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Factors affecting Thai EFL students' behavioral intentions toward mobile-assisted language learning

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Introduction: Recently, researchers have begun to pay more attention to topics related to the adoption of mobile devices for supporting second or foreign language learning. Mobile-assisted language learning (MALL) is now prevalent among language learners and educators because of its convenient and enjoyable features. This study combined and extended the Technology Acceptance Model (TAM) and Expectation Confirmation Theory (ECT) to investigate the factors influencing English as a Foreign Language (EFL) students' behavioral intentions to use MALL at two universities in Bangkok, Thailand.

Methods: Quantitative methods were utilized in this study and the researchers obtained a total of 507 valid responses by using three-step sampling. After using confirmatory factor analysis (CFA) to determine that the study had enough construct validity, structural equation modeling (SEM) was applied to test the research's hypotheses.

Results: The findings revealed that all 15 hypotheses were supported, except that social influence cannot significantly influence behavioral intention.

Discussion and implication: By acquiring a deeper understanding of the factors that impact the behavioral intentions of language learners to utilize MALL, developers and providers can improve their capacity to design more enjoyable and effective applications that align with customer expectations and enhance financial gains. By understanding students' behavioral intentions towards MALL, educators can efficiently raise awareness of its benefits and provide effective training, enabling students to utilize available resources and enhance their language learning experience.

KEYWORDS

mobile-assisted language learning, technology acceptance model, expectation confirmation theory, behavioral intention, English as a foreign language, Thailand, structural equation modeling

1 Introduction

Over the past few decades, the education sector has witnessed a substantial transformation through the increasing integration of electronic devices into teaching and learning, owing to the relentless advancements in information technology (Alghamdi et al., 2022). The critical role of e-learning in educational settings has grown considerably, attracting interest from a great number of learners, educators, and researchers (Yeh and Chu, 2018; Mensah et al., 2022; Shams et al., 2022). E-learning refers to using various electronic devices in the learning process

and is usually characterized by its high convenience, flexibility, interactivity, and self-pacing learning features (Arpaci et al., 2020; Zarei and Mohammadi, 2022). In light of the COVID-19 pandemic involving around 1.6 billion students worldwide, many schools have been compelled to discontinue classroom instruction and encourage remote learning through various electronic devices (Kim et al., 2022).

According to Criollo-C et al. (2021), mobile devices, including smartphones, smart tablets, and laptops, are widely utilized and have become indispensable in everyday life. Mobile learning is a type of e-learning that has experienced a significant increase in popularity among learners, particularly the younger generation (Qashou, 2021). The increased use of mobile learning could be attributed to its user-friendliness and gamification features, which contribute to a more interactive and enjoyable learning environment (Kao et al., 2023). Mobile devices allow learners to access a diverse range of learning materials via the Internet and facilitate the sharing and discussion of knowledge with others (Shadiev et al., 2018). Many countries, Thailand included, exhibit a firm disposition toward encouraging students to adopt mobile learning as a means to save on educational expenses and school years (Aroonsrimarakot et al., 2023). However, according to Buasuwan (2018), only 20% of Thai students would like to use online resources to acquire more knowledge outside of the classroom, and most of them still need to be taught how to use mobile learning effectively.

Undoubtedly, language occupies a pivotal position in all facets of contemporary society. As a form of communication that evolved naturally, language enables humans to express various complex ideas (Brighton et al., 2005). As a global language, English is now widely used for global communication and collaboration. According to Seidlhofer (2017), most non-native English speakers rely strictly on English to communicate with people from other countries. English is becoming increasingly prevalent in Thailand, a country with a thriving tourist economy, serving as the primary mode of communication between Thai people and their international counterparts (Watson Todd, 2006; Baker, 2011). According to Tantiwich and Sinwongsuwat (2021), although most Thai students have received English education from early childhood to university, their English language proficiency is still very low, with an average Common European Framework of Reference for Languages (CEFR) proficiency level of A2.

Mobile devices have emerged as indispensable instruments in the realm of education, particularly in the domain of language acquisition (Liu and Chen, 2015; Mahyoob, 2020). The concept of mobile-assisted language learning (MALL) was first introduced by Chickering and Ehrmann (1996), and since then, numerous studies have been conducted by numerous linguistic and educational researchers. Research on MALL in English language learning has focused on vocabulary, listening, speaking, reading, and grammar (Burston, 2014). Within the existing literature examining the utilization of MALL among native Thai students, the majority of research inquiries have primarily focused on vocabulary, oral communication, and extracurricular activities (Phetsut and Waemusa, 2022; Pingmuang and Koraneekij, 2022).

Existing research on English language learning has focused on specific aspects of language learning, particularly vocabulary and grammar learning, as well as improving listening, speaking, reading, and writing skills. However, a clear gap exists in the comprehensive survey of language learners' utilization of a specific technological product, such as MALL. In the MALL field, the existing literature has conducted several empirical studies on behavioral intentions associated with MALL utilization in language learning. Nevertheless, there is a clear and ongoing need in this field, characterized by the need for further research endeavors that systematically integrate and extend both the Technology Acceptance Model (TAM) and Expectancy Confirmation Theory (ECT). Furthermore, a noticeable literature gap exists regarding the ongoing utilization of MALL among Thai students. This study aims to address this gap by investigating in depth the factors influencing Thai EFL learners' persistent utilization of MALL in the context of Thailand's unique educational and linguistic environment.

This study examines the factors that influence the behavioral intentions of EFL learners toward adopting MALL at two universities in Bangkok, Thailand. The researchers aim to integrate and extend upon the TAM and ECT to explore a model that could more effectively explain learners' intentions to utilize MALL. Furthermore, this study employed social influences, habits, and perceived enjoyment as external variables to improve the model's predictive capacity and better comprehend learners' intentions to utilize MALL. Moreover, this study seeks to enhance educators' understanding of MALL's features and learners' perspectives on its utilization, thereby fostering the integration of mobile technology into language education, ultimately enhancing the effectiveness and outcomes of language learning. Furthermore, it offers valuable insights for MALL service developers and providers, enabling them to better grasp their target users' preferences and needs and, consequently, develop more efficient, convenient, and tailored MALL applications for their customers.

