Chapter 17
Implementing a Mobile App as a Personal Learning Environment for Workplace Learners

Nicole Gu

Abstract With the purpose of developing a strategy for supporting informal learning in the workplace, this study investigates the possibilities of launching an educational mobile application adopting various Web 2.0 tools as a personal learning environment. Functionalities including RSS (Really Simple Syndication), podcasting, Web searching, and microblogging were integrated into the app which is named "MobLearn@Work" to support workplace learners' individual learning activities which are task-oriented. The article reports on the details of designing and developing the app, from both technical and theoretical perspectives. Optimistic results from the study informed possible ways of implementing educational apps to enhance workplace-learning performance from theory to practice. Recommendations for further research are presented by end of the study.

17.1 Introduction

Information technologies, as well as mobile technologies have been continuously playing an important role in educational area since the last decade (Boulos et al. 2006; Cabada et al. 2009; Cochrane and Bateman 2008; Sharples et al. 2010). In the research area of adult learning, the use of information technologies deserves more attention. Driscoll (1998) has summarized the characteristics of adult learners that they have real-life experience, they prefer problem-centered learning, they are continuous learners, they have varied learning styles, they have responsibilities beyond the training situation, they expect learning to be meaningful, and they prefer to manage their own learning. The rapid change in nowadays workplace has led to a continuous learning situation among employees all over the world. The majority of what people learn at work belongs to flexible and self-regulated informal learning activities, which involves a combination of learning from others and personal

N. Gu (✉)
The University of Hong Kong, Hong Kong SAR, People's Republic of China
e-mail: nicole_gj@outlook.com

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experience (Cross 2003; Eraut 2004). This happens in the context of employees' attempt to deal with problems emerging in the workplace. In order to cope with the growing competition, employees in cooperate environments continuously engage in informal learning activities.

Literature informs that employees in cooperate environment continuously engage in informal learning, which describes learning without formally organized content and learning that happens outside of formally organized settings (Sefton-Green 2004). Technology has created a spectrum of possibilities for informal learning. Web 2.0 tools, such as RSS, blogging, Wiki, and social networks have provided quick access to information for employees to engage in informal learning. Currently, the commonly adopted Web 2.0 services in the adult educational field include but are not limited to RSS, podcasting, and microblogging (Garrison 1997; Holotescu and Grosseck 2010; Lee et al. 2008; Williamson 1998). RSS provides an effective approach to searching and managing the vast volume of information on the Internet. 'Podcasting' refers to online audio content that is delivered via an RSS feed. Microblogging is a combination of blogging and instant messaging that allows users to create a short message and post it on their profile. Emerging mobile technologies add a new dimension and considerably increase the possibilities for Web 2.0 technology usage in informal learning; however, the use of mobile technologies in the context of the workplace has not been researched widely, and relevant understanding is lacking.

This article introduces the process of design and development of a mobile App named MobLearn@Work, with the purpose of exploring how mobile Web 2.0 technologies assist individual employees in their work-related informal learning. An integration of several Web 2.0 tools including RSS, podcasting, Web searching, and microblogging was applied to serve as a personal learning environment. The study has also proposed a unique data collecting method via the log system in order to measure learners' actual time spent on the App. Limitations and recommendations for the future design of educational Apps in the context of workplace were both discussed at the end of the study.

17.2 Theoretical Framework

Along with the fast development of ICT technologies and mobile technologies, Apps have become prevalent nowadays. So far, there has been a number of Apps which are designed for educational uses, however, only a few have been developed for adult learning in the workplace to date. These include Apps mainly targeting areas, such as health and safety, operational efficiency, and soft skills, such as leadership or communication, and management skills (e.g., Workplace Safety, Lean Manufacturing, and How2Lead). Most of the learning Apps are standalone, which means that their contents are predefined by the developers. This feature greatly limits the life cycle of an App's. In contrast, net-based Apps that provide dynamic updates using feed technology (such as RSS) guarantee the continuous use by

delivering automatic updates to users' devices. Especially for workplace learners, receiving the most up-to-date information is essential when the workers need to accumulate knowledge rapidly. In this manner, an App that allows users to manage their own learning materials is required. The following of this section introduces a framework for designing an App targeting workplace informal learning, based on the theoretical backgrounds of personal learning environments personal learning environments (PLE), as well as informal learning.

