Dynamic empirical research on user perception behavior of mobile library apps

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Abstract

This paper aims to explore the influencing factors and differences between user perception behavior of mobile library apps at two different points in time. Based on TAM, we constructed the research model. We designed and distributed questionnaires to the users of mobile library apps at an interval of three months to collect dynamic data. A structural equation modeling approach was applied for analysis. The empirical results reveal that PEOU, PU, SI, and FC affect behavior intention, but the impact is different at different times. With users' usage time increasing, TAM is still universal for user perception behavior of mobile library apps; user behavior has dynamic differences; and there are dynamic differences in users' behavior intention to use mobile library apps among different groups. Dynamically tracking and comparing user perception behavior at two different times can help guide the library to improve the quality of mobile library services and reduce user churn.

Introduction

With modern information technology and mobile network developing rapidly, people are apt to get information services from all kinds of mobile terminal devices. At the same time, many universities pay attention to the construction of mobile library apps, new library service systems that extend traditional library services so that users can obtain library information and services via mobile terminal devices anywhere and at anytime. In fact, mobile library apps play critical roles in mobile services of the library, which cannot only comprehensively integrate the library's basic functions, but also demonstrate the features of mobile communication technology, and provide intelligent services, such as location-based services (LBS), context awareness and so on (Yan, 2013). As new platform for knowledge sharing and learning, mobile library apps offer some services, including library catalogue, databases, open classes, library guides and so on, and establishes a new services model, which will improve users' efficiency in daily life and their studies. Cao (2015) investigated 39 academic libraries of Project 985 universities in China, finding that 38 of them had opened mobile library apps services. Liang (2016) found that 52 colleges and universities had opened mobile library apps services in Hubei province. Wei (2017) found that 74.6% of the top 60 university libraries in China provided mobile library services. Therefore, we find that mobile library apps are being promoted and popularized by universities in China.

Mobile library apps in China have developed quickly and smoothly, and many users have downloaded and tried to use it. However, the acceptance and adoption of mobile library apps is relatively low (Zhou, 2012; Gao, 2013; Ming, 2014; Wei, 2014;

Gan, 2015), even fewer university students continue to use them for library services. Consequently, the construction of mobile library apps has not achieved the expected effect. Jasperson (2005) and Limayem (2007) believed that the success of information system depended on whether users continue to use it. The initial adoption of information system is only the first step to its success; if users do not continue to use it subsequently, the information system cannot bring expected usage value to the users. Whether the users continue to use mobile library apps services later will have a bearing on the success or failure of the construction of mobile library apps after users' initial adoption of it. Therefore, it is necessary to conduct dynamically tracking research on user perception behavior of mobile library apps.

Mobile library apps have received extensive attentions from researchers. Existing researches mainly focus on the following aspects: basic theoretical research on mobile library (Huang, 2004; Hey, 2007; Pasanen, 2002; Chen, 2016); research on mobile library apps technology and service model (Ellyssa Kroski, 2008; Zhang, 2014; Miao, 2012;

Liang, 2016); research on mobile library App and development status (Wang, 2012; Tian, 2015; Liu, 2016; Zhang, 2016); and research on user behavior of mobile library apps (Zhu, 2012; Huang, 2013; Yu, 2013; Wang, 2013; Ming, 2014; Ming, 2018).

However, the success of mobile library apps relies on continuous usage. Therefore, we should focus on user's behavior after their initial adoption of mobile library apps. A dynamically tracking research on Chinese users will offer deeper insights into user perception behavior and important considerations for mobile library apps services.

Literature Review

With the rapid development of mobile library apps, researchers explored the influencing factors of users' adoption behavior of it. Zhu (2012) Yu (2014) and Ming (2014) paid attention to the factors that affected users' behavior intention to use mobile library apps in China. They constructed user acceptance model of mobile library apps based on technology acceptance model (TAM), and introduced other variables. The results demonstrated that perceived usefulness, and perceived ease of use had a significant positive effect on users' behavior intention. And Xu (2014), He (2014) and Jin (2014) conducted the empirical study based on the unified theory of acceptance and use of technology (UTAUT). Then, other researchers explored users' behavior intention to use mobile library apps by combining different models and theories. Li (2014) conducted the analysis of user usage of mobile library apps, in which the examined variables were adopted from TAM and the theory of information security. The findings indicated that perceived usefulness and attitude were the pre-causes that affected users' behavior intention to use mobile library apps. And Huang (2013) integrated the TAM and the theory of planned behavior (TPB) to explore users' adoption behavior, and the results showed that perceived usefulness, perceived ease of use, external influence, interpersonal influence, self-efficacy, facilitating conditions, attitude, subjective norms, and perceived behavior control were the main influencing factors for college students to use mobile library apps. Wang (2014) constructed the research model based on the theory of diffusion of innovations (DOI) and DeLone and McLean's information system success model (D&M ISSM), and introduced the perceived usefulness and perceived ease of use. He found that perceived usefulness, perceived ease of use, and visibility positively affected users' willingness to use mobile library apps. Then, other researchers also conducted empirical researches on users' behavior intention to use mobile library apps.

