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Motivation analysis of College Students' use of English vocabulary applications based on UTAUT model

Xiaolin Zhang [a], Yanyan Sun [b], Yuying Li [c], Jingying Wang [d *]

[a] High school Affiliated to Fudan University, Shanghai 200433, China
[b] Faculty of Education, East China Normal University, Shanghai 200062, China
[c] College of Education Sciences, Qingdao University,Qingdao,11065,China
[d*] Faculty of Education, Beijing Normal University, Beijing 100875, China

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ABSTRACT

Despite English vocabulary applications (APP) are common tools for undergraduates' mobile English learning, they have some problems, such as poor perceived effect and the weak willingness of continuous use. This study was to investigate the behavior model of undergraduates' use in English vocabulary learning APP. Based on the unified theory of acceptance and use of technology (UTAUT), a comprehensive research model is proposed by integrating three theories, namely multimodal cognitive learning theory, mobile micro-learning theory, and learning motivation theory. 263 Chinese undergraduate students from a Chinese research university took part in a questionnaire with a followed-up interview. Based on structural equation model (SEM) analysis, results indicated: 1) undergraduate students' usage of English vocabulary learning APP can be explained using this model; 2) perceived playfulness, performance expectancy, perceived resources, and self-management of learning are all significant and direct drivers of attitude intention to utilize English vocabulary learning applications; 3) perceived mobility and facilitating conditions have indirect effects on undergraduate students' attitude intention through the moderation of other factors; 4) the impact of social influence on attitude intention is negligible. This study provides suggestions for future design and development of English vocabulary learning APP from three aspects: learning resources, learning interest, and learning personalization.

1. Introduction

English proficiency has been recognized as a crucial element in gaining access to higher education, decent employment, and more admired lives in modern China (Pan, 2011). Especially for college students, one of the conditions for their graduation and further education is to pass a national standardized English competence test, known as CET-4 (Huang et al.,2018). Learning English took up more than half of Chinese undergraduate students' self-study time (Gao & Wang, 2011). As the basis of English learning, vocabulary acquisition is especially important to the overall development of foreign language learning (Johnson, Acevedo, & Mercado, 2016). Because of the large amount memory characteristics and easy to forget vocabulary ksnowledge, foreign language learners have often struggled with vocabulary learning, while the accessibility and flexibility of mobile learning provide convenience for lexis acquisition (Motallebzadeh et al., 2011; Motallebzadeh & Ganjali, 2011; Saran et al., 2012).

English vocabulary learning applications are widely used among college students, however, they still have some limitations such as poor perceived effect, the weak willingness of incessant use, which leads to the inclination and behavior of giving up (Zhang et al., 2019). As the core of mobile learning, learners need to understand their perception and preference for English vocabulary learning APP (Lai & Zheng, 2018). However, most of the existing research on English lexical application use behavior are based on the current situation, with little theoretical basis (Chen & Jia, 2020), and focus on the analysis from a single perspective of mobile learning or vocabulary acquisition, lacking multi-dimensional comprehensive consideration. This study adopts the UTAUT model with strong explanatory power, based on the mobile micro-learning theory and multimodal cognitive learning theory in the field of vocabulary acquisition, combined with the learning motivation theory, constructs a model of undergraduate students' English vocabulary learning application use behavior, explores the influencing factors and interactive relationships of college students' English vocabulary APP use behavior, and puts forward some

*Corresponding author: Jingying Wang
Email: wangjingying8018@126.com
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suggestions for the use of existing APP from the perspective of user acceptance.

2.Literature Review

2.1 The UTAUT model

The core issue of the application of educational technology in subject teaching research is to understand the various elements influencing the acceptance of technology (Teo et al., 2019). Throughout the years, a number of explanatory frameworks have been suggested and used to describe the link between technology acceptance and its determinants. which includes the Theory of Reasoned Action(TRA)(Ajzen & Fishbein, 1980), the Technology Acceptance Model (TAM)(Davis, 1989), the Theory of Planned Behavior (TPB)(Ajzen, 1991), and so on. Although the TAM is the most authoritative interpretation framework among all of those, it also has its limitations. The TAM focuses on the internal effects such as user perception and ignores the external impact of technology acceptance (Klopping et al., 2004). In recent years, the empirical analysis shows that the UTAUT model integrated by eight related models, including the TRA, TAM, TPB, MPCU, MM, IDT, and so on, can explain more than 70% of the factors affecting users' technology use behavior (see Figure 1), which is better than all the existing theoretical models (Venkatesh et al., 2003). According to the UTAUT model, behavioral intention and use behavior are affected by performance expectancy, effort expectancy, social influence, and facilitating conditions. Gender, age, experience, and voluntariness of use play a regulatory role in the influence path (Venkatesh et al., 2003). Researchers have discovered empirical evidence of utilizing the UTAUT model to assess technology acceptance on different learning platforms, including Facebook (Escobar-Rodriguez et al., 2014), Wikipedia(Yueh et al., 2015), and interactive whiteboards (Sumak & Sorgo, 2016), indicating that the model is useful for explaining technology adoption behavior (Hoi, 2020).

