Research on user needs for mobile information services in Chinese university libraries

Comparison between existing user and potential users

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Abstract

Purpose – This paper aims to investigate the service demand of existing users and potential users for mobile information services provided by university libraries in China. The primary objective is to explore the impact of user experience on user needs, which is conducted by a comparison between two user groups over their needs from three aspects – service function, service mode and information content.

Design/methodology/approach – Data were collected from 353 library users from ten Chinese universities via questionnaires. Based on the user needs model, three dimensions of user needs were established for mobile information services and 26 measurement items were generated through a review of the literature. Furthermore, based on frequency analysis, independent samples *t*-test and the calculation of need rate, the demand differences in mobile information services between existing and potential users were explored.

Findings – Significant differences existed in the needs for service functions and service modes of mobile information services between existing users and potential users. Existing users cared more about such characteristics as intelligence, personalization and the variety of mobile services. Potential users, in contrast, concerned themselves more with the usability of mobile services and similarity to traditional information services. These two user groups showed little difference in the needs for information content, as they both have strict requirements for specialty, richness in and quality of information resources in mobile network environments.

Originality/value – Previous research on user needs for mobile libraries services has been primarily conducted from the perspectives of existing users. This study, however, compared the needs of existing and potential users based on their previous experiences, which can help libraries to know better what their users need and improve the quality of mobile information services to meet those needs. This can also make existing users more willing to use the services and cultivate the usage habits of potential users at the same time.

Keywords Demand differences, Existing users, Library mobile information services, Potential users, Service need rate

Paper type Research paper

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1. Introduction

With the rapid development of mobile communication technologies and the increasing popularity of intelligent mobile devices, the needs for mobile information services are constantly growing. As an important social knowledge carrier, libraries endeavour to proactively offer diverse information services based on mobile networks (Kroski, 2008). Many foreign countries, such as America, Japan, South Korea and Finland, have launched successful mobile library projects beginning in the early 2000s (Jin and Zhang, 2009). Since 2003, some libraries in China have also launched mobile services that involve short messaging services (SMS), mobile online public access catalogs (OPACs), mobile reading, local-based services (LBS) and so on (Li, 2013). Mobile services have made it possible for users to acquire library information resources anytime anywhere and have become the main future development direction of library information services (Jadhav, 2011).

In addition to facilitating changes to the library service model, mobile networks have profoundly affected user information behaviours and habits (Murphy, 2010). In the mobile network environment, the user's need for fragmentary reading is growing. Easier and real-time access to information is expected. Users hope that libraries can not only extend traditional information services to mobile devices but could also develop more intelligent and customized services with the advantages afforded by mobile networks (Kumar, 2014). Therefore, one important premise ensuring that libraries can advantageously exploit the mobile network era is to study specific user needs for mobile library services according to users' changing demands and, thus, provide more effective library mobile services.

In China, the development of mobile libraries is primarily propelled by university libraries. Currently, 253 Chinese university libraries have launched their wireless application protocol (WAP) sites or apps (China's Ministry of Education, 2014). More and more students, teachers and researchers are attempting to use library mobile information services, which leads to growing demand for these services. However, according to a survey conducted by the library of Wuhan University, user satisfaction with university library mobile information services was relatively low and only 20.8 per cent of respondents were very satisfied with the services. Moreover, many users had not tried their library's mobile services yet, owing to the lack of a robust mobile network environment, less advanced mobile devices or simply personal habits. However, the majority of users intend to use mobile services in the future. With the advent of the mobile network era, it has become an important task for libraries to introduce and develop mobile information services. However, the lack of a comprehensive understanding of dynamic user needs in the mobile network environment has impeded the adoption of mobile information services in Chinese university libraries. In addition, many libraries focus only on users who already use their mobile services and neglect the massive potential user demand, which has delayed the popularization progress of mobile services. In this regard, it is necessary for university libraries to understand the specific user needs for service functions, service modes and information content of mobile information services, as well as to pay more attention to the demand differences between existing and potential users to provide more customized services according to the different characteristics of these two user groups.

The study reported in this paper will fill in the research gap and identify potential areas for further improvements of current mobile information services in Chinese university libraries by exploring the following research questions:

RQ1. What are the demand differences of university library's mobile information services between existing and potential users?

RQ2. How are the demand differences generated between existing and potential users and in what ways do they differ?