Foreign researchers have also studied users' adoption behavior of mobile library apps. For example, Saravani (2011) identified the factors influencing user acceptance and usage of mobile library apps with the aid of UTAUT and the investigation of managers or librarians in New Zealand and Australia Library. The results showed that performance expectations, effort expectations, social influence, and facilitating conditions affected users' behavior intention to use mobile library apps. Jaradat (2012) and Mtshali (2013) constructed the research model based on TAM and introduced other variables. The results showed that perceived usefulness and perceived ease of use to be the main factors affecting user acceptance and usage of mobile library apps. Aharony (2014) built a research model based on TAM and introduced individual innovation and media variables. The data collected from Israel Libraries and LIS students was used for empirical analysis. The results showed that perceived ease of use and individual innovation affected user adoption of mobile library apps. Sununthar (2015) constructed a user acceptance research model of mobile library apps based on UTAUT and task-technology fit (TTF), introducing the variables of screen design and interactive interface. An empirical study was conducted with users from four academic libraries at CHULA, BUU, SWU and KU in Thailand. The results showed that social influence, performance expectations, TTF, and effort expectations affected user actual usage of mobile library apps. By referring to the category theory and TAM, Zhang (2016) analyzed the main factors influencing university students' acceptance of mobile library apps. The results showed that social influence positively affected and perceived cost negatively affected users' willingness to use mobile library apps.

We can see that the researchers often construct users' adoption behavior models of mobile library apps based on a single theory, expanding or combining theory model. The theories mainly include TPB, TAM, TTF, DOI, D&M ISSM, UTAUT, and so on. Of these, TAM is the theoretical model used most frequently, followed by UTAUT. A cross-sectional approach is used to statically study the relationship between variables in most TAM studies. The data is collected from objects for a specific time period, so the empirical results can only explain the user perception behavior at a certain time. The user perception and feedback of mobile library apps for a specific time cannot fully reflect the overall status of usage. Neglecting the process will inevitably affect the comprehensiveness of research conclusions (Ming, 2017). Therefore, research on the user perception behavior of mobile library apps should be a long-term dynamic process. This study will dynamically track user behavior and compare the differences between user perception behavior of mobile library apps at two different points in time, so as to truly grasp users' actual behavior of mobile library apps.

The study reported in this paper will address the dynamically tracking research for improvement within current mobile library apps services by exploring the following research questions:

RQ1. What are the key factors that affect user perception behavior of mobile library apps, and are these factors different at two different points in time?

Research Model Construction

Davis (1989) put forward TAM based on TRA, and he thought that perceived usefulness and perceived ease of use were key variables that affected users' acceptance and usage of information system. The research proved that TAM can effectively explain and predict the users' attitude towards and behavior of information system. Since it has a solid theoretical basis, TAM offers an effectively universal research model for researchers to investigate users' behavior intention to use information system. Therefore, this study takes TAM as the basic theory, and introduces other variables to better explain and predict users' behavior intention to use mobile library apps in a new environment.

Timely publicity and information from colleges and libraries, and the usage and promotion by college teachers and students will directly affect students' perception behavior of mobile library apps. In other words, social influence significantly affects users' willingness to use mobile library apps. At the same time, in the initial stages of promoting any new technology or service, ease of use will affect the user perception and use of new technology. The process of using mobile library apps needs the support of mobile terminal devices and a mobile network with stable network speed; that is to say, facilitating conditions affect users' willingness to use mobile library apps. At the same time, with increasing usage time, users perception behavior of mobile library apps will vary. Therefore, this study constructs users' adoption behavior model of mobile library apps based on TAM, and introduces the variables of social influence and facilitating conditions, as shown in Figure 1.