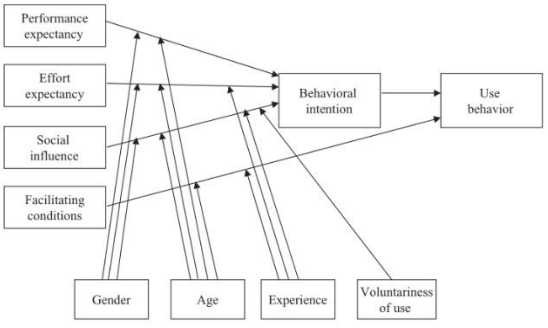

Fig. 1 The unified theory of acceptance and use of technology model (UTAUT)(Venkatesh et al., 2003)

2.2 Learning motivation

Motivation is mainly divided into internal motivation and external motivation (Vallerand, 1997). Internal motivation emphasizes inner desire, while external motivation emphasizes external results. The former is maintained or enhanced through perceptual ability and learning autonomy. Despite the fact that intrinsic motivation is not always linked to academic achievement, it is a positive factor affecting self-regulated learning (Van et al., 2012) and reducing learning pressure (Baker 2014). In contrast, external motivation is more related to external regulation and has nothing to do with self-regulated learning. The intrinsic motivation of language learning is considered to be a possible factor affecting the behavioral intentions of students.

In terms of technology-assisted language learning, some scholars argue that learners' embrace of technology is influenced by two sorts of motivation. One is a heartfelt and innate interest in technology, which motivates students to use emerging technologies rather than traditional methods to learn languages. The other is language learning motivation, which encourages learners to use a variety of tools and techniques to help them learn a language effectively (Ushioda, 2013; Stockwell & Hubbard, 2013). Learners who are intrinsically motivated may not use mobile devices to study English since they may have alternative language learning methods. (Sun & Gao, 2020). This paper aims to explore the influence of motivation on learners' usage behavior of English vocabulary learning applications.

2.3 Mobile Micro-Learning Theory and Multimodal Learning Cognitive Theory

Mobile Micro-Learning Theory can be used to explain mobile language learning behavior (Zhou et al., 2015). Language learning requires a flexible, piecemeal, convenient, and context-rich cultural environment, which is consistent with the advantages of informal and context-sensitive mobile technology (Kukulska-Hulme, 2009). In all aspects of English listening, speaking, reading, and writing, the importance of vocabulary memory is self-evident. Intermittent repetition is better than centralized repetition in the process of vocabulary memory (Nation, 1990).

Li et al. (2016) referred to the cognitive theory of multimodal learning to explore the effect of mobile-assisted language learning on second language vocabulary acquisition in a multimodal environment. Empirical studies show that learning vocabulary in a multimodal manner can minimize the burden of memory and maintain vocabulary memory. Mobile devices with large capacity, small size, and easy portability are suitable for carrying multimodal vocabulary learning resources. Learners can browse rich and dynamic vocabulary resource databases and master new words in repeated review (Yang, 2012). Through experiments, Lu and Yang (2016) found that “picture plus text” is the most popular way of conceptual knowledge presentation by users, which is far better than the results of pure text and video. This is also in line with the fact that multimodal presentation in the cognitive theory of multimodal learning can promote vocabulary learning.

2.4 Mobile-assisted language learning (MALL)

Although researchers have done some theoretical research on mobile learning, there are relatively few empirical studies on mobile technology-assisted language learning for college students, especially in developing countries. When used to analyze the acceptance of mobile Internet services like m-learning, existing information system models can be adapted and expanded according to their own research needs (Pedersen & Ling, 2003). For example, many studies expand the UTAUT model and verify it through empirical research. The more far-reaching external variables are attitude, self-learning management, and perceived playfulness. Studies showed that attitude is the most powerful predictor of higher education learners' willingness to use mobile technology to assist in language learning (Hoi, 2020; Botero, 2018). Self-management of learning significantly affects users' desire to use mobile devices (Wang et al., 2009; Huang, 2012), while a study in Iran found the opposite result (Esfandiari et al., 2016), which may be affected by different

cultural and environmental factors to some extent. Perceived playfulness has received more attention as a factor affecting users' acceptance of mobile learning behavior. Many researchers introduced perceived playfulness into the UTAUT model and obtained significant positive results(Huang et al., 2012; Wang et al., 2009; Pindeh et al., 2016). In addition, Pagani (2006) combined the TTF model and introduced perceptual task technology matching as an external variable. Amberg et al. (2004) and Lei (2008) put forward the factor of perceived cost for the consideration of knowledge payment.

