Library and Learning Experiences Turned Mobile:
A Comparative Study between LIS and non-LIS students

Lau KSN, Lo P, Chiu DKW, Ho KKW, Jiang T, Zhou Q, Percy P, Allard B

Abstract

The rapid developments of wireless telecommunication networks and the widespread increase of smartphone ownership around the world have created tremendous impacts on the services provided by institutions of higher education worldwide on several dimensions. Unarguably, mobile technologies have created new and unforeseen opportunities for educators, information services providers and students to experience the new horizon of teaching, learning, as well as knowledge transfer and creation. Taking into consideration that since Library and Information Science (LIS) students are training to become future LIS professionals, they are expected to be ready as well as active in integrating mobile technology into their daily learning practices.

This study was set up to examine two groups of students (namely: LIS versus non-LIS students) at Peking University – their attitudes and level of activeness in adopting mobile technology in their daily life, as well as in their learning practices. Quantitative questionnaire survey was used for data collection, and a total number of 319 responses (i.e., LIS, 63 and non-LIS, 256) were collected from this study. Findings of this study reveal that no significant differences were found between the two student groups (LIS versus non-LIS) in many areas. In fact, both LIS and non-LIS student groups were using their smartphones to engage in different learning, research, social networking, pastimes, and recreational activities on similar level. However, it was concerning to note that the LIS student group was slightly less active in accessing the online services and resources provided by their university library. This was a particular finding that went against the researchers' original anticipation. However, such unexpected finding did not mean that these LIS students were necessarily less active or 'open' as mobile learners. For the reason that in comparison to their non-LIS counterparts, they were equally as active as in terms of using their mobile devices for other learning (particularly collaborative learning) and research purposes. Further studies are recommended to determine various factors that are hindering these LIS students from using the university library's online resources and services on a more active level.

Introduction

Mobile devices (e.g., smartphones, tablets, and notebooks, etc.) are characterised by their small size, as well as their notable convenience (portability), affordability, and versatility. Today, mobile technology has become an integral part of our daily life and have undoubtedly revolutionized the way people connect and interact with the world, ranging from satisfying our instant information needs to allow both online and offline viewing for a variety of social networking, recreational, entertainment, as well as educational purposes. The learning process in which the leaner makes use of such mobile technology is usually referred to as "mobile

learning." Mobile learning or m-learning can also be defined as "learning across multiple contexts, through social and content interactions, using personal electronic devices" (p. 4).

The rapid developments of wireless telecommunication networks and the widespread increase of smartphone ownership worldwide have created tremendous impacts on the services provided by different types of institutions on several dimensions (Idris, Florence Olutunu, & Ayodeji, 2018). In fact, education institutions of different levels have been moving towards a greater reliance on e-learning or mobile learning (m-learning) (Abdul-Gader, 1996; S. Y. Park, Nam, & Cha, 2012). Mobile technologies have created new and unforeseen opportunities created for both educators and students to experience the new horizon of teaching, learning, as well as transferring knowledge (Mioduser, Nachmias, Lahav, & Oren, 2000). In the context of higher education, mobile technology allows university students to consume, learn, and make use of different online educational resources (including library services and resources) in a manner that is unforeseen by many educators as well as librarians of past generation (Chapman, 2012; Donaldson, 2010; Henderson, 2012; Ko *et al*., 2015; Tran & Glowatz, 2014; (Henderson & Chapman, 2012; Prieto, Migueláñez, & García-Peñalvo, 2015; Sharples, Arnedillo-Sánchez, Milrad, & Vavoula, 2009). For example, in addition to taking both formal and informal learning on-the-go, such portable technology has also brought in many other additional advantages, such as enabling libraries to create new forms of services and strengthening relationships with the end-users, in addition to reaching out to a greater number of new users (Hahn, 2008). The combination of mobile library services, virtual librarians, mobile patrons, and digital contents have created new and ground-breaking opportunities for libraries and their services to shift from having a fixed location to an increasingly pervasive, flexible, versatile, and global service model (Barnhart & Pierce, 2011; Dukic, Chiu & Lo, 2015; Fung *et al*., 2016; Ko *et al*., 2015; Lo *et al*., 2016; Shuk *et al*., 2016; Wang *et al*., 2016).