2 Literature review

2.1 Mobile assisted language learning (MALL)

Mobile learning is a method of electronic learning that employs mobile devices, facilitating learners' access to educational resources (Traxler, 2004). Mobile learning enables learners to access educational resources through mobile devices without being restricted to a fixed location (Yousafzai et al., 2016). As stated by Nuraeni (2021), mobile learning is a modernized educational method that leverages technological advancements to enhance learners' accessibility to educational resources through mobile devices, enabling them to engage in learning activities regardless of time and location. Huang et al. (2012) stated that information technology development has brought a new language-learning method for learners. MALL, an acronym for mobile-assisted language learning, refers to language learning activities conducted on various mobile devices (Rahimi and Miri, 2014). MALL is a kind of mobile learning that exclusively involves using mobile devices for language-learning purposes (Shortt et al., 2023).

In the field of English as a second/foreign language (ESL & EFL), there has been a growing focus on integrating information technology into language learning and teaching. Many researchers have increasingly focused on investigating the integration of various language apps (such as Duolingo, Hellotalk, and WhatsApp) into English learning and teaching (Ahmed et al., 2022; Sadeghi and Chalak, 2023; Sakkir and Syamsuddin, 2023). Recently, a surge in the number of studies conducted has consistently highlighted the significant efficacy of MALL as an effective tool for language learners.

MALL integrates various information technologies into language education, establishing a situated learning context that promotes active learner participation in acquiring language knowledge and exploring individual learning strategies and patterns (Jeong, 2022). MALL facilitates learners' proficiency development and refinement through applying and improving language skills in authentic real-life situations (Sabiri and Shah, 2023). Moreover, an extensive body of literature has investigated the impact of mobile-assisted language learning (MALL) on learners' language competence. A study conducted by Katemba (2021) examined the effectiveness of MALL in rural Indonesian schools, and the results indicated that MALL was effective in strengthening the EFL learners' vocabulary performance. Ghorbani and Ebadi (2020) demonstrated that MALL can significantly enhance the grammatical development of EFL learners, especially grammatical accuracy. According to Gharehblagh and Nasri (2020), EFL learners mostly believe that MALL has the potential to yield positive outcomes in terms of enhancing writing proficiency. Implementing MALL in English learning could effectively reduce grammatical and structural errors in writing and enhance proficiency (Ghorbani and Ebadi, 2020).

Furthermore, several studies have explored the factors affecting language learners' intention to adopt or continue using MALL. Hsu and Lin (2021) conducted a study to test the factors impacting the continuous intention of MALL using an extended technology acceptance model (TAM), which revealed that perceived ease of use and perceived usefulness served as essential factors that can effectively explain the continuous intention of using MALL (R-square = 0.8). In an investigation using Expectation Confirmation Theory (ECT) and focusing on Duolingo as the targeted MALL application, Unal and Güngör (2021) found that various factors, including satisfaction, conformation, and perceived usefulness, significantly influenced individuals' intentions to continue utilizing MALL. Garcia Botero et al. (2022) surveyed 89 higher education language instructors in Colombia and found that social influences significantly influenced teachers' intention to adopt MALL. Undoubtedly, gamification plays a crucial role in MALL apps, encompassing various enjoyable elements such as entertaining mini-games, incentivizing reward mechanisms, rankings, and engaging quest-based activities, which can effectively stimulate language learners' decisions about MALL adoption (Shortt et al., 2023). While the number of studies examining the impact of perceived enjoyment on intention to use MALL remains very limited, much research has consistently confirmed the significant influence of perceived enjoyment on learners' intention to use mobile learning (Cheng, 2014; Mubuke, 2017; Chao, 2019). The concept of habits has consistently been recognized as an essential factor in language learning, receiving considerable attention due to its crucial impact on the overall learning outcome (Patra et al., 2022). So far, empirical investigations about the impact of habits on learners' intention to utilize MALL have been scarce. However, many studies have confirmed that habits significantly influence learners' behavioral intention to engage with mobile learning (Yang et al., 2022; Zacharis and Nikolopoulou, 2022; Jameel et al., 2023).

2.2 Technology acceptance model (TAM)

The degree to which users accept a new information system can indicate the system's success (Qashou, 2021). Davis (1985) initially developed the TAM to explore the acceptance of information technology. The TAM is based on the Theory of Reasoned Action (TRA) proposed by Fishbein and Ajzen (1975), which is designed to evaluate users' acceptance of an information system more effectively. According to Davis et al. (1989), the TAM model is a well-established framework for explaining the factors that guide user acceptance of a technological product. According to Nikou and Economides (2017), the TAM model is recognized as a well-known model for investigating user acceptance of new technologies or systems. Perceived usefulness and perceived ease of use are the major factors controlling user acceptance of a technology or system (Davis et al., 1989). Perceived usefulness refers to the degree to which users perceive that a particular technology or system can enhance their work performance, while perceived ease of use refers to the degree to which users perceive that they can minimize the effort needed (Davis et al., 1989). While perceived usefulness and perceived ease of use are valuable factors for predicting user behavior, they do not provide a comprehensive explanation for user adoption of new technology (Malatji et al., 2020). Incorporating external variables into the TAM model for a particular technology or system can improve its accuracy in forecasting (Davis et al., 1989).

2.3 Expectation confirmation theory (ECT)

Consumers' satisfaction with a product is influenced by their expectations regarding its performance and the confirmation associated with those expectations (Oliver, 1977). When the performance of a product aligns with a customer's expectations, it increases the likelihood of customer repurchase behavior (Oliver, 1980). Expectations are benchmarks for evaluating the actual performance of a product (Oliver, 1980). If the performance surpasses their expectations, users experience a sense of confirmation, leading to an increase in satisfaction. Conversely, if the performance falls below their expectations, users encounter a sense of disconfirmation, resulting in decreased satisfaction (Oliver, 1980; Najmul Islam, 2014). The inception of the ECT by Oliver (1980) marked its pioneering application in exploring customer satisfaction, which emerges from the cognitive dissonance arising from the variance between expectations and realized performance and post-purchase behavior. Inspired by the Technology Acceptance Model and the Theory of Planned Behavior, Bhattacherjee (2001) sought to employ the Expectancy Confirmation Theory to investigate users' satisfaction and behavioral intentions toward information systems. ECT-based research typically investigates customers' pre-behavior and post-behavior regarding technology adoption, thus emphasizing a comprehensive understanding of the customer's adoption progression (Lin et al., 2012). Customer satisfaction and post-behavioral intentions or behaviors are contingent upon their confirmation or disconfirmation of the product (Zhigang et al., 2020).