These extended UTAUT models fully explain the user acceptance behavior under the emerging information technology and provide theoretical guidance for higher education researchers and mobile application developers to try to improve user acceptance. Chinese researchers have made a late start in the study of mobile English learning, and there are even fewer studies on the acceptance model of it. Meng et al. (2018) and Zeng (2019) took English and Japanese learning as examples to analyze the technology acceptance model of mobile language learning in China. Chinese scholars have investigated and analyzed the current situation of the use of English lexical apps. Ling (2019) found that enabling learners to learn vocabulary in context through games can significantly improve their learning effect. Zhang et al. (2017) have studied that the interaction function between users in English vocabulary APP can motivate users to a certain extent and promote learners to keep using applications for vocabulary learning in the form of social interaction. Wang et al. (2018) put forward the active role of learners, pointing out that the special feature of ink memorization is to give learners initiative, and learners can choose the words they want to learn every day from the word list. All these provide a feasible direction for college students to accept the influencing factors of English vocabulary APP behavior.

To sum up, the UTAUT model can effectively analyze college students' behavior of using mobile technology to assist English vocabulary learning. Among the four core variables in the original model, the impact of effort expectation is becoming less and less significant, which is partly due to the advancement of mobile technology. The external variables proposed in existing studies, including perceived playfulness, attitude, self-management of learning, perceived mobility, and perceived financial cost, are unstable and need to be verified in empirical research. In addition, most of the existing research on English lexical APP use behavior are based on the current situation and has no theoretical basis, or from a single perspective of mobile learning or vocabulary acquisition. There is no organic unity of mobile learning acceptance perspective and vocabulary acquisition perspective, and less analysis is made from the perspective of learning motivation. Therefore, this study investigates the influencing variables and interaction of college students' usage of English lexical APP by using the structural equation model (SEM).

3.Research model and hypotheses

Grounded in Venkatesh's UTAUT model, this study attempts to investigate the determinants of undergraduate students' English vocabulary learning applications use behavior. The study model is depicted in Figure 2 with key components and predicted linkages. This model removes the weakening influence factors of effort expectation in the UTAUT model, and brings the two influencing factors of perceived resources and perceived mobility into the model according to the multimodal cognitive learning theory and mobile micro-learning theory. According to the learning motivation theory, perceived playfulness, self-management, and perceived financial cost are included in the model. Additionally, the original UTAUT model does not incorporate attitude, but the study of Thomas et al. (2013) implied that attitude was the most important predictor of behavioral intention, and adding the influence of attitude increases the explanatory variance of behavioral intention by 47.1%. Therefore, in this model, attitude is incorporated into the behavioral intention to form attitude intention, which is defined as college students' positive or negative emotions and intentions when using English lexical APP (Hoi, 2020). The definitions of influencing factors and the hypotheses are shown in Figure 2.

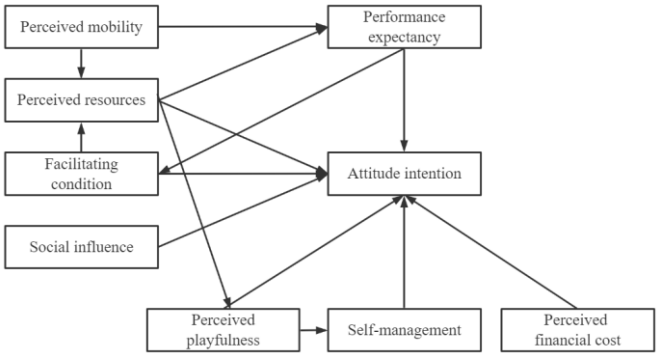

Fig.2 Proposed research model.

3.1 Performance expectancy, social influence, facilitating conditions

In this study, the variables are redefined on the premise of the original UTAUT model. The amount to which college students believe that English lexical APP can improve their vocabulary level and English achievement is referred to as performance expectancy. Social influence refers to the influence of an important person or media environment on whether college students use English vocabulary apps or not. The degree to which college students consider that current technologies, organizations, equipment, and resources promote their usage of English vocabulary applications is referred to as facilitating conditions. In particular, the facilitating conditions in the original model only focus on the support of existing organizations and technical facilities, which have been basically ensured in recent years thanks to the advancement of mobile technology. In the realm of mobile language learning, it is necessary to consider the degree to which resources promote learners' acceptance of technology(Meng et al., 2018). This has also been applied in the research on mobile Japanese learning, so this study includes resource support in facilitating conditions(Shukla, 2021). As a result, the following hypotheses were put forward by the study:

H1. Performance expectancy has a positive significant effect on attitude intention.

H2. Social influence has a positive significant impact on attitude intention.