Seeholzer and Salem (2011) reported that students expressing increased interests in using their mobile devices to access online library sources and services provided by their university library – a finding that went beyond what the researchers had originally expected. Results of this study also indicate that students were keen on using their smartphones for searching databases and the library catalogue, as well as staying informed by the library staff (Seeholzer & Salem, 2011). However, despite the convenience brought by such mobile technology, students would be interested in mobile library services only when they could actually see the need, or when the benefits are obvious to them (Walsh, 2012).

Library and Information Science (LIS) students are training to become future LIS professionals, hence "[they] must not only be aware of diverse information needs, but ensure those needs are met… they must "be open to using technology in new and creative ways, but at the same time, be motivated by the values that we have traditionally focused on," said Linda C. Smith (School of Information Sciences, University of Illinois). As such, mobile learning and mobile library services are particularly crucial for LIS students, who, as future librarians, are likely to be expected to design and/or actively deliver library resources and services in a variety of digital formats. For this reason, understanding current LIS students' mobile learning practices and their level of mobile library usage is important could undoubtedly provide insights into this group of soon-to-be LIS professionals – their openness as well as their professional readiness in adopting such mobile technology in their future workplace. Furthermore, like all university students, Library and Information Science (LIS) students also use university libraries, as well as their resources and services online. Meanwhile, LIS students as mobile library users have been scarcely studied. Taking into consideration that such mobile technology and their impacts on LIS students' daily life, as well as their future careers as LIS professionals, the question arises to what extent LIS students are ready to integrate mobile technology into their daily learning practices, in comparison to students of non-LIS disciplines of the same university.

Aims of the Study

This study aimed at examining a group of LIS students at Peking University -- *their online learning practices*, information needs, interpersonal communications, as well as social networking habits, in particular, to what extent they were accessing the online library resources and services via the use of their mobile devices. This study was set out with the belief that LIS students would engage in a higher level of mobile library usage, particularly in areas related to access library services and resources via their mobile devices online. In order to highlight LIS students' unique online learning practices and information needs, this study was set out to compare and contrast the ways LIS and other non-LIS students used their mobile devices for a variety of academic purposes. This study was guided by the following research questions:

RQ1.   To what extent are these LIS students integrating mobile technology into their daily learning practices, in comparison to other non-LIS students at PKU?

RQ2.   To what extent are these LIS students are using mobile technology for accessing resources and services provided by their university library, in comparison to other non-LIS students?

RQ3.   To what extent are these LIS students using mobile technology for social networking on a daily basis, in comparison to other non-LIS students at PKU?

RQ4.   To what extent are these LIS students using mobile technology for different recreational and entertainment purposes, in comparison to other non-LIS students at PKU?

Methodology and Data Collection

For this study, a self-administered online questionnaire survey was used as the main and only method for data collection. The questionnaire survey was conducted online with the students currently studying at Peking University (PKU). PKU was chosen for this study because it has a long-standing reputation as offering the best LIS programs in Mainland China and is also a member of the iSchools consortium.

Online questionnaire survey was chosen for data collection for this study, as it can be an effective means of measuring the students' actual usage patterns, behaviours, opinions, preferences, attitudes, and intentions of a relatively large number of subjects efficiently, but far less expensive and labour-intensive to administer, in comparison to other qualitative methods (e.g., face-to-face or online interviews, etc.). Since this study aimed at measuring PKU students' mobile learning practices and their mobile library usage patterns with a relatively large study population, the researchers considered the questionnaire to be most suitable for this study.

Survey data was collected via online questionnaire tools. No paper-based questionnaire was used for this study. The original questionnaire was in English and was subsequently translated into Chinese for the purpose of conducting this survey at PKU. The questionnaire was deployed with online survey platforms, WJX (https://www.wjx.cn/) (an alternative in Mainland China as Google is blocked). After the pilot testing, the researchers sent out the online

questionnaire URL to all PKU students via WeChat (a multi-purpose messaging, social media app developed in Mainland China) to call for participation, a follow-up reminder was sent out four weeks later after the first call. Online questionnaires were made available to all respondents at PKU from 1st October to 31st December 2015. The collected data was analysed with the use of SPSS (Statistical Package for Social Science) version 21. SPSS was used to calculate the P value. The Kruskal-Wallis test was used to determine whether there was a significant difference between students of different academic disciplines. Finally, a total number of 319 responses were collected at PKU from students representing both LIS (63; 19.7%) and non-LIS (256/80.3%) student user groups (see Table 1).

