

Article

Understanding Chinese EFL Learners' Acceptance of Gamified Vocabulary Learning Apps: An Integration of Self-Determination Theory and Technology Acceptance Model

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Abstract: Implementing the idea of gamification in mobile-assisted language learning has recently been gaining increasing attention from academia and industry. However, few studies have investigated students' motivation to use and their acceptance of popular gamified English vocabulary learning apps. This study proposes a theoretical framework combining the self-determination theory and the technology acceptance model, and examines it with survey data collected from 272 Chinese college students. The findings of the descriptive statistical and structural equation modeling analysis include: (1) students generally choose these apps out of autonomous motivations instead of controlled motivations; (2) autonomous motivation positively affects both perceived usefulness and ease of use, whereas controlled motivation only shows positive effects on the former; (3) controlled motivation does not affect the autonomous motivation to adopt these apps; and (4) consistent with the TAM frameworks, perceived usefulness and ease of use positively affect behavioral intention and actual behavior in terms of the frequency and duration of use in the gamified English vocabulary learning context. This study is expected to not only provide a solid theoretical explanation about the impact of motivation on the degree of acceptance of learning technologies in the language education context among specific student groups, but also offers practical insights on how to maximize the potential benefits of gamification and mobile learning in foreign language education

Keywords: vocabulary learning; gamification; technology acceptance model; self-determination theory; college students



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1. Introduction

Vocabulary learning, the cornerstone of the entire language learning process, is essential to learners' overall language ability. With a large vocabulary, language learners can better understand what they read or hear in the target foreign language, allowing them to learn the language more effectively. Information can be conveyed without grammar, but there is no way to complete the communication if there is no vocabulary [1]. However, studies have shown that many English as foreign language (EFL) students experience difficulties in enlarging their English vocabulary and consider vocabulary learning a severe obstacle to improve their overall English performances [2]. The heavy burden of English vocabulary learning usually demotivates learners, since mastering multifaceted vocabulary knowledge that involves spelling, pronunciation, meaning, connotation, collocation, and sentence-making requires frequent and continuous input [3]. The traditional paper-based learning approach limits the efficiency of vocabulary learning [1]. With the development of education technology, more and more English vocabulary learning apps with gamification features have emerged, which intend to promote learners' learning motivation and improve their learning efficiency. Ref. [4] has defined the concept of gamification as using game elements and mechanisms in non-gaming contexts to change the usage habits or behaviors of individuals. By combining the characteristics of both mobile assisted language learning (MALL) and educational gamification in the context of vocabulary acquisition,

game-inspired apps are gaining popularity among EFL learners and drawing increasing attention from academic researchers.

Nowadays, one can find hundreds of EFL vocabulary learning mobile apps on app stores. MALL apps can be effective, useful and suitable learning tools for the retention and practicing of new vocabulary when being implemented appropriately [5]. Owing to features of portability, interactivity, and ubiquity, these learner-centered MALL apps enable students to learn words anytime and anywhere, to select learning contents according to their preferences, and to customize their learning processes [6]. In addition, the small screen of mobile devices is suitable for displaying words and phrases in vocabulary learning. Adding gamification elements to the MALL platforms provides additional features to users' learning experience. These gamified apps usually include functions such as vocabulary competitions, study groups, coin/badge collections, and rankings. App users, who pick up roles as game players, complete vocabulary learning tasks in game-styled narratives; they touch their screens to cross words as "cutting"; or they form learning teams with friends to regularly remind each other to accomplish their tasks. Researchers have found that gamified learning can positively affect students' learning behavior, commitment and motivation [7,8], learning enjoyment [9,10], interest to communicate [11], and academic performance [12,13]. These studies have revealed the potential benefits of gamified MALL technologies in EFL learners' vocabulary acquisition. However, to the best of our knowledge, little has been done to investigate the EFL learners' motivations to adopt these apps and their perceptions about their use. Therefore, more research on and a better understanding of the level of acceptance of the platforms are necessary to expand the benefits of this educational technology.

China has a large number of EFL learners, as English is part of the country's compulsory curriculum from primary school to college. According to the College English Teaching Guide issued by College Foreign Language Teaching Steering Committee [14], college English courses aim at fostering students' comprehensive English skills and learning autonomy so that they can conduct effective communication with proficient English for personal development and international exchanges. To achieve that, college EFL learners are required to master a vocabulary of about 5500 words and 1000 phrases [14]. However, English vocabulary learning is considered by many Chinese college EFL learners as challenging [15]. On the one hand, they are sometimes insufficiently trained in class when it comes to vocabulary, because some teachers assume that they are advanced learners who are able to self-study new words before class. On the other hand, some students just learn words by rote and seldom find opportunities to use them, which means new words can be easily forgotten once they have been learnt. Unfortunately, the inefficiency of mastering vocabulary can discourage students from acquiring further English skills such as reading, writing, and speaking [16].

Having taken into account the significance of vocabulary acquisition in EFL learning, the prevalence and potential benefits of gamified English vocabulary learning apps, and the difficulty that Chinese college students experience with English vocabulary, we want to explore in-depth how well these gamified apps are accepted among students. The three objectives of this study are as follows:

- (1) Identify Chinese college EFL learners' motivation to use gamified English vocabulary learning apps and their perceptions about them;
- (2) Explain how users' motivations affect their perceptions in terms of app adoption;
- (3) Develop an integrative model about the antecedents of the use of the apps among Chinese EFL learners by combining the self-determination theory (SDT) and the technology acceptance model (TAM).

