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Research article

Enhancing students' English language learning via M-learning: Integrating technology acceptance model and S-O-R model

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ABSTRACT

With the impact of COVID-19, many university students may not be able to learn English in the physical classroom in a traditional way. Students' English learning effectiveness and outcome were threatened when English learning was forced to turn online. Thus, a variety of technological media and platforms to improve their learning outcomes are in need. Mobile learning (M-learning) that involves interacting with other devices through mobile devices and wireless networks can also be a solution to improve students' online English learning effectiveness. In order to explore the learning behaviors and attitudes of university students when learning English with M-learning, this study integrated technology acceptance model and Stimulus Organism Response model including the concepts of perceived convenience, curiosity and self-efficacy in addition to the original technology acceptance model to verify university students' usage cognition and attitude toward English M-learning. This study disseminated surveys to 10 targeted universities/colleges and collected 1432 valid surveys. This study implemented Smart-PLS 4.0 to examine structural model and verify the hypotheses. Results indicated that perceived convenience have positive impact on perceived ease of use, perceived usefulness and attitude toward using; there is a significant and positive relationship among perceived ease of use, perceived usefulness, attitude toward using and intention to using; curiosity and self-efficacy have positive impact on intention to using. Based on the findings, this study further provides abundant theoretical insights and practical significance on language learning.

1. Introduction

The COVID-19 pandemic since 2019 has qualitatively and quantitatively changed English language learning in all perspectives [1–4], specifically in countries like China in which strict epidemic control, were enforce to effectively prevent the spread of the virus. Thus, various educational technologies extended by distant learning have become inevitable [5]. Distance learning is not simply a technological issue of switching the teaching context from the physical classroom to virtual classrooms. Distance learning has challenged teachers to disseminate knowledge more effectively via the virtual space and students to develop their own learning capacity to make the distance learning more diverse and effective [6–9]. In addition, as compared to other courses, it was more difficult to deliver

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English language instruction effectively online [10,11]. Therefore, in order to better understand the effectiveness of students' English language learning through the medium of technology, this study investigated the factors that impact students English language learning effectiveness through thee medium of technology.

Studies on distance learning have reported some negative impacts on students online learning effectiveness. For example, the study by Aristovnik et al. [12] revealed that nearly half of the students surveyed reported that online learning courses were difficult for them to focus on and did not further help them understand the content of lectures and assignments. Some students surveyed in Aristovnik et al. [12] even stated that not going to school was equivalent to not learning. The study by Kuhfeld et al. [13] showed that teachers generally believed that online instruction increases the educational gap for disadvantaged students, most notably for public and private students. Moreover, studies on distance learning also found that the lack of physical education, extracurricular activities, and human interaction in distance learning space may cause more psychological stress for students and teachers are often not able to capture students' moment to moment psychological status online and thus making the issues even more problematic Kuhfeld et al. [13]. Therefore, well-designed online learning courses that untilize new technological features (e.g., video recording function) are needed to improve students self-learning motivation, online learning effectiveness, and learning outcocme [14,15], specifically in English language online learning context.

M-learning that involves interacting with other devices through mobile devices and wireless networks [16] can also be a solution to improve students' online learning effectiveness. As mobile devices are portable and integrated into wireless networks, learners can learn at any time and space to enjoy the convenience, immediacy, and appropriateness of mobile technology [17]. Chang's [18] study on the cloud-based M-learning also showed that cloud-based M-learning devices have the advantages of convenient access, high interactivity, individualization, self-regulated, and self-learning, which have a significant impact on increasing students' interests in learning and creative performance. This suggests that M-learning can be effective in enhancing the effectiveness and motivation of English language learning. Therefore, this study aimed to investigate how students' continuous intention to learning is enhanced when they use new technological media for M-learning.

Past research on user behaviors in technology has mostly focused on cognitive [19] or attitude [20] bases, but it is insufficient to consider the type of new information technology. The past studies on Technology Acceptance Model (TAM) have mostly suggested that TAM has better explanatory power to explain users behaviors if external variables are effectively included [21, 22]. Yoon and Kim [23] extended the concept of perceived convenience to TAM and their study showed that perceived convenience is one of the external variables that affect the acceptance of wireless LANs; Hossain and Prybutok [24] also found that perceived convenience affects the persistence of radio frequency identification (RFID). Lai and Liew [25] also found that perceived convenience affects consumers' intention to use gamified mobile payment platforms. Xu et al. [5] also found that perceived convenience affects consumers' continuous intention to use tourism mobile applications in Mainland China. However, in the digital learning environment, in addition to the use of mobile devices and wireless networks, an appropriate M-learning system is needed to make learning more convenient and efficient for learners [26]. While TAM is widely used, there are also many studies that emphasized the combination of different models to enrich the TAM theories. In discussing students' use of new technological media in English learning, the stimulus should lead to a change in learning mindset (organism) and subsequently lead to a change in usage behavior or behavioral intention (response). Through the combination of TAM and Stimulus Organism Response (SOR) model, this study will be able to explore more deeply the psychological changes and attitudes of students in learning English, discuss how to enhance students' motivation and commitment in learning English from the perspective of stimulus, and effectively improve students' English learning effectiveness and M-learning intentions. Therefore, this study will examine the impact of M-learning on continuous intention to use by incorporating the perceived ease of use and students' curiosity towards new technological media. This study aims to address the following research question: What is relationship between perceived ease of use, perceived usefulness, usage attitude on university students' continuous intention to use M-learning in English learning context?

2. Literature review

2.1. SOR model

The concept of SOR model will help this study explain the changes in students' mental cognition during the M-learning process and subsequent learning intentions and behavioral responses [27]. The SOR model helps explain the internal psychological changes caused by the individual being stimulated by the environment [28]. In order to confirm whether students using the new technology media would adopt M-learning which in turn would have an impact on the response to the continuous intention to use, this study used SOR model's concepts of perceived convenience, perceived ease of use, and perceived usefulness as important antecedents in the stimulus part [29]. However, in organism, most previous studies have emphasized the psychological factors of intrinsic cognition. Although it is effective to show that stimulus is converted into explicit responses through intrinsic transformation, it should be expressed in subsequent usage attitude [30]. The continuous intention to use of English M-learning depends on students' usage attitudes on English M-learning and self-efficacy [26,31,32]. Therefore, this study will use self-efficacy and usage attitude as organism factors.

2.2. Technology acceptance model

Davis et al. [33] modified and proposed the model of TAM based on the Theory of Reasoned Action (TRA), and simplified the factors influencing attitudes into two external variables: perceived usefulness and perceived ease of use. Davis et al. [33] suggested that usage attitude impacts behavior intention and thus directly impacts the systems usage. However, usage attitude is mainly determined

by perceived usefulness and perceived ease of use. Thus, Davis et al. [33] removed the subjective norm from the TRA model to develop the TAM model. In essence, the two beliefs of perceived usefulness and perceived ease of use in TAM are important factors in computer acceptance behavior [34,35]. Meanwhile, Davis also argued that perceived ease of use and perceived usefulness are influenced by other external variables. Therefore, many studies have suggested that TAM will have better explanatory power on continuous intention to use if it extends to exogenous variables [36,37]. Exogenous variables cover factors that may affect information system adoption, such as Systems Quality [38], Critical Mass [39], Regulatory Support [40], Flow Experiences, Completeness, Accuracy, Information Quality [41], etc.

Many empirical studies on TAM have found that users' continuous intention to use is influenced by the perceived usefulness and ease of use. High perceived ease of use will relatively affect the perceived usefulness, which will in turn impact the continuous intention to use, leading to the actual adoption of technology [42,43]. Since Davis et al. [33] proposed TAM, many studies on technology adoption behaviors have widely adopted this model to explain individuals' technological usage behaviors. Hao et al. [44] studied the factors influencing college students' use of M-learning in Mainland China and found that pedagogical factors have an impact on students' behavioral intention to use M-learning. Cheng [45] combined TAM and the Innovation Diffusion Theory (IDT) to investigate the behavioral intention to use M-learning of 486 learners and found that technological characteristics (including navigation and convenience) and compatibility had a significant effect on the perceived usefulness, perceived ease of use, and perceived enjoyment. Hsia [46] investigated the factors influencing the use of M-learning of 176 university students in Taiwan and found that perceived usefulness, perceived ease of use, and perceived behavioral control all had significant effects on learners' behavioral intention to use M-learning. Therefore, based on TAM, the following hypotheses are proposed in this study.