2. Literature review

2.1 Development of mobile information services in Chinese university libraries

In China, the library of the Beijing Institute of Technology first launched mobile library services in 2003. After that, many Chinese academic libraries successively implemented mobile services and introduced innovative functions and more diversified services (Zhou and Ren, 2013). Qin (2013) conducted a survey about library mobile information services among 65 universities in the "211 Project" and found that most of the university libraries offered basic information services on mobile devices and had developed some special mobile services, such as LBS and QR code retrieval. Wei *et al.* (2012) summarized 20 kinds of mobile services generally available in Chinese university libraries and divided them into four categories: information notifications, retrieval and query, online reading and support services and customization. Considering how few users used the mobile services provided by libraries, the popularization rate of mobile libraries has remained low in Chinese universities. Junren and Chuanhui's (2014) study showed that, although 87.6 per cent of users knew about the mobile library services, only 55.9 per cent of them had utilized the services. What's more, an investigation conducted by Mao (2012b) revealed that user satisfaction of university mobile libraries was low in China: 30.8 per cent of users complained that mobile information services currently offered by universities could hardly meet their requirements in terms of usability and ease of use, as well as in quantity and quality of information resources. In response to this situation, many university libraries have committed to improving their mobile services to expand the depth and breadth of services to attract more users. Compared with the rapid development of Chinese university libraries' practices on mobile information services, most research has been conducted using a comparison between domestic and international developments, the impact on traditional library services, model innovation, technical implementation, case analysis and so on, while research from the angle of potential user needs has not yet been explored (Liu, 2012).

2.2 User needs for library mobile services

Understanding user needs is a prerequisite for libraries to provide information services, which determine service directions. Previous studies have done a lot of work on the theory of user needs (Hiller, 2001; Liu *et al.*, 2009; Zhou and Liu, 2005), demand contents (Harbo and Hansen, 2012; Seeholzer and Salem, 2011; Tenopir, 2003), demand features (Arshad and Shaique, 2014; Lippincott, 2010) and the corresponding influencing factors (James, 2010; Kaunda, 2013; Kumar, 2014; Wang and Jia, 2007). In particular, Tenopir (2003) put forward a demand model of information service for library users from three dimensions: service function, service mode and information content. This model comprehensively summarized

user needs and was extensively adopted by researchers in the field (Kroski, 2008; Nicholson, 2004; Seema, 2013; Walsh, 2012; Zhang, 2011).

With the advent of the mobile network era, user needs for mobile information services are growing rapidly. Many countries are endeavouring to study user needs and hope to make precise predictions to facilitate the development of mobile information services in their countries. For example, researchers and practitioners in South Korea and Japan explored user needs from the perspective of practical applications (Chen and Zhu, 2013; Huang, 2004). In the USA and Europe, related studies primarily focused on the adoption behaviour of mobile services and influencing factors. Nikou and Mezei (2013) used the analytic hierarchy process to identify the most relevant mobile services for consumers and the factors driving the adoption. The results indicated that functionality of mobile services was of utmost importance for the majority of respondents. Hinze *et al.* (2010) reported on a diary study to better understand mobile information needs. Compared with the above-mentioned countries, research in China are still in the start-up phase.

The popularization of mobile networks has brought library information services to revolution and facilitated the rise and development of mobile library services. Researchers have gradually turned their attention to user needs in libraries and other professional fields from the ordinary user needs, committing themselves to exploring the influences of changing user needs in the mobile network environment for the development of library mobile information services. Wilson and McCarthy (2010) analysed how user needs are generated in the mobile networked environment and suggested that libraries could innovate information services through mobile telecommunication technologies based on changing user contexts. Wang *et al.* (2012) explored user needs for library SMS and WAP services through a questionnaire. Mao (2012a) analysed user needs for library mobile information services from the perspectives of time and space pertinence and proposed a service development strategy accordingly. Ye and Du (2014) combined the theory of information needs with the characteristics of mobile library users, and studied the mobile service demand of users from the perspectives of information demand categories, demand features and the law of demand.

Beyond the exploration of content demanded by library user, some researchers further compared the demand degree for different mobile service items so that libraries can develop service functions accordingly. Through a literature review, Murray (2010) proposed seven library mobile services items that users need most: library WAP sites, SMS reference, mobile OPACs, mobile collections, eBooks and mobile reading, mobile instruction and mobile audio/video tours. This finding has been supported by other researchers (Aldrich, 2010; Dong, 2010). Paterson and Low (2011) found that users also urgently needed to check out mobile devices and social network with others. Mao (2012a) compared the attitudes of 511 Chinese library users toward 15 mobile service items by calculating the need rate. The research results mentioned above have provided fundamental theoretical foundations for libraries to understand user needs for mobile information services.

However, the above-mentioned studies are mainly aimed at existing users and did not pay attention to potential users. In fact, because of their lack of knowledge or other conditions, a massive number of users have not used library mobile information services yet, although they have potential demand for these services. If libraries can understand

the demand of potential users, activate their willingness to use and provide corresponding use conditions, potential users can turn into actual users. Researchers in other mobile service fields have utilized the innovation diffusion theory and technology acceptance model to empirically compare adoption behaviours in mobile commerce service and multimedia message service between existing and potential users, and have noted that users' service experiences have an influence on their future information demand (Deng, 2008; Hsu *et al.*, 2007). However, demand differences between users have not been quantitatively analysed. Therefore, based on the current development situation of mobile information services of Chinese university libraries, this study investigated and analysed existing and potential users, respectively, to compare their demand differences quantitatively, as well as figure out the obstacles that keep potential users from using these services, to help Chinese university libraries improve the quality of their mobile services.