H3. Attitude intention is positively influenced by facilitating conditions.

H4. Facilitating conditions have a positive considerable effect on perceived resources.

H5. Performance expectancy has a positive significant impact on facilitating conditions.

3.2 Perceived resources, perceived mobility

The study brings two influencing factors of perceived resources and perceived mobility into the model according to the multimodal cognitive learning theory and mobile micro-learning theory. Perceived resources refer to undergraduate students' perception of resources on English vocabulary APP, including multimodal, rich, easy to obtain, interactive, and so on (Peter et al., 2003). A study proved that perceived resources had a favorable significant influence on behavioral intention (Pindeh et al., 2016). The more satisfied learners feel the resources, the more likely they are to believe that English vocabulary APP can improve their vocabulary level, so this study put forward the hypothesis that perceived resources positively affect performance expectancy (Esfandiari & Sokhanvar, 2016). The more satisfied learners feel the resources, the more likely they are to feel the pleasure of memorizing words (Huang et al., 2012; Wang et al., 2009; Esfandiari & Sokhanvar, 2016).

Perceived mobility referred to college students' perception that English lexical APP can be used anytime and anywhere to obtain information and services and that privacy can be protected (Amberg, 2014). Learners have an increasing demand for access to information and services using English lexical APP anytime and anywhere and pay more attention to user privacy in the mobile era, so the hypothesis that perceived mobility has a positive impact on performance expectancy is put forward (Amberg, 2014). The stronger the perceived mobility, the more convenient the mobile learning resources that learners can feel (Lei, 2008). The hypotheses of the study, H6-H10, were therefore formulated:

H6. Perceived resources have a positive significant effect on performance expectancy

H7. Perceived resources have a positive significant effect on attitude intention

H8. Perceived resources have a major beneficial impact on perceived playfulness

H9. Perceived mobility has a positive significant effect on performance expectancy

H10. Perceived mobility has a positive significant effect on perceived resources

3.3 Perceived playfulness, self-management of learning, perceived financial cost

The study adds perceived playfulness, self-management of learning, and perceived financial cost to the model according to the learning motivation theory. College students' feeling of pleasure, wonder, and enjoyment in utilizing English lexical APP is referred to as perceived playfulness. (Wang et al., 2009). The hypothesis that perceived playfulness positively affects attitude intention has been confirmed in Moon & Kim's (2001) studies.

Self-management of learning refers to the degree of self-restraint and self-sustained participation of College students in the use of English Vocabulary APP(Wang et al., 2009). Considering that the more fun learners feel in mobile learning, the stronger their learning motivation drives them to complete learning tasks, it is hypothesized that perceived playfulness has a positive impact on self-management. Because of the lack of monitoring in the use of English vocabulary APP, learners are required to have intrinsic motivation and self-restraint in order to start and continue to use it (Wang et al., 2009). Perceived financial cost refers to that college students feel the need to spend a certain degree of cost, including equipment, communications, business expenses, and so on when using an English vocabulary APP. According to the findings, the cost of mobile learning is a significant influence on college students' willingness to adopt it, but with the rise of the concept of paying for knowledge among college students, it needs data to prove whether perceived financial cost is still a significant factor (Liu & Wu, 2011). The following hypotheses were proposed accordingly.

H11. Perceived playfulness has a positive significant impact on attitude intention.

H12. Perceived playfulness has a positive significant effect on self-management of learning.

H13. Self-management of learning has a positive significant effect on attitude intention.

H14. Perceived financial cost has a negative significant effect on attitude intention.

4 Materials and methods

4.1 Instrument and Methods

Within a modified UTAUT paradigm, a questionnaire with nine measures (see Appendix A) was constructed to investigate Chinese college students' attitude intention toward using English vocabulary learning applications. The questionnaire adopted the 7-point Likert scale because it not only provides the same response quality as the 5-point Likert scale but also delivers high data dispersion (Sun & Gao, 2020). The nine scales corresponded to the nine main structures: performance expectancy, social influence, facilitating conditions, perceived resources, perceived mobility, perceived playfulness, self-management of learning, perceived financial cost, and attitude attention. The majority of the questionnaire items were derived from earlier research and 5-6 items were set on each scale. Five undergraduates from a university in East China have invited to pre-evaluate the complete questionnaire, then several wordings and expressions were revised according to their feedback to ensure that the items were understood correctly.

4.2 Participants and Data Analysis

Questionnaires were distributed and collected through the network. Participation in the investigation was wholly voluntary and anonymous.Participants were undergraduates who have experience in using English vocabulary apps in a research university in east China. The questionnaire was issued from February 26 to March 3, 2021. In total, 296 surveys were collected. 33 were removed from the data because the polygraph question was answered wrong or the total answer time was short than 60 seconds. Finally, there were 263 valid questionnaires with an 88.9% effective rate.