3 Research model, theoretical background, and research hypotheses

3.1 Research model

The Technology Acceptance Model (TAM) has proven effective in explaining the user's acceptance of a specific technique or technology,

whereas Expectation Confirmation Theory (ECT) models possess the capability to forecast user satisfaction and post-adoption behavior by examining the disconfirmation between performance and expectations. This study integrated and extended the TAM and ECT to elucidate the behavioral intentions of Thai EFL learners in utilizing MALL. Besides that, social influences, habits, and perceived enjoyment were employed as external variables to better explain the behavioral intention to use MALL. The conceptual framework of this research is shown in Figure 1.

3.2 Perceived usefulness (PU)

According to Davis et al. (1989), perceived usefulness (PU) is the extent to which users believe a specific system can increase their productivity. PU is a crucial factor influencing behavioral intention in the TAM model. In ECT, users' post-adoption expectations are also based on PU (Saeed and Abdinnour-Helm, 2008). PU serves as an extrinsic motivator for users to continue using the product when their expectations exceed those that would enable them to be satisfied (Kumar and Natarajan, 2020). This study defined PU as the extent to which Thai EFL students perceived that MALL could enhance their English learning performance.

Hoi and Mu (2021) investigated the adoption of MALL among 293 higher education EFL learners and discovered that PU has a significant impact on learners' intention to use MALL and was the most influential predictor of behavioral intention. Based on TAM and the theory of language learning motivation, Fan (2023) conducted a study involving 834 Chinese undergraduates to explore the relationship between perceived usefulness and behavioral intention, revealing that learners' behavioral intention to utilize mobile platforms for language learning was positively influenced by their perception of the effectiveness of mobile platforms in enhancing their English proficiency. Besides, a great number of studies related to MALL have also confirmed the significant impact of perceived usefulness on satisfaction (Daneji et al., 2019; Al-Sharafi et al., 2021; Li, 2021; Jiang et al., 2022). Therefore, the researchers proposed the following hypotheses:

> *H1a*: Perceived usefulness has a significant impact on behavioral intention.
>
> *H1b*: Perceived usefulness has a significant impact on satisfaction.

3.3 Perceived ease of use (PEOU)

Perceived ease of use (PEOU) is another critical factor influencing behavioral intention in the TAM model. PEOU refers to the extent to which users perceive a particular technology as effortless (Davis et al., 1989). In this study, PEOU refers to the degree to which Thai EFL students perceive MALL to be easy to use.

Hsu and Lin (2021) utilized and extended TAM to investigate 557 Taiwanese EFL learners' intention to use MALL and found that PEOU can significantly influence learners' behavioral intentions. Ebadi and Raygan (2023) investigated the intention to use MALL among 223 Iranian EFL learners and found that PEOU can significantly influence learners' intention to use MALL. Besides, several studies have shown that PEOU can significantly impact the perceived usefulness (Hsu, 2016) and satisfaction (Joo et al., 2018) of MALL users. Therefore, the researchers proposed the following several hypotheses:

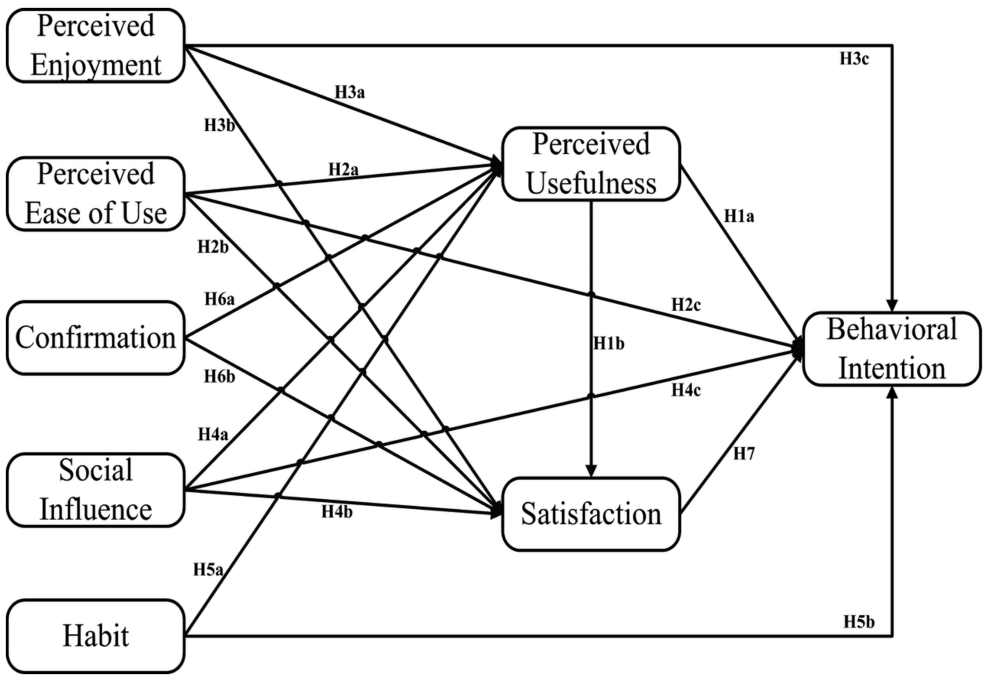

FIGURE 1
Research model.

H2a: Perceived ease of use has a significant impact on perceived usefulness.

H2b: Perceived ease of use has a significant impact on satisfaction.

H2c: Perceived ease of use has a significant impact on behavioral intention.