3. Research methodology

3.1 Questionnaire design

A survey consisting of three parts was conducted to analyse user needs. The first part concerned basic user information, including the respondent's age, gender, occupation, education and whether the respondent had used library mobile information services. For those who had not used the services, an additional question was set to ask whether they were willing to try the services or not. Those who were not willing to try would quit answering the questionnaire, while the others would be deemed as potential users and continue answering the questionnaire. The second part involved questions about specific user experiences and usage barriers. The third part was about the user needs for library mobile information service. From the literature review, we can see that researchers have extensively discussed the content of information service needs from different aspects. With full consideration, the widely accepted model proposed by Tenopir (2003) was adopted in this study. Tenopir's (2003) study summarized and analysed more than 200 research publications published between 1995 and 2003 that focused on the use of electronic library services, so the user needs dimension model in the study is scientific and applicable. Based on this model, user needs were divided into three dimensions for the present study: service function needs, service mode needs and information content needs. *Service function needs* refers to the specific services that users want to utilize to acquire library resources; *function mode needs* refers to the ways that users wish to get access to mobile information services; and *information content needs* refers to the information resources that users wish to acquire through the services. However, not all the items included in the initial model are suitable for analysing user needs in the mobile network environment in the current development situation of Chinese university mobile libraries. To ensure the reliability and validity of the questionnaire, 26 measurement items are proposed for the present study on the basis of the literature review. All items in each construct were adapted from relevant literature, and certain items were revised based on the practical development of Chinese mobile libraries. Detailed information about the constructs and the sources are shown in Table I.

To quantify user need attitudes, a five-point Likert scale was used in which the five rating levels were set to be: "no need", "less need", "mildly need", "comparatively need" and "intensely need". To ensure the content validity of the questionnaire, three experts

Category	Items	User needs	Sources
Service functions (FNC)	FNC1	SMS alerts of personal borrowing records	Kroski (2008), Mao (2012a), Murray (2010), Seeholzer and Salem (2011), Tenopir (2003)
	FNC2	Mobile OPACs	
	FNC3	Multiple retrieval methods	
	FNC4	Mobile reading	
	FNC5	Mobile literature download	
	FNC6	Mobile literature delivery	
	FNC7	Mobile reference services	
	FNC8	Customized services	
	FNC9	LBS	
	FNC10	Mobile devices for lending	
Service mode (MOD)	MOD1	Service mode based on SMS and voice	Mao (2012a), Tenopir (2003), Wang *et al.* (2012)
	MOD2	Service mode based on library WAP sites	
	MOD3	Service mode based on library apps	
	MOD4	Customized service mode	
	MOD5	Social service mode	
	MOD6	Collaborative service mode	
Information content (CON)	CON1	Personal borrowing Information	Kroski (2008), Mao (2012a), Murray (2010), Paterson and Low (2011), Tenopir (2003)
	CON2	Library collections	
	CON3	New resources introductions	
	CON4	Library news or events	
	CON5	Activities notice	
	CON6	Videos of courses, lectures	
	CON7	Professional discipline resources	
	CON8	Electronic newspapers and online news	
	CON9	Apps related to library	
	CON10	Real-time information (e.g. computers available)	

Table I.
User needs for mobile information services in university libraries

in the field of mobile library services polished and revised the initial questionnaire based on the applicability and readability of items.

3.2 Data collection

Ten Chinese university libraries which launched mobile information services early were chosen to complete the survey, including Peking University, Tsinghua University, Renmin University, Wuhan University, Central China Normal University, Southeast University, Shanghai Normal University, Zhejiang University, Nanjing University and Sun Yat-sen University. Through posting the link to the questionnaire on these university libraries' home pages or forums, library users were randomly invited to participate in the survey during the time period of 6 July to 20 August 2014. There were 353 responders to the survey. After deleting invalid questionnaires (those which were incomplete or duplicates; i.e. filled with the same answers), 319 valid questionnaires were finally collected. Cronbach's alpha method (0.95) was used to assess the reliability of the questionnaire and to determine whether the questionnaire was appropriate. Descriptive statistics, such as the frequency tables, bar graphs and calculation of the measures of central tendency, were analysed through SPSS 19.0 (Larson-Hall, 2010).

There were 179 existing users and 140 potential users in the sample. Among all users, the number of males made up roughly the same proportion with the number of females, 48.6 per cent and 51.4 per cent, respectively; the age of users were mainly concentrated

in the 19-25 range (79.6 per cent) and the 26-35 range (11.6 per cent); the majority (80.3 per cent) had bachelor's or master's degrees; and 67.0 per cent of the users were students. However, in comparison with the potential user group, the existing user group consisted of more individuals with master's or doctoral degrees and more teachers and researchers.

