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Research on Influencing Factors of College Students' Willingness to Use Mobile Learning

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Abstract

As a new way of learning, mobile learning is no longer limited by time and space. College students, the main audience group of mobile learning, study the factors that affect college students' willingness to use mobile learning is helpful to improve their motivation for mobile learning. Therefore, based on the theory of technology acceptance model, information literacy theory, self-management theory, and social influence theory, this study designed a questionnaire on factors influencing college students' willingness to use mobile learning by taking variables such as information literacy, perceived usefulness, perceived ease of use, self-learning management, social influence, and flow experience as dimensions. In this paper, 535 students at Hubei University of Medicine were investigated, and structural equation model analysis was used to verify the theoretical model and discuss the effect relationship among the variables. The results proved that information literacy has a positive impact on perceived ease of use and perceived usefulness; perceived ease of use has a positive effect on perceived usefulness; perceived usefulness, self-learning management, and social influence had positive effects on immersion experience.

Keywords: mobile learning, usage willingness, technology acceptance model, influencing factors

1. Introduction

The development of mobile communication, the continuous upgrade of mobile devices and the gradual improvement of mobile software makes it more and more common for learners to use mobile learning, which breaks the traditional way of in person learning and greatly satisfies people's need for continuous learning [1]. When conducting mobile learning, people can use mobile devices to obtain many learning resources in a good network communication environment, and make reasonable use of fragmented time to learn, so as to improve their comprehensive quality [2]. Professor Huang Ronghuai of Beijing Normal University put forward that "mobile learning is the learning that learners take place in non-fixed and non-preset positions, or the learning that takes place by effective use of mobile technology" [3]. At present, the definition of mobile learning refers to a kind of learning that can take place at any time and place with the help of mobile devices.

Mobile computing devices used in mobile learning must be able to effectively present learning content and provide two-way communication between teachers and learners. Mobile learning has changed the time, place, method, and content of learning dramatically. With the popularity of mobile devices, convenient mobile learning is more and more popular among college students [4]. The sudden outbreak of COVID-19 affected offline classroom teaching, and mobile learning gradually became the mainstream learning method during COVID-19 [5], which helped teachers and students realize the goal of "stopping classes without stopping learning". Although mobile learning has many advantages, students' willingness to use it will be affected by some factors. Foreign scholars Ahmed Alsswey and others found that cultural and social factors will have an impact on the acceptance and adoption of mobile learning in the Arab Gulf countries [6]; Chinese scholar He Huimin's research on influencing college students' willingness to use mobile devices to learn English by using Unified Theory of Acceptance and Use of Technology (UTAUT) has found [7] that, among the design variables, perceived self-efficacy, content and resources of educational resources, and performance expectation have great influence on behavioral intention. In this paper, the influencing factors of college students' willingness to use mobile learning were explored by taking college students as the research object. Based on the technology acceptance model (TAM), the influencing factors of college students' willingness to use mobile learning were discussed.

2. Theoretical Basis and Research Hypothesis

2.1 Theoretical Basis

2.1.1 TAM

TAM was proposed by American scholar Fred D. Davis in 1989 and developed based on the Theory of Reasoned Action (TRA) in the field of information system/computer technology. It is mainly used to explain and predict people's acceptance degree of the emerging information technologies [8]. TAM takes external variables, perceived usefulness, perceived ease of use and usage willingness as important structures. As the two key variables of the model, perceived usefulness and perceived ease of use will affect the user's attitude to use, and then the user's specific willingness to use, and finally the user's specific use behavior. Perceived usefulness refers to the extent to which a person believes that using a specific system can help his or her work. Perceived ease of use refers to the extent to which a person accepts the difficulty of using a system [9].

2.1.2 Information Literacy Theory

The concept of information literacy was first put forward by P. G. Zurkowski in 1974, which refers to people's comprehensive ability to identify, acquire and apply information [10]. With the continuous development of information technology, information literacy has been given new connotation, and the elements of information literacy have also been improved and developed. The four elements of information literacy include information awareness, information knowledge, information ability and information morality. Information awareness refers to people's keen perception, judgment, and insight of information; information knowledge refers to theories, knowledge and methods related to information; information capability refers to the ability to understand and acquire information and the ability to use information and information technology; information morality is the ideology and behavior standard used to regulate the relationship between people. In this study, information literacy refers to learners' attitudes, methods, and abilities towards information in the process of mobile learning.