This study is expected to make three major contributions. First, unlike prior studies focusing on the learning effects of gamified learning apps, this study looks at the antecedents of the acceptance behavior from the perspective of both learners and users and discusses how to promote usage. Second, this study extends existing findings about motivations of using mobile/gamified learning apps by explicating relationships between learning

motivation and perceptions of learning technology through an integrative theoretical framework. Finally, this study specifically investigates Chinese EFL learners by focusing on their unique learning culture and habits, which can inspire further academic and practical explorations about language education technologies used by specific groups. Overall, this study is expected to not only provide a solid theoretical explanation of students' behavior of using gamified language learning technologies, but also offer practical insights on how to maximize the potential benefits of gamification and mobile learning in foreign language education.

2. Literature Review

This study has developed an exploration method combining knowledge from SDT and TAM. The justification for integrating these two theoretical frameworks is presented as follows.

2.1. Self-Determination Theory

The self-determination theory classifies motivation into amotivation, intrinsic motivation, and extrinsic motivation [17]. Amotivation means that an individual lacks intention or drive to conduct an activity. Intrinsic motivation concerns people performing certain behaviors for the sake of inherent satisfaction and over the fact that the behavior itself is purely interesting or enjoyable. Extrinsic motivation involves individuals doing certain things for a separable outcome they lead to, including integrated regulation, identified regulation, introjected regulation, and external regulation, all with different degrees of behavior autonomy. Among the four, integrated regulation is the most autonomous type of extrinsic motivation, followed by identified, introjected, and external regulation. Autonomous motivation comprises identified and integrated regulation of extrinsic motivation as well as intrinsic motivation, whereas controlled motivation consists of introjected and external regulation of extrinsic motivation. Within educational contexts, autonomous motivation concerns learning activities that students engage out of their own will. Specifically, students conduct autonomous motivated learning behaviors either because they consciously accept such behaviors or consider them important for themselves (identified regulation), they deem such behaviors congruent with other values and needs of their own (integrated regulation), or they find them purely interesting, fun, or challenging (intrinsic motivation). By contrast, controlled motivation refers to learning behaviors that students perform out of internal or external psychological pressure. Students conduct controlled motivated learning behaviors because they feel obliged to improve their self-esteem or avoid guilt or shame (introjected regulation), or to obtain contingent rewards or avoid negative impact (external regulation).

As one of the most popular theories for explaining human motivation, SDT has been widely applied in the educational domain [18]. Many researchers who study the influence of autonomous and controlled motivations have argued that autonomous motivation can lead to better learning outcomes comparing to controlled motivation. For example, [19] reported that autonomous motivation leads to higher grades among students, and [9] found that controlled motivation relates negatively to both high grades and school satisfaction. Specifically, [20] suggested that students' autonomous motivation levels are positively related to their engagement and academic achievement in foreign language learning. Similarly, [21] found that students who learn a language out of more autonomous motivations demonstrate better grades in language proficiency tests. Meanwhile, other studies have reported that controlled motivation correlates with negative outcomes in learning, including frustration [22], procrastination [23], and dropping out of school [24]. In practice, control motivation and autonomous motivation often exist simultaneously. For example, it was found that non-English major students in China possess a mixture of autonomous and controlled learning motivations in the context of English learning [25]. Some researchers have suggested that the appropriate combination of controlled and autonomous motivation may optimize learning outcomes in some specific contexts. For example, high levels of

autonomous motivation can translate into more physical activity among young adults when coinciding with motivation at moderate levels [26], and they may lead to higher grades among adolescent students when combined with low levels of controlled motivation [27]. As discussed by [27], controlled motivations are able to drive students to conduct certain learning behaviors, but the efforts predicted by controlled motivation are not always in line with the in-depth learning strategies characterized by high-quality engagement. Therefore, it seems that controlled motivation needs to be coordinated with autonomous motivation in a reasonable and complementary way.

2.2. Technology Acceptance Model

The TAM developed by Davis [28] is a theoretical model about people's innovation adoption behaviors. Extending the theory of reasoned action, this model has been utilized in a variety of studies to explain predictors of human behaviors toward potential acceptance or rejection of a technology [29]. According to TAM [28], users' acceptance to a technology can be affected by three antecedents: perceived usefulness, perceived ease of use, and behavioral intention. Among them, perceived usefulness concerns people's belief that using the technology can help them in performance improvement and perceived ease of use represents people's belief that using the technology can be free of effort. The premise of TAM is that users' perceived ease of use and perceived usefulness can both influence their behavioral intention directly, which determines the actual use behavior, whereas perceived ease of use can also impact perceived usefulness. Theoretically, when people perceive more ease of use towards a technology, they will perceive usefulness of it, and when they perceive more ease of use and usefulness, they will have more behavioral intention to accept the technology and actually use it. In the present study, perceived usefulness is defined operationally as the extent to which students believe that gamified apps can enhance their English vocabulary learning productivity and the perceived ease of use is students' judgment of whether using gamified English learning apps are free of effort.

