Understanding Higher Education Learners' Acceptance and Use of Mobile Devices in Language Learning: A Rasch-based Path Modeling Approach

Abstract

The widespread use of mobile devices and the wider coverage of wireless networks offer the educational sectors various alternatives in enhancing learning and teaching. Mobile assisted language learning (MALL) emerges from this trend and draws traction from relevant stakeholders. While much research has been done on the application of mobile technologies in promoting language learning, and the educational practices that foster that learning approach, relatively little empirical evidence has been given to understand the acceptance and use of MALL by higher education learners, particularly in the context of a developing country. This study sought to fill this gap by applying the modified version of the Unified Theory of Acceptance and Use of Technology (UTAUT). Survey data from 293 higher education learners from Vietnam were analyzed by the Rasch-based path model. Results indicated the important roles of attitude and performance expectancy in predicting learners' behavior intention and their actual use of MALL. Facilitating condition was found to have no direct effect on learners' actual use of MALL, representing a departure from the literature. The findings offered implications regarding the use of the UTAUT as an appropriate model for examining MALL acceptance, the improvement of technical and organizational supports, as well as the development of instructional approaches that foster the use of MALL, particularly in the context of a developing country like Vietnam.

Key words: Mobile learning, Teaching/learning strategies, Applications in subject areas, Pedagogical issues, Post-secondary education

1. Introduction

Mobile technologies have infiltrated deeply into the life and work of people, evidenced by the incessant expanding of the mobile industry, the increasing rate of personal ownership, and the wider accessibility to mobile-cellular network in both developed and developing countries (Hao, Dennen, & Mei, 2017; Kaliisa, Palmer, & Miller, 2019). It was estimated that 95% of the world's population had access to mobile-cellular networks in 2015 (Kaliisa et al., 2019), and the number of new mobile subscribers would reach 5.9 billion by 2025, more than 70% of the world's population (GSMA, 2016). In addition, innovative features of mobile technologies such as email, instant messaging, internet access, audio/video recording, and picture capturing are constantly incorporated into subsequent generations of mobile devices, thus leveraging their ubiquity and blurring the boundaries between everyday life, work, entertainment, and learning (Kukulska-Hulme, 2013; Wu et al., 2012).

Against the backdrop of mobile innovations, the educational affordances of mobile devices have prompted practitioners, educators and researchers to develop numerous educational applications and pedagogical practices that promote teaching and learning in various scenarios, including collaborative learning (Hine, Rentoul, & Specht, 2004), independent learning (Bull & Reid, 2004), and lifelong learning (Attewell & Savill-Smith, 2004). The educational advantages of mobile devices have been discussed extensively in the literature, such as they bridge the gap between formal and informal learning (Kolb, 2006; Wagner & Wilson, 2005), extend learning beyond the traditional classroom (Wu, 2016), enhance teacher and peer interaction (Abdous, Camarena, & Facer, 2009; Wu, 2014), and enable easy access to learning resources (Kaliisa et al., 2019). In the context of second/foreign language learning, students enjoy these advantages in an educational approach referred to as mobile assisted language learning (MALL).

Mobile assisted language learning is defined as "the use of smart phones and other mobile technologies in language learning, especially in situations where portability and situated learning offer specific advantages" (Kukulska-Hulme, 2013, p.1). According to Loewen et al. (2019), definition of MALL may vary but key unique features remain consistent, namely flexibility, continuity, accessibility, and adaptability. Specifically, mobile devices enable learners to learn languages flexibly at a time and place convenient to them, to transfer language learning across different mobile devices and learning platforms, to access information easily, and to adapt to their personal learning habits. In addition to its portability and mobility, mobile devices also facilitate language learning via different engagement modes, such as web browsers and mobile applications, and different categories of support, such as built-in learning materials or mobile-assisted activities (Reinders & Pegrum, 2017).