3.4 Perceived enjoyment (PE)

Perceived enjoyment (PE) is an external variable in this study. PE is a kind of intrinsic motivation that indicates the degree of pleasure users believe a technology can provide (Chao, 2019). Users are more inclined to adopt a technology or system when they perceive its utilization will result in happiness and pleasure (Lu et al., 2009). Integrating enjoyable elements within MALL applications can greatly enhance learners' engagement, motivation, and persistence, fostering more pleasant language learning experiences and yielding higher learning effectiveness (An et al., 2021; Zheng and Zhou, 2022). In this study, PE refers to how Thai EFL learners experience happiness and pleasure when using MALL.

Al-Bashayreh et al. (2022) conducted a study on 415 Jordanian students to examine their acceptance of m-learning. The study revealed that perceived enjoyment is the most critical factor influencing the students' behavioral intention to use m-learning. The researchers also concluded that incorporating more enjoyable elements in the design of m-learning apps is crucial for enhancing learners' adoption and continued use of m-learning. Li et al. (2021) conducted a study involving 199 Chinese higher education EFL students who utilized e-learning. They discovered that the students' perceived enjoyment of e-learning significantly influenced their perceived usefulness and behavioral intentions. Li et al. (2022) conducted a survey of 493 Chinese university students, investigating their behavioral intention and satisfaction with online learning. The study established a significant relationship between perceived enjoyment and user satisfaction. Therefore, the researchers proposed hypotheses as follows:

H3a: Perceived Enjoyment has a significant impact on perceived usefulness.

H3b: Perceived Enjoyment has a significant impact on satisfaction.

H3c: Perceived Enjoyment has a significant impact on behavioral intention.

3.5 Social influence (SI)

Social influence (SI) is another external variable in this study. SI refers to how individuals believe others' feelings about adopting a specific technology (Venkatesh et al., 2003). In this research, SI refers to the extent to which Thai EFL learners perceive that others support their use of MALL for English language study.

Garcia Botero et al. (2022) and Alyoussef (2021) conducted studies that revealed that social influences can significantly influence the perceived usefulness and behavioral intentions of MALL users. Lutfi et al. (2022) combined the Unified Theory of Acceptance and Use of Technology (UTAUT) with the Expectation Confirmation Model (ECM) to investigate the adoption of mobile learning among 428 university students from King Faisal University, revealing a significant impact of social influence on user satisfaction. In contrast, Huang et al. (2023) conducted a survey involving 681 online short video application users, which indicated that social influence cannot significantly influence users' behavioral intentions. Therefore, the researchers proposed the following hypotheses:

H4a: Social influence has a significant impact on perceived usefulness.

H4b: Social influence has a significant impact on satisfaction.

H4c: Social influence has a significant impact on behavioral intention.

3.6 Habit (HA)

Habit (HA) is also an external variable in this study. HA refers to a regular and automated manner of behavior resulting from repeated learning (Limayem et al., 2007). HA is commonly characterized as recurrent behaviors that are subject to the individual subconscious (Shiau and Luo, 2013; Yoo and Cho, 2020). HA exerts a direct and interactive influence on the user's behavior (Triandis, 1979; Isbell et al., 2017). In this study, HA pertains to the extent to which Thai EFL learners perceive the utilization of MALL as an automated behavioral pattern.

Alhadiah (2023) investigated the adoption behavior of MALL among 945 undergraduate EFL learners in Saudi Arabia and found that HA can significantly influence learners' behavioral intentions. Wu and Perng's (2016) study of mobile learning with 344 university students at the Shanghai Open University found that habits can significantly influence users' perceived usefulness and behavioral intention. Soria-Barreto et al. (2021) employed the ECM to investigate the online learning behavior of 452 university students from Spain, Chile, and Jordan, revealing a significant relationship between habit and continuance intention. Therefore, the researchers proposed the following hypotheses:

H5a: Habit has a significant impact on perceived usefulness.

H5b: Habit has a significant impact on behavioral intention.

3.7 Confirmation (CON)

Confirmation (CON) is one of the essential variables in ECM. CON refers to the difference between the user's perceived actual performance and expectations of a specific product (Bhattacherjee, 2001). In this study, CON pertains to the discrepancy between the perceived performance of Thai EFL learners during their utilization of MALL and their initial expectations.

Meng and Li (2023) explored the use of m-learning by 231 Chinese in-service teachers and revealed that confirmation can significantly affect perceived usefulness and satisfaction.

Alhumaid (2021) conducted a survey of 420 students at Zayed University and found that confirmation can significantly affect the perceived usefulness and satisfaction of using mobile learning. Therefore, the researchers proposed hypotheses as follows:

> *H6a*: Confirmation has a significant impact on perceived usefulness.
>
> *H6b*: Confirmation has a significant impact on satisfaction.

3.8 Satisfaction (SAT)

Satisfaction (SAT) is another critical variable in ECM. SAT refers to the degree to which a person fulfills his or her needs and desires (Kotler, 2000). Within the information systems context, SAT denotes an individual user's cognitive and affective response while engaging with a specific product or system (McNamara and Kirakowski, 2011; Habib et al., 2022). In this study, SAT refers to the extent to which Thai EFL learners are satisfied with using MALL.

Chao (2019) explored the utilization of m-learning among 1,562 learners from 10 universities in Taiwan, revealing that learners' perception of satisfaction with m-learning significantly impacted their behavioral intention to employ m-learning. In a study conducted by Alshurideh et al. (2023) involving a sample of 448 students, the findings revealed a significant relationship between satisfaction and continuance intentions of utilization of mobile learning platforms. Similarly, Al-Hamad et al. (2021) found that satisfaction can significantly influence behavioral intention in their study on students' use of m-learning in higher education contexts.

> *H7*: Satisfaction has a significant impact on behavioral intention.

4 Research methodology

4.1 Research design

This research aimed to examine the factors that influence the behavioral intention of EFL learners to utilize MALL at two universities in Thailand. This study used a quantitative research methodology and selected a previous questionnaire as the research instrument. Following a three-step sampling procedure, the researcher employed SPSS 24 and Amos 27 for data analysis and hypothesis testing.