With reference to the design of the questionnaire, the first group of questionnaire items sought to build a framework of mobile information needs amongst the PKU students. The second group of questionnaire items were set out to measure the extent these PKU students were using their mobile devices to engage in a variety of formal and informal learning activities (e.g., online discussions and other collaborative learning activities with classmates). The next set of questionnaire items focused on identifying the range of difficulties and/or barriers faced when using such mobile technology for different learning activities. The remaining questionnaire items were designed to identify the extent these students were using their mobile devices for accessing different online services and resources provided by PKU Library.   For a summary of questionnaire items used for this survey study, see Appendix.

Technical Limitations

This study was based solely on quantitative questionnaire data collected from students at PKU. The use of quantitative questionnaire survey method, although it could provide insights at a large scale, it could not reveal the underlying incentives behind individual students' engagement in mobile learning or their levels of satisfaction towards the online resources or services provided by PKU Library. Furthermore, the scope of this study is limited to one single university in Mainland China alone. Hence, the result of the study could not be generalised beyond this population. Finally, the sample size of the non-LIS student population is much larger than that of the LIS counterpart. This might affect the validity and reliability of the overall comparison.

Literature Review

Definition of mobile learning

Mobile learning could be defined as learning activities carried out through mobile devices, with a focus on mobile technologies and different types of mobile devices (Hyman, Moser & Segala, 2014; Keskin & Metcalf, 2011). Several researchers also refer to mobile learning (m-learning) as a form of e-learning (Horton, 2006; Kadirire, 2009; Morales, 2013). According to Peters (2007), because of the versatility and convenience brought by mobile technologies, learning carried out via mobile devices (m-learning) enables individuals to learn at any time and anywhere. O'Malley (2003) further explains the nature and power of m-learning from the learners' perspective. According to O'Malley, "any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies" (p. 7). In short, learning via the use of portable devices enables users to take part in educational activities without the restrictions of physical location (Keegan, 2005; Morales, 2013), thereby creating opportunities as well as challenges for both the m-learning services providers (e.g., librarians) and the end-users.

Mobile technologies and impacts on higher education

Because of the rapid developments of different mobile technologies and handheld devices, the lifestyle of people in the twenty-first century has undergone radical changes. People have become increasingly attached to digital devices produced in portable forms. Living in the digital age, speed, convenience and the power of information sharing is the key to peoples' daily lives and their ultimate successes on both personal and professional levels. Mobile technologies and portable devices have radically changed peoples' standards and styles of living in inconceivable speed, and in multiple dimensions (El-Hussein & Cronje, 2010; Wu et al., 2012). Mobile technologies come in the format of different hand-held devices, such as smartphones, PDAs, and I-pads, with the capabilities (compatible to a PC) to perform a wide variety of tasks, including email, voice calls, text messaging, internet surfing, online streaming, gaming, photo-taking, video-recording, plus more (Idris *et al*., 2018). Portability, instant connectivity, and context sensitivity (Churchill & Churchill, 2008; Sharples, 2000) are the main and unique features of mobile devices which enable the users to connect to a vast amount of information online – satisfying their instant gratifications for information (mostly quick facts), as well as allowing people to be connected different media, or platforms for a wide variety of social networking purposes (Vinu, Sherimon, & Krishnan, 2011).

In addition to revolutionising the ways we lead our daily lives; mobile technologies have also completely transformed our current education environment. The advancements of wireless technologies and the increasingly ubiquitous mobile devices have prompted many researchers and educators to investigate the educational use of mobile devices, as well as its ultimate implications in different educational, socioeconomic and sociocultural contexts Dukic, Chiu & Lo, 2015; Fung *et al.*, 2016; Ko *et al.*, 2015; Kukulska-Hulme, 2005; Lo *et al.*, 2016; Shuk *et al.*, 2016; Wang *et al.*, 2016). Owing to the rapid advancements made in mobile technologies, the scopes of formal and informal learning are undoubtedly widening, as well as overlapping each other, as learners can gain online and 24/7 access to an overwhelming large amount of resources and services without stepping a foot inside the physical library (Cheon, Lee, Crooks, & Song, 2012).

Benefits and barriers found in mobile learning

As mentioned previously, m-learning allows users to learn and access information virtually at any time and from anywhere (Morales, 2013; Peters, 2007; Young, 2011). More importantly, mobile technologies have the potentials to engage unwilling learners to overcome their learning difficulties, by encouraging them to share thoughts via online interactions and virtual communications (Attewell, 2005).