H1. Perceived ease of use has a positive effect on the perceived usefulness of using M-learning.

H2. Perceived ease of use has a positive effect on usage attitudes toward the use of M-learning.

H3. Perceived usefulness has a positive effect on usage attitudes toward the use of M − learning.

H4. There is a positive relationship between the usage attitude and the continuous intention to use English M-learning.

2.3. Perceived convenience

Brown [47] classified convenience into five dimensions: time, location, access, use, and implementation, to explain the convenience of services and products provided to consumers, while Berry et al. [48] assessed the convenience of services in terms of the time invested and the effort required. In Yoon and Kim's [23] study of wireless LAN, they used Brown's [47] convenience as a basis and removed the two dimensions of access and use to include three dimensions in convenience: time, place, and execution. Yoon and Kim [23] have defined perceived convenience as the convenience of perception in time, location, and implementation when using wireless LAN. In recent years, many empirical studies have found that perceived convenience is an acceptance factor for new technologies or systems. For example, Chang et al. [45] found a strong positive correlation between perceived convenience and perceived ease of use in their study of mobile technology and English language learning among college students. Lai et al. [49] studied learners' acceptance of e-textbook applications and found that perceived convenience impacted perceived ease of use. Mokhtar et al. [50] also found that perceived convenience impacted perceived ease of use in their study of teachers' intention to use LMS. Chen and Tsai [51] investigated how consumers used personalized location-based mobile tourism application to conduct travel plan and they found a significant relationship between perceived convenience and perceived ease of use. Malik et al. [52] also found that perceived convenience affects perceived ease of use in their study of college students' adoption intention for chatbot. Therefore, the following hypothesis is proposed in this study:

H5. Perceived convenience positively affects perceived ease of use.

Yoon and Kim [23] found that perceived convenience positively influenced perceived usefulness. Therefore, for those who use mobile technology for learning, the convenience of location and time is effective in enhancing students' use of M-learning; when users perceive that it is meaningful to use mobile technology for learning, they also perceive it as useful [44, 45]. Bansah and Agyei [53] in their study assessing learners' acceptance of LMS found that perceived convenience was positively correlated with perceived usefulness and perceived effectiveness. Jatimoyo et al. [54] in their study of consumers' continuous intention to use online shopping service also found that perceived convenience and perceived usefulness were positively related. Wardana et al. [55] also found that perceived ease of use was significantly correlated with perceived usefulness and perceived usefulness was significantly correlated with the intention to use in their study of consumers' intention to use e-wallet. Therefore, based on the above arguments, the following hypotheses were proposed in this study:

H6. Perceived convenience has a positive effect on perceived usefulness.

Gupta and Kim's [56] study on online shopping found that perceived convenience positively influenced consumers' intention to re-use online shopping, and Hossain and Prybutok's [24] study also found that perceived convenience positively influenced intention to use RFID technology. Hsu and Chang [57] in their study of consumers' intention to use Moodle system found that perceived convenience positively impacted consumers' intention to use Moodle system. Lu et al. [58] also found that perceived convenience positively influenced consumers' intention to use smart healthcare devices in their study on the use of smart healthcare devices. Huang and Chueh [59] also found that perceived convenience increased pet owners' intention to use chatbot for veterinary consultations. Therefore, hypothesis 7 was proposed in this study:

H7. Perceived convenience of M-learning has a positive effect on the attitude toward using.

2.4. Curiosity

The concept of curiosity is derived from the Flow Theory. Individuals are often more willing to interact with their surroundings when they are immersed in flow [60, 61]. Hoffman and Novak [62] suggested that users could become immersed in flow when they are focused on the activities on the website. In contrast, the absence of flow can often lead to anxiety or boredom. Kashdan et al. [63] also suggested that curiosity can lead to flow and thus result in high levels of interaction. Therefore, when users are in a state of flow, curiosity about the use of the information system is also generated during interaction. Malone [64] argued that individual's curiosity can often be aroused in a state of entertainment. This need for novelty is often considered as a concept of intrinsic motivation [65, 66, 67, 68, 69]. In the Internet environment, the main factor that motivates people to explore and use the websites is not that consumers have interests in websites, but that they are curious about using websites through the variety of website content provided by website operators [70, 71]. Wang et al. [72] showed that making consumers feel curious is one important factor for them to keep visiting the website. Yang et al. [73] study on the effectiveness of AR technology on website advertising showed that AR technology used in shopping websites could increase consumer curiosity and attention to advertisements, and thus increase sales. Dai et al. [43] showed that curiosity had a positive effect on students' intention to use MOOC platforms on a consistent basis, and Chang et al. [42] showed that curiosity had a positive effect on high school students' intention to use PDA devices on a consistent basis. Similarly, a study by Israel et al. [74] found that consumers' curiosity was stimulated by telepresence of smartphone-based virtual reality system (SBVR), which significantly enhanced their perceived usefulness and perceived enjoyment and increased their chances of booking a hotel. In other words, the perceived ease of use of the website platform on the English M-learning platform develops students' curiosity about the content of the English learning platform and further develops the intention to use it. Therefore, the relationship between perceived ease of use, curiosity, and continuous intention to use in the context of English M-learning is expected to be as follow in this study:

H8. Perceived ease of use has a positive effect on curiosity.

H9. Curiosity has a positive effect on continuous intention to use.

2.5. Self-efficacy

Bandura [75] clarified the relationship between self-efficacy and motivation, stating that self-efficacy is a cognitive process that regulates behavior. He believed that motivation is an internal psychological process that leads people to a certain activity and allows them to stay engaged [76]. However, he also believes that motivation involves many cognitive activities, including thoughts about subsequent outcomes that are cognitive in nature, and reactions to goal setting and self-assessment that represent an individual's self-efficacy [29]. The products of such a cognitive process become the driving force of the individual's performance. According to Bandura, self-efficacy is an antecedent variable in the intrinsic process, and motivation is listed after self-efficacy. Some studies have also found that individuals' creative self-efficacy has a significant positive effect on intrinsic motivation [77, 78].

However, in the learning framework proposed by Pintrich and Schrauben [79], they discussed the impact of the motivational components and the cognitive components on academic performance. The motivational beliefs defined by Pintrich and Schrauben [79] include components such as expectation, value, and emotion. The expectation component in the motivation beliefs is often referred to individual's expectations on their own performance, self-efficacy, assessments on self-regulation and expectation on task completion such as self-evaluating "Can I do the job?" [4] This component is consistent with the concept of self-efficacy. The value component involves the individual's commitment to the task and their beliefs about the importance, uniqueness, and interest of the task, e.g., Why do I want to do this job? Studies have found that when students have high expectations of their self-assessment or task success, they tend to be more effectively motivated to learn, which could in turn motivates them to use more cognitive and learning strategies to improve learning efficiency and effectiveness [80]. This is in line with the concept of intrinsic and extrinsic motivation as defined by Amabile [81]. It is worth noting that both Bandura's social cognitive theory and Pintrich and Schrauben's learning framework are used to examine academic learning. Thus, this study aimed to explore whether such a combined framework can be used to explore the applications and extensions of M-learning.