17.2.1 Personal Learning Environments (PLE)

The concept of PLE was first introduced by van Harmelen (2006), who describes PLEs as systems that help learners take control of and manage their own learning. A PLE is an individual e-learning system that provides learners access to a variety of learning resources. According to Chatti and his colleagues (2010), the concept of PLE "supports self-organized, informal, lifelong learning and network learning and translates the principles of constructivism and connectivism into actual practice" (p. 79). In PLE settings, the learner is expected to set their own learning goals, manage their learning contents, implementing learning strategies, and in the same time communicating with others with the purpose of achieving learning goals (Van Harmelen 2006). PLE is not simply an application, but rather a new approach of learning that emphasizes the importance of learner's self-direction in the process of learning via the use of technologies. Researchers have explored different means to bring the concept of PLE into practice, with an agreed standpoint that the use of a set of different tools may be feasible in the PLE pattern (Attwell 2007; Sclater 2008; Wilson et al. 2007). Chatti and his colleagues (2010) mentioned the RSS feeds (such as iGoogle) that allowed the integration of different services into a single personal platform, which to some extend matched the characteristics of PLE.

17.2.2 A Personal Informal Learning Framework in the Context of Mobile Web 2.0

Informal learning, a relatively underresearched term, is used to describe learning without formally organized contents and learning happens outside formally organized settings (Sefton-Green 2004). Schugurensky (2000) has generated three forms of informal learning, which are self-directed, incidental, and socialization. Intentionality and awareness have been used as the criteria to distinguish among the three forms. As one major form that is both intentional and self-aware, self-directed learning refers to learning activities undertaken by individuals or group of learners without the assistance of an instructor. Interpreted by Knowles (1975), the process of self-directed learning includes diagnosing and formulating goals, identifying

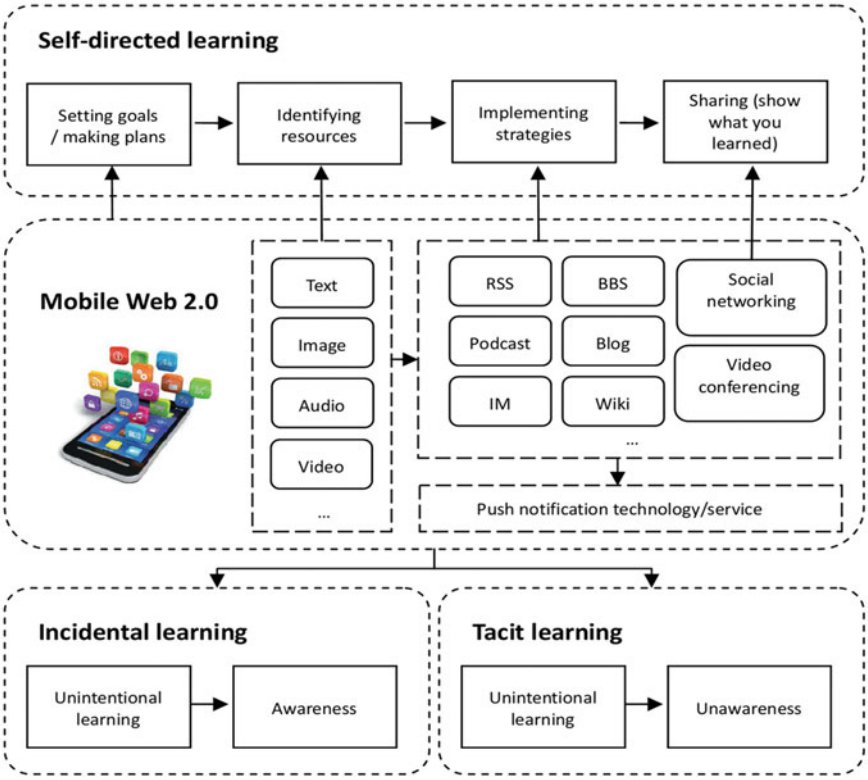

Fig. 17.1 Workplace informal learning framework in the context of mobile Web 2.0

resources, selecting and implementing suitable strategies, and evaluating outcomes. Incidental learning is not intentionally initiated by the learner, but afterwards the learner become aware that learning has occurred during the previous experience. Socialization is also known as tacit learning, which means neither does the learner intend to learn anything, nor the learner is aware of having learned anything. Based on the works of Knowles and Schugurensky, there has been summarized a design framework guiding the development of the App as shown in Fig. 17.1.