The sample features are shown in Table 1. 66 males (25.1%) and 197 females (74.9%) participated so the ratio of male to female is 1:3, which is basically in line with the sex ratio of undergraduates of this university. The distribution of grades is balanced, and the proportion of freshmen to seniors is close to 25%. So the sample basically

reflects the overall situation. All the samples have experience in using English vocabulary APP, ranging from less than 3 months to more than 2 years. 36.5% of the samples used English lexical APP for less than 3 months, which was presumed to be related to the relatively large number of freshman samples; 27.8% had more than one year's experience in using English lexical APP. 59.7% of the samples use English vocabulary APP for less than 15 minutes per day on average, which is in line with the pattern and needs of English vocabulary learning fragmentation.

Table 1 Respondent demographic information (N=263)

Demographic variable	Frequency	Percentage
Gender		
··Male	66	25.1
··Female	197	74.9
Grade		
··Freshman	75	28.5
··Sophomore	64	24.3
··Junior	62	23.6
··Senior	62	23.6
Experience in using English lexical APP		
··<3 months	96	36.5
··3-6 months	58	22.1
··6-12 months	36	13.7
··1-2 years	25	9.5
··>2 years	48	18.3
Average daily use of English lexical APP		
··<15 minutes	157	59.7
··16-30 minutes	77	29.3
··31-45 minutes	19	7.2
46-60 minutes	9	3.4
··>1 hour	1	0.4

This study also investigates the English vocabulary APP commonly used by college students, and the results are shown in Table 2. The survey's findings reveal that there is a wide choice of English vocabulary APP, and college students often choose 2-3 APP to help each other to memorize words. The most frequently used APP words are Baicizhan (57%), shanbay words (28.9%), maimemo words (22.1%), and Bubei words (22.1%). Among them, 57% of the students most often use Baicizhan, which is far more than other similar APP. The characteristic of Baicizhan is picture memory, which is consistent with the "picture-text type", and it is considered to be the best way to promote vocabulary learning in this survey. The basic descriptive statistical analysis was carried out by using IBM SPSS Statistical 25. The maximum likelihood estimation method was used to fit the initial model and test the hypothesis by AMOS 23.

Table 2 Vocabulary APP usage distribution

Name	Frequency	Percentage
Baicizhan	150	57.0
Shanbay words	76	28.9
Maimemo words	58	22.1
Bubei words	58	22.1
Spark English	37	14.1
Hujiang words	15	5.7
Towords	13	4.9
Others（Eudic, Zhimi words, Ileci, etc.）	37	14.1

5 Results

The means, standard deviations, and Cronbach's alpha of the participants' responses are displayed in Table 3. The data showed that the sample showed a positive attitude towards all 9 potential variables (M>4). The Cronbach's alpha value is more than or equal to 0.7, indicating strong reliability, and less than 0.7 but greater than 0.5, suggesting acceptable reliability. In this survey, the Cronbach's alpha values of eight variables, including performance expectancy, social influence, promotion conditions, perceived resources, perceived mobility, perceived playfulness, self-management, and attitude intention, all showed good reliability, and only perceived financial cost (α= 0.643) was acceptable.

In the validity test, after excluding the perceived financial cost latent variables and other items with poor convergence validity, the standardized factor loads, average extraction variances (AVE), and combinatorial reliability (CR) of all the remaining 8 latent variables were more than 0.7. The measurement model showed good convergence validity. To evaluate the discriminant validity of these factors, the square root of the average variance of the extracted potential variables can be compared with the correlation between the factors (Fornell & Larcker, 1981). In each case, the square root of the extracted average variance surpasses the correlation between the respective factors and every other factor in the model. Therefore, all factors achieve discriminant validity.

Table 3 Mean (M), standard deviation (SD), and Cronbach's alpha

Variable (number of items)	Mean	Standard deviation	Cronbach's α
Performance expectancy (5)	4.91	1.37	0.874
Social influence (5)	5.26	1.31	0.828
Facilitating conditions (5)	5.92	1.23	0.785
Perceived resources (7)	5.15	1.42	0.840
Perceived mobility (5)	5.38	1.45	0.785
Perceived playfulness (5)	4.15	1.63	0.903
Self-management of learning (5)	4.45	1.40	0.905
Perceived financial cost (3)	4.76	1.62	0.643
Attitude attention (5)	4.87	1.53	0.906

The fitness index of the initial model is shown in Table 4. It is known from the table that the initial structure model can be adapted, but the fitness is not good enough. Only x^2/ df showed good results, and the other indicators were acceptable.