4. Research results

4.1 Application status of existing users

Although mobile library services at Chinese universities have grown rapidly in recent years, they have not been in existence for very long. Most of the existing users had a service experience of less than one year and only 10.6 per cent of them have used the mobile library for over two years, as shown in Figure 1. It is clear that the adoption of mobile information services among users is relatively low and many users are still in the initial trial stage.

In terms of usage frequency of mobile information services, regular users who had used the services more than 20 times accounted for a small portion of total users, while most of the users used the services for less than ten times and only used them when they needed to retrieve literature and a computer was not available. Another 24.0 per cent of users had used the services before, but because of a poor user experience, unfriendly operation interface and limited service function, they basically never used them again, as shown in Figure 2. This indicates that most users have not formed the habit of using mobile services and only use it as a substitute for traditional library services.

The proportion of different mobile terminals held by existing users is shown in Figure 3. Currently, smartphones and tablets are the most prominent mobile service devices. With the growing popularity of e-book readers in recent years, more and more users are attempting to access the library's literature resources through e-book readers. Some Chinese universities, such as Peking University and Nanjing University, even provide borrowing services for e-book readers to users. In addition, some of the non-smartphone users could get mobile information services via SMS, voice and other modes, such as receiving an SMS alert to borrow or return books.

Figure 4 shows the main pathways to obtain mobile information services. Library WAP sites and SMS have become the most popular ways to use services. With the

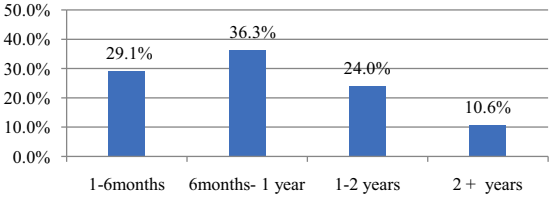

Figure 1.
How long existing users have adopted mobile information services

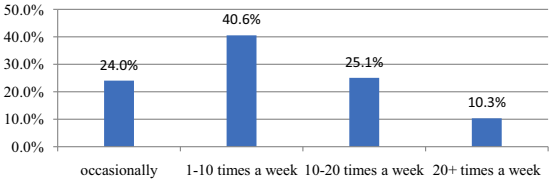

Figure 2.
Existing users use of mobile information services

popularity of smart mobile terminals, more and more university libraries have begun to develop their own app services that could bring users a more flexible and convenient experience. In recent years, with the wide use of mobile social media in library services, the public accounts of university libraries, such as official Weibo or WeChat, have become new ways to obtain information services.

4.2 Utilization barriers for potential users

Although potential users were willing to use mobile information services, some barriers kept them from trying, as shown in Figure 5. The procedures for using mobile services are different from traditional information services. For most potential users, the unfamiliar procedures were the major barrier to use mobile services. In addition, almost half of potential users believed query, borrow and other operations on the mobile terminal were too cumbersome, and not as convenient as the same operation on a PC. Some potential users with strong personalized demands thought that the current mobile services provided by university libraries were too limited to satisfy their individual demands, such as historical inquiry record and discipline thematic service. In addition, the lack of a wireless network environment and other factors were important constraints for potential users. However, all those users showed certain needs for mobile information services, proved by their answers in the questionnaire.

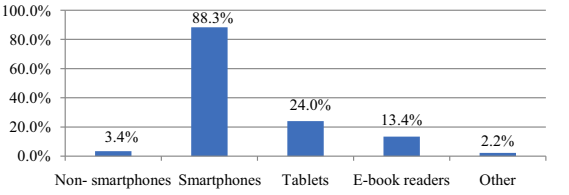

Figure 3.
Types of mobile devices held by existing users

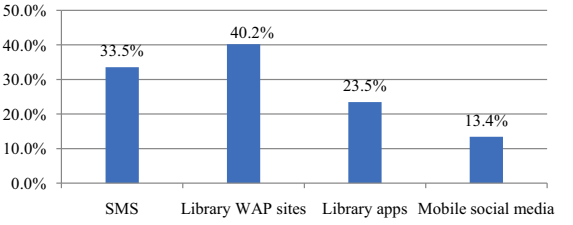

Figure 4.
Major access avenues to mobile information services for existing users

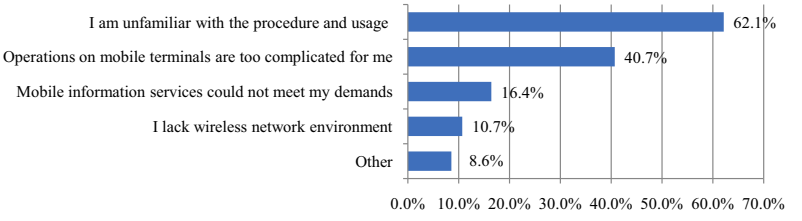

Figure 5.
Main utilization barriers for potential users

4.3 Comparison of users need attitudes

To determine needs for mobile information services of existing users and potential users in service functions, service modes and information content, a frequency analysis was conducted. Table II shows the results of the frequency analysis for the existing users group. It can be seen that the portion of existing users selecting "intensely need" items of information content and service functions was generally higher than that of service modes, indicating that they had stronger needs in terms of service functions and information resources. The portion of existing users selecting "no need" or "less need" was much lower than the average proportion of those choosing "mildly need", "comparatively need" and "intensely need", indicating that the users had extensive needs for the mobile information services in university libraries.