In recent years, TAM has emerged as a leading paradigm in explaining technology adoption in many fields, such as social media [30], healthcare technologies [31], online banking [32], and education [33–36]. With the theoretical guidance of TAM, many researchers have examined teachers or students' adoption of E-learning platforms or materials. For example, [33] explored factors affecting E-learning outcomes; [34] investigated students' acceptance of learning materials from Youtube; [35] studied users' behavioral utilization intention of the E-book format; and [36] explained why lecturers and students love or hate online teaching/learning under the background of the COVID-19 pandemic. Moreover, there are studies examining users' acceptance of mobile apps using TAM. For example, based on TAM, [37] investigated the acceptance of mobile library apps; [38] explored consumers' acceptance of a quick response (QR) code for a food traceability system; and [39] studied determinants of behavioral intention to use personalized location-based mobile tourism apps. The above literature shows the extensive applicability of TAM in both the education domain and mobile apps. However, to the best of our knowledge, effort using TAM to examine learners' acceptance of gamified vocabulary learning apps has been limited and the topic deserves further exploration. In addition, it is noteworthy that the potential impact of cultural and human factors in the environment where the target technology is located should be thoroughly considered when applying TAM. Reference [40] argued that researchers need to transfer this theoretical framework across cultures in caution. Considering the characteristics of Chinese college EFL learners mentioned above, which may contain some special influencing motivational features, it seems meaningful to examine the application of TAM in the present study and contribute to the multi-cultural examination of TAM.

2.3. Hypothesis Development

TAM has been extended or integrated with other theories such as the theory of planned behavior and the theory of self-regulation in existing literature. By adding factors, such

as age, past use, brand loyalty, or perceived enjoyment and quality, to the original TAM framework, researchers have accumulated understandings about the antecedents and outcomes of users' behaviors, considering the characteristics of specific technologies. In order to extend explorations about the motivation of technology adoption, researchers combined SDT and TAM in several contexts such as online social networking sites continuance intention [41] and technology-enhanced learning during COVID-19 [42,43]. In addition, drawing on SDT and TAM, [44] analyzed users' reactions to a gamified recruitment tool and found that applicants' perceptions of ease of use and usefulness are correlated with the tool's ability to satisfy users' needs for competence and autonomy and to promote autonomous motivation. In the present study, we try to build connections between these two theories and establish explicit relations between users' autonomous and controlled motivation, respectively, with perceptual factors influencing their adoption of gamified English vocabulary learning apps.

Previous studies have shown that students' motivations may influence their perceptions about e-learning. Controlled motivations, such as getting a good reputation, social recognition, and social influence, can positively affect students' perceived usefulness [45] and ease of use about massive, online open courses [46]. In addition, autonomous motivation, such as the enjoyable learning experience, makes students consider virtual laboratories useful [47] and the e-learning system easy to use [48]. In addition, existing literature has shown that student-controlled motivation might trigger autonomous motivation in language learning. For example, [49] indicated that students' desire for winning scholarships or obtaining good grades (controlled motivation) could enhance their good feelings and confidence (autonomous motivation) during language learning processes. In line with these previous studies, we hypothesize:

H1: *Controlled motivation has a positive effect on the perceived usefulness of gamified English learning apps.*

H2: *Controlled motivation has a positive effect on the perceived ease of use of gamified English learning apps.*

H3: *Controlled motivation has a positive effect on autonomous motivation.*

H4: *Autonomous motivation has a positive effect on the perceived usefulness of gamified English learning apps.*

H5: *Autonomous motivation has a positive effect on the perceived ease of use of gamified English learning apps.*

Additionally, there are studies showed that the more people feel that a learning technology is easy to use, the more they feel that it is useful [50,51], and both of these two perceptions serve as the determinants of their intentions to use a range of learning technologies, such as mobile learning [52], commercial learning management systems [53], massive open online courses [54], and even videos on YouTube [34]. Therefore, the following hypotheses are proposed:

H6: *Perceived ease of use has a positive effect on students' behavioral intention to use gamified English learning apps.*

H7: *Perceived ease of use has a positive effect on students' perceived usefulness of gamified English learning apps.*

H8: *Perceived usefulness has a positive effect on students' behavioral intention to use gamified English learning apps.*

It is noteworthy that existing findings about the influence of behavioral intention on learning technology use behavior are inconsistent. Reference [55] revealed that students with high behavioral intention were likely to increase the frequency and the duration of using mobile English learning apps. However, [56] found that intention was positively correlated with the time spent, whereas its effect on enhancing the frequency of use could not be observed. In order to explicate this issue in the context of gamified English vocabulary learning apps, the last hypothesis is postulated:

H9: Behavioral intention to use gamified English learning apps has a positive effect on the frequency of actual use behaviors.

H10: Behavioral intention to use gamified English learning apps has a positive effect on the duration of actual use behaviors.

Based on the above hypotheses, we developed an empirical conceptual model describing the relationships between constructs of SDT and TAM as shown in Figure 1.