Other researchers also point to the advantages brought by mobile technologies in the context of education (Hashemi, Azizinezhad, Najafi, & Nesari, 2011). For example, learning via mobile devices (m-learning) enables users at different levels to create their own unique environment to learn – i.e., an environment that is outside the "rigid" traditional classrooms or lecture rooms (Karagiannidis, Koumpis, Lekakos, S A, & Greece, 2005; Nyiri, 2002; Rogers, 2011; Walker, 2007). For example, allowing users of different age groups and at different academic levels to create their own online forums enable users to engage with other learners and to exchange their knowledge through peer-to-peer interactions (Ho, 2014). Other researchers (Attewell, 2005; Koole, 2009) also found that m-learning is useful to encourage both collective and individual learning experiences, as the attributes of mobile technology could enhance an individual's self-learning and collective leaning ability and spirit.

Although m-learning brings many benefits, it is not without limitations and/or disadvantages. For example, Rogers (2011) and Haag (2011) both point to the technical limitation of mobile technology, such as small screen and low-resolution display are the major factors hindering

users' adopt m-learning on a more active level. Other technical restraints include instability of network speeds (Handal, MacNish, & Petocz, 2013; Y. Park, 2011), short battery life (Wang, Wu, & Wang, 2009), as well as the scarceness of standard mobile platforms (Haag, 2011; Sarrab, 2013). Some scholars also highlighted the pedagogical restraints found in m-learning (Traxler, 2010).

According to Park (2011), students' concentration and their learning progress may be influenced or even suffer from sudden interruptions of unstable internet connectivity via mobile devices. In addition, some scholars are concerned with different psychological constraints as a result of m-learning. Corbeil and Valdes-Corbeil (2007) and Park (2011) note that some users favour using mobile devices for leisure activities (such as sending text messages to friends and listening to music) to formal learning (academic studies).

Mobile technologies and impacts on library services

According to Nor Shahriza Abdul, Siti Hawa, and Ramlah (2006), the widespread use of mobile devices among student communities has hastened the adoption and implementation of mobile/digital services provided by academic libraries. M-library is often referred to e-library or digital library services to be delivered via hand-held mobile devices (Jaradat, 2012), while being free from the restrictions or bounds imposed by the physical library (Choi, 2009; Jaradat, 2012). In short, mobile technology ultimately improves the accessibility and flexibility of library services (Nor Shahriza Abdul et al., 2006; Sonia, 2007).

Although the development of mobile technology leads different libraries to design their own individual platforms to provide services in online mobile format – in order to meet their end-users' fast-changing needs and expectations. Nevertheless, libraries are still competing for their end-users' attention (particularly Google). Islam and Elahi (2014) surveyed 85 students from Dhaka University (located in Bangladesh) to investigate their mobile library usage frequencies. Findings of this study reveal that almost half of the total respondents never used and rarely "visited" the library through mobile devices. Smith *et al*. (2009) also discovered that a majority of college students did not use mobile library services as frequently as the librarians originally expected. Nevertheless, it has become increasingly popular for libraries to engage students and to help them in their academic journey by creating different social media apps and digital library interface (Kong *et al*., 2016). In summary, despite the power and convenience of our technological advances, "value of technology is high if it becomes not like a 'goddess' to which

you pray" Sarah Thomas (Former University Librarian, Harvard University) (Lo *et al.*, 2019, p. 9). In order for mobile learning to be successful, librarians have important roles to play in teaching and learning, and most importantly promoting information and services accessibility.

Methodology and Data Collection

For this study, a self-administered *online questionnaire survey was used* as the main and only method for data collection. The questionnaire survey was conducted online with the students currently studying at Peking University (PKU). PKU was chosen for this study because it has a long-standing reputation as offering the best LIS programs in Mainland China and is also a member of the iSchools consortium.

We employed a quantitative questionnaire in this study and collected responses from the students at Peking University. The questionnaire was extended from the research conducted by Ko, Chiu, Lo, and Ho (2015) and was translated into Chinese. The participants were first asked to respond to questions about the demographic information, such as gender, age, education background, and types of wireless services and mobile device they used. In the second part, the subjects were asked to respond to questions related to the practices and smartphones usage in daily lives and various scenarios, followed by asking questions related to the subjects' m-learning experiences, including the barriers encountered and the experience in m-library services using smartphones.