4.2 Sampling

The researchers distributed 600 questionnaires to full-time students at two universities in Bangkok, Thailand, of which 507 were deemed valid, with an 84.5% validity return rate.

This study employed a meticulous three-stage sampling method, including stratified, snowball, and judgmental sampling. In the stratified sampling stage, the researchers systematically obtained the total number of full-time students from the registration offices of the two involved universities. The researchers initially intended to collect 600 questionnaires, and by calculating the proportion of full-time students at the two universities, the researchers determined the number of questionnaires that needed to be distributed at each university. For the next stage, the researchers employed the snowball sampling method by distributing the questionnaires in the form of QR codes to acquaintances at the two universities in order to facilitate a more extensive distribution of the questionnaires. The last stage involved judgmental sampling, which entailed a careful selection procedure based on screening questions. The researcher ensured the questionnaire was only gathered from full-time students at the specified universities with at least one year of MALL experience. Finally, the researchers received 507 valid questionnaires, and to thank the participants for participating, the researchers expressed gratitude through a gift worth 20 baht.

The study gathered demographic data by acquiring three pieces of information from participants, encompassing gender, educational level, and previous experience with MALL. As shown in Table 1, the gender distribution revealed that male participants accounted for 53.65% ($n = 272$), while the female counterparts accounted for 46.35% ($n = 235$). In terms of educational level, the majority comprised undergraduates, encompassing 72.19% ($n = 366$), followed by master's degree candidates at 21.30% ($n = 108$) and doctoral degree candidates at 6.51% ($n = 33$). About the previous experience with MALL, 8.28% ($n = 42$) reported less than one year of experience, 36.88% ($n = 187$) reported one to three years, 41.81% ($n = 212$) reported three to five years, and 13.02% ($n = 66$) affirmed an experience over five years.

4.3 Questionnaire design

In this research, the questionnaire consisted of three main parts: screening questions, demographic questions, and scaling questions. The screening questions were applied to help the researchers determine the appropriateness of the participants, including asking whether they were full-time students and their experience with mobile-assisted language learning. Demographic questions were used to gather personal information, including gender, educational level, and experience with MALL. Last, the scaling questions contained eight factors, totaling 32 scale items. All scale items were on a five-point Likert scale, ranging from strongly disagree (1) to strongly agree (5). Also, all scale items were derived from the adaptation of previous

TABLE 1 Demographic information.

Demographic factors	Type	Frequency	Percentage
Gender	Male	272	53.65%
	Female	235	46.35%
Educational level	Bachelor	366	72.19%
	Master	108	21.30%
	Doctoral	33	6.51%
Experience	Less than one year	42	8.28%
	1–3 years	187	36.88%
	3–5 years	212	41.81%
	over five years	66	13.02%

literature questionnaires. The items for perceived usefulness and behavioral intention are from Buabeng-Andoh (2018), perceived ease of use is from Chang et al. (2012), social influence is from Garcia Botero et al. (2022), perceived enjoyment is from Alyoussef (2021), satisfaction and confirmation are from Faozi and Handayani (2023), and habit is from Voicu and Muntean (2023).

4.4 Pilot test

The pilot test serves as a preliminary evaluation to determine the feasibility and reliability of the study (Malmqvist et al., 2019). According to Kieser and Wassmer (1996), a sample size ranging from 30 to 40 individuals would be appropriate for conducting pilot research. Therefore, the researchers selected to include a sample of 35 full-time Thai EFL students from two universities in the pilot test. The Cronbach Alpha coefficients for the six factors examined in the pilot study were as follows: perceived usefulness (0.836), perceived ease of use (0.867), satisfaction (0.901), confirmation (0.822), perceived enjoyment (0.835), social influence (0.808), habit (0.855), and behavioral intention (0.834). All the Cronbach Alpha exhibited values greater than 0.8, indicating a high level of reliability for the questionnaire and affirming the feasibility of the study.

4.5 Data analysis

The study employed SPSS 24 software to conduct a descriptive analysis of demographic questions and reliability. After that, the Amos 27 software will be applied to perform a confirmatory factor analysis (CFA) to assess the research study's discriminant and convergent validity. Lastly, structural equation modeling (SEM) was used for hypothesis testing by using Amos 27 software.

5 Results

5.1 Measurement model

The reliability of this research was measured using Cronbach's alpha. Cronbach's alpha, a reliability coefficient used to measure internal consistency between items, is considered acceptable when its value exceeds 0.7 (Taber, 2018). As shown in Table 2, the study demonstrates adequate reliability and internal consistency, with Cronbach's alpha ranging from 0.821 to 0.878 across the dimensions.

The convergent validity was evaluated using three metrics: factor loadings, composite reliability (CR), and average variance extracted (AVE). According to Hair et al. (2010), factor loadings represent the correlation coefficients between latent and observed variables and are considered ideal when they exceed 0.7 and are statistically significant. Table 2 demonstrates that all the factor loadings are statistically significant and range from 0.712 to 0.917, indicating that the factor loadings in this study could be considered adequate. Composite reliability, akin to Cronbach's alpha, is a measure of internal consistency of dimensions, with an acceptable range typically falling between 0.7 and 0.95 (Hair et al., 2020). As shown in Table 2, the composite reliability ranged between 0.820 and 0.911, demonstrating sufficient internal consistency. An average variance extracted over 0.5 can indicate sufficient convergent validity (Fornell and Larcker, 1981). The convergent validity has been ensured as all dimensions in Table 2 exhibited AVE values that exceeded the threshold of 0.5.

To ensure adequate discriminant validity, the square root of the AVE must exceed all correlation coefficients between it and the other dimensions (Fornell and Larcker, 1981). According to Table 3, the discriminant validity was confirmed as the square root of the AVE for all dimensions exceeded the correlation coefficients with the other dimensions. The heterotrait-monotrait (HTMT) correlation ratio is another method for evaluating discriminant validity. According to Henseler et al. (2015), any coefficient beyond 0.9 in the HTMT table indicates a lack of discriminant validity. As shown in Table 4, the

TABLE 2 Reliability and convergent validity.