Coupled with the growing number of mobile applications for language learning (see, Godwin-Jones, 2011 for a review of these mobile apps) is a surge of research studies on the effectiveness of MALL both inside and beyond the classroom. Generally, research findings pointed to the effectiveness of MALL for vocabulary learning (Motallebzadeh, Beh-Afarin, & Daliry Rad, 2011; Motallebzadeh & Ganjali, 2011; Saran, Seferoglu, & Cagiltay, 2012), reading comprehension (Chen & Hsu, 2008; Lin, 2014; Wu, Sung, Huang, Yang, & Yang, 2011; Zurita & Nussbaum, 2004a, 2004b), listening and speaking (Liu, 2009; Papadima-Sophocleous, Georgiadou, & Mallouris, 2012; Robertson, 2009), and grammar (Li & Hegelheimer, 2013).

MALL is not without limitations, however. Small screen size, low display resolution, limited memory, slow speed (Hayati, Jalilifar, & Mashhadi, 2013; Li & Hegelheimer, 2013), and typing difficulties (Chang, Lee, Chao, Wang, & Chen, 2010; Li & Hegelheimer, 2013) may undermine students' learning experience, and affect their learning outcomes. In addition, not all educational

contexts achieve successes in mobile learning integration, nor do they all show willingness for mobile learning applications (Ramli, Ismail, & Idrus, 2010; Stockwell, 2010). Stockwell (2010), for example, found that Japanese students' usage of mobile phones for English vocabulary learning remained quite low over a three year period, which could be explained by their perception of the low utility of mobile phones as compared with other educational platforms. In a similar vein, although Malaysia possesses a mobile phone penetration rate of more than 100%, Ramli et al. (2010) found that learners in their study had problems with learning transfer, primarily because they did not perceive mobile phone to be useful. In a study on learners' attitude toward MALL, Hsu (2013) reported that students with different nationalities held different attitudes toward MALL due in part to their cultural and educational values. Factors that negatively affected their attitude toward MALL included the teacher-centered educational approach they had been familiar with, their habit of using mobile devices for entertainment and communication rather than as an educational tool, and the difficulty with which mobile devices could be used for language learning.

Whilst the technical limitations of mobile learning, as discussed above, can be improved by newer generations of mobile devices (Godwin-Jones, 2011), other mental aspects, such as learners' attitude and intention, must be explored prior to the application of MALL in specific contexts. Lai and Zheng (2018) argued that as learners were placed at the heart of mobile learning rather than the mobility of the technology, an informed understanding of their perception and preferred use of mobile learning was critical to the successful application of such an educational platform. It follows that equipping learners with mobile devices and readily accessible wireless networks may not necessarily lead to the adoption of MALL, and subsequently to learning gain. Without a positive attitude toward the use of mobile devices in

language learning as well as a critical awareness of the educational affordances and the effectiveness of MALL, learners may be reluctant, and ultimately resistant to that learning approach. Given the limited studies on the factors that affect the acceptance and use of MALL in the literature, and even fewer studies conducted in the context of a developing country such as Vietnam, this study sets out to explore the salient factors and their relationships that govern the attitude toward and the intention to use MALL by Vietnamese higher education learners. The Unified Theory of Acceptance and Use of Technology (UTAUT, Venkatesh, Morris, Davis, & Davis, 2003) was employed as a point of departure to inform the research model and data analysis.

2. Literature review

In order to promote the use of technology innovations, potential users must first be made aware of the technology and accept it (Teo, Doleck, Bazelais, & Lemay, 2019). Understanding the various factors that affect the acceptance of technology is at the heart of technology adoption research (Marangunić & Granić, 2015; Teo et al., 2019; Williams, Rana, & Dwivedi, 2015), and helps to inform relevant stakeholders' decision making process (Teo et al., 2019). Numerous explanatory frameworks have been proposed and utilized over the years to model the relationship between technology acceptance and its determinants. These include, but are not limited to, the Theory of Reasoned Action (TRA, Ajzen & Fishbein, 1980), the Theory of Planned Behavior (TPB, Ajzen, 1991), the Technology Acceptance Model (TAM, Davis, 1989), the Decomposed Theory of Planned Behavior (DTPB, Taylor & Todd, 1995b), the combined model of TAM and TPB (C-TAM-TPB, Taylor & Todd, 1995a), the Motivational Model (MM, Davis, Bagozzi, & Warshaw, 1992) the Model of PC Utilization (MPCU, Triandis, 1977), the Innovation Diffusion Theory (IDT, Rogers, 1995), and the Social Cognitive Theory (SCT, Bandura, 1986).