Survey data was collected via online questionnaire tools without paper-based questionnaires. The questionnaire was deployed with online survey platforms, Sojump.com (an alternative in Mainland China as Google is blocked). After the pilot testing, the researchers sent out the online questionnaire URL to all PKU students via WeChat to call for participation, a follow-up reminder was sent out four weeks later after the first call.

For this questionnaire survey, a total number of 345 responses were collected. Amongst all responses collected, 26 incomplete responses have been removed. Finally, a total number of 319 usable responses remained for data analysis (i.e., 63 responses from LIS respondents; and 256 response from students) (see Table 1). All PKU students were invited to take part in this questionnaire survey on a voluntary basis, and without providing any incentives. As the non-LIS student population was much larger than that of LIS's (with a ratio of 1:4.1). In order to

improve the validity of our comparison, we compared the mean differences with statistical significance testing with sufficient sampling (Gould & Ryan, 2015).

Data Analysis

The data was collected based on the Likert scale and was analysed by using Microsoft Excel, IBM SPSS (Statistical Package for Social Science) version 25. The Mann-Whitney U test was used to determine whether significant differences existed between the LIS and non-LIS student groups by using the Z-score system.

Demographics and profile of the study population

Over 90% of the survey population were under the age of 30, and the gender distributions between the two groups (LIS vs. non-LIS) are about the same, i.e., 50:50 (see Table 1). With reference to their mobile phone ownership rates, 99% of the total study population are using smartphones, and all of which are equipped with mobile internet access function. It is also surprising to note that only one single respondent is using normal phones (not smartphones) but with internet access (see Table 2).

<Insert Tables 1 & 2 here>

Mobile devices and recreational/daily use

With reference to using mobile devices for various recreational and other daily-use purposes, both student groups (LIS vs. non-LIS) show similar usage patterns in most areas, except for the following three activities:

    (1) Banking and financial management (LIS, 2.81 vs. non-LIS, 2.17);

    (2) Pastimes activities (e.g., gaming) (LIS, 4.14 vs. non-LIS, 4.35);

    (3) Using search engines: Google, Yahoo, and Baidu (LIS, 4.79 vs. non-LIS, 4.62).

According to the SPSS analysis, the difference in results for "Pastimes activities" and "Using search engines" are medium significant ($P < 0.05$). Statistically speaking, LIS students were more actively using their smartphone to carry out "Banking and financial management" activities, as well as using their devices to search against commercial search engines, e.g., Google, Yahoo, & Baidu, etc. for quick facts. On the other hand, LIS students were less frequently involved "Pastimes activities" in this regard. For future studies, it would be interesting to find out how much of these quick facts sought by these LIS students are directly or indirectly related to their formal learning (see Table 3).

Use of mobile devices for formal learning purposes

Both groups show similar patterns in terms of using their smartphones for formal learning purposes. In other words, no significant differences could be found between the two student groups in this area. However, it is interesting to note that LIS students were slightly more active in using their smartphones for reading E-books and to obtaining learning materials from learning management systems (e.g. Moodle). On the other hand, the LIS group was slightly less active in "Reading articles on professional journals or magazines" via their mobile devices. For further studies, it would be interesting to find out the genres of E-books sought by these LIS students and whether such E-books were directly related to their formal curriculum (e.g., textbooks or reading assigned by the LIS professors) (see Table 4).

<Insert Table 4>

Use of mobile devices for accessing library resources

Again, no significant difference has been identified in this area between the two student groups. Unexpectedly, survey results reveal that LIS students were less active in using their mobile devices for accessing digital resources (e.g., online databases, bibliographies, & other references resources) provided by their university library. Originally, the researchers anticipated that since these LIS students were training to become future librarians, they would be far more active as digital library users in comparison to their non-LIS counterparts. This unexpected finding will be further discussed in the subsequent sections (see Table 5).

<Insert Table 5>

Use of mobile devices' productivity tools for learning and research purpose

No significant difference could be found in this area. However, it is interesting to note that LIS students were active in using different productivity tools via their mobile devices for learning/research purposes, i.e., including taking notes, creating documents and scheduling appointments, etc. (see Table 6).