Table III demonstrates the results of frequency analysis in the potential users group. The portion of users selecting "intensely need" for every item was higher than 25 per cent. Additionally, among potential users, the portion of "intensely need" of items in service functions, service modes and information content were roughly alike, suggesting the existence of strong needs for mobile services in all three categories. And, in most items, the percentage of potential users choosing "mildly need" was higher than that choosing "comparatively need", indicating their needs for mobile services were not

	Percentage among existing users (%)				
User need item	Intensely need	Comparatively need	Mildly need	Less need	No need
FNC1	35.35	24.44	23.46	7.26	9.50
FNC2	43.58	32.40	15.63	4.47	3.91
FNC3	39.55	23.91	23.58	7.38	5.59
FNC4	46.36	29.05	13.97	7.83	2.79
FNC5	50.84	27.37	16.21	2.24	3.36
FNC6	25.15	25.69	24.58	13.29	9.30
FNC7	29.61	30.17	25.70	8.37	6.16
FNC8	35.90	25.13	22.05	8.64	7.26
FNC9	41.35	23.46	21.79	7.82	5.59
FNC10	27.38	25.70	25.13	12.30	9.49
MOD1	33.62	28.96	22.90	7.81	6.70
MOD2	50.37	25.72	12.37	6.15	5.39
MOD3	32.38	34.09	20.69	6.14	6.65
MOD4	37.99	31.83	21.24	5.59	3.34
MOD5	31.28	29.05	26.25	10.05	3.35
MOD6	35.75	32.97	18.45	7.82	5.03
CON1	33.84	27.93	23.47	8.39	6.37
CON2	46.72	27.81	18.19	2.23	5.03
CON3	41.90	28.49	17.88	6.70	5.03
CON4	32.95	24.59	26.60	9.14	6.70
CON5	37.43	26.82	23.47	5.59	6.71
CON6	43.57	26.81	19.00	5.04	5.58
CON7	52.75	27.14	15.64	1.11	3.35
CON8	35.22	30.40	18.99	13.03	3.36
CON9	35.20	30.73	20.12	8.39	5.58
CON10	37.79	26.60	21.79	9.91	3.91

Table II. Existing users' need attitudes toward university library mobile services

particularly strong. Although potential users have certain needs for all the services questioned in the survey, the proportion selecting "less need" was a bit high on some service items (> 15 per cent), such as mobile retrieval and library app services. It seems that many potential users have not yet had much need for certain services, especially the services that are quite different from traditional ones.

Moreover, an independent *t*-test was conducted to infer whether significant differences exist between the two user groups on service functions, service modes and information content. The result is shown in Table IV. According to *p*-values, the

	Percentage among potential users (%)				
User need item	Intensely need	Comparatively need	Mildly need	Less need	No need
FNC1	33.57	24.29	27.86	8.57	5.71
FNC2	35.57	25.43	24.57	9.86	4.57
FNC3	30.00	20.57	24.29	15.71	9.43
FNC4	52.14	24.29	13.57	6.43	3.57
FNC5	38.00	20.57	25.14	12.71	3.57
FNC6	38.57	24.29	20.86	11.29	5.00
FNC7	31.23	23.86	24.20	12.14	8.57
FNC8	37.71	20.14	24.00	10.86	8.29
FNC9	26.43	23.29	25.86	14.29	10.14
FNC10	38.57	26.71	19.86	8.00	6.86
MOD1	42.00	23.86	20.57	8.57	5.00
MOD2	33.14	28.43	24.29	7.29	6.86
MOD3	30.29	21.57	23.43	15.14	10.57
MOD4	30.00	25.86	27.57	13.71	2.86
MOD5	38.57	26.86	20.57	10.43	3.57
MOD6	32.14	25.71	24.29	13.57	4.29
CON1	41.29	24.14	20.86	7.14	6.57
CON2	53.57	27.86	12.86	3.57	2.14
CON3	40.29	22.71	24.43	9.00	3.57
CON4	43.29	22.69	24.46	6.14	3.43
CON5	36.43	23.86	25.57	10.14	4.00
CON6	32.29	23.14	29.29	12.86	2.43
CON7	35.71	21.85	25.86	10.86	5.71
CON8	43.57	21.43	27.14	5.71	2.14
CON9	36.43	20.86	21.71	13.14	7.86
CON10	50.00	26.43	15.00	3.57	5.00