The top-dotted rectangle represents the circle of self-directed learning process, consisting of four steps:

- Setting goals and making plans. Learners decide what knowledge and skills they want to gain, when to learn, how to learn, and estimate the expected learning outcomes.
- Identifying resources. Learners make decisions about where and how to find a variety of learning resources.

- Implementing strategies. Learners find and choose the appropriate methods of learning and formulate personal learning programs according to their own situations.
- Sharing. Learners show what they have learned by sharing to other platforms. Through everyday social networking activities, new learning needs, and motivations may be triggered and a new cycle is thus formed. They may even become a subscribing source for other learners within the same circle.

Depending on the data sources from the mobile Internet, Step 2 is further divided into two categories: searching and subscribing. The action of searching is intentionally taken by the learners. Learners initiate a new search action whenever there is any learning requirement. Information is provided through rich multimedia tools (e.g., text, image, video) from various sources (e.g., Web, news, blogs, Wikis) based on the latest Web 2.0 technologies. Learners are able to select the most appropriate source according to their different search requirements. 'Subscribing' refers to the obtaining of learning materials provided by Web feeds (e.g., RSS, podcasting), which push updated contents to the learners periodically. It is a more complicated process. Although the action of subscription itself is intentional, the synchronizing and the learners' reading activities could be passive and incidental since the contents are not known before they have been downloaded for learning. Therefore, this can be considered as a 'semi-intentional learning activity.' In the context of this study, 'socialization' mainly refers to online interactions based on social networking services. Social networking services with mobile technology nowadays allow sharing of learning achievements more easily than before. From another perspective, learners can also benefit from social networking since it could be regarded as one of their subscribing sources for receiving new learning contents.

17.3 Design and Development of MobLearn@Work

Open platform technologies, such as IOS, Android, and Windows Phone have brought great opportunities to develop application software for mobile terminals; however, it currently remains difficult to satisfy the specific demands of end users and overcome the technical constraints of mobile devices. To address the constantly changing software requirements, Extreme Programming (XP) (Silva 2007) has the advantages of on-time delivery, reliance on team members' knowledge rather than documentation, short release cycles, tight customer integration, incremental design, constant communication, and coordination. Based on the XP, Abrahamsson and his colleagues (1990) developed an agile approach called 'Mobile-D' for the mobile application (Symbian platforms), which mainly emphasizes the early identification and solving of technique issues, rather than considering usability during the development process. Usability measures the quality of a user's experience when interacting with a product of system. Due to the limitations of mobile devices, user experience is of great importance during the development. In today's IOS and

Android platforms, user-centered design (UCD) is an approach for employing usability. It helps to provide the users with the real usage context, which means that users are able to touch the buttons and see how the software actually works (Rogers 1997). Hussain and his colleagues (1992) integrated the agile process and usability into his project life cycle of a mobile multimedia streaming App. The above methodologies have been successfully applied to each individual App context.

However, a complex mobile application development process is required in educational scenarios, where there usually exist three roles: the designer/tutor who may be unfamiliar with the technical implementations; the developer, who is unfamiliar with the fundamentals of education; and the end user, who has rapidly changing requirements. It is essential to separate the interactions among them during development in order to enhance efficiency regarding technical issues and usability.