Although the generous alternatives offer researchers flexibility in model selection given a specific context or research problem, the important constructs unique to each model may be ignored, thus attenuating the explanatory power of each parsimonious model (Dwivedi, Rana, Jeyaraj, Clement, & Williams, 2019; King & He, 2006; Sun & Zhang, 2006). Cognizant of this, Venkatesh et al. (2003) thoroughly reviewed and integrated eight different acceptance models, including the TRA, TPB, TAM, MM, MPCU, C-TAM-TPB, SCT, and IDT into the Unified Theory of Acceptance and Use of Technology (UTAUT). Generally, the UTAUT posits that the behavioral intention to use a specific technology and the use behavior can be directly determined by four core constructs of performance expectancy, effort expectancy, social influence and facilitating condition. These constructs are, in turn, moderated by age, gender, experience and voluntariness. Since its inception, the UTAUT model has been used widely to examine technology acceptance in education across different learning platforms, such as the use of websites (Tan, 2013; Van Schaik, 2009), podcast (Lin, Zimmer, & Lee, 2013), wikis and blogs (Avci & Askar, 2012; Yueh, Huang, & Chang, 2015), interactive whiteboard (Šumak & Šorgo, 2016; Tosuntaş, Karadağ, & Orhan, 2015), mobile learning (Abu-Al-Aish & Love 2013; Kallaya, Prasong, & Kittima, 2009; Thomas, Singh, & Gaffar, 2013), and mobile-assisted language learning (Botero, Questier, Cincinnato, He, & Zhu, 2019).

Although the UTAUT has proved to be a useful model for examining technology acceptance, only a few studies actually explored the entire original model by Venkatesh et al. (2003), with all its constructs, moderating variables and hypothesized relationships. Based on a comprehensive review of the UTAUT model and relevant empirical research studies, Dwivedi et al. (2019) proposed a modified UTAUT model to keep abreast of the current research trend. In addition to the original constructs and the hypothesized relationships thereof, the modified UTAUT model

introduces an additional individual construct, namely the learners' attitude. Attitude is considered by Dwivedi et al. (2019) as an important missing piece from the UTAUT since theoretical and empirical evidence attested to its significant role in explaining technology acceptance. Furthermore, all moderating variables in the original model are dropped because Dwivedi et al. (2019) believed that the effect of moderating variables depended largely on the specific contexts under investigation. The modified UTAUT also proposes a direct relationship between facilitating condition and behavioral intention as suggested by empirical research findings. The next section delineates each of the constructs and the hypothesized relationships thereof to examine the acceptance of MALL by Vietnamese students in the present study.

3. Research model and hypotheses

This study sought to understand the acceptance of MALL by Vietnamese learners by modeling the relationships among the modified UTAUT constructs. Figure 1 depicts the research model with relevant constructs and their hypothesized relationships. Further explanations follow.

