowerPoint presentation on a small screen. To promote mobile access to the LMS, the interface and functionality of the mobile version (e.g., Mobile Theme of Moodle) should be improved to expand the functionality, remove the existing issues, and increase the ease-of-use. This evaluation shows that one of the most effective methods to accomplish these aims is through a dedicated mobile application for accessing LMS functions.

In spite of the higher access frequency for the repository use, some students did access Moodle using their mobile for taking online quizzes. Students complimented the efficiency resulting from using their mobile devices to do quizzes on Moodle. A minority of students even specifically remarked that using a computer access to Moodle would in fact restrict where they were able to access Moodle, whereas the convenience of mobile access lies in its availability regardless of the place. Also, being under time constraints also prompted students to use Moodle via mobile access for interaction, such as contributing to forums. Still, there are limitations of mobile Moodle imposed by several usability issues. First is the small screens of mobile phones which students were unable to adapt to, especially when accessing Moodle to submit assignments, which is more usually done on a computer. Another related issue is the small keyboard that can cause students to type less, or even completely remove students' desire to type in tasks that required inputting words. This also explained why students' mobile access to Moodle for interaction was relatively less frequent, since interactive Moodle activities such as forums and Quickmail always require input of words. Similar to what Hu et al. (2016) suggested, students felt more comfortable when conducting simple and low-stakes tasks with mobile access to Moodle.

Mobile learning offers students opportunities for interactions and collaboration (Donaldson, 2011). This is parallel with the corresponding uses of mobile Moodle, as exemplified by interactive and collaborative Moodle activities such as Discussion Forums and Wikis. Yet, when accessing Moodle with mobile phones, students disliked inputting words using the phone keyboards and this excluded them from enjoying the benefits of mobile learning through mobile access to Moodle. Despite that, students' tendency to access mobile Moodle for resource access reveals that the integration of Moodle and m-learning can be an emerging direction as shown from the results of this study. There are numerous perspectives characterizing m-learning. M-learning is an extension of e-learning that takes place anytime and anywhere with the help of a mobile communication device (Kadirire and Guy, 2009), whereas another perspective (e.g., O'Malley et al., 2005) asserts that m-learning is any sort of learning when the learner is not at a fixed and predetermined location. Regardless of whichever uses of mobile Moodle were concerned, being able to fulfil learning objectives whenever and wherever necessary was amongst the dominant motivating factors driving students to access courses' Moodle pages using their mobile phones.

M-learning is also present when the learning activity "allows an individual to be more productive when consuming, interacting with, or creating information, through a compact digital portable device that individual carries on a regular basis" (Wexler et al., 2008). In this sense, mobile access to some Moodle activities including Announcements and Quizzes did demonstrate the effectiveness of integrating m-learning with LMS as it raised students' productivity in achieving

their context-specific objectives (i.e., carrying out a task during transportation) in the process of learning when compared to using computer access.

E) Conclusion

This project evaluated the usage patterns of mobile Moodle across four faculties at HKU. In general, students tended to use mobile access to Moodle more frequently for viewing course-related information and retrieving materials. Although various other Moodle activities (e.g. Forums) were less frequently accessed, some students still reported the advantage of mobile access to Moodle usage as being able to fulfil an instantaneous need regardless of time and location. Interestingly, findings also showed that mobile access to Moodle always served as a back-up option to the primary means, computer access, where mobile Moodle came in handy especially when computer access was either unavailable or less efficient for a specific task to be done in a certain context, such as attempting a Moodle quiz on a transport. Ultimately, instructors should take the lead to fully utilize LMSs to facilitate the teaching and learning of their courses. This report supports the efficacy of utilizing low-stakes assessment items to improve student engagement and utilization of LMS systems. Further investigation could be done to obtain students' perceptions towards Moodle and their opinions on using Moodle for learning.

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