Construct	Items	Factor Loading	Alpha	CR	AVE
PE	PE1	0.741***	0.821	0.823	0.539
	PE2	0.711***			
	PE3	0.788***			
	PE4	0.692***			
PEOU	PEOU1	0.710***	0.825	0.827	0.544
	PEOU2	0.731***			
	PEOU3	0.721***			
	PEOU4	0.787***			
CON	CON1	0.761***	0.846	0.846	0.579
	CON2	0.768***			
	CON3	0.761***			
	CON4	0.752***			
SI	SI1	0.773***	0.878	0.879	0.646
	SI2	0.764***			
	SI3	0.833***			
	SI4	0.841***			
HA	HA1	0.902***	0.86	0.862	0.559
	HA2	0.652***			
	HA3	0.706***			
	HA4	0.770***			
	HA5	0.682***			
PU	PU1	0.745***	0.841	0.843	0.574
	PU2	0.797***			
	PU3	0.737***			
	PU4	0.750***			
SAT	SAT1	0.727***	0.836	0.837	0.563
	SAT2	0.795***			
	SAT3	0.745***			
	SAT4	0.732***			
BI	BI1	0.781***	0.824	0.826	0.612
	BI2	0.781***			
	BI3	0.785***			

***p <0.001.

discriminant validity of the study was established as all coefficients in the table are less than 0.9.

5.2 Structural model

Before conducting hypothesis testing, the researchers analyzed the goodness-of-fit for the structural model. Based on the results shown in Table 5, all the goodness-of-fit indices are above thresholds, which shows a strong match between the data and the proposed model. Therefore, the researchers can start hypothesis testing using this proposed model. Subsequently, the researchers conducted structural equation modeling (SEM) to examine all the research hypotheses. According to the results in Table 6, hypotheses H4b (the effect of society on satisfaction) was not supported, while the remaining 14 hypotheses were supported. The results of the structural model are presented in Figure 2.

The R-squared is a statistical measure that quantifies the proportion of variation in endogenous variables that can be accounted for by exogenous variables (Hair et al., 2013). As demonstrated in Figure 2, the R-square of behavioral intention is 0.773, indicating that all dimensions can explain 77.3% of behavioral intention. That is, the study's variables have a good explanation for the behavioral intention to use MALL. The R-squared values for the remaining dimensions are perceived usefulness (0.313) and satisfaction (0.356).

6 Conclusion and discussion

The advent and widespread adoption of mobile devices have presented novel opportunities and potential for the development of second language acquisition and foreign language learning (Sung et al., 2015). Due to its effectiveness, convenience, and entertainment features, Mobile Assisted Language Learning (MALL) is gradually gaining prominence as the preferred autonomous language learning approach among young individuals (Wu, 2015). In Thailand, English is spoken as a foreign language, and the English proficiency of Thai university students still needs to be improved (Tantiwich and Sinwongsuwat, 2021). Younger generation students increasingly rely on intelligent mobile devices and are initiating to employ such devices for educational purposes, particularly in language learning (Pikhart and Klímová, 2020; Salehan and Negahban, 2013).

By integrating and extending TAM and ECT, this study aims to investigate the factors influencing EFL learners' behavioral intention to use MALL at two universities in Bangkok, Thailand. A total of 507 valid samples were collected through a three-step sampling process. Following the utilization of CFA to assess the structural validity of the study, the researcher employed SEM to test all research hypotheses. The results revealed that all the hypotheses were supported except for the impact of social influence on behavioral intention.

In the current study, the explanatory level of all factors for the behavioral intention of Thai EFL learners to continuously use MALL was 77.3% (R-square = 0.773). All investigated factors exhibited a significant impact on the behavioral intention of Thai EFL learners to use MALL, with perceived enjoyment (PE) emerging as the most influential factor ($\beta = 0.5809$, $p < 0.05$). This finding is consistent with the conclusions of previous studies (Li et al., 2021, 2022; Al-Bashayreh et al., 2022). PE plays a crucial role in language learning because it increases learners' effectiveness and overall satisfaction (Zheng and Zhou, 2022). When learners enjoy the language-learning process, they are more likely to be actively involved and engaged in language learning (Mierzwa, 2019). Moreover, individuals who experience enjoyment from using mobile devices for language acquisition are inclined to engage actively with MALL, explore various language learning applications, and maintain their learning efforts over an extended period (An et al., 2021). Learning English can be an extremely challenging endeavor for Thai students, who must dedicate a significant amount of time and effort to improving their English competencies, making it difficult for many Thai students to keep learning English on their mobile devices. Currently, there is a growing trend in the development of MALL applications that prioritize user enjoyment and satisfaction. While learning English, learners have the opportunity to engage with various kinds of exciting videos and interactive games. Incorporating entertaining features like gamification is exciting to young MALL users, and the level of enjoyment derived from their experiences plays a crucial role in determining their intention to use MALL (Shortt et al., 2023).

Perceived usefulness (PU), a crucial factor in TAM and ECM research, is identified as one of the most significant variables that can impact the behavioral intention of Thai EFL learners to adopt MALL in the present study ($\beta = 0.3597$, $p < 0.05$). This finding is consistent with the conclusions of previous studies (Kim and Lee, 2016; Hoi and Mu, 2021; Fan, 2023). PU has been consistently demonstrated as one of the critical variables within information systems research, exerting significant influence on individuals' behavioral intentions (Saeed and

TABLE 3 Fornell-Larcker criterion.

	PE	PEOU	CON	SI	HA	PU	SAT	BI
PE	**0.734**							
PEOU	0.349	**0.737**						
CON	0.175	0.115	**0.761**					
SI	0.244	0.142	0.174	**0.804**				
HA	0.339	0.228	0.199	0.218	**0.748**			
PU	0.372	0.251	0.400	0.352	0.298	**0.758**		
SAT	0.395	0.292	0.329	0.260	0.282	0.508	**0.750**	
BI	0.654	0.415	0.279	0.394	0.500	0.629	0.594	**0.782**

Bold text represents the square root of the average variance extracted.