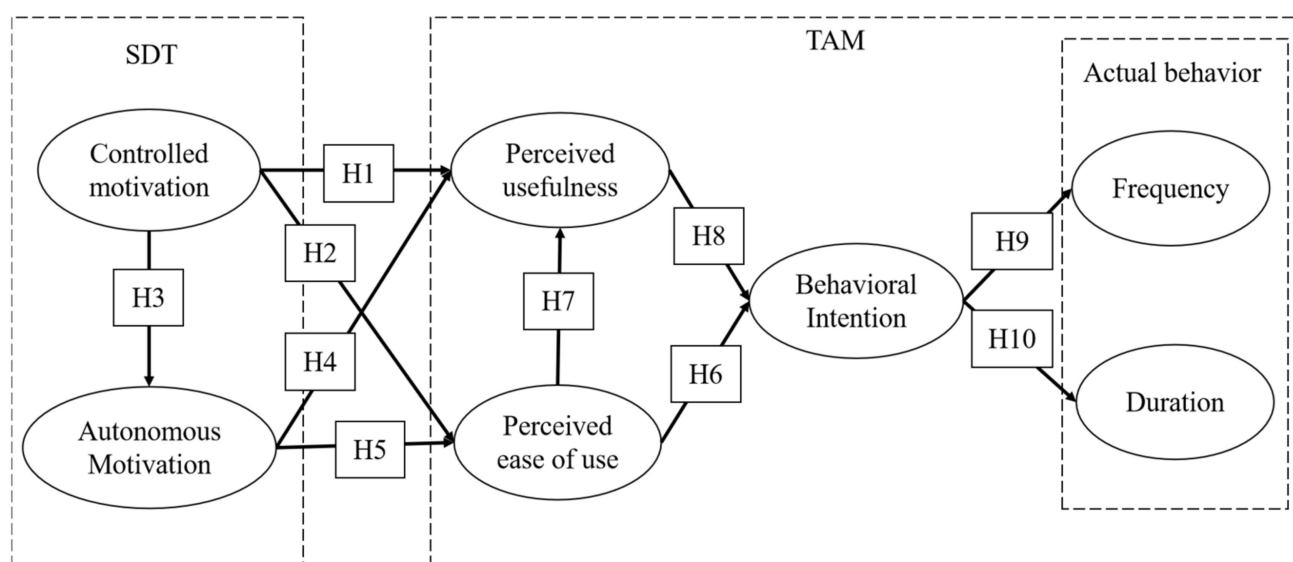


Figure 1. The proposed conceptual model.

3. Research Methods

3.1. Measurement Instruments

This study conducted a survey to examine the above research hypotheses. The survey began with a brief introduction describing the research objectives, defining gamified English vocabulary learning apps, and listing five popular apps as examples for reference. Next, participants were asked about demographic information and habits of using gamified English vocabulary learning apps. Then, 23 measurement items were presented as survey questions. Responses to 21 of them were measured using a five-point Likert scale, with responses labeled as “1” (extremely disagree), “2” (disagree), “3” (neutral), “4” (agree), and “5” (extremely agree), and those to the remaining two items about frequency and duration were categorized into five levels from low to high. All measurement items were referenced from existing studies with minor modifications to fit the current scenario in order to ensure the validity [28,57–60]. The measurement items were originally in English and translated into Chinese. Two experts were invited to review the initial version of the survey and ten students participated in a pilot study. Based on their feedback, some word accuracy and layout issues were fixed. The final version of the survey is shown in the Appendix A.

3.2. Data Collection

This study used a Chinese online survey platform offering paid sampling services, www.wjx.cn, to collect representative and extensive data. The sampling criterion was that all participants should be Chinese undergraduate students. Two hundred and seventy-nine responses from non-duplicate IP addresses were collected within one week, and the average completion time was 243 s. Seven responses which suggested that the respondent had no experience of using any gamified English vocabulary apps were discarded. Eventually, a total of 272 responses were retained with a valid response rate of 97.49%.

3.3. Participants

The demographic profiles and the respondents' use habits of gamified English vocabulary apps of the 272 valid responses are summarized in Table 1. The demographic information shows that the sample of this study comprehensively covers Chinese college students in gender, age, major, and years in school, so it can be regarded as appropriate for studying the target user group. As for using behaviors, 94.11% of the respondents used the apps more than once a week and 79.04% used them for more than one hour per week. The usage behavior data was analyzed with other feedback from the respondents.

Table 1. Demographic information of the respondents.

	Item	Number	Percentage (%)
Gender	Male	165	60.66%
	Female	107	39.34%
Age	18–22	250	91.91%
	>22	22	8.09%
	Science	35	12.87%
Major	Technology	106	38.97%
	Engineering	103	37.87%
	Mathematics	28	10.29%
Years of Study	Freshman	49	18.01%
	Sophomore	72	26.47%
	Junior	98	36.03%
	Senior	53	19.49%
Usage Frequency	Less than once a week	6	2.21%
	Once a week	10	3.68%
	2–3 times a week	88	32.35%
	4–5 times a week	91	33.46%
	At least once everyday	77	28.31%
Hours spent per Week	<1 h	57	20.96%
	≥1 h, <3 h	137	50.37%
	≥3 h, <5h	47	17.28%
	≥5 h, <7 h	19	6.99%
	≥7 h	12	4.41%

4. Results

4.1. Descriptive Statistics

The descriptive statistical analysis of the model constructs regarding two types of motivation and two types of perceptions examines why students use the apps and how they perceive them. Figure 2 presents results about motivation measurement items. The averages of CM1 and CM2, which refer to external regulation, are 2.60 and 2.49; the averages of CM3 to CM6, which refer to introjected regulation, are 2.30, 2.73, 3.01, and 2.29. As for items for autonomous motivation, the averages of AM1 and AM2, referring to identified regulation, are 3.58 and 4.11; the averages of AM3 and AM4, referring to integrated regulation, are 4.17 and 3.70; and the averages of AM5 and AM6, referring to intrinsic regulation, are both 3.77. Except for CM5 (3.01), the scores of the remaining controlled motivation items are lower than the neutral value (3.000), whereas those of all the autonomous motivation items are higher. The average score of all controlled motivation items (2.57) is lower than neutral,

whereas that of the autonomous ones (3.85) is higher. When adding up the percentages of agreement and extreme agreement, or disagreement and extreme disagreement, for calculating consensus, we found that CM2, CM3, and CM6 have negative consensus values that are larger than 50%, whereas AM2 and AM3 have positive ones. Among them, CM3 shows the highest negative consensus (59.6%) and AM3 presents the highest positive one (76.9%). Figure 3 presents results about perception measurement items. The averages of PU1 to PU3, which refer to perceived usefulness, are 3.80, 3.88, and 3.79, respectively, and that of PEOU1 to PEOU3, which refer to perceived ease of use, are 3.72, 3.96, and 3.83, respectively. All these average values are above the neutral score of 3.0. In terms of consensus, the values of all items are positive and higher than 50%.