In TAM, perceived usefulness is the basis of positive attitudes. Technology adopters who have a positive perceived usefulness on the technology often demonstrate confidence in adopting new learning tools that they are not familiar with [82–84]. In the SOR model, perceived usefulness can be regarded as the external stimulus for users to accept new technology. When users have positive perceptions on the stimulus of new technology, they are more likely to demonstrate kind perceptions on the use environment thus reducing their uncertainty and powerlessness on new technology [85]. Meanwhile, when users assess that new technology can be applied to learning tasks and achieve good results, it will effectively improve users' learning ability and increase their confidence and expectation to complete learning tasks [86]. The same argument was also made by many scholars: when multimedia interactive technology is used as a learning tool to increase the richness of the learning environment, students can feel the joy of learning from the M-learning process and thus reducing their resistance and stress to learning and increasing their confidence in completing learning tasks [87]. Therefore, the following hypotheses were proposed:

Davis [33] stated that self-efficacy is an important factor that influences an individual's intention to use technology. Empirically, the findings of Valtonen et al. [88] and Li et al. [89] showed that an individual's self-efficacy directly affects their intention to use new technologies. In other words, when an individual has a high level of self-efficacy, they are more likely to have higher behavioral intention to accept the challenge of uncertainty in unfamiliar contexts [90, 91]. In addition, many studies on the influence of

individuals' intention to use information systems indicated that self-efficacy allowed people to believe that they have sufficient knowledge to solve their work problems [92, 93]. For example, Chung et al. [94] study found that nurses' self-efficacy had a significant and positive effect on their intention to use online patient personal health records (PHRs). Joo et al. [95] study found that preservice teachers' self-efficacy had an influence on their intention to use technology. Kwon et al. [77] in their study on secondary school teachers' integration of mobile computing device also found that their self-efficacy for mobile technology predicted their integration of mobile computing device. Balapour et al.'s [96] study also found that patients' self-efficacy influenced their intention to use the mHealth. Yamin et al. [97] also found that users' self-efficacy predicted their intention to use the wireless sensor network application for medical assistance. In addition, research also found that people with higher self-efficacy strength are more likely to adopt e-learning [32]. For example, Bao and Shang [98] conducted a meta-analysis review on the relationship of self-efficacy and continuous intention of Web 2.0 platforms, and they found a medium-sized positive correlation. In other words, individuals with high self-efficacy are more likely to have a higher intention to adopt new information applications compared to individuals with lower self-efficacy. Therefore, based on the above findings, this study suggested that there is a positive relationship between self-efficacy and individuals' intention to use new technologies. Therefore, based on the above arguments, the following hypotheses were proposed in this study:

H10. Perceived usefulness has a positive effect on self-efficacy.

H11. Self-efficacy has a positive effect on continuous intention to use.

Based on the arguments above, we develop our research model as shown in Fig. 1. In this model, we integrate the SOR model and TAM, adding perceived convenience, self-efficacy and curiosity to the TAM to verify the effect of the stimulus variables on the organization variables, and the subsequent response variables.

3. Methodology

3.1. Sampling

According to research aims, in order to understand students' attitudes and status in M-learning, we used a questionnaire in this quantitative study to collect and analyze data. Since this study did not have a specific sampling frame, we are not able to employ a random sampling strategy to all potential M-learning users in Mainland China. This research was approved by the academic committee of Fujian Jiangxia University and complied with ethical standards. The researcher sought and got the consent of the participants to participate in the study. All participants accepted and voluntarily participated in the study after the researcher assured them of anonymity and that their responses were solely for academic purposes. In addition, Wang et al. [99] found that the effort expectancy on the intention to use M-learning moderates with the increase of age. Scholars also found that the determinants of users' intention to revisit a website (e.g., perceived ease of use and perceived usefulness) are influenced by users' experience of the website. Therefore, this study employed purposive sampling strategy to maximize the sampling effect and to reduce the sampling bias through the setting of conditions [4, 76]. First, the research target of study was the users who do not have many experiences in English M-learning and of similar age. After their actual participation in English M-learning, a scale was used to collect the constructs of the study to test the relationship between the variables in the model proposed in this study. Since university students often have to change classrooms and have more odd hours in between classes, in addition to the fact that there is often no wireless LAN on campus, it is particularly

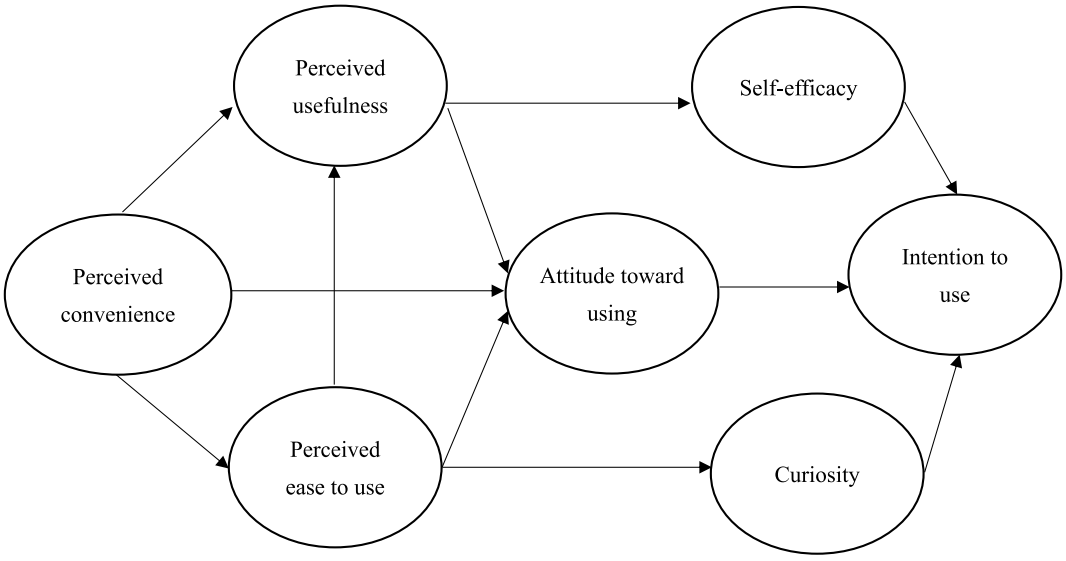

Fig. 1. Research framework.

appropriate for them to learn English through M-learning. To ensure that the results are representative, we expanded the sample size by following the recommendation of scholars that the sample size required for structural equation modelling should exceed 10–20 times the size of the questions [100]. Also, considering the large base of the parent population, we increased the number of schools to obtain a larger sample of students. Therefore, a sample of 10 colleges and universities in mainland China was selected for this study. The questionnaires were collected from March 2022 to May 2022. A total of 2000 questionnaires were distributed to each college-s/university, and 1432 valid questionnaires were obtained. Table 1 shows descriptive statistics of samples.

3.2. Measures

This study adopted a total of 19 items of the TAM concepts of perceived ease of use, perceived usefulness, usage attitude and usage intention in Daivs [33] and Venkatesh et al. [101], such as "Mobile English learning enhances my learning efficiency", "It would be easy for me to become skillful at using the English learning system. I find the English learning system to be easy to use" and "Assuming that I have access to the English learning system, I intend to use it". As for the perceived convenience, we adopted 4 items in the scale developed by Yoon and Kim [23], such as "It is convenient for me to complete a task by using the English learning system" and "I have access to the English learning system everywhere". As defined in previous research, curiosity refers to the degree to which people are willing to interact with their environment when they are immersed in flow. This study adopted 2 items of curiosity from scale developed by Moon and Kim [102], such as "Mobile English learning stimulates my curiosity to learn English" and "Mobile English learning leads me to explore English". Self-efficacy is an individual's perception that they will achieve a goal before starting the necessary tasks. Self-efficacy has a considerable influence on the choice of tasks, level of task performance, effort made to finish tasks, and persistence regarding task performance. The scale developed by Rigotti et al. [103] was revised to integrate 6 items of higher reliability and validity, such as "I can remain calm when facing difficulties in my English learning because I can rely on my abilities" and "Whatever comes my way in my English learning, I can usually handle it".

4. Results

4.1. Measurement

Confirmatory factor analysis (CFA) was utilized to validate the proposed factor structure via Smart-PLS 4.0 and confirm whether modification is required. Detailed values of reliability and validity of the questionnaire are represented in Table 2. The reliability test for Cronach's alpha of all items was above 0.7 [104]. The coefficient of Composite Reliability was up to the 0.7 suggested by Ref. [104]. Factor loadings of each observation item was more than 0.7, showing a good composite reliability. In terms of convergent validity, according to Ref. [105], the Average Variance Extracted of each dimension in this study was greater than 0.5. In the study, the correlation coefficient of each dimension was less than the square root of the Average Variance Extracted, and all cross-loadings were all less than the factor loadings of the dimension as suggest by Ref. [104], demonstrating a good discriminate validity (in Table 3).