TABLE 4 HTMT.

	SAT	BI	PU	PE	PEOU	CON	SI	HA
SAT								
BI	0.714							
PU	0.601	0.750						
PE	0.474	0.792	0.442					
PEOU	0.351	0.502	0.301	0.425				
CON	0.391	0.334	0.474	0.210	0.139			
SI	0.303	0.464	0.408	0.290	0.169	0.200		
HA	0.332	0.594	0.349	0.404	0.268	0.233	0.252	

TABLE 5 Goodness of fit indices.

Index	Acceptable Value	Measurement Values	Result
CMIN/DF	< 3.00 (Awang, 2012)	1.776	Acceptable fit
GFI	≥0.80 (Sica and Ghisi, 2007)	0.907	Acceptable fit
AGFI	≥0.80 (Sica and Ghisi, 2007)	0.891	Acceptable fit
CFI	≥0.90 (Byrne, 1994)	0.955	Acceptable fit
NFI	≥0.90 (Byrne, 1994)	0.904	Acceptable fit
TLI	≥0.90 (Byrne, 1994)	0.951	Acceptable fit
RMSEA	<0.05 (Byrne, 1994)	0.039	Acceptable fit

Abdinnour-Helm, 2008). In language learning, individuals who perceive MALL as beneficial for enhancing their language learning proficiency are more inclined to use it (Aratusa et al., 2022). Language learners will only adopt or utilize MALL in the long term if they believe that MALL can enhance their learning efficiency and outcomes (Soleimani et al., 2014).

Habit (HA), as an external variable in this study, is a critical factor affecting language learning. In this research, HA can significantly influence Thai EFL learners' behavioral intention to continuously use MALL ($\beta = 0.2596$, $p < 0.05$). This finding is consistent with previous results in the literature (Soria-Barreto et al., 2021; Alhadiah, 2023). HA plays a critical role in both language learning and mobile learning (Yoo and Cho, 2020). Several studies have demonstrated that HA can determine whether learners are able to adopt language learning (Bailey and Onwuegbuzie, 2002; Chiang, 2016) and m-learning (Wu and Perng, 2016; Nikolopoulou et al., 2021) consistently and effectively, which in turn affects their language learning outcomes. HA can impact learners' active involvement, persistence, and effectiveness in consistently and proficiently employing MALL (Isbell et al., 2017).

Satisfaction (SAT), a critical factor in ECT, is often used to predict users' behavioral intentions. The findings of this research indicate that the level of satisfaction among Thai EFL learners about the use of MALL significantly influences their behavioral intention ($\beta = 0.2344$, $p < 0.05$). This finding is consistent with the results of a substantial number of previous studies (Chao, 2019; Al-Hamad et al., 2021; Alshurideh et al., 2023). In language learning, a high level of satisfaction fosters active involvement and perseverance among learners, boosting their learning achievements and outcomes (Chiu, 2022). If language learners are satisfied with MALL, they are more likely to keep a positive learning attitude and motivation, thus leading to their ongoing utilization of MALL (Habib et al., 2022).

Perceived ease of use (PEOU), another vital factor in TAM, is considered to be able to impact perceived usefulness and behavioral intention. The current study found that the PEOU of the MALL had a significant impact on Thai EFL learners' intention to utilize the MALL ($\beta = 0.1036$, $p < 0.05$). It is consistent with a great number of findings from previous studies (Hsu and Lin, 2021; Ebadi and Raygan, 2023). Language learners tend to prefer MALL apps characterized by simple interface design, efficient functionality, and enhanced interactive experiences, as these attributes help them save much time in adapting to the MALL (Viberg and Grönlund, 2012).

Lastly, social influence (SI), a crucial factor influencing behavioral intention in the unified theory of acceptance and use of technology (UTAUT), is an external variable in this study. In this research, SI can significantly influence Thai EFL learners' behavioral intention to use MALL ($\beta = 0.1024$, $p < 0.05$). This is consistent with the findings of a number of previous studies (Alyoussef, 2021; Garcia Botero et al., 2022). Language learners' attitudes and motivation positively correlate with the social recognition of language learning as a significant pursuit, thereby influencing their eagerness to develop proficiency in the target language (Dörnyei, 2003).

The explanatory level of the remaining factors in this study for the satisfaction of Thai EFL learners in using MALL was 35.6% (R-square = 0.356). Among all the factors, perceived usefulness was the most influential factor, and a great number of studies also confirmed this finding (Al-Sharafi et al., 2021; Jiang et al., 2022). On the other hand, social influence was found unable to significantly influence satisfaction, which is also consistent with Huang et al. (2023). The remaining factors all had a significant effect on satisfaction, which were perceived enjoyment ($\beta = 0.2445$, $p < 0.05$), confirmation ($\beta = 0.1355$, $p < 0.05$), and perceived ease of use ($\beta = 0.1262$, $p < 0.05$).

In this study, the explanatory level of the factors for the perceived usefulness of MALL by Thai EFL learners was 31.3% (R-square = 0.313). Among all factors, confirmation could most significantly influence perceived usefulness ($\beta = 0.3209$, $p < 0.05$), which is also consistent with the findings of previous studies (Alhumaid, 2021; Meng and Li, 2023). The remaining factors all significantly influenced perceived usefulness, which were social influence ($\beta = 0.1923$, $p < 0.05$), perceived enjoyment ($\beta = 0.2884$, $p < 0.05$), habits ($\beta = 0.1370$, $p < 0.05$), and perceived ease of use ($\beta = 0.1036$, $p < 0.05$).

TABLE 6 Hypothesis testing.