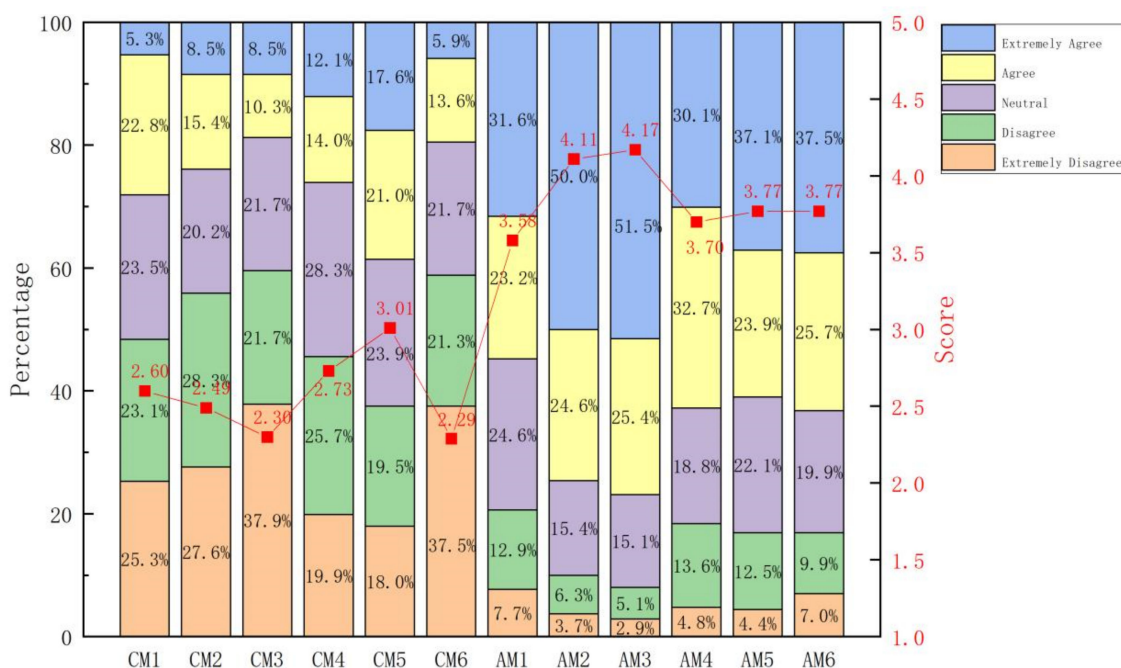


Figure 2. Descriptive analysis results of controlled motivation and autonomous motivation.

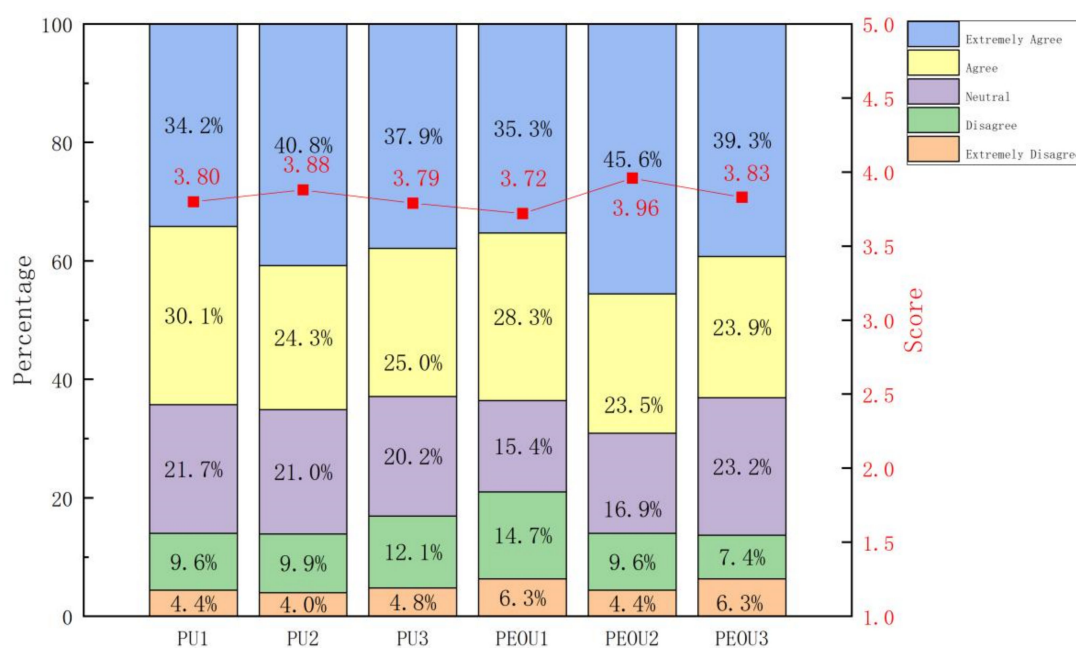


Figure 3. Descriptive analysis results of perceived usefulness and perceived ease of use.