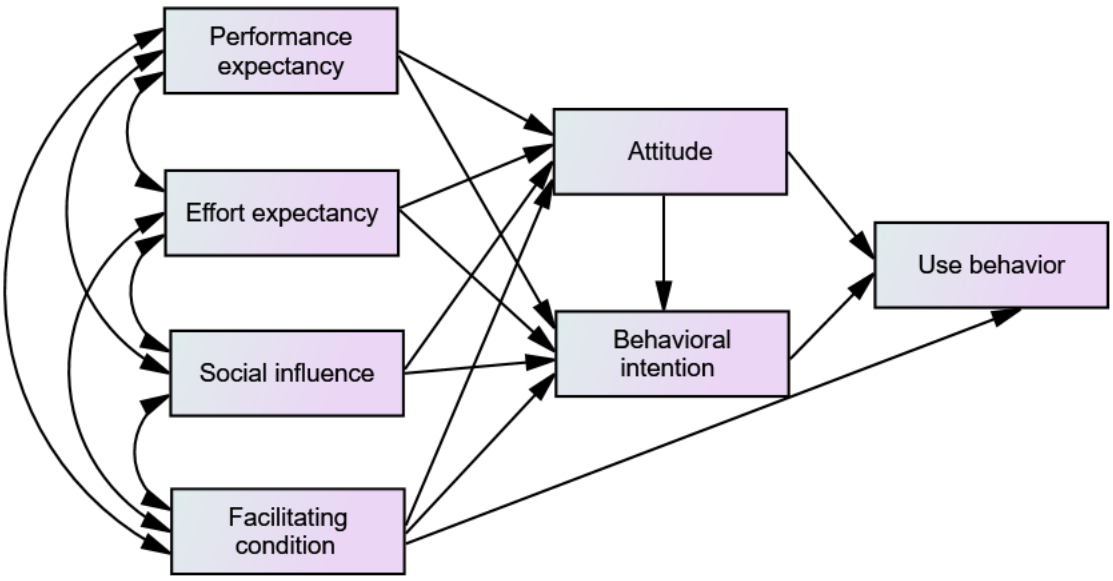


Figure 1: Proposed research model

3.1. Performance expectancy

Performance expectancy refers to the extent to which an individual believes that their job performance can be enhanced by the new system or technology (Venkatesh et al., 2003). In the context of MALL, it refers to the belief held by language learners that mobile devices promote language performance and learning gain. Performance expectancy is employed as perceived usefulness in TAM/TAM2 and C-TAM-TPB, extrinsic motivation in MM, job-fit in MPCU, relative advantage in IDT, and outcome expectation in SCT. Performance expectancy was the most powerful predictor of intention in the literature (Botero et al., 2019; Chan, Chi, Chin, & Lin, 2011; Hao et al., 2017; Venkatesh et al., 2003), and an important component in technology acceptance in educational contexts (Lin et al., 2013; Moran, Hawkes, & El Gayar, 2010; Tan, 2013). Therefore, the following hypothesis was adopted:

H1 Performance expectancy has a positive significant effect on behavioral intention to use MALL

3.2. Effort expectancy

Effort expectancy is defined as the degree of ease with which the new system or technology can be utilized. For MALL learners, it is associated with their belief of how easy and convenient it is to use mobile devices for language learning. Effort expectancy is likened to perceived ease of use in TAM/TAM2, complexity in MPCU and ease of use in IDT. Venkatesh et al. (2003) suggested that effort expectancy was a significant predictor only during early stages of usage, but its role became diminished over time. Effort expectancy was found to have positive impact in Sabah (2016), Hao et al. (2017), Chavoshi and Hamidi (2019) and Almaiah, Jalil, and Man (2016), but negative impact in Milošević, Živković, Manasijević, and Nikolić (2015) on the intention to use

m-learning. In a MALL study, Botero et al. (2019) found no effect of effort expectancy on attitude and behavioral intention. These mixed findings appeal to more empirical studies to better understand the role of effort expectancy in MALL adoption (Botero et al., 2019). Therefore, the following hypothesis was formulated:

H2 Effort expectancy has a positive significant effect on behavioral intention to use MALL

3.3. Social influence

Social influence is defined as the extent to which individuals' intention to use the new system or technology is influenced by important others. In the context of MALL, learners' intention to use mobile devices for language learning may be influenced by other important individuals, such as peers, teachers, or family. Social influence is used as subjective norm in TRA, TAM/TAM2, TPB/DTPB, and C-TAM-TPB, and image in IDT. Social influence played an important role in explaining behavioral intention in Briz-Ponce, Pereira, Carvalho, Juanes-Méndez, and García-Peñalvo (2017), Sabah (2016), Hao et al. (2017), Yeap, Ramayah, and Soto-Acosta (2016) and Botero et al. (2019), and even the most important antecedent to the intention to use m-learning in Mohammadi (2015). Therefore, the following hypothesis was proposed for the current study:

H3 Social influence has a positive significant effect on behavioral intention to use MALL

3.4. Facilitating condition

Facilitating condition refers to an individual's belief that the use of a new system or technology can be supported by the available organizational and technical facilities. This is transferred to the MALL environment as the technical and organizational support available for learners' use of mobile devices for language learning, such as access to wireless networks, provision of mobile devices and technical assistance when needed. Facilitating condition is positioned in other

models as perceived behavioral control (TPB/DTPB, C-TAM-TPB), facilitating condition (MPCU), and compatibility (IDT). Venkatesh et al. (2003) found that facilitating condition was predictive of intention only if effort expectancy was excluded from the model. This argument found no support in later studies (Botero et al., 2019; Duyck et al., 2010; Dwivedi et al., 2019; Hao et al., 2017). Therefore, Dwivedi et al. (2019) proposed that facilitating condition significantly predicted behavioral intention, even in the presence of effort expectancy. Facilitating condition was also theorized and found to have positive effect on the use behavior (Moran et al., 2010; Tan, 2013; Venkatesh et al., 2003). The following hypotheses were proposed accordingly,

H4 Facilitating condition has a positive significant effect on behavioral intention to use MALL

H5 Facilitating condition has a positive significant effect on the use behavior of MALL

3.5. Attitude

Within the context of technology acceptance research, attitude is defined as an individual's overall affective reaction toward the use of a new technology (Venkatesh et al., 2003). In the present study, attitude concerns the extent to which students have the ambition to use mobile devices for language learning (Ardies, De Maeyer, Gijbels, & van Keulen, 2015). Attitude was not modeled in the original UTAUT. This, in fact, represented a departure from earlier theories and models of information technology acceptance such as TRA, TPB, DTPB, and TAM (Dwivedi et al., 2019). Empirical findings in later studies were also suggestive of the decisive role of attitude in technology acceptance. Attitude was theorized and found to have direct effect on behavioral intention (Ajzen, 1991; Davis, 1989; Dwivedi et al., 2017), and was also found to

mediate the effect of performance expectancy, effort expectancy, social influence and facilitating condition on behavioral intention and the use behavior (Dwivedi et al., 2019). Therefore, the following hypotheses were formulated:

H6 Performance expectancy has a positive significant effect on the attitude toward MALL

H7 Effort expectancy has a positive significant effect on the attitude toward MALL

H8 Social influence has a positive significant effect on the attitude toward MALL

H9 Facilitating condition has a positive significant effect on the attitude toward MALL

H10 Attitude significantly mediates the effect of performance expectancy, effort expectancy, social influence, and facilitating condition on behavioral intention to use MALL

H11 Attitude has a positive significant effect on the use behavior of MALL

3.6. Behavioral intention

Behavioral intention was hypothesized to have a positive significant effect on technology usage in most of the technology acceptance models. Therefore, it was hypothesized in the current study that:

H12 Behavioral intention has a positive significant effect on the use behavior of MALL

3.7. Use behavior

Use behavior was rarely included in previous UTAUT studies due to a lack of consensus upon how the construct should be measured (Botero et al., 2019). Generally, objective and subjective measures can be undertaken (Agudo-Peregrina, Hernández-García, & Pascual-Miguel, 2014). The former involves the recording of real-time usage of the technology/system, such as data

from system logs, number of logins, and number of system interactions. The latter, by contrast, refers to users' self-reported usage of technology, which may be subject to response bias. Given that the use of mobile devices for language learning may happen in the classroom as well as in the students' personal learning domains where access to real-time data is limited, the current study measured the use behavior by students' self-reported usage of mobile devices for language learning.