Table III.
Potential users' need attitudes toward university library mobile services

	Existing users		Potential users		
User need category	Mean	SD	Mean	SD	*t* value
FNC	3.86	0.30	3.62	0.29	0.313***
MOD	3.77	0.14	3.34	0.13	−0.985***
CON	3.94	0.19	3.89	0.19	−0.615

Note: ***$p < 0.01$

Table IV.
Results of independent samples *t*-test

conclusion could be drawn that, while differences in the needs for service functions and service modes were remarkable between existing users and potential users, there were no significant differences in their needs for information content. At the same time, the average values indicate that existing users have stronger needs for service functions and modes. In addition, the average values were all above three, indicating that both of the groups have positive attitudes toward mobile information services and, thus, further confirmed the earlier conclusion.

To further explore the divergence of needs between the two user groups, "general need rate" and "strong need rate" of each item was calculated on the basis of the results in Tables II and III. This calculating method was proposed by Mao (2012a) in his study about the user needs for library mobile services, in which "general need rate" was defined as the sum of "intensely need rate", "comparatively need rate" and "mildly need rate", while "strong need rate" was the sum of "intensely need rate" and "comparatively need rate". On the basis of the two indexes, the degree of users' general needs and strong needs for varied service items were specified, to provide insight for university libraries endeavouring to improve their services. After consulting experts in the field of mobile library services for advice, the "general need rate" and the "strong need rate" were defined as the final results greater than or equal to 85 and 65 per cent, separately. The results are displayed in Table V in descending order. Apparently, the number of existing users who have general needs or strong needs, in terms of service function, service mode and information content, is greater than that of potential users. Moreover, in these three categories, the specific service items with "general need rate" or "strong need rate" differed greatly between existing and potential users. There were also significant differences in the extent of the need for each item between the two user groups.

5. Discussion

Findings from this study show that both existing and potential users have extensive requirements of library mobile information services. However, because of different

	Percentage among existing users (%)			Percentage among potential users (%)		
	FNC	MOD	CON	FNC	MOD	CON
General need items	FNC5 (94.42)	MOD4 (91.06)	CON7 (95.53)	FNC4 (90.00)	MOD2 (86.43)	CON2 (94.29)
	FNC2 (91.61)	MOD2 (88.46)	CON2 (92.72)	FNC1 (85.72)	MOD5 (86.00)	CON8 (92.14)
	FNC4 (89.38)	MOD6 (87.17)	CON6 (89.38)	FNC2 (85.57)	MOD1 (85.86)	CON10 (91.43)
	FNC3 (87.04)	MOD3 (87.16)	CON3 (88.27)	FNC10 (85.14)		CON3 (87.43)
	FNC9 (86.60)	MOD5 (86.58)	CON8 (87.72)			CON5 (85.86)
	FNC7 (85.48)	MOD1 (85.48)	CON10 (86.18)			CON4 (85.44)
			CON9 (86.05)			CON1 (85.29)
			CON1 (85.24)			
Strong need items	FNC5 (78.21)	MOD2 (76.09)	CON7 (79.89)	FNC4 (76.43)	MOD1 (65.86)	CON2 (81.43)
	FNC2 (75.98)	MOD4 (69.82)	CON2 (74.53)	FNC10 (65.28)	MOD5 (65.43)	CON10 (76.43)
	FNC4 (75.41)	MOD6 (68.72)	CON3 (70.39)			CON4 (65.98)
		MOD3 (66.47)	CON6 (70.38)			CON1 (65.43)
			CON9 (65.93)			
			CON8 (65.42)			

Table V. Comparison of existing users' and potential users' needs

service experiences, their cognitions about the service functions, service modes and information content are different, which leads to distinctly different requirements.

5.1 The difference in service functions needs

With respect to the needs for service functions, both existing and potential users have needs for basic service functions, such as mobile OPACs and mobile reading. However, for existing users, as they are already familiar with using mobile services, the dependency on a mobile network environment for them is much stronger than for potential users. They consider the smooth transition of basic functions from the internet to the mobile network to be necessary, but it is also important for libraries to provide some new services that are fitting for the situational and ubiquitous mobile network, such as bar code/QR code retrieval and LBS. The finding is consistent with Wilson and McCarthy's (2010) research. In contrast, as a consequence of lacking experience in mobile services, potential users did not show general needs for diversified mobile retrieval methods and LBS. Meanwhile, as most potential users expect to use mobile services but do not have competent and satisfactory devices, they expressed strong desire for libraries to lend mobile devices.