<Insert Table 6>

Use of mobile devices for collaborative learning

Despite no significant difference could be found, findings of this study reveal that the LIS student group was slightly more active in engaging collaborative learning via their smartphones, e.g.:

(1) Discussing assignments with classmates (LIS, 4.16 vs. non-LIS, 4.07);

(2) Discussing research topics with lecturers/classmates (LIS, 3.83 vs. non-LIS, 3.68);

(3) Creating research-related posts on learning platforms (LIS, 2.83 vs. non-LIS, 2.55);

(4) Publishing research-related content on social bookmarking sites (LIS, 2.56 vs. non-LIS, 2.35).

For further studies, it would be useful for librarians and other LIS educators to find out the contents and nature of discussions between LIS students and their professors, as well as how other students are responding the research contents published online (see Table 7).

<Insert Table 7>

Barriers faced in mobile learning

"Lack of Wi-Fi" service was found is the major obstacle to m-learning (LIS = 3.31 and non-LIS = 3.09), followed by "Reading difficulties for files with defective format." "Website format is not suitable for smartphone" was reported to be another major barrier to m-learning. Significant differences could be found in the following areas between the two groups: (10 "Screen size too small;" (2) "Typing difficulties" ($p<0.01$), and (3) "Long loading times" ($p<0.05$) (see Table 8).

<Insert Table 8>

Using mobile devices for accessing library services/resources online

LIS student group was found to be slightly less active in using their smartphones for accessing services and resources provided by their university library, particularly in the following areas:

(1) Contacting librarians (LIS, 1.80 vs. non-LIS, 1.88);

(2) Providing (new books / services) recommendations (LIS, 1.71 vs. non-LIS, 1.88);

(3) Searching OPAC (LIS, 2.22 vs. non-LIS, 2.30);

(4) Searching and accessing electronic materials (LIS, 2.27 vs. non-LIS, 2.30).

This is another set of findings that went against the researchers' original anticipation and will be further discussed in detail in the subsequent section.

<Insert Table 9>

Discussion

"The advantages of mobile devices facilitate an improved access to data and information; and therefore, it provides new ways for individuals to enhance and facilitate their learning efforts. Consequently, the acquisition of – from an individual perspective – 'relevant' knowledge becomes feasible for a much wider audience at an increasingly personal level… [Therefore] enhancing learner-centricity especially implies accounting for the aspects of individuality and personalisation, communication, coordination and collaboration in the concept of mobile learning" (Denk, Weber & Belfin, 2007, p. 124-126).

This study was set out with the assumption that greater exposure and experience with mobile devices at student stage may actually change and improve attitudes of the study population (LIS students) as soon-to-be LIS professionals towards incorporating mobile services at future workplace. In that sense, the more active these LIS students are as mobile learners and mobile library users, the more likely they would assimilate such mobile technological innovations into their future workplaces as future LIS professionals. With this belief on mind, the researchers originally anticipated that the LIS student groups would be more active or expressing a significantly higher preference towards using their mobile devices for different (both formal and informal) learning practices, in comparison to their non-LIS counterparts -- particularly when it comes to accessing both online resources and services provided by their own university library. Unexpectedly, some of the findings of this study have proven otherwise.

Use of mobile devices for accessing library resources and services online
It is interesting to note that in comparison to the other non-LIS group, the LIS students in this study did not express higher preference towards using mobile devices for accessing library services online in the following areas: (1) Renewing books or applying related services using individual library account; (2) Reserving seat, laptop or study room; (3) Providing recommendations; and (4) Contacting librarian. LIS students were also slightly less active in

using their mobile devices for "Assessing or searching library bibliographies" and "electronic databases."

Furthermore, LIS students' preferences were relatively low in terms of: (1) Searching in library catalogue; (2) Searching and accessing electronic materials via mobile library services. This is a subject that raised concerns on the development of suitable academic apps for class-based communication. Furthermore, by comparison, LIS students' levels of perceived ease of use of mobile technology were lower than their non-LIS counterparts, particularly in areas related to "Screen size too small;" "Typing difficulties;" and "Long Loading time." "Lack of customised mobile apps" was also reported to be another main and high barrier amongst the LIS students. Interestingly, other technical barriers (e.g., small display screens, small keyboards, inefficient input, limited computing capability, loading time, and connectivity issues, etc.) to mobile learning reported in this study are something that seem universal and unavoidable (Denk, 2007; Dukic, Chiu & Lo, 2015; Fung *et al.*, 2016; Ko *et al.*, 2015; Lo *et al.*, 2016; Shuk *et al.*, 2016; Wang *et al.*, 2016). Yet, such technical barriers should not outweigh the advantages of mobile learning, for the reason that mobile-supported collaborative learning has its own values and unique features that offers tremendous potentials to learners, including LIS students.