4.2. Model Evaluation

This study used structural equation modeling to examine the antecedent factors of students' actual use of gamified apps with statistical analysis software SPSS 26 and AMOS 26, because this analytical method is effective and reliable in examining theoretical models with multiple variables and casual relations [61]. Specifically, a two-step examination was conducted: (1) a measurement model evaluation to test the validity and reliability of the measurement items, and (2) a structural model examination to assess the proposed theoretical hypotheses.

A confirmatory factor analysis was conducted to evaluate the validity and reliability of the measurement model with the maximum likelihood estimation method, and the overall results showed the model fit the statistical requirements. Specifically, the results of the ratio of chi-square to degrees of freedom (χ^2/df) = 1.073 (p = 0.000), root mean square error of approximation (RMSEA) = 0.016, standardized root-mean-square residual (SRMR) = 0.033, adjusted goodness-of-fit index (AGFI) = 0.92, goodness-of-fit index (GFI) = 0.938, comparative fit index (CFI) = 0.996, and incremental fit index (IFI) = 0.996, suggest that the model is a good fit in construct validity since the thresholds of χ^2/df < 3 [62], RMSEA < 0.09 [61], SRMR < 0.08 [63], AGFI > 0.80 [61], GFI, CFI and IFI > 0.90 [64] are all satisfied. As shown in Table 2, all the average variance extracted (AVE) values exceed 0.50 and the square root of AVE values are higher than the paired correlation values, confirming that the measurement items have a high convergent and discriminant validity [65]. Both the Cronbach's alpha (α) and composite reliability (CR) values are above 0.70, indicating that the model constructs have a good internal consistency in reliability [66]. In addition, all the correlation values are positive and lower than 0.70, suggesting that there is no severe multicollinearity issue in this study [67].

Table 2. Results of the correlations, average variance extracted (AVE), square root of AVE, Cronbach's alpha (α), and composite reliability (CR) of the model constructs.

Construct	CM	AM	PU	PEOU	AVE	$\sqrt{\text{AVE}}$	α	CR
CM					0.665	0.815	0.922	0.992
AM	0.091				0.654	0.809	0.918	0.919
PU	0.470	0.370			0.591	0.769	0.806	0.811
PEOU	0.095	0.358	0.473		0.87	0.933	0.918	0.691
BI	0.45	0.307	0.362	0.397	0.584	0.764	0.807	0.808

4.3. Structural Model Examination

The structural model was examined with the maximum likelihood estimation method and showed good fit with the statistics of χ^2 = 425.056, χ^2/df = 1.915 (p = 0.000), RMSEA = 0.058, AGFI = 0.892, GFI = 0.913, CFI = 0.945, and IFI = 0.942 [68]. Table 3 presents findings about the hypothesized relationships examination. The hypotheses H2 and H3 are not supported and all the rest are well supported.

Table 3. Analysis of standardized path coefficient (***: p < 0.001, ^{ns} not significant).

Hypothesis	Path	Coefficient	S.E.	T-Value
H1	CM→PU	0.453	0.056	7.507 ***
H2	CM→PEOU	0.087	0.058	1.431 ^{ns}
H3	CM→AM	0.127	0.064	1.925 ^{ns}
H4	AM→PU	0.312	0.065	4.614 ***
H5	AM→PEOU	0.493	0.066	7.360 ***
H6	PEOU→BI	0.430	0.058	5.814 ***
H7	PU→PEOU	0.270	0.067	3.908 ***
H8	PU→BI	0.448	0.061	5.850 ***
H9	BI→Frequency	0.627	0.104	9.255 ***
H10	BI→Duration	0.503	0.106	7.501 ***

Besides examining the hypotheses, we calculated the values of R^2 in order to evaluate the explanatory power of the research model (see Figure 4). All the R^2 are beyond 0.10, suggesting that the independent explanatory variables are acceptable [47,69]. The R^2 values of PU, PEOU, BI, behavior frequency, and behavior duration showed that these variables were explained by their antecedents in 53.2%, 26.1%, 57.6%, 39.3%, and 25.3%, respectively. Figure 4 shows the structural model examination results findings about the hypothesized relationships examination.