Research Hypothesis

In TAM, perceived ease of use refers to the degree to which a person believes that using a particular system will be free of effort, and perceived usefulness is defined as the degree to which a person believes that using a particular system will enhance his or her job performance (Davis,1989). In the context of mobile library apps, users will tend to use it if they perceive that mobile library apps interface is simple and easy to operate. However, as usage time increases, users acquire more experience. Therefore, the impact of perceived ease of use on users' behavior intention to use mobile library apps will weaken. If users perceive that mobile library apps is useful to them, and that it can significantly improve their learning and work efficiency, then they will tend to use mobile library apps. However, as usage time increases, users will not continue to use it if it is merely easy to operate but has poor actual utility. The impact of perceived usefulness will increase users' behavior intention to use mobile library apps. Perceived ease of use will improve user's experience, thus enhancing user's perceived usefulness. However, as usage time increases, the impact of perceived ease of use on perceived usefulness will weaken. From this discussion, we propose:

H1a. Perceived ease of use has a positive influence on users' behavior intention to use mobile library apps.

H1b. With increasing usage time, the impact of perceived ease of use on users' behavior Intention to use mobile library apps will gradually weaken.

H2a. Perceived usefulness has a positive influence on users' behavior intention to use mobile library apps.

H2b. With increasing usage time, the impact of perceived usefulness on users' behavior intention to use mobile library apps will gradually enhance.

H3a. Perceived ease of use has a positive influence on user perceived usefulness of mobile library apps.

H3b. With increasing usage time, the impact of perceived ease of use on the perceived usefulness of mobile library apps will gradually weaken.

Social influence is defined as the degree to which an individual perceives that important others believe he or she should use the new system (Venkatesh,2003). In the context of mobile library apps, if the college and library promote it, and the relevant teachers, classmates and friends use and recommend mobile library apps services, it will enhance the useful cognition of

mobile library apps. In turn, perceived usefulness will prompt users to use mobile library apps. However, as usage time increases, users gradually become more rational. Whether they continue to use mobile library apps will mainly depend on perceived usefulness, and the impact of social influence will weaken. Consequently, we propose:

H4a. Social influence has a positive influence on users’ behavior intention to use mobile library apps.

H4b. With increasing usage time, the impact of social influence on users’ behavior intention to use mobile library apps will gradually weaken.

H5a. Social influence has a positive influence on perceived usefulness of mobile library apps.

H5b. With increasing usage time, the impact of social influence on the perceived usefulness of mobile library apps will gradually weaken.

Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support usage of the system (Venkatesh,2003). In the context of mobile library apps, users will tend to use it if they have mobile terminal devices, such as smart-phones or tablets, and can easily access mobile library services via a stable and cheap mobile network. However, as usage time increases, the impact of facilitating conditions on the usage of mobile library apps will become more apparent, and, therefore, the effect will increase. Good facilitating conditions will affect perceived ease of use. Increasing usage time will enhance this relationship. Consequently, we propose:

H6a. Facilitating conditions have a positive influence on users’ behavior intention to use mobile library apps.

H6b. With increasing usage time, the impact of facilitating conditions on users’ behavior intention to use mobile library apps will gradually enhance.

H7a. Facilitating conditions have a positive influence on perceived ease of use of mobile library apps.

H7b. With increasing usage time, the impact of facilitating conditions on perceived ease of use will gradually enhance.

Research Method

Selection of respondents

University students were selected as the respondents for the empirical research based on the following three points: (1) The respondents have rich information technology knowledge and high mobile information literacy, and they are willing to accept and use it. They are the main users of mobile library apps. (2) The current research on user adoption behavior use structured questionnaires to obtain user perception feedback. In a limited resource environment, it is relatively easy for us to obtain respondents’ support and to collect valid sample data. (3) The usage experience and respondents’ feedback will improve mobile library apps information services and promote the construction of mobile library apps.

Measurement development

Based on the maturity scales in the existing literature, combining with the specific characteristics of mobile library app, we designed measurement items of each construct. Perceived ease of use, perceived usefulness, behavior intention are adapted from Davis(1989);Social influence, facilitating conditions are adapted from Venkatesh (2003). Detailed information about the constructs are shown in Table 1.