	Path	Estimate	S. E.	*t* value	*p*	Conclusion
H1a	PU → BI	0.3597	0.0543	6.6209	***	Supported
H1b	PU → SAT	0.3797	0.0657	5.7841	***	Supported
H2a	PEOU → PU	0.1036	0.0428	2.4235	0.0154	Supported
H2b	PEOU → SAT	0.1262	0.0431	2.9261	0.0034	Supported
H2c	PEOU → BI	0.1484	0.0352	4.2164	***	Supported
H3a	PE → PU	0.2884	0.0571	5.0528	***	Supported
H3b	PE → SAT	0.2445	0.0592	4.1312	***	Supported
H3c	PE → BI	0.5809	0.0593	9.7878	***	Supported
H4a	SI → PU	0.1923	0.0341	5.6424	***	Supported
H4b	SI → SAT	0.0338	0.0347	0.9751	0.3295	Not Supported
H4c	SI → BI	0.1024	0.0276	3.7145	***	Supported
H5a	HA → PU	0.1370	0.0411	3.3296	***	Supported
H5b	HA → BI	0.2596	0.0353	7.3458	***	Supported
H6a	CON → PU	0.3209	0.0450	7.1292	***	Supported
H6b	CON → SAT	0.1355	0.0467	2.8991	0.0034	Supported
H7	SAT → BI	0.2344	0.0518	4.5222	***	Supported

***p <0.001.

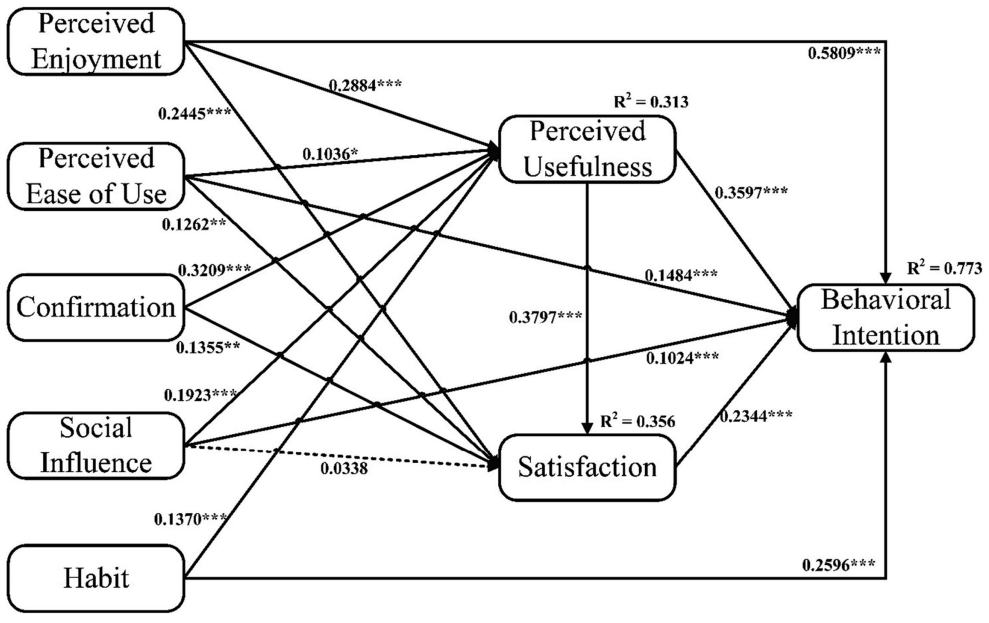

FIGURE 2
Structural model results.

7 Implications

7.1 Theoretical implications

This research introduces an integrated and extended TAM and ECM model that incorporates perceived enjoyment, social influence, and habits as external factors to explore the factors that influence behavioral intention to use MALL among university students in Thailand. Numerous research studies have used the TAM and ECT to forecast behavioral intentions related to e-learning, online learning, or m-learning. However, there is limited research that integrated TAM and ECT to explore behavioral intentions to use MALL, especially in the Thai cultural context.

Therefore, this study not only expands the theoretical understanding of technology adoption in the context of MALLs but also provides a more comprehensive framework for exploring the factors influencing MALL use intention among Thai university students.

7.2 Practical implications

The influential impact of perceived enjoyment on behavioral intention demonstrates the importance of substituting enjoyable elements into language learning. EFL learners always face many challenges while learning English, including remembering wide-ranging vocabulary and grammatical rules and improving the four basic language skills (listening, speaking, reading, and writing). Many EFL learners discontinue using MALL because they find English too tricky and lose interest. Most young language learners perceive MALL as an enjoyable experience, contributing to their persistence and commitment to language learning. Therefore, it is important for educators to focus on the fun aspect of learning content in language teaching so that learners can be motivated to learn a foreign language more efficiently and for a more extended period. For MALL developers and providers, it is essential to design language learning apps that provide a more enjoyable and immersive learning experience for learners. The frequent utilization of MALL by EFL learners is more likely to occur when they are exposed to engaging games and exciting videos in their English learning progress.

Perceived usefulness also holds a considerable influence on the behavioral intention of language learners toward MALL. Learners who recognize the potential of MALL to improve language learning's efficacy and performance are more likely to be motivated and inclined to accept it as a means of language learning. Educators should emphasize the functions and advantages of MALLs in language learning to encourage learners to incorporate MALLs into their language learning. MALL developers and providers should focus more on developing functions that can improve learners' foreign language ability efficiently to gain more advantages in the market competition.

Apart from perceived enjoyment and perceived usefulness, the other factors investigated in this research also revealed significant effects on the behavioral intention of Thai EFL learners to use MALL. These discoveries have the potential to provide valuable insights for researchers, educators, and developers to improve the effectiveness of MALL in promoting language learning outcomes.

8 Limitations and future research

The current research only obtained data from a sample of 507 university students enrolled at two universities in Bangkok, Thailand. It is important to point out that the findings of this study may not be fully representative of the overall population of Thai EFL learners. Hence, a broader and more diversified sample might provide a more exhaustive comprehension of the factors that impact the behavioral inclination of EFL learners toward using MALL.

Moreover, this research's findings may only apply to EFL learners in Thai educational settings. The Thai education system has a comparatively higher degree of flexibility and tolerance than many other Asian countries, with a greater emphasis on fostering enjoyable educational experiences for students. Therefore, the researchers encourage future studies to be conducted in other countries using the extended TAM model.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Stamford International University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

LP: Formal analysis, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. YY: Conceptualization, Project administration, Resources, Supervision, Writing – review & editing. XL: Data curation, Investigation, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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