2.1.3 Self-Management Theory

Drucker, a contemporary management scientist, put forward the theory of "self-management" in 1954. Self-management refers to the self-management of an individual to himself and his goals, thoughts, behaviors, and psychology to motivate, restrain and manage himself. The main contents of self-management include their own management of their own time, health, learning, emotional intelligence, and other content. The main contents of self-management include the management of your own time, health, learning, emotional intelligence, etc. People constantly meet their own needs, enrich the original knowledge structure, obtain valuable information, and ultimately achieve success without independent learning, and independent learning depends on self-management of learning. In this study, self-learning management refers to learners' arrangements and plans for their mobile learning.

2.1.4 Social Influence Theory

Kelman, the proponent of the social influence theory, hold the view that social influence refers to the fact that individuals' thoughts, attitudes, and behaviors will be more or less affected under the influence of others or the external environment. The social influence will affect the subjective norms of individuals through compliance, identification, and internalization [11]. Some scholars have revealed that social influence will have an indirect impact on college students' willingness to use mobile learning [12]. In this study, social influence refers to the extent to which learners' own willingness to use is influenced by others important people, such as teachers, friends, parents, etc.

2.2 Research Hypothesis

According to the technology acceptance model and relevant theoretical basis, this study takes information literacy, self-learning management and social influence as external variables, retains the two factors of perceived usefulness and perceived ease of use in the model, and adds the intermediate variable of flow experience combined with relevant literature, which has strong subjective feelings. Since only the influencing factors of college students' willingness to use mobile learning are discussed, the result variable is only the usage willingness. The research model established in this study is shown in Figure 1.

Information literacy and perceived usefulness, perceived ease of use: The information literacy of college students is that they can judge when they need information and know how to obtain information and how to evaluate and effectively use the information they need according to their own ability. When college students have good information literacy, they can use their information ability to better choose, understand and use information. Therefore, information literacy has a positive impact on perceived usefulness and perceived ease of use. Kuang

Yun et al. believed that information literacy has a significant positive impact on perceived usefulness and perceived ease of use in the study of the factors affecting the acceptance of flipped classroom of students in a vocational college [13]. The following hypothesis was proposed.

H1: Information literacy positively affects perceived usefulness.

H2: Information literacy positively affects perceived ease of use.

Perceived ease of use and perceived usefulness: In the technology acceptance model, perceived usefulness is affected by perceived ease of use. In this study, the more convenient mobile learning is, the more useful it is for college students. Through an empirical study, Xu Shun discovered that in the study on influencing factors of learners' willingness to use mobile learning platforms, perceived ease of use variable would have a significant impact on perceived usefulness [14]. The following hypothesis was proposed.

H3: Perceived ease of use positively affects perceived usefulness.

Perceived usefulness, perceived ease of use, self-learning management, social influence, and flow experience: Research shows that the higher the sense of usefulness is, the stronger the sense of flow experience is [15]. Hsu C L and Lu H P used the technology acceptance model to predict users' acceptance of online games and believed that perceived ease of use would have a positive impact on the flow experience [16]. People with strong self-learning management ability have strong self-discipline and strong anti-interference ability, and thus have stronger flow experience in mobile learning. Lulu Chen found that social influence would have a positive impact on mobile live broadcast users' flow experience in her research on factors influencing their willingness to pay [17]. The following hypothesis was proposed.

H4: Perceived usefulness positively affects flow experience.

H5: Perceived ease of use positively affects flow experience.

H6: Self-learning management positively affects flow experience.

H7: Social influences positively affects flow experiences.

Flow experience and usage willingness: The impact of flow experience on usage willingness is positive in many research fields. When college students are immersed in mobile learning, it means that they have a good experience of using mobile learning, and the pleasure brought by mobile learning will increase their intention to use mobile learning.

H8: Flow experiences positively affects usage willingness.