Table 4 The fitness index of the initial model

Fit degree index	Adaptation standard		Observed value	Result
	Good	Acceptable		
χ^2/df	<3	3.0-5.0	2.792	Good
GFI	>0.9	0.7-0.9	0.793	Acceptable
RMSEA	<0.08	0.08-0.1	0.083	Acceptable
AGFI	>0.9	0.7-0.9	0.755	Acceptable
CFI	>0.9	0.7-0.9	0.887	Acceptable

The findings of the model path analysis are displayed in Table 5. The study assumes that H1 and H4-H13 are supported and that H2 and H3 are not significant and are not supported. Among them, it is assumed that the path of H13 self-management attitude intention is significant at .05 level, the path of H7 perceived resources attitude intention is significant at .01 level, and the significance test of each other path is significant at .001 level. The total effect of standardization on attitude and intention is obtained by

adding the direct effect and indirect effect of standardization. The order from high to low is perceived mobility (β= 0.502), perceived playfulness (β= 0.365), performance expectancy (β=0.270), promotion conditions (β=0.259), perceived resources (β=0.133), and self-management (β=0.130). It is worth noting that perceived mobility only indirectly affects attitude and intention but shows the highest overall effect of standardization among the six influencing factors.

Table 5 Path Analysis Results

	X	→	Y	Standardized path coefficient	SE	z(CR value)	p	Findings
H_1	PE	→	AI	0.24	0.07	3.42	***	Supported
H_2	SI	→	AI	0.02	0.04	0.48	.63	Rejected
H_3	FC	→	AI	0.08	0.06	1.30	.195	Rejected
H_4	FC	→	PR	0.42	0.53	4.64	***	Supported
H_5	PE	→	FC	0.55	0.29	5.38	***	Supported
H_6	PR	→	PE	0.70	0.18	9.46	***	Supported
H_7	PR	→	AI	0.31	0.09	2.94	.003**	Supported
H_8	PR	→	PP	0.76	0.08	9.69	***	Supported
H_9	PM	→	PE	0.81	0.15	5.33	***	Supported
H_{10}	PM	→	PR	0.32	0.38	6.09	***	Supported
H_{11}	PP	→	AI	0.42	0.07	5.07	***	Supported
H_{12}	PP	→	SM	0.74	0.07	10.32	***	Supported
H_{13}	SM	→	AI	0.13	0.04	2.00	.045*	Supported

*p<.05; **p<.01; ***p<.001. PE: performance expectancy, AI: attitude intention, SI: social influence,FC: facilitating conditions, PR: perceived resources, PP: perceived playfulness, PM: perceived mobility, SM: self-management of learning.

The final model is shown in figure 3, with solid lines showing significant paths and dotted lines as insignificant paths. Perceived playfulness, performance expectancy, perceived resources and self-management directly affect attitude intention. Perceived mobility and promotion conditions indirectly affect attitude intention through the regulation of other factors, while the impact of social influence on attitude intention is negligible.

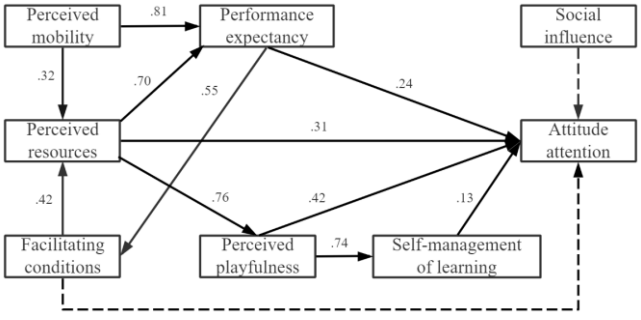

Fig.3 Path diagram for the revised model, including path coefficients.

6 Discussion

6.1 Perceived mobility

According to the fitting results of the model, perceived mobility is the most important factor influencing college students' behavior of using English lexical APP (the total effect of standardization is 0.502). It indirectly affects attitude intention through the regulation of performance expectancy (H9) and perceived resources (H10) but has no direct effect on attitude intention. The results are consistent with the research results of Xu et al. (2020), Yang (2020) in Chinese college students, and Pramana (2018) in Indonesian college students. With the development of the information age, college students pay more and more attention to the mobility of English vocabulary APP, and there is a growing demand for vocabulary learning using English vocabulary APP anytime and anywhere. When choosing English vocabulary APP, they will give priority to whether it is convenient, fast, and real-time to obtain information and services, which matches the advantages of high efficiency and mobility of mobile learning. It is worth noting that the hypothesis that "learners need to protect privacy when using English lexical APP" added to the dimension of perceived mobility has not been verified. The items "my privacy can be well maintained when using English lexical APP" and "my personal information will not be disclosed when using English lexical APP" do not pass the convergence validity test. This is slightly different from the existing research results on the mobile learning platform. The author speculates that this may be explained by the fact that compared with other English learning APP that records learners' learning dynamics, usage habits, address book relationships, and even pronunciation, English vocabulary APP often does not need users to fill in too much personal real information, so users have not paid too much attention to the privacy issues when using English vocabulary APP, and different learners have different feelings about privacy protection when using English vocabulary APP.