5.2 The difference in service modes needs

Compared with potential users, existing users showed a more diversified demand for mobile service modes. They expressed their general needs for all the six modes in the survey, while potential users seemed to have need for only three of them. Moreover, because of their different usage experiences, their attitudes toward specific modes differed remarkably. Existing users expressed strong demand for WAP, apps and other personalized and collaborative services. This can be explained by the following reasons. First, as existing users tend to log in the library using mobile terminals, they urgently need libraries to provide easy access approaches, such as WAP and apps, for them to acquire information services. Second, with their enriched experiences in mobile services, they will not be content with the basic service modes as before. They expect that libraries can take advantage of the end-to-end trait of the mobile terminals to provide more customized services. Furthermore, relying on the local library mobile services could hardly meet users' growing information requirements, as users are asking for inter-library coordination services. In contrast, in their lack of easy access to library WAP sites or apps, potential users showed strong needs for service modes based on SMS or voice. However, it is noteworthy that, although many potential users lack experience in using mobile services, they have strong needs for libraries' social media services which are supported by various social media platforms, such as WeChat and Weibo. This is reasonable, as many of them are users of mobile social media applications and have strong dependency on information services of these applications. Thus, compared with the existing users, potential users pay more attention to easy access and usability of mobile information services.

5.3 The difference in information content needs

Both existing and potential users possess more general needs and strong needs in the information content than service functions and modes, indicating that, even in the mobile network environment, information resources are still the main concern when users access library mobile services. Differences among items with "general need rate" in information content were not significant between the two groups, compared with that

in service functions and modes: both groups expressed extensive demand for basic information resources, such as library collections, personal borrowing information and library news. However, as for items with "strong need rate", responses of the two groups were quite different. Existing users strongly needed professional and real-time discipline resources related to their own research subjects, in addition to library collection information. Additionally, they expected libraries to further integrate information resources of various platforms, enrich the information content and provide varied types of mobile multimedia resources, such as course and lecture videos, apart from traditional digitized literature. They agreed that recommended apps associated with the library would be helpful. In contrast, potential users' selection was relatively simple. They attached greater importance to the timeliness and the consistency of information content, so they expressed strong needs for information about collections of the library, real-time availability status of computers and study rooms, library news and personal borrowing records. These are basically consistent with the findings of Wanqiu's (2009) research that studied user information needs under the internet environment.

6. Conclusions

This study explored the differences in user needs for mobile information services between existing and potential users in Chinese university libraries. The results demonstrated that, because of their different experiences with mobile information services, user needs for service functions and modes were apparently different between the two user groups. For existing users, apart from basic functions, they also expected that libraries could provide more customized and intelligent services according to the advantages of mobile networks. At the same time, they also attached great importance to the diversified and collaborative service modes, hoping for more efficient and convenient access to library resources. Thus, university libraries should lead the revolution and break out of the limitations caused by traditional service modes and, based on mobile networks' context sensitivity and multi-dimensional interactivity characteristics, provide more intelligent services, such as context awareness, augmented reality and LBS in the applications of mobile libraries. Secondly, university libraries could analyse the mobile service preferences and behaviours of their users by data collected via mobile terminals, thus providing existing users with customized retrieval, personal subscriptions, information push and other customized services. Thirdly, librarians should strengthen the collaboration with other libraries or information services institutions via the mobile network to offer users more diversified service modes, improve user satisfaction, and strengthen their sustainable willingness to utilize mobile information services. As for potential users, as they lack the mobile service experiences, libraries should emphasize the ease of use and consistency with traditional library services when providing mobile services. On the one hand, libraries should improve the promotion of mobile services and actively carry out targeted training to help potential users to use mobile services as soon as possible. On the other hand, libraries should spare no effort to create a favourable environment for the use of mobile services. For instance, they can offer mobile devices for checkout or provide users with more convenient and diversified channels of mobile services through their Weibo and WeChat. These services will effectively encourage potential users to try mobile information services and then develop their habitual use of the services.

Furthermore, it is noted that, even in a mobile network environment, information content is still the focus of user needs for both existing and potential users. Information content needs between the two user groups are similar and both of them put forward high requirements for the timeliness and convenience of access to information resources, with specialization and richness of information content. Therefore, university libraries should integrate information resources across all kinds of platforms in the library and make it possible for them to be retrieved, displayed and applied on various mobile devices. To meet the strong demand for specialized knowledge resources of users in diverse fields, librarians can invite domain experts to consolidate the collections of certain areas to improve the quality of information resources. Meanwhile, concerning users' growing fragmented reading requirements in the mobile network environment, libraries can integrate the information resources that are both informative and entertaining. For example, libraries can offer users leisure reading collections, mobile exhibitions and lecture video services.

The findings of this study will help university libraries in China better understand the needs of different types of users and improve the usefulness and relevance of mobile information services. In this way, user satisfaction and loyalty will surely be improved, which can further propel the development of library mobile services. In addition, this study may help existing and potential users better exploit their actual needs and find their potential needs. Then, they can select proper services that meet their personal requirements better.