Table 1. Measurement of each construct in research model

Construct	Item
Perceived Ease of Use(PEOU)	PEOU1: Learning to operate mobile library apps will be easy for me
	PEOU2: I find it easy to use mobile library apps to do what I want it to do
	PEOU3: Using mobile library apps will not cost me a lot of energy
	PEOU4: I will find mobile library apps easy to use
Perceived Usefulness(PU)	PU1: Using mobile library apps will enhances my learning efficiency
	PU2: Using mobile library apps can help me in my daily life
	PU3: Mobile library apps is useful for me
Social Influence (SI)	SI1: I know mobile library apps from the promotion of it by school
	SI2: Classmates or teachers around me are using mobile library apps
	SI3:Classmates or teachers around me recommend mobile library apps to me
	SI4: I use the mobile library apps because librarians suggest using it
Facilitating Conditions (FC)	FC1: I have mobile terminal devices for using mobile library apps
	FC2: I can use mobile library apps with campus mobile network
	FC3: When I have trouble using mobile library apps, I can get help in time
Behavior Intention (BI)	BI1:I am willing to learn how to use mobile library apps
	BI2:I will recommend mobile library apps to others
	BI3:I will often use mobile library apps in the future

Data collection

The data used to test the research model was collected via a survey questionnaire. The questionnaire items were measured by five-point Likert scales that ranged from “strongly disagree (1)” to “strongly agree (5)”. To avoid semantic problems, we improved the initial questionnaire according to suggestions from two experts and scholars in the field of library and information studies. Then, to examine the validity of the questionnaire, we administered a pretest to 15 students. We revised the questionnaire according to their suggestions.

The formal questionnaire consisted of two parts: (1) the demographic information on the respondents, and (2) questions based on the five-point Likert scales. The paper questionnaires were used to obtain sample data. With the help of library directors and their staff, we targeted student groups and others in information retrieval courses at Wuhan University, Central China Normal University and Wuhan Institute of Technology. All of them have opened mobile library apps services and set up information retrieval courses in the first semester of junior year. Before releasing the questionnaires, the members of research group clarified the purpose and significance of the survey to the respondents in order to receive their support. Those interested in taking part in future research were encouraged to leave their contact information at the end of the questionnaire. We released and collected the first questionnaires in September 2017 (recorded as point T1), and we received a total of 252 valid responses. We issued and collected the second questionnaires in December 2017 (recorded as point T2), and we received a total of 226 valid responses. The questionnaires were collected at an interval of three months. To compare and analyze changes in user perception of mobile library apps during three months, 226 valid responses were chosen.

Table 2 presents the demographic data of the 226 respondents. Of them, 59.3% were male, 40.7% were female, 88.9% were below 25 years old, 84.5% were undergraduate students, and 77.4% were majoring in social and human sciences.

Table2. Demographic data of respondents

Demographics	Item	Subjects	
		Frequency	Percentage(%)
Gender	Male	134	59.3
	Female	92	40.7
Age	18-24	201	88.9
	25-30	18	8.0
	31-35	4	1.8
	>35	3	1.3
Fields of study	Natural sciences	43	19
	Human and social sciences	175	77.4
	Other	8	3.5
Education	Undergraduate student	191	84.5
	Graduate student	35	15.5

Results

I used the PLS-SEM to conduct the empirical analysis, mainly taking the follows into consideration: PLS-SEM modeling approach fits exploratory research, the objective of the study is explaining and predicting target constructs, and the researchers are working with a small sample size (Sarstedt,2017).

Measurement model analysis

To further validate the reliability and validity of the variables in the research model, an internal consistency reliability test and a convergent validity test were measured by using SmartPLS2.0[1]. The results are shown in Table3. Internal consistency reliability was measured by composite reliability (CR), a criterion suggested by Fornell and Larcker (1981); convergent validity was measured by the average variance extracted (AVE) of the potential variables and the corresponding factor loading. The Cronbach's α of each construct was also calculated. From the results, all the CR values were above 0.7969 and the Cronbach's α values were above 0.6648. According to Nunnally (1978), the results suggested high reliability. The AVE values were above 0.50, indicating that convergent validity was good based on the suggestions of Fornell and Larcker (1981).

For satisfactory discriminant validity, the square root of the AVE from the construct should be larger than the correlation shared between the construct and other constructs in the model. As shown in Table 4, the square root of the AVE from the construct is larger than its corresponding correlation coefficients with other constructs, satisfying Fornell and Larcker's (1981) criteria for discriminant validity.