17.3.1 An Agile Design Approach

As mentioned above, the modified agile development process of an educational App must consider interactions between different parties. In the context of educational Apps, a bi-loop-based software development process is proposed in order to improve the software quality and meet learners' changing requirements, which is illustrated in Fig. 17.2. Three roles in the development life cycle have been identified: the participant is the customer of the App; the designer turns the theory into practice; and the developer takes charge of the implementation. The designer and developer, however, may actually be the same person. The development process consists of two loops. The one on the left represents interaction between the participant and the designer, while the one on the right shows the relationship between the designer and the developer. The designer acts as a bridge connecting the other

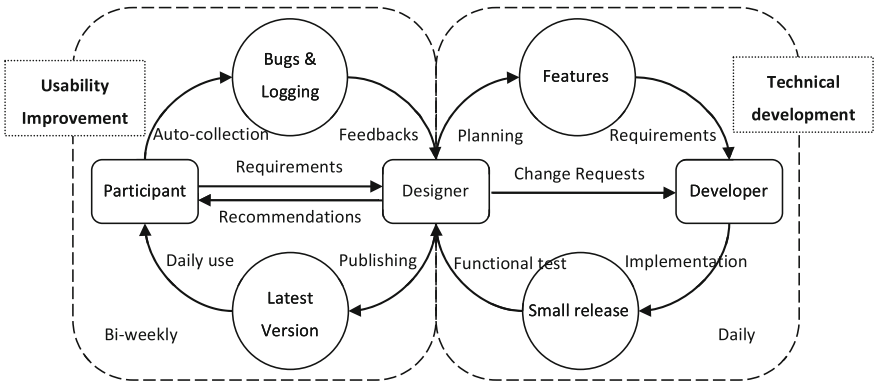

Fig. 17.2 App development process

two. The designer periodically publishes the latest version of the App for participants to use. The designer also collects feedback on users' experience through random discussions with participants. Based on this feedback, improvements, and new features are generated and transferred to the developer for an improved new version. The two loops run in a continuous manner until a satisfactory balance between the participant and designer is achieved.

The cycle on the right, referring mainly to technical development, is a traditional agile development process. The left circle is novel. Such a circle, associated with the end user and the designer, mainly focus on the improvement of usability. Unlike the traditional desktop software, the concept of UCD is crucial because the usability determines whether or not the user continuously uses the App. Therefore, the UCD design process is a separate loop at the same level as the technical development. The periodicity of the two cycles differs. The upgrading of new versions from the designer to the participant is biweekly or more frequent, while the small releases from the developer to the designer occur on a daily basis.

Regarding the emerging educational applications, the bi-loop development process for the mobile App combines usability and the agile process together, while considering different roles in the design process with the purpose of putting educational theory more effectively into practice. It has been proven to be efficient in response to the participants' learning requirements.

17.3.2 Functions of MobLearn@Work

In this section, we describe in detail how MobLearn@Work works by the use-case analysis with examples of some major activities involved in the App. Figure 17.3 describes four major functions—microblogging, RSS, podcasting, and mobile Web searching—included on the start page. With a click of the feedback button, an automatically generated email attaching the user log report is sent to the designer. The microblogging site was set-up via an open-source software tool called 'Sharetronix' (Kreber 1998).

RSS and podcasting service work similarly through Web syndication. The App features a preinstalled list of feeds, according to participants' preferences as identified during the initial interviews. Basically, when participants click the RSS/Podcasting button, they see a list of feeds. Once, they choose to read a specific item, they will find several option buttons at the bottom of the page: previous item, next item, original link, Web searching, return to homepage, share internally (to the MobLearn@Work microblog), and share externally (any external services installed on the mobile phone). Users are able to add or delete any feed items as needed. The App provides two ways of adding RSS feeds: adding by search and adding manually. Details of RSS/Podcasting can be found in Fig. 17.4 (left).

Unlike traditional mobile searching on a mobile browser, this App provides a parallel Web searching function which returns Web, image, video, news, blog, and Wiki simultaneously for a single query, thus strongly improving the searching