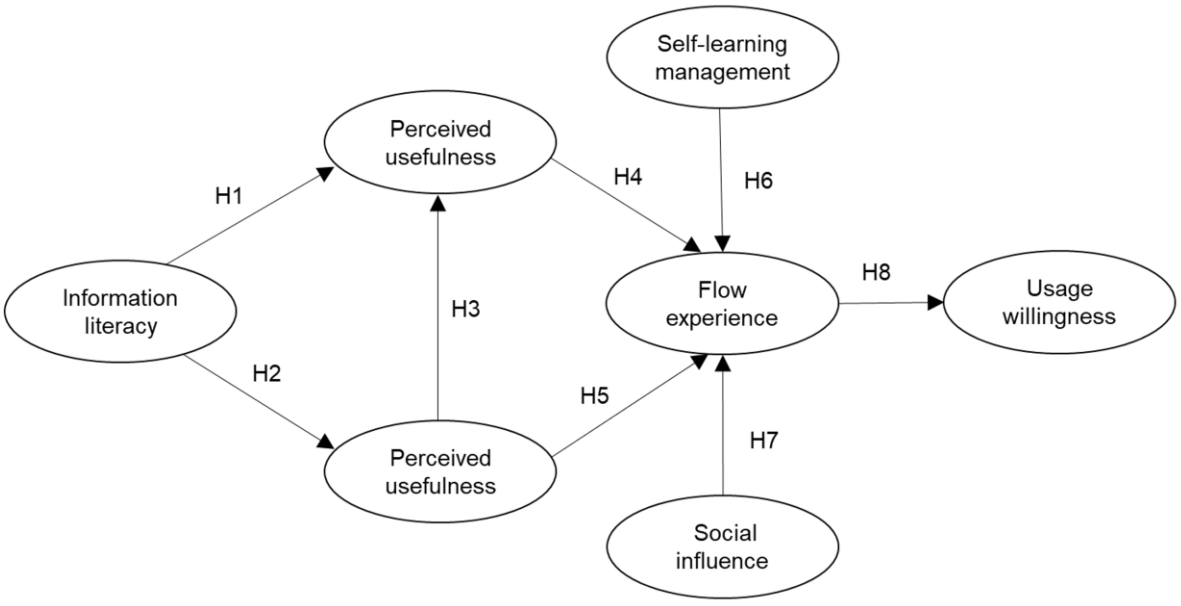

Figure 1. Model assumption

3. Research Method

3.1 Sample

According to relevant theories, a questionnaire was prepared and an online survey was conducted by using the questionnaire star. The respondents were undergraduates of Hubei University of Medicine. A total of 842 questionnaires were collected, and 535 valid questionnaires were obtained after screening, which means that all the respondents have experience in using mobile learning. Among college students with mobile learning experience, male students account for 42.8%, female students account for 57.2%. In terms of the duration of using mobile devices for mobile learning, 204 students use mobile devices for 2-4 hours a day, accounting for 38.1% of the total. Secondly, 136 people use mobile devices to study for 4-6 hours every day, accounting for 25.4%. Meanwhile, 134 students, accounting for 25% of the total, study on mobile devices for 0-2 hours a day. The number of people who use mobile devices for 6-8 hours is 42, accounting for 7.9%. At least 19 people (3.6%) use mobile devices to study for more than 8 hours. The overall conclusion is that college students use mobile devices to study for more than 2 hours a day.

3.2 Reliability and Validity Analysis

3.2.1 Validity Analysis

Validity test is to verify the validity of the questionnaire, that is, whether the questions in the questionnaire can truly and effectively reflect the purpose of the research. In this paper, principal component analysis and variance maximization orthogonal rotation method in exploratory factor analysis were used to extract common factors, and then confirmatory factor analysis was used to verify the degree of fitting between the generated model and the sample data. Exploratory factor analysis and confirmatory factor analysis were analyzed with SPSS23.0 and AMOS24.0 software, respectively.

3.2.1.1 Exploratory Factor Analysis

Before the factor analysis, it is necessary to conduct KMO test and Bartlett sphericity test to judge whether the sample data is suitable for the factor analysis. The results illustrated that KMO value is 0.907 and Bartlett sphericity test is less than 0.010, which indicated that the data is suitable for the factor analysis. Exploratory factor analysis was carried out on all items, and the factor load of the item "If the conditions of equipment and resources are met, I am willing to conduct mobile learning" was less than 0.4, and the item "I am willing to recommend people around to use mobile learning" did not support the dimension of perceived ease of use in theory, and was also deleted. The KMO value of the second factor analysis was 0.903, the Bartlett sphericity test was less than 0.010, and the remaining 28 items were restricted to extract 7 common factors. The variance of the total variance interpretation obtained by the principal component analysis method was 62.707%. The component matrix after rotation obtained by the maximum variance method is shown in Table 1, including the factor load values of 28 items in 7 dimensions.