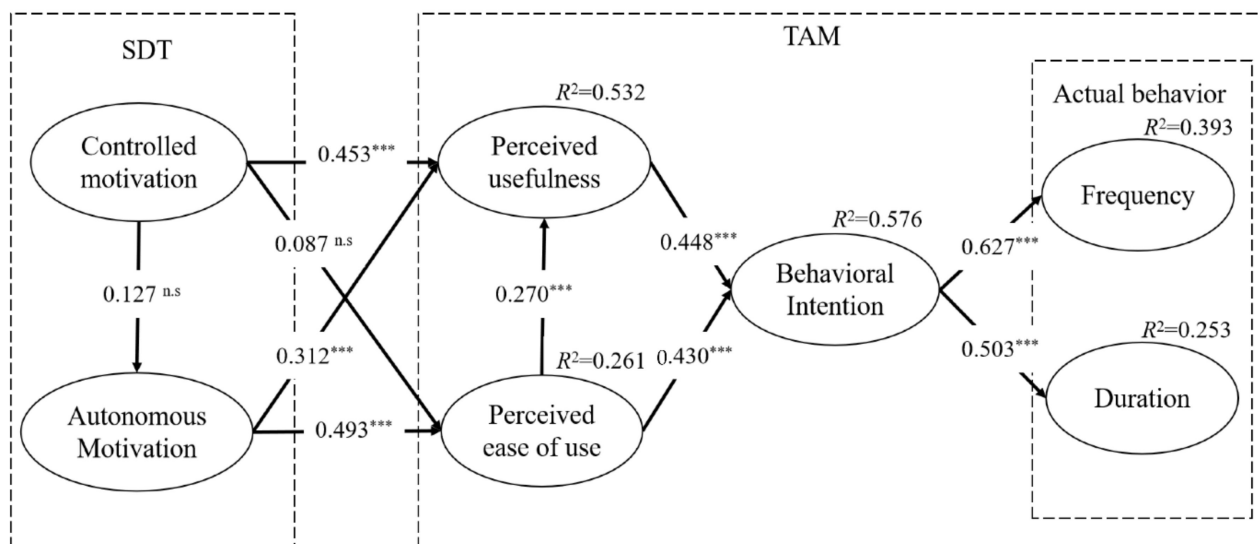


Figure 4. Results of structural model analysis (***: $p < 0.001$; n.s.: not significant).

5. Discussion

The results of descriptive statistical analysis reveal that students hold different attitudes towards the two types of behavior motivations proposed. They are generally motivated by autonomous factors to learn with the apps, not much by controlled factors. When they choose to benefit from the apps, it is basically neither because of external regulations, such as satisfying an external demand or to obtain an externally imposed reward, nor because of introjected regulation, such as avoiding criticism from others or feeling ashamed. Existing literature has indicated that Chinese students, different from their counterparts in Western cultures, show a greater tendency to exhibit and internalize some extrinsic types of motivation [70,71]. By comparison, findings of this study have indicated that Chinese EFL learners show limited controlled motivation in learning with these apps. On the one hand, this may be explained by the fact that these apps have not been extensively integrated into formal teaching activities and few teachers require students to use apps for their assignments. On the other hand, this learning approach allows students to make more independent decisions without interference from others, and the euphemistic reinforcement system of game settings alleviates anxiety about criticism. As for autonomous motivation, the majority of the participants reported that their use behaviors are motivated by factors of identified, integrated, and intrinsic regulation, which are more self-determined motivations. Students identify the value of using this learning method and integrate it with personal growth, because they tend to be influenced by instrumental foreign language learning motivation as adult EFL learners and have a utilitarian attitude towards using this educational technology. Furthermore, the motivation of the enjoyment of using the gamified apps were well recognized by these participants. Prior literature indicated that, different from children [72] and teenagers [73], adult students could be less affected by educational gamification [74]. However, this study confirms that Chinese college EFL learners have acknowledged that the fun of gaming does motivate their learning behaviors of using the gamified apps. In addition, the descriptive findings suggested that most participants

perceived these apps as useful to their learning and easy to use. It indicated that, in general, these apps offer attractive functions and interactive interface design for their adult users.

The results of Hypotheses 1–5 explain the relationships between students' motivation and perception towards the apps. H1 (controlled motivation-perceived usefulness) is supported and H2 (controlled motivation-perceived ease of use) is not, which suggests that these college students consider the apps more useful when they receive more positive influence regarding the benefits of apps from others, but their perception of usability is independent of the external world. This could be because that the outcomes of a language learning activity, especially vocabulary learning, usually cannot be manifested thoroughly immediately, but is more often revealed in tests or communication after a period of continuous input. Therefore, users' perception of the effectiveness of learning with these apps could be affected by external factors, such as information from others. However, the judgment of ease is purely subjective feelings that can be obtained directly in real time with less external interference. The unsupported H3 (controlled motivation-autonomous motivation) means that students' controlled motivation has no significant impact on their autonomous motivation in terms of using the gamified learning apps. Different from existing findings which suggest positive relations between the two types of motivations, our results could be explained by the age of the research subjects, who are adult EFL learners and have relatively clear judgment about their behavioral motivation. The supported H4 (autonomous motivation-perceived usefulness) and H5 (autonomous motivation-perceived ease of use) indicate that when users are motivated by autonomous factors, such as identifying the learning behavior as meaningful and beneficial or enjoying the fun from gamified settings, they have higher perceptions of both usefulness and ease of use towards using the gamified apps. It indicates the significance of self-determined motivation in the decision process of using behavior. Our finding has reinforced the existing research conclusion that autonomous motivation playing an important role in influencing people's perceptions [46].

Third, hypotheses 6–10 examine the relations among users' perception, behavioral intention, and actual behavior of using the gamified apps under the theoretical framework of TAM. All these four hypotheses are supported, and it indicates that TAM is a suitable model to explain Chinese college EFL students' behavior of using gamified English vocabulary learning apps. H6 (perceived ease of use-behavioral intention) and H8 (perceived usefulness-behavioral intention) suggest that these students' behavioral intention of using the apps is significantly promoted by their perceived usefulness and ease of use significantly. H7 (perceived ease of use-perceived usefulness) shows that the more users feel that the gamified apps are easy to use, the more they feel the apps are useful for learning English vocabularies, which are in line with many existing studies about technology adoption [40,48]. In addition, the supported H9 and H10 (behavior intention-actual behavior) suggests that no gap was identified between the behavioral intention and actual behavior. When users want to learn vocabulary with the apps, they will most probably go ahead and do it. Specifically, students with stronger intentions to use the apps would use them more frequently and behave so more persistently. However, as reflected by the R^2 values, the explanatory power results of frequency and duration suggest that behavioral intention is not a dominate indicator of the students' actual use of the apps. Other potentially influencing factors, such as the students' available time, use scenario, or study plans, may also interfere with their actual use and deserve further exploration.