Fig. 17.3 Use case and screenshot of MobLearn@Work

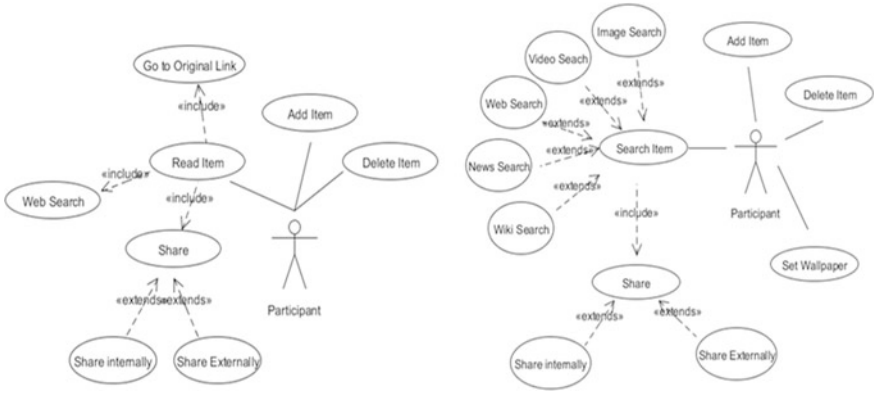

Fig. 17.4 Use case (*left* RSS/Podcasting; *right* mobile Web searching)

experience. This means that when the user searches for something, he/she may get results on all of these six aspects at the same time. Details of the searching activities can also be found in Fig. 17.4 (right). There are basically two kinds of searching activities in the study. One is initiated by clicking a keyword from the search list, and the other by adding a new search item. MobLearn@Work provides a series of online open courses for users. For example, a list of the financial open courses from MIT and Yale were provided as recommendations to help users to get started with the App.

17.3.3 UI Improvements of MobLearn@Work

With the purpose of enhancing the users' experience, we have emphasized more on the improvement of the usability rather than functionality of the App. The affordance of the App determines the activities of daily use. As a private product, the smart phone is usually installed by its user the applications that are most frequently used. Therefore, the usability of mobile Apps must be continuously improved in order to extend an App's life cycle.

Being different from desktop applications, the design of a mobile App should take into account the benefits and limitations of a mobile device. On the one hand, mobile devices obviously have some operational superiority to the PC. Recent mobile devices attract users through their excellent touch experience. The operations are usually simple and can be accomplished just with the fingers. Desktop applications often contain a complicated operational procedure, and must be manipulated by the mouse and keyboard. On the other hand, the user interfaces of mobile Apps must be well designed. Input by finger is less accurate than that by mouse and keyboard. This causes the designers of the user interface to consider the most amenable style. Therefore, the UCD is of great importance in App design.

During the development iteration, several important changes regarding the affordance of the App were made, as shown in Fig. 17.5.

- As proposed by the latest Android reference design, the action bar and swipe UI were used. Common operations are integrated into the action bar. Operations regarding switching pages were replaced by introducing a gesture (Fig. 17.5-1).
- Most content carriers were modified to be Web-based. This creates consistency in the content arrangement. Pinch open and close gestures allow users to zoom in and out the target contents, overcoming limitations of the small screen on mobile phones (Fig. 17.5-2).
- A global navigation was added to the action bar. Users can go to any of the four functions freely at any time. This saves a lot of time and makes it much easier for the users to switch between Apps (Fig. 17.5-3).
- A global search function was added to the action bar. This enables users to conduct a new Web searching activity anywhere in the App, instead of switching to the Web searching page (Fig. 17.5-4).

Fig. 17.5 UI Improvements of MobLear@Work

- A search widget was developed to meet users' emergent searching requirements. It also allows users to subscribe to recommendations from outside sources that are daily updated (Fig. 17.5-5).

There was a noticeable increase in the five participants' total time spent on the App after the UI improvements, especially on the Web searching function. Such a trend is clearly demonstrated by the dashed orange lines in Fig. 17.6.

According to Fig. 17.6 (top), the time of each participant spent on MobLearn@Work was around 20–38 min at the beginning of the study, which had increased to around 40-82 min by the end of the second month. The first inflection point occurred at the end of the third week when the widget of the search bar was introduced to the participants. According to Fig. 17.6 (bottom), after the search widget was published, the search count significantly increased. Participants reported