Table 3.Overview of measurement model

T1					T2				
Construct	Items	Standardized loading	CR	AVE	Cronbach's α	Standardized loading	CR	AVE	Cronbach's α
PEOU	PEOU1	0.8043	0.8952	0.6811	0.8439	0.8468	0.8900	0.6692	0.8351
	PEOU2	0.8284				0.7949			
	PEOU3	0.8392				0.8221			
	PEOU4	0.8288				0.8074			
PU	PU1	0.8765	0.8997	0.7497	0.8325	0.8329	0.8589	0.6701	0.7545
	PU2	0.8190				0.7852			
	PU3	0.9000				0.8367			
SI	SI1	0.6867	0.7969	0.5018	0.6751	0.7681	0.8390	0.5663	0.7458
	SI2	0.5165				0.7642			
	SI3	0.7996				0.7860			
	SI4	0.7933				0.6881			
FC	FC1	0.7795	0.8760	0.7023	0.7866	0.7362	0.8172	0.5992	0.6648
	FC2	0.8705				0.7467			
	FC3	0.8612				0.8355			
BI	BI1	0.8737	0.8926	0.7349	0.8197	0.8711	0.9158	0.7839	0.8622
	BI2	0.8715				0.8742			
	BI3	0.8257				0.9103			

Note:CR=composite reliability;AVE=average variance extracted;PEOU=Perceived Ease of Use;PU=Perceived Usefulness;SI=Social Influence;FC=Facilitating Conditions;BI=Behavior Intention.

Table 4. Correlation matrix and discriminant assessment

	T1					T2				
	BI	FC	PEOU	PU	SI	BI	FC	PEOU	PU	SI
BI	0.8573					0.8854				
FC	0.3490	0.8380				0.4670	0.7741			
PEOU	0.6959	0.4418	0.8283			0.4342	0.6056	0.8180		
PU	0.6098	0.3600	0.5922	0.8659		0.4755	0.4229	0.5075	0.8186	
SI	0.3876	0.3256	0.3858	0.4065	0.7084	0.3038	0.4793	0.3001	0.2706	0.7525

Note :The bold value is the square root value of each variable AVE.PEOU=Perceived Ease of Use;PU=Perceived Usefulness;SI=Social Influence;FC=Facilitating Conditions;BI=Behavior Intention.

Structural model analysis

We estimated the structural model by using SmartPLS2.0. The results of structural equation model are shown in figure 2. The standardized path coefficients for the research model are shown in Table 5. From the results, all the 14 paths were at the significant level of 0.001, 0.01 or 0.05.

Therefore, at the point of T1 and T2, all the hypothesis were accepted. Facilitating conditions, perceived ease of use, perceived usefulness and social influence directly affect user' behavior intention to use mobile library apps. Comparing T2 with T1, as usage time increases, the impact of perceived usefulness and facilitating conditions on user' behavior intention to use mobile library apps was enhanced. The impact of facilitating conditions on user perceived ease of use was also enhanced. However, the impact of perceived ease of use and social influence on user' behavior intention to use mobile library apps weakens, the impact of social influence on the perceived usefulness becomes weaker, and the impact of perceived ease of use on perceived usefulness also diminishes.

At the point of T1, the explanatory power of the model variable is 54.98% for behavior intention, 19.51% for perceived ease of use, and 38.79% for perceived usefulness; but at the point of T2, the explanatory power is 32.45% for behavior intention, 36.67% for perceived ease of use, and 27.29% for perceived usefulness. As usage time increases, the explanatory power of the model variance for user' behavior intention to use decreases. This indicates that, with accumulating experience, the user decides whether to continue using mobile library apps or not, and that this is dependent on other elements besides perceived ease of use, perceived usefulness, social influence and facilitating conditions.

Table 5. The results of model verification

hypothesis	Path	Coefficients (T1)	Coefficients (T2)	The variation of coefficients from T1 to T2
H1a	PEOU→BI	0.4970***	0.1207***	↓
H2a	PU→BI	0.2821***	0.2952***	↑
H3a	PEOU→PU	0.5115***	0.4685***	↓
H4a	SI→BI	0.0807***	0.0763**	↓
H5a	SI→PU	0.2091***	0.1300***	↓
H6a	FC→BI	0.0017*	0.2325***	↑
H7a	FC→PEOU	0.4418***	0.6056***	↑

Note: *:p<0.05; **:p<0.01; ***:p<0.001. PEOU=Perceived Ease of Use; PU=Perceived Usefulness;

SI=Social Influence; FC=Facilitating Conditions; BI=Behavior Intention.