6.2 Perceived playfulness

Perceived playfulness positively affects attitude intention (H11), and indirectly affects attitude intention (H9) through self-management (the total effect of standardization is 0.365), which accounts for a larger proportion than the existing research results. When studying Indonesian middle school pupils' embrace of mobile learning, Ahmad (2021) pointed out that millennials (born in late 1990 and early 2000) were more accustomed to the ubiquitous influence of mobile technology in their lives because they were born at the time of the rise of the social network. Compared to the practicality of mobile learning (performance expectancy, etc.), they pay more attention to interest, that is, no matter how useful a mobile learning device/application is, if they do not enjoy it, they may not continue to use it. This is consistent with the sample group characteristics of this study. In addition, English vocabulary learning is boring compared with other English learning. Therefore, considering the time background and the characteristics of English vocabulary learning, learners will pay more attention to its interest when choosing English vocabulary APP, to make word learning more simple and efficient. From the path that perceived playfulness positively affects self-management, it can be analyzed that the more interesting learners find it to be using English lexical APP to memorize words, the more they can stimulate their self-management ability and improve their intrinsic motivation, and they will be more willing to use English lexical APP for learning.

6.3 Performance expectancy

The hypothesis that performance expectancy (H1) positively affects attitude intention is verified, which is in line with the existing study findings. It can be explained by college students' motivation to use English vocabulary APP. Whether it is the external motivation of most students who want to pass the English proficiency test or the internal motivation of a small number of students who want to improve themselves. Their need to improve their vocabulary level drives them to use English vocabulary APP. For college students, the more they believe that utilizing English lexical

APP can enhance their vocabulary and English performance, the stronger their attitude intention to use them.

6.4 Perceived resources

Perceived resources have a direct effect on attitude intention (H7), and also have an indirect impact through performance expectancy (H6) and perceived playfulness (H8). This shows that college students think that the more resources in English vocabulary APP are helpful to learning, the more they are willing to use them for learning. Moreover, the better the resources, the more learners think that using English lexical APP can help them improve their English vocabulary and feel happier when learning, therefore they are more willing to use English lexical APP for learning.

Mobile learning resources are the necessary material basis of English vocabulary APP. The characteristics of fragmented learning time, unrestricted learning location, brief and applied learning contents (Chen & Wang, 2012) meet the needs of vocabulary acquisition. According to the literature review and results of the questionnaire, the resources that are helpful to college students' mobile English vocabulary learning are multimodal, easy to obtain, fragmented, and by the law of memory. Multimodal presentation of a large number of fragmented English vocabulary knowledge can mobilize learners' multi-sensory experience, reduce the burden of learners' working memory and improve the effect of learners' word memory. Among them, the vocabulary presentation form of "picture + text + audio" is considered by college students to be the most effective, and it also matches the picture-text memory mode of Baicizhan APP, which has the highest utilization rate in the Chinese market. In addition, although VR/AR can promote vocabulary acquisition by mobilizing more sensory experiences (Chen et al., 2021; Nicolaidou et al., 2021), the data of this research show that learners believe that the use of virtual reality technology and augmented reality technology to present learning content can not improve their learning effect when using English vocabulary APP, which may be related to the fact that VR/AR technology has not been applied to English vocabulary APP yet. According to the additional interview, interviewee A said that "there is no experience of using VR/AR to learn English vocabulary, so it is impossible to say that it can improve my vocabulary memory, but I look forward to having VR or AR technology to show the use of vocabulary in the future when memorizing words." this verifies the author's hypothesis to some extent. It is worth noting that although the vast majority of college students have the experience of using English vocabulary APP, it does not have an irreplaceable position compared with traditional pen-and-paper memory. For college students, only when the presentation form of mobile learning in English vocabulary APP is interesting and appropriate enough, the resources are rich enough, and the review mechanism is scientific enough, can they be more willing to use it. Interviewee B said that if she found that the quality of resources was poor and could not meet their learning needs in audio-visual aspects when using English vocabulary APP, she would reduce the proportion of mobile learning or even give up mobile learning and choose the traditional way of memorizing words by "pen and paper + physical word book".