Table 1. Results of exploratory factor analysis

Items	Component						
	1	2	3	4	5	6	7
Mobile learning can improve my academic performance.		0.778					
Mobile learning can improve my learning efficiency.		0.763					
Mobile learning allows me to study in my spare time.		0.749					
Mobile learning is helpful to my life.		0.751					
I can skillfully use mobile devices for learning.				0.746			
Mobile learning interface interaction is simple.				0.795			
It doesn't take much effort to adapt to mobile learning.				0.673			
Mobile learning always makes me forget about the world around me.					0.784		
When it comes to mobile learning, time always seems to fly by.					0.739		
When I use mobile learning, my attention will not be distracted elsewhere.					0.705		
When mobile learning encounters difficulties, I will use network information as an important reference to			0.709				

find answers.					
When conducting mobile learning, I can quickly identify which learning resources are really useful.		0.678			
In mobile learning, I can summarize and integrate the information obtained.		0.573			
In mobile learning, I will consciously resist bad information, not to create and spread junk information.		0.467			
I can use mobile learning to solve the problems I encounter.		0.476			
When I encounter difficulties in learning, I believe I can solve them independently.		0.468			
I can reasonably arrange my time for mobile learning according to my learning goals.	0.605				
After starting mobile learning, I can complete the learning task without interference.	0.644				
I am a self-disciplined person in learning and research.	0.806				
In life, I can easily deal with the relationship between entertainment and learning.	0.763				
I can effectively manage my study time and complete my homework easily.	0.744				
I can independently make learning plans and complete learning tasks.	0.718				
My friend's recommendation will affect my use of mobile learning.				0.758	
My teacher's recommendation will influence my use of mobile learning.				0.823	
My family's recommendation will influence my use of m-learning.				0.693	
I enjoy interacting with teachers and students when I'm in mobile learning.					0.656
I like others to praise and reply to my learning experience.					0.748
I like to share interesting things about my study on social media.					0.809

Extraction method: Principal component analysis.
Rotation method: Kaiser's method of maximum variance normalization.
a. The rotation has converged after 7 iterations.

3.2.1.2 Confirmatory Factor Analysis

Structural validity: In the first confirmatory factor analysis, items with factor load lower than 0.5 in the dimension were deleted. Among them, the items "when mobile learning encounters difficulties, I will take network information as an important reference for seeking answers" and "when mobile learning, I will consciously resist bad information and not create and spread junk information" had factor loads less than 0.5, so they were deleted. The fitting index was obtained after the second confirmatory factor analysis of the remaining 26 items, as shown in Table 2. All indicators meet the fitness criteria, which indicates that the model fits well and the structure validity of the questionnaire is satisfactory.

Table 2. Fitting index

	χ^2/df	GFI	AGFI	CFI	IFI	TLI	SRMR	RMSEA
Fitting index	2.418	0.908	0.884	0.927	0.927	0.914	0.045	0.052

Convergent validity: Convergent validity emphasizes those measures that should belong to the same factor (indicator) and do fall under the same factor when measured. Average variance extraction (AVE) and combined reliability (CR) are often used to evaluate the convergent validity under the same dimension. Studies have demonstrated that AVE values >0.4 and CR values >0.6 indicate that the convergent validity is within the acceptable range [18]. In this study, the AVE value of each dimension is 0.413-0.571, and the CR value is 0.686-0.877, which indicates that the combination reliability and convergence validity of each dimension pass the test.

Discriminant validity: To verify the differentiation validity of each factor, this study conducted a confirmatory factor test with Amos 24.0 software to compare the fit of seven factor, six factor, five factor, four factor, three factor, two factor and single factor models. It can be seen from Table 3 that the seven-factor model has the best fitting degree, so the seven-factor model has good discriminative validity.