Moderating effect analysis

Venkatesh (2003) and Sun and Zhang (2006) emphasized the importance of moderating variables in the study of TAM. Through the comparative analysis of the moderating variables, we can find the causality between variables under different conditions and the reasons for their changes (Su,2011), which will help us better understand user behavior with mobile library apps. Chawla (2018) found that gender, age, qualification, experience, occupation, income and marital status were significant moderating variables to user adoption of mobile banking. Gender is very important for us to understand the decision-making process of user acceptance and usage of information systems, and researches have shown that gender played an important role in influencing individual behavior (Venkatesh,2000). Different age and discipline can also cause differences in individual behavior. Questions concern whether there are differences in individual behavior when it is influenced by a moderating variable, how the moderating variable influences their continuous behavior and what kind of difference exists. Therefore, it is necessary

to explore the impact of the moderating variables in the dynamically tracking of user perception behavior of mobile library apps. Due to the limitations of the sample data, most of sample data comes from undergraduate students, and the age distribution is also relatively concentrated. The proportion of males and females is relatively similar. Therefore, this study will use gender as an moderating variable to verify the moderating effect. At the same time, we analyze perception behavior at the T1 and T2 time points for samples between 18 and 24 years of age, those majoring in human and social sciences, and those pursuing an undergraduate degree, in order to explore whether there are different factors that affect behavior and the reasons for any differences.

Gender is very important to understand user acceptance of information systems. There are differences in male and female subjective evaluation of the external world, and in their attitudes to and adoption of an information system. This study believes that gender has a moderating effect on user behavior of mobile library apps. Therefore, we conducted structure equation test to verify the effect. The results are shown in Table 6.

Table 6. The results of the analysis of the moderating effect of gender

hypothesis	Path	Coefficients(T1)		Coefficients(T2)	
		Male	Female	Male	Female
H1a	PEOU→BI	0.6806***	0.5717***	0.4557***	0.1638
H2a	PU→BI	0.2447**	0.3494***	0.1756**	0.3290***
H3a	PEOU→PU	0.5176***	0.5093***	0.5139***	0.4543***
H4a	SI→BI	0.0724	0.2482***	0.0480	0.1305
H5a	SI→PU	0.1178	0.3650***	0.1821	0.1242
H6a	FC→BI	0.2694***	0.2973***	0.2118	0.4469***
H7a	FC→PEOU	0.4104***	0.4729***	0.4687***	0.6614***

Note:**, $p < 0.01$;*** < 0.001 .PEOU=Perceived Ease of Use;PU=Perceived Usefulness;

SI=Social Influence;FC=Facilitating Conditions;BI=Behavior Intention.

The results of the analysis of the moderating effect of other variables are shown in Table 7.

Table 7. The results of the analysis of the moderating effect of other variables

hypothesis	Path	18–24		Human and social sciences		Undergraduate student	
		T1	T2	T1	T2	T1	T2
H1a	PEOU→BI	0.6545***	0.2582***	0.5587***	0.1938**	0.6447***	0.2580***
H2a	PU→BI	0.2702***	0.3408***	0.1779**	0.3278***	0.2705***	0.3012***
H3a	PEOU→PU	0.5323***	0.4839***	0.2564***	0.4335***	0.5019***	0.4681***
H4a	SI→BI	0.1176**	0.1752*	0.2336***	0.1415	0.1279**	0.1094
H5a	SI→PU	0.1736**	0.0888	0.3828***	0.1169	0.2193***	0.1317
H6a	FC→BI	0.3065***	0.3007***	0.1542**	0.3524***	0.2934***	0.3860***
H7a	FC→PEOU	0.4423***	0.5836***	0.3878***	0.5704***	0.4105***	0.6026***

Note:*, $p < 0.05$;**, $p < 0.01$;*** < 0.001 .PEOU=Perceived Ease of Use;PU=Perceived Usefulness;SI=Social Influence;FC=Facilitating Conditions;BI=Behavior Intention.

[1] You can apply for downloading SmartPLS2.0 by email, and you can download it from <http://www.smartpls.com> after official authorization.

Discussion

According to the results of significance analysis of path coefficients, we find that perceived usefulness, perceived ease of use, social influence and facilitating conditions affect user perception behavior of mobile library apps. At the same time, the acting force of influencing factors and their significance to user behavior are different at the points T1 and T2. Some meaningful findings and discussion will be demonstrated as follows.

With increasing usage time, TAM is still universal for user perception behavior of mobile library apps.