Use of mobile devices for collaborative learning purposes

Despite no significant differences could be found between two student groups, survey results indicate that LIS students were slightly more active in engaging in the following learning-related activities with their mobile devices, namely: (1) Discussing academic topics or assignments with classmates; (2) Discussing research related topics with lecturers or classmates; (3) Creating or replying research-related posts on forum/learning platform; and (4) Publishing research-related content on social bookmarking sites. In higher education, students are often directed to participate in group work for the purpose of encouraging collaborative knowledge sharing, creation, and synthesis for the advantages stated above (Bell *et al.*, 2010).

Findings of this study suggest that the power and convenience brought by mobile technologies (e.g., enhanced the level of freedom, flexibility and independence in their course of learning, etc.) have also created new channels for students to communicate with their teachers, and to interact with each other, in addition to having 24/7 access to course materials and learning instructions (Aderinoye, Ojokheta & Olojede, 2007; El-Hussein & Cronje, 2010), as well as sharing knowledge by allowing them to "publish research-related contents on different online

social media." According to Denk, Weber and Belfin (2007), "the real-time feature of mobile applications in general allows synchronous communication and, thus, dynamic interaction in learning settings, particularly in collaborative learning situations…. (peer-to-peer) discussions, just-in-time access to information resources, and instant feedback during learning (e.g. on questions emerging when doing homework) or in assessment situations… [thereby] improving the reachability of peers, teachers and learners as well as the accessibility of learning material and assessment, which facilitates coordination, cooperation, and hence, collaboration" (p. 130). Ferscha, Holzmann, and Oppl (2004) also pointed to the particular importance and value of team-based context for effective learning which facilitates building team knowledge or knowledge sharing via different means of online communication, only made possible by mobile technology. Meanwhile, Cheon *et al.* (2012) also highlighted the advantages of students being immersed in an environment that is truly supportive of collaborative learning, a learning environment supported by mobile app-based technology.

Meanwhile, PKU Library's online resources/services have not been fully utilised by the LIS students on a more active level, which could be related to the fact that such resources are currently not adequate for meeting their information needs and/or expectations. Factors behind this interesting phenomenon could be related to the fact that LIS faculties are actively encouraging their students to participate in collaborative learning and/or group work. However, that might be not enough to encourage these LIS students to use the readily available services and resources provided by their university library in a more active manner. For example, it is quite possible that mobile learning has not yet been tightly integrated into the LIS curriculum or library user education (LUE) at PKU.

As libraries are now experiencing continuous change, both professional librarians and soon to be librarians (LIS students) should use the most up-to-date technologies, in order to stay relevant for their users. For example, the demands for virtual collaborative environments amongst students is likely to increase as there is increasing mobile-based support for other aspects of their academic studies, for instance, mobile catalogue interface from libraries, group discussion room booking on campus, etc. similar to Library User Education (LUE) and the acquisition of Information Literacy (IL) skills (Liu, Lo & Itsumura, 2016; Liu, Lo & Itsumura, 2019). The researchers (as LIS educators) believe that close collaboration between librarians and LIS faculty is the key for effective promotion amongst the student community, if these LIS students are to become active users of the library services (both online and in person). In other

words, whether students could become active users of online library services is heavily dependent on effective marketing and promotions carried out on the part of the librarians. The researchers truly believe that as soon-to-be LIS professionals, it is important that they "recognise the benefits and costs of the newest [mobile] technologies, use them to their fullest advantage, and serve library users with the most current means. They should also understand that by using mobile services in libraries they will increase the number of users, since people can access the library without the restrictions of distance and time" (Aharony, 2014, p. 210). For this reason, LIS faculty might consider collaborating with the LUE librarians by offering new and more incentives, in order to motivate their LIS students to make use of the online services/resources on a more active level, e.g., by integrating that into their regular curriculum at different academic levels.