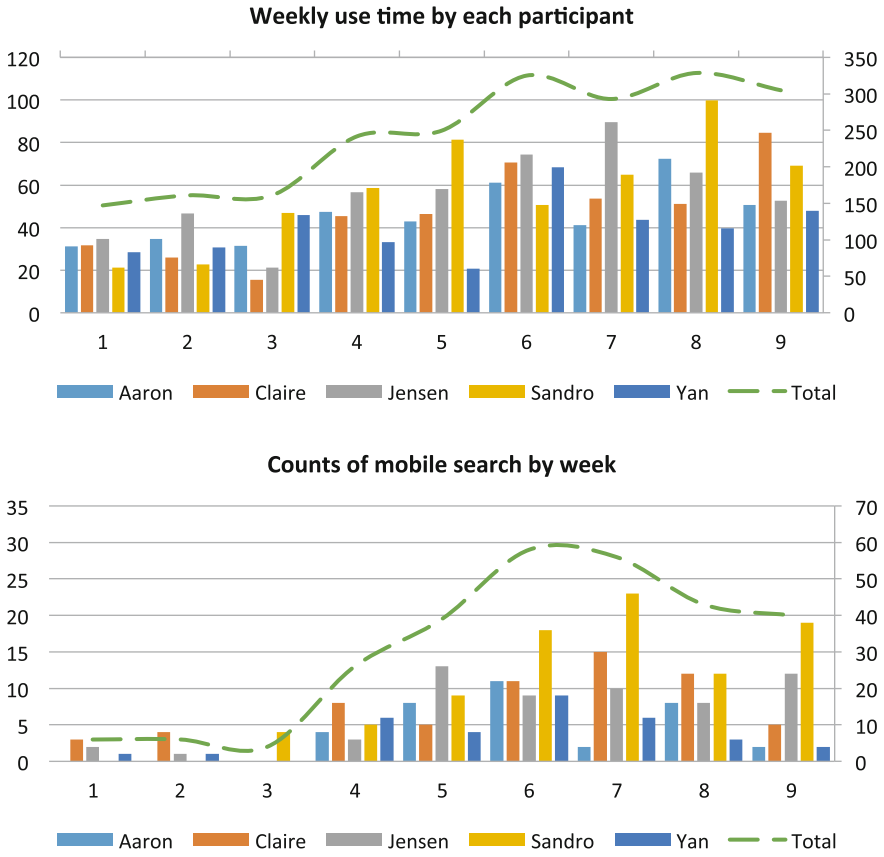

Fig. 17.6 Statistics by 9 weeks, coordinates of total are to the right axis (*top* each participant's time spent on the App; *bottom* counts of participants' mobile search activities)

that they were quite satisfied with searching for something by simply clicking the search bar widget instead of opening the App. The second inflection point occurred at the end of the fifth week when the swipe UI was published. Swipe is initiated by gestures rather than by clicks. Participants reported that the page swiping reduced the intervals of traditional page transitions that they disliked, while substantially increasing ease of use.

Another interesting phenomenon was that both curves of Fig. 17.6 fluctuate, which is especially apparent in Fig. 17.6 (top). The utility times usually rose when new updates were released and then fell after approximately 1-2 weeks. This implies that the continuous improvement of the App is a good way to increase user stickiness. Such a phenomenon is likely to occur when an App is first introduced to users. Based on Fig. 17.6 (top), the biweekly periodicity of the updates is considered to be appropriate. After several weeks, the utility time is likely to become steady, as seen in the tail of Fig. 17.6.

17.4 A Novel Method for Quantifying the Data

17.4.1 The Log System

After installing MobLearn@Work and receiving the basic training on how to use it, participants were required to start exploring the app as they want. The researcher has talked with each participant occasionally to get their feedback and suggestions with the purpose of further improving the functions and usability. Besides, a log system has been installed within the App to quantify the data by recording each learner's time spent on each function and certain activities. This complements the findings to a great extent by providing strong evidence, which leads to the improvement of the app.

The built-in logging system plays an important role in providing rich information on how each participant uses the app. Unlike the traditional bug reporting system, the logging system is used to collect the user activities towards the mobile app. Figure 17.7 is a part of a sample log report generated by learner's mobile device.