At the points T1 and T2, the hypothesis H1a, H2a and H3a proposed by this research were supported. Consistent with the studies of Davis (1989), Zhu (2012) and Liu (2016), the three original hypothesis of the TAM are supported. Furthermore, this study supports the ability of the TAM to interpret and predict user behavior of mobile library apps. In this study, perceived ease of use and perceived usefulness positively affect user' behavior intention to use mobile library apps. Users initially accept and use it, and they often give greater consideration to its perceived ease of use and perceived usefulness, since mobile library apps are new to them. When users perceive that mobile library apps are easy to operate and are useful for their learning and working, they will be apt to use mobile library apps. In addition, easy operation will enhance the user's experience of using mobile library apps, thus enhancing the perceived usefulness.

Social influence has a positive effect on user' behavior intention to use mobile library apps. The results are consistent with the studies of Taiwo (2012) and Gan (2017). Social influence positively affects perceived usefulness of mobile library apps, and the results are consistent with the study of Wang (2013). Facilitating conditions positively affect user' behavior intention to use, and the results are consistent with the studies of Mursalin (2012), Li (2016) and Gan (2017). Facilitating conditions positively affect perceived ease of use. Users are affected by the publicity of school and recommendations of friends, teachers and others. The perceived usefulness will then be enhanced, and users will be more inclined to use mobile library apps. A free and stable mobile network, available mobile terminal devices (such as smartphones and tablet computers) and other facilitating conditions will also affect perceived ease of use, since mobile library apps requires the support of mobile devices and mobile networks, thus affecting the users' actual use of mobile library apps.

The user perception behavior has dynamic differences

From T1 to T2, with increasing usage time, the empirical results show that perceived usefulness and facilitating conditions have an increased impact on user' behavior intention to use mobile library apps, and facilitating conditions have increased impact on perceived ease of use. The impact of perceived ease of use and social influence on user' behavior intention to use mobile library apps becomes weaker, and social influence on the perceived usefulness lessens, and perceived ease of use on perceived usefulness also becomes weaker.

From T1 to T2, for college students who are accustomed to using various types of apps, perceived ease of use has a significant influence on behavior in the early stages of usage. However, with increasing usage time, the impact of perceived ease of use on perceived usefulness and behavior intention gradually diminishes. Usefulness reflects the degree to which the product's value fits in with users' needs. With the accumulation of actual usage experience, when users perceive that mobile library apps can meet their needs well and that using mobile library apps can significantly improve their efficiency, the impact of perceived usefulness on actual usage increases. At the early usage stage of mobile library apps, users were susceptible to others' behavior and comments. Social influences have a great influence on users' initial usage behavior by affecting their perception of mobile library apps. As their usage time increases, the users' actual experience was enhanced. User perception behavior becomes more rational, and the impact of social influence on perceived usefulness weakens. When the user decides whether to continue using the mobile library apps, they pay attention to its actual utility and convenience. With the rapid increase of mobile network speeds and the expansion of network coverage, people are accustomed to using various types of apps in high-speed and stable mobile networks. Mobile library apps also needs mobile networks as a support, and the status of school mobile

networks will have a direct impact on students' attitudes towards mobile library apps. After initial usage, the impact of facilitating conditions on perceived ease of use is gradually weakened. Users are increasingly dependent on mobile networks, the impact of network quality on continuous usage increase, and the impact of facilitating conditions on user' behavior intention to use increases. It can be seen that user perception behavior of mobile library apps has dynamic differences.

There are dynamic differences in user' behavior intention to use mobile library apps among different groups.

From Table 6, we can see that male behavior intention to use mobile library apps is mainly influenced by facilitating conditions, perceived ease of use and perceived usefulness. Facilitating conditions positively affect perceived ease of use, and perceived ease of use positively affects perceived usefulness at the point of T1. Female behavior intention to use mobile library apps is mainly influenced by facilitating conditions, perceived ease of use, perceived usefulness and social influence. Facilitating conditions positively affect perceived ease of use, and perceived ease of use and social influence positively affect perceived usefulness. Empirical results show that the impact of social influence on user' behavior intention to use mobile library apps are different between males and females, and that females are susceptible to social influence. However, male behavior intention to use mobile library apps is mainly influenced by perceived ease of use and perceived usefulness at the point of T2. Facilitating conditions positively affect perceived ease of use, and perceived ease of use positively affects perceived usefulness. Female behavior intention to use mobile library apps is mainly influenced by facilitating conditions and perceived usefulness. Facilitating conditions have a positive effect on perceived ease of use, and perceived ease of use has a positive effect on perceived usefulness.