The next section expounds on the study's research methods and data analytic procedure.

4. Materials and Methods

4.1. Instrument

An Acceptance and Use of Mobile Assisted Language Learning Questionnaire comprising seven scales (see Appendix A) was developed to examine Vietnamese learners' behavioral intention to use and their usage of MALL within a modified UTAUT model. The questionnaire was composed of two parts: a demographic information section and the main part where participants showed their degree of agreement with the statements by their endorsement of the 6-point Likert scale items (strongly disagree, disagree, slightly disagree, slightly agree, agree, and strongly agree). The seven scales were relevant to the seven core constructs specified in the modified UTAUT model, including performance expectancy, effort expectancy, social influence, facilitating conditions, attitude, behavioral intention, and use behavior. The questionnaire items were primarily adapted from previous studies that examined the acceptance of mobile learning in general and MALL in various educational contexts (Botero et al., 2019; Chang, Yan, & Tseng, 2012; Chavoshi & Hamidi, 2019; Lai, Li, & Wang, 2017), with minor modifications to suit the specific context of Vietnamese education. Given the varied levels of English proficiency of the

participants, all the items were translated into Vietnamese by two translation experts who have PhDs in applied linguistics and TESOL. The complete questionnaire was then piloted with a group of nine undergraduate students at a university in central Vietnam who provided comments on the wording, clarity, and comprehensibility of the items. Several items were then reworded in light of their comments.

The performance expectancy scale, including five items (e.g., Using mobile devices helps maintain and enhance my motivation and interest in language learning), examined participants' belief about the usefulness of mobile devices in promoting language learning. The effort expectancy scale, with seven items (e.g., Using mobile devices to learn a foreign language is easy for me) assessed participants' belief about the ease with which mobile devices could be used to learn a foreign language. The effect of other important individuals on participants' intention to use MALL was measured by the social influence scale which comprised four items (e.g., My friends' recommendation influences my decision to use mobile devices for language learning). Six items in the facilitating condition scale (e.g., I can get technical support if I have problems learning foreign languages on mobile devices) represented participants' belief that their use of mobile devices for language learning could be assisted by organizational and technical infrastructure. The attitude scale, consisting of five items (e.g., Using mobile devices for language learning in the classroom is a good idea), captured participants' attitude toward the use of mobile devices in language learning. The participants' intention to use mobile devices for language learning was measured by the behavioral intention scale with four items (e.g., I intend to use/ continue to use mobile devices for language learning). Finally, following Lai and Zheng (2018) and Yueh et al. (2015), participants' usage of mobile devices to learn a foreign language was measured by their indication of the average amount of time (hours per week) they use

mobile devices for language learning. In addition, an open-ended item was included that required participants to indicate the mobile applications and associated learning activities that they usually used to learn a foreign language either in the classroom or in their personal learning domains. The purpose for the inclusion of this item was twofold: to encourage participants to reflect on their language learning experience with mobile devices, which in turn helps leverage the accuracy of their self-reported usage of MALL, and to gain a better understanding of students' usage of MALL. Results related to this item are briefly discussed in section 4.2.

4.2. Participants

The questionnaire was distributed online to undergraduate and postgraduate students who were learning foreign languages as part of their programs at three universities in Vietnam. A link to the online questionnaire, consent information package, and response instruction was sent to the relevant faculties' Facebook pages with approval from the page administrators. It was confirmed by the administrators that the Facebook groups were created as an academic space for students who were learning foreign languages at the relevant faculties. Only those who had their student identity verified were admitted to the groups, thus it is fair to assume that the distribution of the questionnaire via the Facebook groups maximizes the possibility that the questionnaires reach the targeted participants. It was indicated in the consent information package that participants showed their consent to participate in the study by completing and submitting the questionnaires. The questionnaire was made public for a period of one month, after which responses were collected and processed.

A total of two hundred and ninety three complete responses were returned, which constituted the main data set for further analysis. The sample consisted of 70% undergraduate students (N = 205) and 30% postgraduate students (N = 88), all were English as a foreign language learners.