Date	Time	Function	Action	Duration
2012/7/6	10:49:57	com.cngsoftware.rss.RssActivity		15156ms
2012/7/6	10:50:12	com.cngsoftware.rss.RssItemListActivity		9258ms
2012/7/6	10:51:19	com.cngsoftware.rss.RssItemActivity	SHARE_EXTERNAL	
2012/7/6	10:52:20	com.cngsoftware.rss.RssItemActivity		27268ms
2012/7/7	11:59:52	com.cngsoftware.rss.RssItemListActivity		2734ms
2012/7/7	12:01:03	com.cngsoftware.rss.RssItemActivity		43578ms
2012/7/7	12:02:22	com.cngsoftware.rss.RssItemActivity		69929ms
2012/7/7	12:03:30	com.cngsoftware.rss.RssItemActivity		54024ms

Fig. 17.7 Screenshot of a sample log report

The life cycle of a mobile App in Android OS has been looked into in order to develop the log system. Android names every visible App window as the "activity," and every invisible part of the app which provides functions at backend as the "service." If the invisibility of windows is regarded as the moment when user releases their focuses on the app, the total time of the app use is equal to the live period of the activity. Therefore, the statistics of foreground lifetime reflects the tendency and favor of each user. Based on it, several indicators, such as the total foreground lifetime by function, the total foreground lifetime by week, and the total foreground lifetime by day, are easy to derive. Besides, users' activities in using the app are of great interests, such as adding a new RSS item, adding a new search, etc. The tendency of social sharing is also easy to obtain by counting the times and recording the sharing targets. Benefiting from Android OS, users can share their learning achievements to whatever targets that have been installed on their phones. In this study, the sharing destinies are classified into two categories, the internal microblog site built for the study, and the external platforms, e.g., Sina microblog, Facebook, Twitter, etc. The internal microblog represents for a closed community of participants while the external denotes the social networks of each individual learner.

Due to privacy issues, the detailed contents of what learners read, listen, and search are not recorded. Data collected from the log system, combined with data from interviews and other means, shall be analyzed to get a comprehensive understanding of each participant's way of using the app based on his or her own situations under certain specific contexts.

Figure shows the results from the participants' weekly log reports during the first 1 month of testing to examine the App. RSS was the mostly adopted function for gathering information by the participants, allowing participants to get what they want to learn semi-intentionally. According to conversations with all the participants during the second interview by end of the study, they all admitted that RSS had been the mostly common used application in MobLearn@Work. It thus could be concluded that reading subscribed contents anytime and anywhere contributes most to participants' learning requirements in the workplace (Fig. 17.8).

However, the usage of the other three applications are relatively lacking compared with RSS. Searching function was used to some extent but not satisfying. Microblogging was seldom used which was mainly due to the limited number of users, according to participants' reflections thereafter. Based on discussions with participants during the testing period, there existed certain difficulties while they were interacting with the app. For example, data informed that the majority of them felt not comfortable adding a new RSS feed. Aiming at this issue, a number of UI improvements had been adopted to solve the raising problems, which was discussed in the earlier part of this article.

During the testing period, it has also been found that sharing was one of the participants' major activities in the study. This informs the importance of socialization in the process of workplace informal learning. However, there has been noticed a huge difference between internal share and external share. Participants tended to repost more on their own social networks instead of sharing internally to

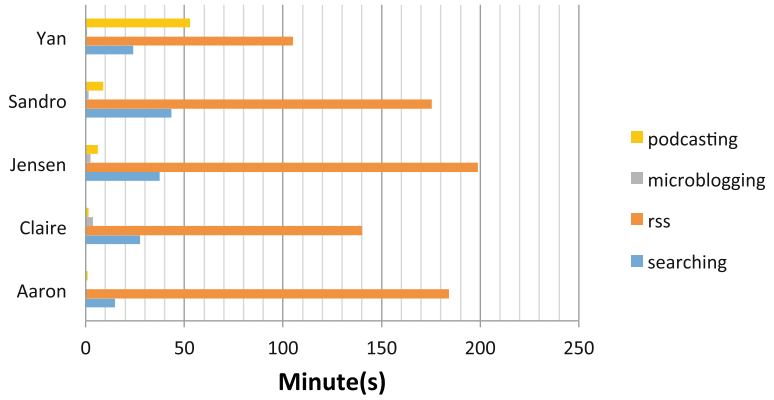

Fig. 17.8 Participants' time spent on each function separately (first month)

the MobLearn@Work's microblog. In the researcher's opinion, a newly set-up internal social networking platform with only five users is without doubt less appealing than a mature one. This situation could be improved by increasing the number of participants or establishing connection between each learner in the future. For corporations and classroom settings, such problem may be solved easily.