4.2. Hypotheses testing

Partial Least Squares-SEM was adopted as the main method for data analysis in this study, and BootStrap was taken to estimate the T-value of path coefficient [106], so as to estimate the results of hypothesis test proposed in this study. Stone-Geisser-Criterion (Q^2), coefficient of determination (R^2), and standardized root mean square residuals (SRMR) are used to assess the overall model fit. R^2 values were more significant than 0.20, Q^2 values were above 0, and SRMR was less than 0.08 [107].

Table 1
Descriptive statistics of samples.

Characteristic	Scale	Number	Percentage
Gender	Male	743	51.9
	Female	689	48.1
Part-time job	Yes	583	40.7
	No	849	59.3
Scholarship	Yes	582	40.6
	No	850	59.4
First-generation college student	Yes	863	60.3
	No	569	39.7
Majors	Social science	738	51.5
	Natural Science	694	48.5
Dedication to class preparation	Yes	943	65.9
	No	489	34.1
Weekly study hours spent on major courses	Less than 5	693	48.4
	5 to less than 10	372	26.0
	10 to less than 15	251	17.5
	15 to less than 20	63	4.4
	More than 20	53	3.7

Table 2
Reliability and validity of all variables.

Variables and Items	Factor loadings	Mean	Percentages of the participants' answer to the items				
			1	2	3	4	5
Perceived convenience (PC) AVE = .718 CR = .911 alpha = .893							
PC1	0.85	3.463	1.3	6.0	47.5	35.5	9.7
PC2	0.86	3.419	0.9	9.7	45.5	34.5	9.4
PC3	0.84	3.479	1.3	9.9	40.6	36.0	12.2
PC4	0.84	3.361	1.0	13.2	45.4	29.4	10.9
Perceived ease to use (PEU) AVE = .728 CR = .889 alpha = .853							
PEU1	0.86	3.298	1.9	11.7	49.1	29.4	7.9
PEU2	0.85	3.577	0.6	6.0	41.4	38.9	13.1
PEU3	0.85	3.594	1.3	5.8	39.4	39.5	14.1
Perceived usefulness (PU) AVE = .714 CR = .909 alpha = .872							
PU1	0.85	3.547	1.0	6.0	39.2	44.7	9.1
PU2	0.86	3.580	0.3	5.8	38.9	45.9	9.2
PU3	0.84	3.567	0.8	5.4	39.9	44.3	9.7
PU4	0.83	3.808	0.1	2.9	30.9	48.2	17.9
Attitude toward using (AU) AVE = .710 CR = .907 alpha = .884							
AU1	0.82	3.478	2.5	8.1	38.1	41.8	9.6
AU2	0.86	3.531	2.4	6.3	37.2	44.0	10.1
AU3	0.85	3.558	1.3	6.7	39.2	40.6	12.2
AU4	0.84	3.562	2.0	7.9	36.2	39.5	14.3
Intention to using (IU) AVE = .781 CR = .914 alpha = .863							
IU1	0.89	3.650	1.1	3.0	38.7	43.9	13.2
IU2	0.90	3.701	0.9	4.2	33.5	47.0	14.5
IU3	0.86	3.640	1.3	5.3	34.1	46.9	12.5
Self-efficacy AVE = .720 CR = .939 alpha = .893							
Self-efficacy 1	0.84	3.709	0.9	3.9	32.8	48.2	14.2
Self-efficacy 2	0.85	3.786	1.1	3.3	29.8	47.4	18.4
Self-efficacy 3	0.85	3.755	0.8	2.5	32.3	49.3	15.1
Self-efficacy 4	0.85	3.725	1.1	3.1	33.6	46.4	15.7
Self-efficacy 5	0.87	3.609	1.9	4.8	37.7	41.8	13.8
Self-efficacy 6	0.83	3.527	2.8	5.5	39.7	40.1	11.8
Curiosity AVE = .793 CR = .885 alpha = .833							
Curiosity 1	.898	3.501	3.8	6.2	38.6	39.1	12.3
Curiosity 2	.883	3.650	2.9	4.8	33.1	42.9	16.4

Table 3
Discriminant validity.

	1	2	3	4	5	6	7
1. PC	0.847						
2. PEU	0.713	0.853					
3. PU	0.646	0.732	0.845				
4. AU	0.630	0.720	0.732	0.843			
5. IU	0.657	0.728	0.745	0.732	0.884		
6. Self-efficacy	0.631	0.639	0.723	0.743	0.730	0.849	
7. Curiosity	0.663	0.711	0.762	0.744	0.721	0.712	0.891

After confirming that there is a certain reliability and validity for the measurement results, a hypothesis test was conducted. Fig. 2 is the structural model of this study, presenting the path coefficients between variables and the R^2 of dependent variables in the model. Table 4 shows t-value, p value and f^2 of each path. The results indicate the positive and significant effects of perceived convenience on perceived ease to use ($\beta = 0.362$, $p < 0.001$), perceived usefulness ($\beta = 0.284$, $p < 0.001$) and attitude toward using ($\beta = 0.274$, $p < 0.001$). So H5, H6 and H7 are supported. Moreover, the results show that relationship paths among perceived ease to use, perceived usefulness, attitude toward using and intention to using were positive and significant, which supporting H1, H2, H3, and H4. Similarly, perceived usefulness ($\beta = 0.443$, $p < 0.001$) has positive impact on self-efficacy and self-efficacy ($\beta = 0.583$, $p < 0.001$) has positive impact on intention to using, so H10 and H11 are confirmed. Finally, regarding the role of curiosity, the results indicate that perceived ease to use ($\beta = 0.325$, $p < 0.001$) has positive impact on curiosity and curiosity ($\beta = 0.272$, $p < 0.001$) has positive impact on intention to using; thus, H8 and H9 are supported.

5. Discussion and conclusions

Convenience is one of the important characteristics of M-learning, and few past studies have combined convenience with TAM to examine the effects of students' use of technology as a medium for M-learning. Also, M-learning has become an important tool for

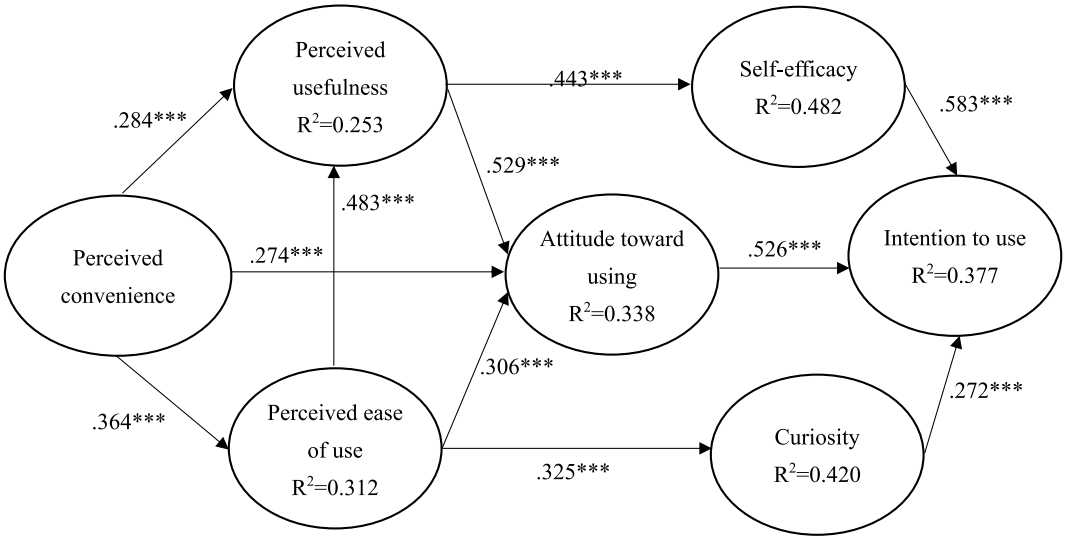

Fig. 2. Structural model.

Table 4
Results of paths.