Table 3. Discriminative Validity Analysis

Model	Factors	$\chi 2$	df	$\chi 2$/df	RMESA	GFI	CFI
Model 1(Seven-factor model)	PU,PEU,FE,IL,SLM,SI,UW	672.264	278	2.418	0.052	0.908	0.927
Model 2 (Six-factor model)	PU+PEU,FE,IL,SLM,SI,UW	930.601	284	3.277	0.065	0.87	0.88
Model 3 (Six-factor model)	PU,PEU+FE,IL,SLM,SI,UW	1050.409	284	3.699	0.071	0.842	0.857
Model 4 (Six-factor model)	PU,PEU,FE+IL,SLM,SI,UW	918.978	284	3.236	0.065	0.869	0.882
Model 5 (Five-factor model)	PU+PEU+FE,IL,SLM,SI,UW	1242.94	289	4.301	0.079	0.826	0.823
Model 6 (Five-factor model)	PU,PEU+FE+IL,SLM,SI,UW	1096.605	289	3.794	0.072	0.842	0.85
Model 7(Five-factor model)	PU,PEU,FE+IL+SLM,SI,UW	1112.427	289	3.849	0.073	0.841	0.847
Model 8(Four-factor model)	PU+PEU+FE+IL,SLM,SI,UW	1407.892	293	4.805	0.084	0.803	0.793
Model 9 (Four-factor model)	PU,PEU+FE+IL+SLM,SI,UW	1378.405	293	4.704	0.083	0.794	0.798
Mode 10(Three-factor model)	PU+PEU+FE+IL+SLM,SI,UW	1859.81	296	6.283	0.099	0.732	0.709
Model 11(Three-factor model)	PU,PEU+FE+IL+SLM+SI,UW	1647.412	296	5.566	0.092	0.769	0.749
Model 12(Two-factor model)	PU+PEU+FE+IL+SLM+SI,UW	2131.158	298	7.152	0.107	0.71	0.659
Model 13(Single factor model)	PU+PEU+FE+IL+SLM+SI+UW	2296.493	299	7.681	0.112	0.694	0.628

PU: Perceived usefulness; PEU: Perceived ease of use; FE: Flow experience;
IL: Information literacy; SLM: Self-learning management; SI: Social influence;
UW: Usage willingness.

3.2.2 Reliability Analysis

Reliability test is the reliability test of the questionnaire, which is to test the internal consistency of each dimension measurement items. This paper used Cronbach's Alpha coefficient to test the reliability of the data. The larger Cronbach's Alpha coefficient is, the higher the reliability of each variable is. In general, Cronbach's Alpha coefficient is above 0.6, which indicates that the questionnaire data had good reliability [19]. SPSS 23.0 was used for the reliability analysis of the questionnaire data. Cronbach's Alpha coefficient of each latent variable in the first reliability test is 0.641-0.876. After the validity test, the Cronbach's Alpha coefficient results of each latent variable in the second reliability test are shown in Table 4. Cronbach's Alpha coefficients of all potential variables are greater than 0.6, which indicates that the measurement reliability of potential variables in the questionnaire measured by this model is relatively good.

Table 4. Reliability Analysis

Variable	Cronbach's α coefficient	Quantity of measurement items
Perceived usefulness	0.838	4
Perceived ease of use	0.718	3
Flow experience	0.750	3
Information literacy	0.733	4
Self-learning management	0.876	6
Social influence	0.742	3
Usage willingness	0.685	3

4. Model Analysis

Structural equation model (SEM) was used to test the relationship between constructs. After examining multiple indicators suitable for the models according to Bollen's (1989) suggestion, the goodness of fit of each model was determined using several statistical functions. The parameters were Chi-square/degree of freedom (χ2/df), adjusted goodness of fit index (AGFI), comparative fit index (CFI) and root mean square error approximation (RMSEA) [20]. AMOS24.0 software was used for data analysis.