17.4.2 Measure of Actual Learning Time via MobLearn@Work

In fact, the logged time does not equal the actual time spent on informal learning. It is difficult to measure the accurate time of informal learning. Therefore, this study assumes a ratio η between the logged time t and the estimated time $\widetilde{t}$ for each participant, denoted by

$$\widetilde{t} = \eta \times t \tag{1}$$

The ratio was obtained by a questionnaire. The contents were classified into different categories, such as professional knowledge, communication skills, finance, business, politics, technology, entertainment, etc. Participants were required to mark the relevance of the use frequency of each category. Final result of the questionnaire was quantized into a number between $0 \sim 1$. The average learning time μ_t gathered from the log system and the estimated average learning time $\tilde{\mu}_t$ obtained from the questionnaire are summarized in Table 17.1. The estimated average learning time per week approximately equals the time of a traditional training session in most workplace environments.

Table 17.1 Weekly Use Times of MobLearn@Work (min/week)

Participants	μ_t (min)	η	$\tilde{\mu}_t$ (min)
Aaron	49.19	0.89	43.78
Claire	43.87	0.85	37.29
Jensen	52.95	0.87	46.06
Sandro	61.49	0.90	55.34
Yan	42.33	0.89	37.67

17.5 Recommendations for Future Study

MobLearn@Work has been generously adopted by participants during the period of the study in their own ways to cope with work-related learning demands. RSS was the major function used by all the participants to acquire information. Podcasting was the main source of language learning for participants with such learning requirements. The Web searching function provided participants a unique searching experience. However, the built-in microblogging site was seldom used. The reason for this situation was simply due to a poor sense of connectedness between participants. The five participants were chosen from different industries and different companies, with the purpose of providing rich and varied data in the study. The biggest problem was that they did not know each other. Although some of them shared similar learning demands, e.g., Aaron and Yan both had language learning requirements, and Sandro and Jensen was in need for massive industry news, it was still difficult to get them interact with each other via microblog. They had their own circle of friends in external platforms, such as Sina weibo by time of the study. Contrary to the situation with internal microblogging site, participants were recorded of being active in their own microblogs. However, data was mainly obtained through participants' recall of their past experience during the second interviews. It is therefore suggested that further studies be carried out within a same organization with participants who know each other, and who have already interacted or willing to interact with each other. It is in this way that more intensive and in-depth results will be achieved to explore possibilities of informal learning and team learning in online community.

Furthermore, it would be helpful to replicate the study with more experimental subjects to explore individual informal learning in the workplace. People from different industries and professional backgrounds have their own learning styles. Other factors may also affect the outcomes, e.g., gender issues, personality, and character issues, the level of self-discipline, company cultures, etc. The more we know about how different forms of informal learning can be enhanced by mobile and Web 2.0 technologies, the more we are able to broaden the opportunities of personal growth within organizations.

17.6 Conclusion

This article reports on the development of a mobile App, which is considered as a personal informal learning tool that integrates several Web 2.0 services into a single platform. A novel method for evaluating the effectiveness of the informal learning tool by analyzing learners' use time on the App has been proposed in this study. Since the logged time spent on MobLearn@Work did not equal the actual time spent on informal learning, data on the quantitative relationship between the two were collected using a simple questionnaire. Although the data collected in this way were deemed to be rough, they still provided a feasible means of measuring the time spent on informal learning. Further study needs to be conducted in this respect.

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Author Biography

Nicole Gu is a Ph.D. candidate in the Faculty of Education, The University of Hong Kong. Her major research interests cover the areas including but not limited to mobile learning, Web 2.0 technologies and adult learning. Her current research topic is to evaluate workplace informal learning activities in the context of mobile Web 2.0 via the use of a customized App.