Paths	β	t-value	p value	f^2	Results
H1: Perceived ease to use → Perceived usefulness	.483	3.766	<0.001	0.480	Support
H2: Perceived ease to use → Attitude toward using	.306	4.238	<0.001	0.050	Support
H3: Perceived usefulness → Attitude toward using	.529	8.943	<0.001	0.027	Support
H4: Attitude toward using →Intention to use	.526	7.775	<0.001	0.155	Support
H5: Perceived convenience → Perceived ease to use	.362	5.344	<0.001	0.493	Support
H6: Perceived convenience → Perceived usefulness	.284	3.562	<0.001	0.511	Support
H7: Perceived convenience → Attitude toward using	.274	5.735	<0.001	0.019	Support
H8: Perceived ease to use → Curiosity	.325	4.866	<0.001	0.292	Support
H9: Curiosity → Intention to using	.272	5.546	<0.001	0.059	Support
H10: Perceived usefulness → Self-efficacy	.443	6.388	<0.001	0.391	Support
H11: Self-efficacy → Intention to using	.583	8.621	<0.001	0.192	Support

students to learn English in the context of COVID-19. Therefore, this study used perceived convenience as an external variable to extend TAM, proposed and tested a TAM for English M-learning. The results of this study provided meaningful insights into the relationships among the components of perceived convenience, perceived ease of use, perceived usefulness, usage attitudes, and continuous intention to use. Few studies in the past have examined the acceptance of M-learning after actual use of specific M-learning systems [17, 26]. Moreover, several review studies stated that further investigation on digital learning or M-learning that examines the relationship between perceived convenience and the TAM constructs is required based on various research perspectives [26, 86]. Therefore, the findings of this study may provide a reference for future TAM and M-learning research.

First, the results of this study showed that perceived convenience positively influenced perceived ease of use, perceived usefulness and usage attitudes, which is in line with the hypothesis of this study. The findings of this study are also in line with the studies of Bansah and Agyei [53], Chen and Tsai [51] Lai and Rushikesh Ulhas [49], Mokhtar et al. [50] and Yoon and Kim [23] in that convenience not only affects usage attitudes towards the use of new technological media, but also their cognitive state of use. The findings are also consistent with the theoretical proposition of the SOR model, which states that individuals can effectively form positive perceptions and attitudes under the influence of external stimuli [27,108, 109, 110]. Scholars also point out that some past studies have applied the SOR model to examine individuals' use of information technology to understand users' perceptions and behaviors in using communication technology [111]. These arguments also suggested that the combination of SOR model and TAM is beneficial in explaining students' attitudes and behaviors when using mobile for M-learning [112]. When users perceive that the use of technology will make their consumption or learning behaviors more effective, they will be more likely to demonstrate less uncertain and less anxiety about using the new technology and will be more engaged in using it [22, 109]. Based on above arguments, in the context of English M-learning, perceived convenience, perceived ease of use, and perceived usefulness are all important antecedents that influence usage attitudes and continuous intention to use.

In addition, this study investigated the relationship between perceived ease of use, perceived usefulness, usage attitude, and continuous intention to use in traditional TAM to examine how English M-learning works in TAM. The results of this study showed that the relationships between perceived ease of use, perceived usefulness, attitude toward using, and continuous intention to use were positive and significant, implying that students have positive attitudes and perceptions during the use of English M-learning and the

technology medium of English M-learning was functional. The findings are consistent with the relationships between the variables in TAM proposed by Davis [33], Cheng [45], Hao et al. [44], Hsia [46] and Peng and Yan [22]. However, this study differs from the study by Yoon and Kim [23], who suggested that perceived ease of use positively affects intention to use, and this relationship was not discussed further in this study. This study used TAM to examine students' cognitive and behavioral use of English M-learning and verified that the relationships between the main variables in TAM were also strongly positively significant in the context of education and learning research [22, 26, 112]. Particularly, the effect of perceived usefulness on attitude toward using was relatively larger than the effect of perceived ease of use. This finding is similar to that of previous studies, showing that while the ease of use of a learning technology medium may attract students to use it, it further enhances students' attitudes and engagement in English M-learning when they perceive the technology to be useful [44,45,113].

In this study, the relationship between self-efficacy and curiosity was further discussed by combining the SOR model, which suggested that the operation of internal cognitive mechanisms effectively mediates the relationship between external stimuli and response behaviors. This study found that self-efficacy and curiosity had a positive and significant effect on continuous intention to use. This study also found that perceived ease of use and perceived usefulness had a positive effect on curiosity and self-efficacy, suggesting that the combination of the SOR model and TAM is beneficial in explaining students' attitudes when using English M-learning and enhancing the effects of external stimuli [114]. The findings are consistent with Israel et al. [74] and Yang et al. [73] assertions that the only way to effectively transform external stimuli into positive responses and behaviors is through the operation of internal psychological processes. Self-efficacy and curiosity, as a process mechanism when students use English M-learning, help to explain the black box of the psychological dimension between stimulus and behavioral response, illustrating the importance of the process perspective [32, 114]. Bigne et al. [108] emphasized that the individual's assessment process of external stimuli is central to the entire model and influences subsequent decision making.

6. Practical implications

This study presents a number of theoretical implications for the integration between theoretical models and suggests possible recommendations for educational administrators based the findings. First, this study found that perceived usefulness is an important factor that affects users' continuous intention to use English M-learning, so increasing the usefulness of mobile English learning systems will help increase users' self-efficacy and continuous intention to use them. Therefore, increasing the convenience and ease of use of English M-learning will help increase usefulness and usage attitudes, which in turn will increase continuous intention to use of English M-learning. This study suggested that educational administrators can collaborate with organizations or individuals who provide M-learning. As argued by Bansah and Agyei [53], the technological innovation of learning management system should provide intuitive user interface, and the school needs to cooperate with the system developer in order to optimize the usage and improve students' intention to use. Educational administrators understand students' usage attitudes and perceptions when using M-learning devices, and can therefore work with designers to design, develop, or provide better services to improve the user interface for greater convenience [115,116].

Furthermore, for designers of English M-learning systems, this study provides suggestions for them to develop useful learning features such as learning guides, adaptive assessment, and control and recording of learning progress [53,116]. M-learning instructional designers or content providers should design content that is appropriate to the cognitive abilities and needs of users, and provide adequate, up-to-date, and useful information to enhance the effectiveness of M-learning [18,42]. In terms of ease of use, designers of M-learning systems should design user-friendly interfaces and intelligent input methods (e.g., handwriting recognition and natural language input) to reduce the use of complex hardware and software in order to allow novice users to quickly adapt to the system to improve the efficiency of M-learning use and to increase learners' self-efficacy, curiosity, usage attitudes and continuous intention to use [43,45]. Furthermore, self-efficacy and curiosity play an important role in mediating between perceived ease to use, perceived usefulness and intention to use. In addition to enhance the use of technology, it is also necessary for teachers to provide richer English course design content [87]. For example, Dai et al. [43] demonstrated that instructors or designers must be prudent in advertising the courses to motivate learners to persist in learning the course and in turn to promote education equality. This study proposes that instructors should increase the number of interactive sessions and encourage students to apply English in their daily lives. As Hayat and Shateri [80] suggested, it is advisable to provide more supportive cognitions for college students to know not only what strategies to use, but also when and how to employ them. Instructors should also make students feel capable of completing course content and assignments while keeping learning English interesting by using real-time English dialogues and story reading to increase students' engagement in learning [76, 77, 95].

In terms of convenience, in addition to the convenience of mobile devices and wireless networks in terms of time and place of learning, mobile learning system developers or content providers should provide users with the convenience of accessing the system and content and increase the convenience of the user implementation process in order to enhance the convenience of mobile learning [25].

7. Limitations

Although this study presents many theoretical and practical implications, there are still many limitations that future researchers are expected to further improve. First, this study examines students' attitudes and perceptions when using mobile learning in English language learning context. In addition to English language learning, there are more subject areas that can be included, such as STEM learning, professional course learning, and other foreign language learning. Therefore, in the future, researchers can include different

disciplines of M-learning to understand the learning effects of students' use and non-use of M-learning, which will generate richer meaning.