There are several limitations in this study. First, individuals in the sample were restricted to university library users, excluding users of other types of library. Second, the limited size of the sample made the stratified sampling according to the types of university library users impractical and, as a consequence, undergraduate and graduate students accounted for the vast majority. Finally, items describing user needs listed in the survey were mainly based on the mobile information services that Chinese university libraries launched (or plan to launch) recently. However, with the continuous improvement of the services, these items may need adjustment and supplement. In future research, user needs of public libraries and scientific institution libraries will be taken into consideration and the sample size is expected to be enlarged. Willingness to continue to use library mobile services and usage behaviour are also promising directions for future work. This will allow for even more valuable suggestions to be put forward, to facilitate the rapid development of mobile libraries in China.

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Appendix 1

Questionnaire of user needs for mobile information services in Chinese university libraries

This survey aims to collect relevant information about users' needs for library mobile information services in Chinese universities. This is an anonymous survey, and your response are totally confidential and will be exclusively used in this research project. Thank you for your participation!

Part I

1. What is your age?

○18 or below

○19~25

○26~35

○36~45

○46 or over

2. What is your gender?

○Female

○Male

3. What is your occupation?

○Student

○Teacher

○Researcher

○Other

4. What is your highest level of education?

○High school

○College degree

○Bachelor' degree

○Master' degree

○Doctoral degree

○Other

5. Have you ever used library mobile services?

○Yes (please go to Part II)

○No (please answer question 6 in Part I)

6. Are you willing to try library mobile services?

○Yes (Please jump to question 5 in Part II)

○No (Please quit answering the questionnaire)

Part II

If you have used library mobile information services in university libraries, please answer question 1~4, or you can just answer question 5.

1. How long have you been using the library mobile services?

○1~ 6 months

○6 months ~ less than 1 year

○1 year ~ less than 2 years

○2 years or over

2. How often do you use the library mobile services?

○Occasionally

○1~10 times a week

○10~20 times a week

○20 times or more a week

3. What kind of mobile devices do you hold? (Please select all that apply)

□Non-smart phones

□Smart phones

□Tablets

□E-book readers

4. What are your main pathways to obtain library mobile services? (Please select all that apply)

□SMS

□Library WAP

□Library apps

□Mobile social media

5. What are the barriers for you to use library mobile services? (Please select all that apply)

□I am unfamiliar with the procedure and usage.

□Operations on mobile terminals are too complicated for me.

□Mobile information services could not meet my demands.

□Wireless network environment is not available for me.

□Other (please specify) _____

Part III

Note:					
"1" stands for "no need" ; "2" stands for "less need";					
"3" stands for "mildly need"; "4" stands for "comparatively need";					
"5" stands for "intensely need".					
1.Service functions (FNC):What service functions do you need?					
FNC 1: SMS alerts of personal borrowing records	**1**	**2**	**3**	**4**	**5**
FNC 2: Mobile OPACs	**1**	**2**	**3**	**4**	**5**
FNC 3: Multiple retrieval methods	**1**	**2**	**3**	**4**	**5**
FNC 4: Mobile reading	**1**	**2**	**3**	**4**	**5**
FNC 5: Mobile Literature download	**1**	**2**	**3**	**4**	**5**
FNC 6: Mobile literature delivery	**1**	**2**	**3**	**4**	**5**
FNC 7: Mobile reference services	**1**	**2**	**3**	**4**	**5**
FNC 8: Customized services	**1**	**2**	**3**	**4**	**5**
FNC 9: Local-based service (LBS)	**1**	**2**	**3**	**4**	**5**
FNC 10: Mobile devices for lending	**1**	**2**	**3**	**4**	**5**
2. Service mode (MOD): What service modes do you need?					
MOD1: Service mode based on SMS and voice	**1**	**2**	**3**	**4**	**5**
MOD2: Service mode based on library WAP	**1**	**2**	**3**	**4**	**5**
MOD3: Service mode based on library apps	**1**	**2**	**3**	**4**	**5**
MOD4: Customized service mode	**1**	**2**	**3**	**4**	**5**
MOD5: Social service mode	**1**	**2**	**3**	**4**	**5**
MOD6: Collaborative service mode	**1**	**2**	**3**	**4**	**5**
3. Information content (CON): What information content do you need?					
CON1: Personal borrowing Information	**1**	**2**	**3**	**4**	**5**
CON2: Library collections	**1**	**2**	**3**	**4**	**5**
CON3: New resources introductions	**1**	**2**	**3**	**4**	**5**
CON4: Library news or events	**1**	**2**	**3**	**4**	**5**
CON5: Activities notice	**1**	**2**	**3**	**4**	**5**
CON6: Videos of courses, lectures	**1**	**2**	**3**	**4**	**5**
CON7: Professional discipline resources	**1**	**2**	**3**	**4**	**5**
CON8: Electronic newspapers and online news	**1**	**2**	**3**	**4**	**5**
CON9: Apps related to library	**1**	**2**	**3**	**4**	**5**
CON10: Real-time information (e.g. computers available)	**1**	**2**	**3**	**4**	**5**

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