6.5 Facilitating conditions

The hypothesis that facilitating conditions positively affect attitude intention (H3) is not supported. Xu Ling (2013), a Chinese scholar, explained that mobile learning as a way of informal learning has not been greatly promoted, and many college students have not yet formed the consciousness and habit of mobile learning. The author believes that with the development of mobile learning, this explanation is no longer applicable to some extent. Focusing on the field of mobile language learning, Hoi (2020) obtained similar rejection results in the study of Vietnamese college students learning foreign languages on mobile devices. He speculates that limited access to high-speed wireless networks and the deficiency of technicians, make it impossible for learners to acquire a foreign language on an incessant and steady basis using phones or pads. However, in today's China, where mobile communication networks are developing rapidly, technology support is no longer an obstacle. This study demonstrates that facilitating conditions indirectly affect attitude intention by affecting perceived resources. This shows that no matter how favorable the external technology and conditions are if the students themselves think that the resources of the English vocabulary APP are not good enough, their acceptance attitude and intention to use will still be very low.

6.6 Social influence

Social influence (H2) has no significant effect on attitude intention, which is contrary to the former research on group mobile learning of college students. On the one hand, this may be due to the individualization and low level of English vocabulary learning. Compared with English dialogue learning, English vocabulary learning often takes place within individuals rather than between groups. The demand for interaction in vocabulary learning is low, and learning can be completed without interactive dialogue, which is one of the reasons for the weak influence of the community. Another feature of English vocabulary learning is the low level of learners. Vocabulary is the foundation of English learning, and there are strong individual differences in vocabulary mastery among different individuals. Learners may feel ashamed because others in the community think they can't or are not familiar with it, so learners tend to deliberately avoid social influence. In the additional interview, interviewee C mentioned that "I don't like to let the students around me participate in the process of memorizing words, and I don't want others to know that I don't even know some simple words, which will be very embarrassing." This also confirms the current situation that the acquaintance network community of English lexical APP is more inactive than that of English conversational APP.

On the other hand, from the perspective of learners' characteristics, studies show that millennials have more self-awareness, weaker social influence, and more attention to personal feelings than before. The author speculates that when college students use English vocabulary APP, their performance expectancy is the main influencing factor, while the support and recommendation of others is the secondary factor. They tend to take the advice of others when picking English learning APPs, on the one hand, from public platforms like as Zhihu, Douban, and Weibo, and on the other side, from suggestions from teachers and classmates around them (Zhang et al., 2019), however, if they feel that the effect is not good after using it in person, they will not continue to use it. Venkatesh et al. (2003) showed that the social influence is greatest at the early stage of technological adoption, and weakens with time, which supports the author's conjecture to some extent. When English lexical APP is no longer a new thing, college students' willingness to use it has gradually faded from the

psychology of following the trend, paying more attention to perceived usefulness, perceived ease of use, and so on.

6.7 Self-management of learning

Self-management has a significant effect on attitude intention (H13), which is consistent with the research results of some scholars. Whether the learners' self-management ability is strong or weak, including whether they can make a good word learning plan, and whether they can supervise themselves to review on time, have a certain impact on their willingness to use English vocabulary APP.

7 Conclusions

This study applies the modified UTAUT model, combined with mobile language learning, to construct an APP usage behavior model for college students' English vocabulary. The results show that the UTAUT model is suitable for mobile English vocabulary learning. Perceived playfulness, performance expectancy, perceived resources and self-management directly affect attitude intention. Perceived mobility and facilitating conditions indirectly affect attitude intention through the regulation of other factors, while social influence has no significant effect on attitude intention. Performance expectancy is still a vital aspect affecting undergraduates' use of English lexical APP. College students have higher and higher requirements for the interest and convenience of vocabulary learning. Social influence has no significant influence on college students' usage of English lexical APP. Therefore, the author puts forward some suggestions on the design and development of the existing English vocabulary APP from three aspects: learning resources, learning interest, and learning personalization.

Firstly, develop high-quality mobile English vocabulary learning resources. In content, fully integrate resources and establish a scientific review mechanism. In the form of presentation, a variety of modes are collected, and vocabulary is presented in a trinity way of pictures, text, and sound. In the future, with the development of virtual reality technology, the experience of "immersive memorization of words" will be developed. Secondly, make the most of the benefits of mobile learning and infiltrate game-based learning strategies. In the design and development of English vocabulary APP, the fun of vocabulary learning should be highlighted more, combined with the learning rules of college students, adding functions such as punching in, collecting badges, and so on, to make users feel fun and self-efficacy when memorizing words, to enhance their willingness to continue to use them. Thirdly, strengthen the individualization of learning, weaken the social mechanism, and establish a map of learners' progress. Summarize the user's vocabulary learning situation regularly and push it visually. To protect the privacy of users, do not obtain user address book, user location, and other information including the real circle of friends. So that learners can break away from the real community, present their real vocabulary learning situation in the virtual network, and do not have to worry about negative emotions due to the difference in vocabulary between themselves and their classmates. Instead, English lexical APP can present the overall vocabulary level of learners in different cities, grades, test goals, and other dimensions, so that learners know their level in the whole, and they can see their progress in the whole after a while so that they can continue to use English lexical APP based on paying attention to themselves and grasping the whole.

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