Table 6 shows that there are dynamic differences between men and women from the impact of facilitating conditions, perceived ease of use and social influence on behavior intention, and from the impact of social influence on perceived usefulness. Moreover, there are no dynamic differences between men and women from the impact of facilitating conditions on perceived ease of use, from perceived ease of use on perceived usefulness, and from perceived usefulness on behavior intention. Male decision-making is not affected by social influence, but females are affected by social influence at the early usage stage of information technology. As time goes by, the role of social influence decreases.

From Table 7, we can see that undergraduate students who are majoring in human and social sciences are mainly affected by facilitating conditions, perceived ease of use, perceived usefulness, and social influence at the point of T1, but are mainly affected by facilitating conditions, perceived ease of use and perceived usefulness at the point of T2. That is to say, users are susceptible to social influence during the initial usage stage, but with increasing usage time and accumulating experience, their behavior becomes rational and no longer affected by social influence. The users between 18 and 24 years old are affected by the four variables at the point of T1, but the impact of social influence decreases at the point of T2. The impact of social influence on behavior intention between male and female, undergraduate students who are 18–24 and majoring in human and social sciences are different.

We can conclude that there are dynamic differences in user' behavior intention to use mobile library apps among different groups.

Conclusions And Implications

Conclusions

This study constructed a user adoption behavior model of mobile library apps based on TAM, and it introduced social influence and facilitating conditions. We issued questionnaires to collect data at two different points in time, and conducted the empirical analysis by using SmartPLS2.0. The empirical results show that there are differences in user' behavior intention to use mobile library apps, and factors that affecting user' behavior intention to use mobile library apps are different at different times. With increasing usage time, perceived usefulness and facilitating conditions have an increased effect on user' behavior intention to use mobile library apps, and the impact of social influence and perceived ease of use diminish.

Implications

In the future, mobile library apps should enrich the content of services to meet the individual needs and further enhance the perceived ease of use and perceived usefulness of mobile library apps. The university library can provide information and services for different targeted users in the process of using mobile library apps by analyzing their behavior to tap their potential requirements, which will enhance user perceived usefulness of mobile library apps. At the same time, it is also necessary to actively promote and attract users' positive responses. During the construction of mobile library apps, the university and library must also facilitate conditions for users to use mobile library apps, such as by providing two-dimensional codes for users to download, conducting related lectures, popularizing mobile library apps related knowledge, and providing users with timely online helping services.

Limitations

There are some limitations in this study. First, the model variables of this study include only four independent variables: perceived ease of use, perceived usefulness, social influence, and facilitating conditions. These four variables cannot comprehensively explain and predict user behavior intention to use mobile library apps. The model has yet to be further expanded and improved to better explain and predict user behavior of mobile library apps. Therefore, in the follow-up study, we must consider adding more variables that affect user perception behavior, such as individual innovation, perceived trust, perceived pleasure, information quality, and service quality, in order to extend and improve the model to better study users' dynamic behavior of mobile library apps. Second, due to the limitations of the sample data, this study analyzed only the moderating effect of gender. The sample is concentrated on a certain type of characteristic group, so several other variables cannot be analyzed for moderating effects, and it is only possible to compare whether there are differences at the points T1 and T2. Therefore, in future research, it is necessary to expand the sample scope and sample size to ensure the uniform distribution and representativeness of the sample, further studying the influencing factors under different population characteristics, and better studying users' dynamic perception behavior of mobile library apps. Third, the sample data of this study has mainly come from colleges in Wuhan. It did not collect data from universities with high coverage of mobile library apps, such as Beijing, Zhejiang, Guangdong, and Shanghai. Therefore, the research results still need further verification. In the future, it will be necessary to expand the scope of the sample acquisition. By dynamically tracking users to obtain the perception and feedback data at different times and by combining the log data of mobile library apps platforms, we are better able to analyze user dynamic behavior to verify the dynamic applicability for the conclusions, and to compare and analyze the influencing factors and users' behavioral differences of mobile library apps in different regions.

Declarations

Funding

Not applicable

Code availability

(Not applicable)

Declaration of Conflict of Interest

The authors declare that they have no conflict of interest.

Data Availability Statement

All data generated or analyzed during this study are included in this article.

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Figures

Figure 1

Research model

Figure 2

The results of structural equation model