6. Conclusions

Alongside the development of mobile learning technologies in recent years, gamified English vocabulary apps are getting increasingly popular and providing a new learning style for EFL learners. It is important to understand why learners choose to adopt these apps and learn with them. To achieve that, this study has developed a research model integrating SDT and TAM and applied the model to analyze data collected from 277 Chinese College EFL learners. The findings suggest that students generally learn with these apps out of autonomous motivations instead of controlled motivations. Autonomous motivation

positively affects both perceived usefulness and ease of use, whereas controlled motivation only shows positive effects on the former. Moreover, this study has demonstrated that controlled motivation does not affect the students' autonomous motivation in adopting these apps, and, consistent with the TAM frameworks, concludes that students' perceived usefulness and ease of use positively affect their use intention and actual use behavior in terms of use frequency and duration. In addition to discussing the research findings, this study has also presented theoretical and practical implications for researchers, teachers, and app designers.

6.1. Theoretical and Practical Implications

This study has developed and validated a motivation-technology acceptance model concerning Chinese college EFL learners' behavioral decision-making process of using gamified vocabulary learning apps. This integrated study framework has not only demonstrated the relationship between users' perceptions of the apps and their actual behavior of using them, but has also uncovered the impact of learners' controlled and autonomous motivation attitudes on their perceptions towards using the apps. By correlating motivation and perception, this study has extended the typical model of both TAM and SDT to the context of gamified English vocabulary learning apps.

Given the study's findings on the positive influence of controlled motivation on perceived usefulness of the apps, English teachers can play a more active role in promoting the use of gamified English vocabulary learning apps. The collectivistic culture and parenting style in China mean that Chinese students are more willing to fulfill the expectations of others or endorse social reasons for studying [75]. Therefore, English teachers may try to enhance the influence of controlled motivation by integrating this learning method into teaching practices. Meanwhile, considering the significant role of the autonomous motivating factors in the adoption of the educational technology, app designers should make efforts to activate students' intrinsic motivation and identified/integrated forms of extrinsic motivation. App designers should introduce features that constantly highlight students' progress to inform usefulness, simplify interactions to enhance usability, or add more game elements to make the user experience more entertaining. Autonomous motivation is powerful; however, the autonomous learning style usually requires responsible and initiative learners [5]. Therefore, apps designers and teachers could try to activate users'/students' inner desire to improve their EFL achievements with various approaches.

6.2. Limitations and Future Work

This study has three limitations that need to be acknowledged. First, the research data collected in this study is limited to a self-reported survey. Since some of the questions are related to personal learning behaviors and habits, participants might provide biased and subjective feedback [76]. Future research may consider adding objective measurements to collect both subjective and objective data in order to depict a more comprehensive picture of the research subject. Second, this study is limited to an analysis of a cross-sectional data set and is unable to capture the variations of users' motivation, perception, and behaviors in use, if there are any. Therefore, it is suggested that future studies involve longitudinal paradigms to describe users' dynamic data considering students' cumulative study time might make differences in research findings. In addition, this study is focused on undergraduate students from a few majors in China, which may limit the generalizability of the results. Future studies can examine this topic with samples from other learner groups and explore the potential similarities and differences across cultural backgrounds and educational contexts.

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Appendix A

Measurement items

Controlled motivation (CM) [57]

I use gamified English vocabulary learning apps

CM1: because that's what I'm supposed to do.

CM2: because that's the rule.

CM3: so that my teachers/classmates/friends/family won't get mad at me.

CM4: because my teachers/classmates/friends/family say I should.

CM5: because I feel pressure from my teachers/classmates/friends/family.

CM6: because I feel ashamed when I do not use them.

Autonomous motivation (AM) [57]

I use gamified English vocabulary learning apps

AM1: because I think it is important for me.

AM2: because I think it is meaningful.

AM3: because I think it helps with my personal growth.

AM4: because I think it benefits my English learning.

AM5: because it is fun.

AM6: because it is interesting.

Perceived usefulness (PU) [58]

PU1: I find English vocabulary learning apps useful for me.

PU2: I find that using English vocabulary learning apps can improve my academic performance.

PU3: I find that using English vocabulary learning apps can enhance my effectiveness in learning.

Perceived ease of use (PEOU) [59]

PEOU1: I find it easy to use English vocabulary learning apps.

PEOU2: I find that learning to operate English vocabulary learning apps is easy.

PEOU3: I find that it's easy to become skillful at using English vocabulary learning apps.

Behavioral intention (BI) [59,60]

BI1: I will frequently use English vocabulary learning apps.

BI2: I would like to use English vocabulary learning apps in the future.

BI3: I will continue using English vocabulary learning apps in the future.

Actual behavior (AB) [59,60]

Table A1. The frequency of using the apps each week.

1	2	3	4	5
Less than once a week	Once a week	2–3 times a week	4–5 times a week	At least once everyday

Table A2. The duration of using the apps each week.

1	2	3	4	5
<1 h	≥1 h, <3 h	≥3 h, <5h	≥5 h, <7 h	≥7 h

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