Furthermore, this study combines the SOR model to explore the theoretical extensions of TAM. Combining different theories and models will produce more diverse effects. Therefore, this study suggests that future researchers can incorporate different variables and theoretical models to extend TAM's related models, whether they are used in M – learning or consumer behavior or not, which will help increase the theoretical richness of TAM.

Finally, English language learning is considered an important language learning in Chinese universities. However, the various degrees of importance that different countries attached to English language learning may affect users' usage attitudes and perceptions. Therefore, this study suggests that future researchers may conduct research in different regions and countries where non-English is the native language, such as Japan, Korea, and Vietnam, to examine students' behavioral patterns when using English M-learning.

Declarations

Author contribution statement

Michael Yao-Ping Peng: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper. Yunying Xu: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper. Cheng Xu: Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare no competing interest.

References

[1] L. Darling-Hammond, M.E. Hyler, Preparing educators for the time of COVID. and beyond, Eur. J. Teach. Educ. 43 (4) (2020) 457–465.
[2] K. Gonzalez, The impact of school crises on students and families from a social justice perspective, in: J. Glanz (Ed.), Crisis and Pandemic Leadership: Implications for Meeting the Needs of Students, Teachers, and Parents, Rowman & Little field, 2021, pp. 113–124.
[3] J. Hoofman, E. Secord, The effect of COVID-19 on education, Pediatric Clinics 68 (5) (2021) 1071–1079.
[4] P. Xu, M.Y.P. Peng, M.K. Anser, Effective learning support towards sustainable student learning and well-being influenced by global pandemic of COVID-19: a comparison between mainland China and Taiwanese students, Front. Psychol. 12 (2021), 561289.
[5] F. Xu, S.S. Huang, S. Li, Time, money, or convenience: what determines Chinese consumers' continuance usage intention and behavior of using tourism mobile apps? Int. J. Cult. Tourism Hospit. Res. 13 (3) (2019) 288–302.
[6] V. Gewin, Five tips for moving teaching online as COVID-19 takes hold, Nature 580 (7802) (2020) 295–296.
[7] M.Y.P. Peng, Y. Feng, X. Zhao, W. Chong, Use of knowledge transfer theory to improve learning outcomes of cognitive and non-cognitive skills of university students: evidence from Taiwan, Front. Psychol. 12 (2021), 583722.
[8] L. Sun, Y. Tang, W. Zuo, Coronavirus pushes education online, Nat. Mater. 19 (6) (2020) 687.
[9] L. Zhou, S. Wu, M. Zhou, F. Li, 'School's out, but class' on', the largest online education in the world today: taking China's practical exploration during the COVID-19 epidemic prevention and control as an example, Best Evidence of Chinese Education 4 (2) (2020) 501–519.
[10] M.I. Kamal, S. Zubanova, A. Isaeva, V. Movchun, Distance learning impact on the English language teaching during COVID-19, Educ. Inf. Technol. 26 (6) (2021) 7307–7319.
[11] J. Yao, J. Rao, T. Jiang, C. Xiong, What role should teachers play in online teaching during the COVID-19 pandemic? Evidence from China, Sci. Insigt. Edu. Front. 5 (2) (2020) 517–524.
[12] A. Aristovnik, D. Keržič, D. Ravšelj, N. Tomaževič, L. Umek, Impacts of the COVID-19 pandemic on life of higher education students: a global perspective, Sustainability 12 (20) (2020) 8438.
[13] M. Kuhfeld, D.J. Condron, D.B. Downey, When does inequality grow? A seasonal analysis of racial/ethnic disparities in learning from kindergarten through eighth grade, Educ. Res. 50 (4) (2021) 225–238.
[14] R.L. Bradley, B.L. Browne, H.M. Kelley, Examining the influence of self-efficacy and self-regulation in online learning, Coll. Student J. 51 (4) (2017) 518–530.
[15] A.P. Gilakjani, A detailed analysis over some important issues towards using computer technology into the EFL classrooms, Univers. J. Educ. Res. 2 (2) (2014) 146–153.
[16] S. Criollo-C, S. Luján-Mora, A. Jaramillo-Alcázar, Advantages and disadvantages of M-learning in current education, in: IEEE World Engineering Education Conference (EDUNINE), IEEE, 2018, pp. 1–6.
[17] M. Sarrab, L. Elgamel, H. Aldabbas, Mobile learning (m-learning) and educational environments, Int. J. Parallel Emergent Distrib. 3 (4) (2012) 31.
[18] Y.S. Chang, The mediating role of motivation for creative performance of cloud-based m-learning, Australas. J. Educ. Technol. 35 (4) (2019) 34–45.
[19] F.C. Blumberg, P.J. Brooks (Eds.), Cognitive Development in Digital Contexts, Academic Press, 2017.
[20] J. Njiku, J.F. Maniraho, V. Mutarutinya, Understanding teachers' attitude towards computer technology integration in education: a review of literature, Educ. Inf. Technol. 24 (5) (2019) 3041–3052.
[21] Y. Lee, K.A. Kozar, K.R. Larsen, The technology acceptance model: past, present, and future, Commun. Assoc. Inf. Syst. 12 (1) (2003) 752–780.
[22] M.Y.P. Peng, X. Yan, Exploring what influence behaviour intention to use of multiple media kiosks through TRAM model, Front. Psychol. 13 (2022), 852394.