They were aged between 17 and 31 (M = 21.26, SD = 1.62), 90.4% were female (N = 265) and 9.6% were male (N = 28). 48.1% students (N = 141) self-reported their English proficiency as advanced, 45.1% as intermediate (N = 132) and 6.8% as elementary (N = 20).

All students reported to have used smart phones or tablets to learn English, either in formal settings or beyond-classroom contexts. YouTube and TFLAT (an English-Vietnamese dictionary app) are the two most popular mobile applications reported by the study participants. Regular learning activities associated with these applications include checking vocabulary, watching English movies, listening to English songs, and learning English via YouTube channels. Other common mobile applications employed by the participants are Google Translate, Facebook, Radio apps, News apps, and Grammar apps.

4.3. Data analysis

Questionnaire with Likert-type scales has been used as the primary instrument for data collection in previous studies on technology acceptance. The raw scores derived from the survey responses were then computed into statistical software for further analyses based on classical test theory (CTT), such as structural equation modeling (SEM). Generally, a two-step approach to modeling the UTAUT constructs was adopted: a measurement model in which the relationship between each UTAUT latent construct and their observed indicators (scale items) was established in a confirmatory factor analysis; and a structural model in which the hypothesized relationships among the UTAUT latent constructs were examined.

From a measurement perspective, however, the use of these CTT-based methods to analyze Likert-type scale survey data is constrained by several limitations. First, they draw on the sample statistics to estimate scale properties (e.g., item-total correlation, Cronbach's alpha), the derived

values of which vary depending on the specific samples used. This renders the scale properties sample-dependent and limits the generalizability of the research findings (Embretson & Reise, 2000; Fan, 2016; Fan & Bond, 2014; Oon, Spencer, & Chester, 2017; Oon & Subramaniam, 2011). Second, analytic methods informed by classical test theory assume that data obtained are interval in nature. In other words, data derived from survey responses are treated as if each data point/response category has an equal interval on the same linear scale and equal value across items. This is a misleading assumption because raw data from Likert-type survey scale are ordinal in nature, representing only ordering without any proportional levels of meaning (Bond & Fox, 2015; Wright, 1997; Yan & Cheng, 2015). As aptly pointed out by Boone (2016), a respondent's endorsement of a "strongly agree" on an item only indicates more agreement than an "agree" on the same item, but by an unquantified degree. Likewise, as items have different levels of difficulty/endorsibility, a rating of "agree" on an item does not necessarily carry the same value or meaning across others. By "disregarding the subjective nature of the (survey scale) data" and "making unwarranted assumptions about their meaning", the use of classical test theory principles in analyzing Likert-type scale data is "counterintuitive and mathematically inappropriate" (Bond & Fox, 2007, p.101).

Rasch measurement, underpinned by item response theory, can overcome these limitations by using raw scores from Likert-type scale data to compute the linear person and item measures. Put it differently, Rasch analysis applies mathematical principles and measurement theories (Boone, 2016) to convert the ordinal-level data from survey scales into interval-level data with constant interval meaning for objective measurement (Linacre, 2019; Yan & Cheng, 2015). The fit of the data to the expectations of the Rasch model allows the calibration of the person measures and

item measures, which are now mutually independent, onto the same unidimensional linear interval scale, thus enabling the direct comparisons of their relative standings.