5. Research Results

Through structural equation model analysis, the fit of the whole model was tested, and the results showed that the fit of the model is good. χ2/df=2.665, which was less than 3 suggested by Kline [21]. Among the similarity indicators, the goodness of fit index (GFI), adjusted goodness of fit index (AGFI), comparative fit index (CFI), incremental fit index (IFI) and Tucker-Lewis index (TLI) are all close to 0.9, which indicates that the model similarity indicators fit well. In the anisotropy indexes, root mean residual (RMR)<0.05 and root-mean-square error of approximation (RMSEA)< 0.08, which suggests that the model anisotropy indexes are well fitted (See Table 5 for data results). Information literacy and perceived usefulness (β=0.471, P<0.001), information literacy and perceived ease of use (β= 0.663, P<0.001), perceived ease of use and perceived usefulness (β= 0.224, P<0.01), perceived usefulness and immersion experience (β=0.274, P<0.001), self-learning management and flow experience (β= 0.454, P<0.001), social impact and immersion experience (β= 0.180, P<0.01) and immersion experience and willingness to use (β= 0.493, P<0.001) indicate that the hypothesis H1, H2, H3, H5, H6, H7, and H8 is supported. According to the results of the test model, no evidence was found to support hypothesis H4. The results of path analysis to verify the hypothesis model are shown in Figure 2 and Table 6.

Table 5. Model fitting index

	χ2/df	GFI	AGFI	CFI	IFI	TLI	RMR	RMSEA
Fitting index	2.665	0.896	0.873	0.911	0.911	0.899	0.041	0.056

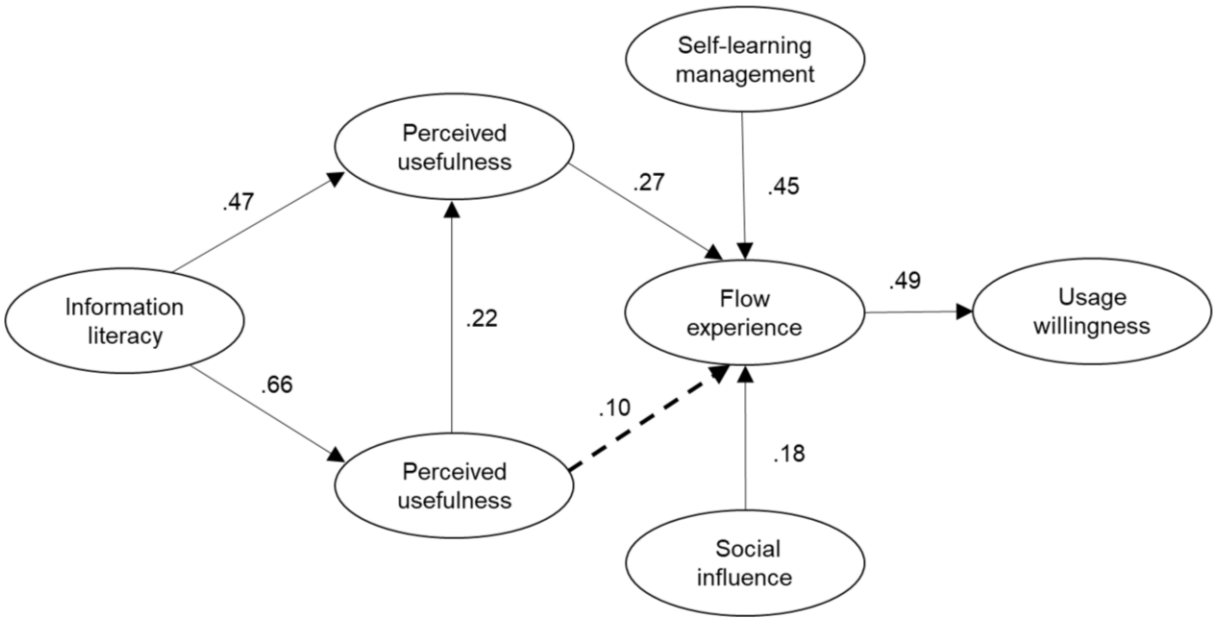

Figure 2. Final model

Table 6. Path analysis for hypothesis testing

Hypothetical path			Standardization coefficient β	C.R.	P	Pass the test
PEU	<---	IL	0.663	8.522	***	Yes
PU	<---	IL	0.471	6.193	***	Yes
PU	<---	PEU	0.224	3.04	0.002	Yes
FE	<---	PU	0.274	4.282	***	Yes