The LIS students not being as active as users of digital library services does raise concerns. Librarians worldwide have been investigating a great deal of manpower and resources in making their collections and services online. In order to reach that end, many libraries have to either they completely reorganise their workflows or restructure their services (e.g., e-book and e-journal policies) or even organisational structures, in order to hasten the adoption and implementation of digital library services. There is no exception for PKU Library. Furthermore, because of the current digital scholarly publishing environment, "commercial publishers are charging ever higher subscription costs to libraries and as a consequence are increasing the profits that they make these publishing giants are inhibiting the power of the publishing medium (to disseminate and distribute), particularly the digital, in order to extract maximum revenue" (McDowell, 2018, p. 52). Given the large amount of time, manpower, and resources devoted towards implementing digital library services, if students (as end-users) are not making use these online resources to a fuller extent, this would simply defeat the purpose and funding could not be fully justified (Lo *et al*., 2017). Although not all LIS graduates would eventually choose a career in librarianship, a significant portion of these students are definitely being trained to become future librarians (Ho *et al*., 2018; Lo *et al*., 2015; Lo *et al*., 2016). The researchers are therefore concerned that their speculated "less-inclined attitude"' would be passed onto their future workplaces or future generations of LIS students. In other words, inspiring these soon-to-be librarians to have a positive attitude towards all learning technologies, m-learning inclusive is indeed crucial. Osang *et al*. (2013) state that if educators are interested in using any technology, they will take ownership of such projects and drive them in such a way that they will be beneficial to the students and other

stakeholders. For this reason, the same belief and principle should also be applied to librarians, since they are playing a vital role in supporting the teaching, learning, and research activities of the university community as a whole.

According to Shonola and Joy (2014), in order to overcome the barriers to mobile learning, more cooperation of related factors like curriculum developers, teachers, technological specialists (e.g., librarians) as well as virtual and actual interaction among learners [are needed]" (p. 3325). As a result, the researchers recommend that further studies be carried out to determine the interrelations between the following:

(1) LIS students' assignment formats and requirements, e.g., to what extent these students need to depend on the PKU Library's digital resources for writing up their assignments;

(2) To what extent mobile learning has been made part of their formal LIS curriculum;

(3) LIS students' perceptions towards existing services/resources provided by PKU Library;

(4) To what extent digital library services have been made an integral part of library user education (LUE) programmes tailor-made for the LIS students;

(5) User-friendliness of various online resources and digital library services catered for the LIS students.

In summary, no significant differences can be found between the two student groups (LIS versus non-LIS) in many areas. Both LIS and non-LIS student groups were using their smartphones to engage in different learning, research, social networking, pastimes, and recreational activities on similar level. The findings went against the researchers' original anticipation and lies in the fact that the LIS student group was less inclined to access the online services and resources provided by their own university library. However, such finding does not mean that these LIS students were less active as mobile learners, for the reason that these they were equally as active (if not significantly higher, frequency-wise) as their counterparts in terms of using their mobile devices for other learning (particularly collaborative learning) and research purposes, e.g., reading e-books, browsing information from Moodle, using different productivity tools to take notes and to creating documents or tables, etc.

Conclusion

This study was set up to explore and highlight PKU LIS students' mobile learning practices, by comparing them against other non-LIS students at the same university. By determining how

active they are (as mobile learners and digital library users) – it was hoped that they could be used as key traits attributable to the openness, as well as their professional readiness in adopting such mobile technology in their future workplace. Unexpectedly, findings of this study went against the researchers' original anticipation, owing to the fact that these LIS were less active in accessing certain online library resources and service platforms in comparison to their non-LIS counterparts. Findings on the other hand suggest that the LIS students were more slightly inclined to read e-books, and to engage in different forms of collaborative learning. As a result, it is premature to conclude that these LIS students are not "professionally ready" in adopting mobile technologies in their future workplace. Further research in the area is needed for gaining a more complete understanding of how LIS students learn, research and socialising in the context of mobile technology and digital library services.

Despite the limitations, this study has provided a glimpse into the mobile learning practices of LIS students. It is hoped that this study would contribute to the existing body of LIS literature, and provide new insights for future research in the same field. In order to gain a broader perspective, it is recommended that further studies with larger study participants amongst other iSchools or library schools in the Greater China Region (China, Hong Kong or Taiwan), as well as in other overseas countries to be carried out – in order to gain a more regional and international perspective on the same issues. The researchers suggest further studies could include how the LIS faculty and students use and respond to the different websites and mobile apps tailor-made for this discipline. Another aspect that could be taken into consideration is how LIS students (soon-to-be LIS professionals) wish to express different learned skills or assimilate technological innovations into their future LIS workplaces.

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