[23] C. Yoon, S. Kim, Convenience and TAM in a ubiquitous computing environment: the case of wireless LAN, Electron. Commer. Res. Appl. 6 (1) (2007) 102–112.
[24] M.M. Hossain, V.R. Prybutok, Consumer acceptance of RFID technology: an exploratory study, IEEE Trans. Eng. Manag. 55 (2) (2008) 316–328.
[25] P.C. Lai, E.J. Liew, Towards a cashless society: the effects of perceived convenience and security on gamified mobile payment platform adoption, Australasian Journal of Information Systems 25 (2021) 1–25.
[26] M. Al-Emran, V. Mezhuyev, A. Kamaludin, Technology acceptance model in M-learning context: a systematic review, Comput. Educ. 125 (2018) 389–412.
[27] J. Yang, M.Y.P. Peng, S. Wong, W. Chong, How E-learning environmental stimuli influence determinates of learning engagement in the context of COVID-19? SOR model perspective, Front. Psychol. 12 (2021), 584976.
[28] J. Lin, S. Lin, O. Turel, F. Xu, The buffering effect of flow experience on the relationship between overload and social media users' discontinuance intentions, Telematics Inf. 49 (2020), 101374.
[29] G. Zhang, X. Yue, Y. Ye, M.Y.P. Peng, Understanding the impact of the psychological cognitive process on student learning satisfaction: combination of the social cognitive career theory and SOR model, Front. Psychol. 12 (2021).
[30] C.F. Chen, G. Vg, Antecedents and outcomes of use experience of airport service robot: the stimulus-organism-response (SOR) framework, J. Vacat. Mark. (2022) (Advance online publication).
[31] M. Menekse, S. Anwar, S. Purzer, Self-efficacy and mobile learning technologies: a case study of CourseMIRROR, in: Self-efficacy in Instructional Technology Contexts, Springer, 2018, pp. 57–74.
[32] X. Pan, Technology acceptance, technological self-efficacy, and attitude toward technology-based self-directed learning: learning motivation as a mediator, Front. Psychol. 11 (2020), 564294.
[33] F.D. Davis, Perceived usefulness, perceived ease of use, and user acceptance of information technology, MIS Q. (1989) 319–340.
[34] M. Aung, K. San, Usefulness of Google classroom for management students of a Thai private university, APHEIT Int. J. 10 (2) (2021) 1–10.
[35] L. Chen, A.K. Aklikokou, Determinants of E-government adoption: testing the mediating effects of perceived usefulness and perceived ease of use, Int. J. Publ. Adm. 43 (10) (2020) 850–865.
[36] J.S. Lim, J. Zhang, Adoption of AI-driven personalization in digital news platforms: an integrative model of technology acceptance and perceived contingency, Technol. Soc. 69 (2022), 101965.
[37] B. Wu, X. Chen, Continuance intention to use MOOCs: integrating the technology acceptance model (TAM) and task technology fit (TTF) model, Comput. Hum. Behav. 67 (2017) 221–232.
[38] H.F. Lin, The impact of website quality dimensions on customer satisfaction in the B2C e-commerce context, Total Qual. Manag. Bus. Excel. 18 (4) (2007) 363–378.
[39] C.L. Hsu, H.P. Lu, Why do people play on-line games? An extended TAM with social influences and flow experience, Inf. Manag. 41 (7) (2004) 853–868.
[40] K.S. Tan, An Empirical Study of Internet-Based ICT Adoption Among SMEs in Southern Malaysia (Doctoral Dissertation, Multimedia University, 2009.
[41] O. Turel, A. Serenko, P. Giles, Integrating technology addiction and use: an empirical investigation of online auction users, MIS Q. 35 (4) (2011) 1043–1061.
[42] C.C. Chang, K.H. Tseng, C. Liang, C.F. Yan, The influence of perceived convenience and curiosity on continuance intention in mobile English learning for high school students using PDAs, Technol. Pedagog. Educ. 22 (3) (2013) 373–386.
[43] H.M. Dai, T. Teo, N.A. Rappa, F. Huang, Explaining Chinese university students' continuance learning intention in the MOOC setting: a modified expectation confirmation model perspective, Comput. Educ. 150 (1) (2020), 103850.
[44] S. Hao, V.P. Dennen, L. Mei, Influential factors for mobile learning acceptance among Chinese users, Educ. Technol. Res. Dev. 65 (1) (2016) 101–123.
[45] Y.M. Cheng, Towards an understanding of the factors affecting m-learning acceptance: roles of technological characteristics and compatibility, Asia Pac. Manag. Rev. 20 (3) (2015) 109–119.
[46] J.W. Hsia, The effects of locus of control on university students' mobile learning adoption, J. Comput. High Educ. 28 (1) (2016) 1–17.
[47] D.J. Brown, Decentralization and School-Based Management, Psychology Press, 1990.
[48] L.L. Berry, K. Seiders, D. Grewal, Understanding service convenience, J. Market. 66 (3) (2002) 1–17.
[49] J.Y. Lai, K. Rushikesh Ulhas, Understanding acceptance of dedicated e-textbook applications for learning: involving Taiwanese university students, Electron. Libr. 20 (3) (2012), 321–228.
[50] S.A. Mokhtar, H. Katan, I. Hidayat-ur-Rehman, Instructors' behavioural intention to use learning management system: an integrated TAM perspective, TEM J. 7 (3) (2018) 513.
[51] C.C. Chen, J.L. Tsai, Determinants of behavioral intention to use the personalized location-based mobile tourism application: an empirical study by integrating TAM with ISSM, Future Generat. Comput. Syst. 96 (2019) 628–638.
[52] R. Malik, A. Shrama, S. Trivedi, R. Mishra, Adoption of chatbots for learning among university students: role of perceived convenience and enhanced performance, Int. J. Emerg. Technol. Learn. 16 (18) (2021) 200–212.
[53] A.K. Bansah, D.D. Agyei, Perceived convenience, usefulness, effectiveness and user acceptance of information technology: evaluating students' experiences of a learning management system, Technol. Pedagog. Educ. (2022) 1–19.
[54] D. Jatimoyo, F. Rohman, A. Djazuli, The effect of perceived ease of use on continuance intention through perceived usefulness and trust: a study on Klikindomaret service users in Malang city, Int. J. Res. Bus. Soc. Sci. 10 (4) (2021) 430–437.
[55] A.A. Wardana, E.P. Saputro, M. Wahyuddin, N.I. Abas, The effect of convenience, perceived ease of use, and perceived usefulness on intention to use E-wallet, in: *International Conferenc*e on Economics and Business Studies, Atlantis Press, 2022, June, pp. 386–395.
[56] S. Gupta, H.W. Kim, The moderating effect of transaction experience on the decision calculus in on-line repurchase, Int. J. Electron. Commer. 12 (1) (2007) 127–158.
[57] H.H. Hsu, Y.Y. Chang, Extended TAM model: impacts of convenience on acceptance and use of Moodle, Online Submission 3 (4) (2013) 211–218.
[58] X. Lu, J. Hao, B. Shan, A. Gu, Determinants of the intention to use smart healthcare devices: a framework and public policy implications, J. Healthc. Eng. (2021) 1–7.
[59] D.H. Huang, H.E. Chueh, Chatbot usage intention analysis: veterinary consultation, J. Innov. Knowl. 6 (3) (2021) 135–144.
[60] M. Csikszentmihalyi, Beyond Boredom and Anxiety, Jossey-Bass, 1975.
[61] M. Csikszentmihalyi, Toward a psychology of optimal experience, in: M. Csikszentmihalyi (Ed.), Flow and the Foundations of Positive Psychology, Springer, 2014, pp. 209–226.
[62] D.L. Hoffman, T.P. Novak, Marketing in hypermedia computer-mediated environments: conceptual foundations, J. Market. 60 (3) (1996) 50–68.
[63] T.B. Kashdan, M.W. Gallagher, P.J. Silvia, B.P. Winterstein, W.E. Breen, D. Terhar, M.F. Steger, The curiosity and exploration inventory-II: development, factor structure, and psychometrics, J. Res. Pers. 43 (2009) 987–998.
[64] T.W. Malone, Toward a theory of intrinsically motivating instruction, Cognit. Sci. 5 (4) (1981) 333–369.
[65] T. Fulya Eyupoglu, J.L. Nietfeld, Intrinsic motivation in game-based learning environments, in: Game-based Assessment Revisited, Springer, 2019, pp. 85–102.
[66] T. Li, Y. Chen, Will virtual reality be a double-edged sword? Exploring the moderation effects of the expected enjoyment of a destination on travel intention, J. Destin. Market. Manag. 12 (2019) 15–26.
[67] R.N. Rashid, Educational games for learning, Int. J. Law Manag. 4 (5) (2020) 1–11.
[68] R.M. Ryan, E.L. Deci, Intrinsic and extrinsic motivations: classic definitions and new directions, Contemp. Educ. Psychol. 25 (1) (2000) 54–67.
[69] R.J. Vallerand, Toward a hierarchical model of intrinsic and extrinsic motivation, in: Advances in Experimental Social Psychology 29, Academic Press, 1997, pp. 271–360.
[70] L.S. Huang, Ten pointers for enhancing learners' motivation, Bus. Commun. Q. 66 (4) (2003) 88–95.
[71] Y. Hwang, J. Jeong, Electronic commerce and online consumer behavior research, Inf. Dev. 32 (3) (2016) 377–388.
[72] S.K. Wang, T.C. Reeves, The effects of a web-based learning environment on student motivation in a high school earth science course, Educ. Technol. Res. Dev. 55 (2) (2007) 169–192.