FE	<---	SI	0.18	2.988	0.003	Yes
FE	<---	SLM	0.454	6.772	***	Yes
FE	<---	PEU	-0.096	-1.475	0.14	No
UW	<---	FE	0.493	6.866	***	Yes

PEU: Perceived ease of use; IL: Information literacy; PU: Perceived usefulness; FE: Flow experience; SI: Social influence; SLM: Self-learning management; UW: Usage willingness
*P<0.05**P<0.01***P<0.001

6. Discussion

Based on TAM, this study explored the effects of information literacy, perceived usefulness, perceived ease of use, self-learning management, social influence, and flow experience on college students' willingness to use mobile learning. Information literacy, self-learning management and social influence are the external variables, and flow experience is the intermediate variable. Our research results proved that the factor that directly affects college students' willingness to use mobile learning is immersion experience. When college students are completely immersed in mobile learning, they will have great pleasure in mobile learning and will not be bored for a long time, and then will have a stronger willingness to use. The variables that directly affect flow experience are perceived usefulness, self-learning management, and social influence. The influence intensity of the three factors was self-learning management (0.45) > perceived usefulness (0.27) > social influence (0.18). College students with stronger self-learning management have stronger self-discipline and are more likely to be immersed in the state of mobile learning. However, studies have shown that whether college students can enter the state of immersion learning has nothing to do with self-learning management [22]. More mobile learning users think that the knowledge of mobile learning is useful. When they devote themselves to mobile learning, they will have better immersion experience. Flow experience is often affected by the external environment, and the positive influence of the external environment will significantly improve the level of flow experience. The positive influence of perceived usefulness on information literacy and perceived ease of use was 0.47 and 0.22, respectively, and the positive influence of perceived ease of use on information literacy was 0.66. College students with higher information literacy have stronger information awareness, attitude, and evaluation ability, which has a positive impact on the perceived usefulness and ease of use of mobile learning. Similarly, perceived ease of use has a positive impact on perceived usefulness in line with the assumptions in the technology acceptance model.

The intensity of the variables that have a positive impact on college students' willingness to use mobile learning is as follows: immersion experience (0.49)>self-learning management (0.22)>perceived usefulness (0.14)>social impact (0.09)>information literacy (0.08)>perceived ease of use (0.03). According to our research, immersion experience will have a positive impact on college students' intention to use mobile learning, which is consistent with the research results that immersion experience will have an impact on the intention to use/participate in/purchase something [23-24]. Once immersed in mobile learning, mobile learners will have a pleasant experience of mobile learning. The stronger the sense of immersion is, the stronger the willingness to use mobile learning will be. This requires mobile learning developers to focus on the specific needs of college students' mobile use and introduce gamification elements to make mobile learning more attractive to users. College students with strong self-learning management ability have the strong willingness to use, and self-learning management will have a positive effect on the willingness to use mobile learning [25]. The COVID-19 has made online mobile learning the main way of learning. Although online learning abandons the disadvantages of traditional learning, it increases the factors that interfere with and tempt learning [26]. Therefore, only by actively improving self-learning management ability can college students consciously resist the temptation and enhance their willingness to use mobile learning. In the technology acceptance model, perceived usefulness and usage attitude jointly influence usage willingness, while usage attitude is jointly influenced by perceived usefulness and perceived ease of use. Therefore, perceived usefulness and ease of use will directly or indirectly have a positive impact on usage willingness. The results of this study are consistent with the theory of TAM. When college students feel that mobile learning is simple, convenient, and fruitful, they will have a higher willingness to use mobile learning [27]. The willingness to use mobile learning is often influenced by mobile learning users such as classmates, friends or teachers, and individual willingness is largely influenced by society. Therefore, the acceptance and support of mobile learning in the external environment will promote college students to use mobile learning more actively. Finally, the results of this study revealed that college students with high information literacy will have a strong intention to use mobile learning. Therefore, improving college students' information literacy will help improve their intention to use mobile learning.

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Author Contributions

Qun Wang (1981-), female, Luzhou, Sichuan province, professor: Conceptualization, Writing original draft, Data curation, Formal analysis, Funding acquisition.

Yong Yu (1982-) (corresponding author), male, Shiyan, Hubei Province, professor: Methodology, Software, Supervision, Review & editing.

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