[73] S. Yang, J.R. Carlson, S. Chen, How augmented reality affects advertising effectiveness: the mediating effects of curiosity and attention toward the ad, J. Retailing Consum. Serv. 54 (2020), 102020.
[74] K. Israel, C. Zerres, D.K. Tscheulin, Presenting hotels in virtual reality: does it influence the booking intention? J. Hosp. Tour. Technol. 10 (3) (2019) 443–463.
[75] A. Bandura, Self-efficacy: toward a unifying theory of behavioral change, Psychol. Rev. 84 (2) (1977) 191.
[76] X. Liu, M.Y.P. Peng, M.K. Anser, W.L. Chong, B. Lin, Key teacher attitudes for sustainable development of student employability by social cognitive career theory: the mediating roles of self-efficacy and problem-based learning, Front. Psychol. 11 (2020) 1945.
[77] K. Kwon, A.T. Ottenbreit-Leftwich, A.R. Sari, Z. Khlaif, M. Zhu, H. Nadir, F. Gok, Teachers' self-efficacy matters: exploring the integration of mobile computing device in middle schools, TechTrends 63 (6) (2019) 682–692.
[78] Y.J. Lin, H.C. Wang, Using virtual reality to facilitate learners' creative self-efficacy and intrinsic motivation in an EFL classroom, Educ. Inf. Technol. 26 (4) (2021) 4487–4505.
[79] P.R. Pintrich, B. Schrauben, Students' motivational beliefs and their cognitive engagement in classroom academic tasks. Student perceptions in the classroom 7 (1) (1992) 149–183.
[80] A.A. Hayat, K. Shateri, The role of academic self-efficacy in improving students' metacognitive learning strategies, J. Adv. Med. Educ. Prof. 7 (4) (2019) 205.
[81] T.M. Amabile, Creativity and Innovation in organizations, 5, Harvard Business School, 1996.
[82] F. Gunawan, M.M. Ali, A. Nugroho, Analysis of the effects of perceived ease of use and perceived usefulness on consumer attitude and their impacts on purchase decision on PT Tokopedia in Jabodetabek, Eur. J. Bus. Manag. 4 (5) (2019) 1–6.
[83] Y. Peng, P. Yin, Z. Deng, R. Wang, Patient–physician interaction and trust in online health community: the role of perceived usefulness of health information and services, Int. J. Environ. Res. Publ. Health 17 (1) (2020) 139.
[84] N.H. Um, Antecedents and consequences of consumers' attitude toward social commerce sites, J. Promot. Manag. 25 (4) (2019) 500–519.
[85] W. Ge, H. Bai, H. Wu, J. He, Teacher supported behaviors affecting MOOC learners' intention based on TAM and SOR model, in: *2020 Ninth International* Conference of Educational Innovation through Technology (EITT), IEEE, 2020, December, pp. 41–46.
[86] X. Zhai, L. Shi, Understanding how the perceived usefulness of mobile technology impacts physics learning achievement: a pedagogical perspective, J. Sci. Educ. Technol. 29 (6) (2020) 743–757.
[87] C. Lai, Learning beliefs and autonomous language learning with technology beyond the classroom, Lang. Aware. 28 (4) (2019) 291–309.
[88] T. Valtonen, J. Kukkonen, S. Kontkanen, P. Dillon, E. Sointu, The impact of authentic learning experiences with ICT on pre-service teachers' intentions to use ICT for teaching and learning, Comput. Educ. 81 (2015) 49–58.
[89] K. Li, Y. Li, T. Franklin, Preservice teachers' intention to adopt technology in their future classrooms, Journal of Educational Computing 54 (7) (2016) 946–966.
[90] G. Huang, Y. Ren, Linking technological functions of fitness mobile apps with continuance usage among Chinese users: moderating role of exercise self-efficacy, Comput. Hum. Behav. 103 (2020) 151–160.
[91] Y. Zheng, J. Wang, W. Doll, X. Deng, M. Williams, The impact of organisational support, technical support, and self-efficacy on faculty perceived benefits of using learning management system, Behav. Inf. Technol. 37 (4) (2018) 311–319.
[92] M.H. Li, R. Eschenauer, V. Persaud, Between avoidance and problem solving: resilience, self-efficacy, and social support seeking, J. Counsel. Dev. 96 (2) (2018) 132–143.
[93] D. Zhou, X. Du, K.T. Hau, H. Luo, P. Feng, J. Liu, Teacher-student relationship and mathematical problem-solving ability: mediating roles of self-efficacy and mathematical anxiety, Educ. Psychol. 40 (4) (2020) 473–489.
[94] M.H. Chung, C.H. Ho, H.C. Wen, Predicting intentions of nurses to adopt patient personal health records: a structural equation modeling approach, Comput. Methods Progr. Biomed. 136 (2016) 45–53.
[95] Y.J. Joo, S. Park, E. Lim, Factors influencing preservice teachers' intention to use technology: TPACK, teacher self-efficacy, and technology acceptance model, Journal of Educational Technology & Society 21 (3) (2018) 48–59.
[96] A. Balapour, I. Reychav, R. Sabherwal, J. Azuri, Mobile technology identity and self-efficacy: implications for the adoption of clinically supported mobile health apps, Int. J. Inf. Manag. 49 (2019) 58–68.
[97] M.A.Y. Yamin, B.A. Alyoubi, Adoption of telemedicine applications among Saudi citizens during COVID-19 pandemic: an alternative health delivery system, Journal of infection and public health 13 (12) (2020) 1845–1855.
[98] Z. Bao, B. Shang, Self-efficacy and continuance intention of Web 2.0 platforms: a meta-analysis, Data Technologies and Applications 55 (4) (2021) 511–526.
[99] Y.S. Wang, M.C. Wu, H.Y. Wang, Investigating the determinants and age and gender differences in the acceptance of mobile learning, Br. J. Educ. Technol. 40 (1) (2009) 92–118.
[100] B.R. Bae, Structural Equation Modeling with Amos 19: Principles and Practice, Chungram Books, 2011, pp. 1–668.
[101] V. Venkatesh, M.G. Morris, G.B. Davis, F.D. Davis, User acceptance of information technology: toward a unified view, MIS Q. (2003) 425–478.
[102] J.W. Moon, Y.G. Kim, Extending the TAM for a world-wide-web context, Inf. Manag. 38 (4) (2001) 217–230.
[103] T. Rigotti, B. Schyns, G. Mohr, A short version of the occupational self-efficacy scale: structural and construct validity across five countries, J. Career Assess. 16 (2) (2008) 238–255.
[104] J. Hair, J.F. Hair, C.B. William, B.J. Babin, R.E. Anderson, et al., Multivariate data analysis, 2010, in: Multivariate Data Analysis, fifth ed., Prentice Hall, Englewood Cliffs, NJ, 1998.
[105] R.P. Bagozzi, Y. Yi, On the evaluation of structural equation models, J. Acad. Market. Sci. 16 (1) (1988) 74–94.
[106] K.A. Bollen, R.A. Stine, Bootstrapping goodness-of-fit measures in structural equation models, Socio. Methods Res. 21 (2) (1992) 205–229.
[107] W.L. Shiau, Y. Yuan, X. Pu, S. Ray, C.C. Chen, Understanding fintech continuance: perspectives from self-efficacy and ECT-IS theories, Ind. Manag. Data Syst. 120 (9) (2020) 1659–1689.
[108] E. Bigne, K. Chatzipanagiotou, C. Ruiz, Pictorial content, sequence of conflicting online reviews and consumer decision-making: the stimulus-organism-response model revisited, J. Bus. Res. 115 (2020) 403–416.
[109] S. Pandita, H.G. Mishra, S. Chib, Psychological impact of covid-19 crises on students through the lens of Stimulus-Organism-Response (SOR) model, Child. Youth Serv. Rev. 120 (2021), 105783.
[110] M.Y.P. Peng, X. Yue, Enhancing career decision status of socioeconomically disadvantaged students through learning engagement: perspective of SOR model, Front. Psychol. 13 (2022).
[111] M.J. Kim, C.K. Lee, T. Jung, Exploring consumer behavior in virtual reality tourism using an extended stimulus-organism-response model, J. Trav. Res. 59 (1) (2020) 69–89.
[112] J. Jeong, D. Kim, X. Li, Q. Li, I. Choi, J. Kim, An empirical investigation of personalized recommendation and reward effect on customer behavior: a stimulus–organism–response (SOR) model perspective, Sustainability 14 (22) (2022), 15369.
[113] C.C. Chang, C.F. Yan, J.S. Tseng, Perceived convenience in an extended technology acceptance model: mobile technology and English learning for college students, Australas. J. Educ. Technol. 28 (5) (2012) 809–826.
[114] B. Dutta, M.H. Peng, C.C. Chen, S.L. Sun, Interpreting usability factors predicting sustainable adoption of cloud-based E-learning environment during COVID-19 pandemic, Sustainability 13 (16) (2021) 9329.
[115] P. Bazelais, T. Doleck, D.J. Lemay, Investigating the predictive power of TAM: a case study of CEGEP students' intentions to use online learning technologies, Educ. Inf. Technol. 23 (1) (2018) 93–111.
[116] M. Mailizar, D. Burg, S. Maulina, Examining university students' behavioural intention to use e-learning during the COVID-19 pandemic: an extended TAM model, Educ. Inf. Technol. 26 (6) (2021) 7057–7077.