Since all scale items in the study questionnaire were designed on the same six-point Likert scale, the Rasch-Andrich Rating Scale Model (Andrich, 1978) emerged as the most appropriate statistical approach. WINSTEP Rasch version 4.4.4 (Linacre, 2019) was performed to examine the quality of the items and the adequacy of the response categories. Item quality was evaluated on the basis of essential quality-control criteria, including item fit, item reliability, item separation and the point-measure correlation (PTMEA). Item fit refers to the extent to which the scale items conform to the expectations of the Rasch model. Two item fit indexes are normally used, infit mean-square (MNSQ) and outfit mean-square (MNSQ). Infit MNSQ is an information-weighted index representing the erratic patterns of scores that are close to the mean item difficulty. Outfit MNSQ is not weighted, and therefore is more sensitive to outliers departing from the expected score patterns. MNSQ values in the range of 0.6-1.4 represent good fit to the Rasch model (Bond & Fox, 2015; Wright & Linacre, 1994), while values in the range of 0.5 – 1.5 are productive for measurement (Linacre, 2002b). Low item separation (< 3) with item reliability below .90 indicate that the sample is not large enough to reproduce the item difficulty hierarchy, while negative or zero PTMEA correlations imply that the scale items function in an opposite direction to the Rasch dimension (Fan & Bond, 2019; Green, 2013). The evaluation of the response categories was based on the guidelines by Fan and Bond (2019) and Linacre (2002a): a) at least 10 observed counts for each category, b) monotonic increase in the average category measures, c) outfit MNSQ lower than 2, d) category thresholds advance monotonically and in the range of 1.4 – 5.0 logits, and e) distinct peak for each category in the category probability curve.

Rasch was performed on each of the six scales representing six constructs in the modified UTAUT model. The use behavior construct includes only one item, and therefore was not Rasch-calibrated. Following Fan and Bond (2019), the unidimensionality of each scale was examined by considering not only the item fit and item PTMEA, but also the unexplained variance in the first contrast of the principle component analysis of Rasch residuals. The unexplained variance in the first contrast lower than two, with no meaningful patterns of standardized Rasch residuals indicate that no additional dimensions are detected after the primary Rasch dimension has been extracted.

The Rasch-calibrated person measures were subsequently subjected to a path analytic model to understand the relationship among the UTAUT constructs, using IBM SPSS AMOS version 22. The global model fit was assessed on the basis of key goodness-of-fit indices suggested in the literature (Hair, Black, Babin, & Anderson, 2014; Kline, 2016). These includes the χ^2 statistics with its degree of freedom and associated *p* value, the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), the Standardized Root Mean Square Residual (SRMR), and the Root Mean Square Error of Approximation (RMSEA) with its confidence interval. Non-significant χ^2 with χ^2/DF lower than 3, CFI and TLI higher than 0.95, SRMR lower than 0.08 and RMSEA lower than 0.07 with its confidence interval in the range of $0.00 < RMSEA < 0.09$ collectively indicate a good model fit, which in turn enables the examination of the specific hypothesized relationships among the constructs in the model.

5. Results

The psychometric properties of the six scales were examined by consulting the Rasch statistics as presented in Table 1. As an essential assumption of the Rasch model, the unidimensionality of

each scale was first scrutinized by performing the principle component analysis of Rasch residuals.

	Infit MNSQ	*Outfit MNSQ*	*PTMEA correlation*	*Item reliability*	*Item separation*	*First contrast*	*Variance explained by Rasch*
Performance expectancy				0.95	4.44	1.55	42.6%
1	0.88	0.89	0.73				
2	1.17	1.13	0.68				
3	0.99	0.99	0.73				
4	0.88	0.89	0.74				
5	1.06	1.10	0.65				
Effort expectancy				0.99	11.70	1.85	51.4%
1	0.82	0.92	0.61				
2	1.06	0.91	0.56				
3	0.98	0.92	0.63				
4	1.08	1.09	0.58				
5	1.20	1.20	0.57				
6	0.89	0.94	0.59				
7	1.01	1.12	0.53				
Social influence				0.99	8.80	1.61	60.3%
1	0.91	0.93	0.77				

2	0.90	0.91	0.78				
3	1.02	0.98	0.75				
4	1.19	1.11	0.70				
Facilitating condition				0.97	5.46	1.62	44%
1	1.32	1.31	0.60				
2	0.88	0.88	0.67				
3	0.81	0.81	0.69				
4	0.84	0.85	0.70				
5	1.09	1.08	0.62				
6	1.04	1.08	0.64				
Behavioral intention				0.99	8.16	1.52	60.8%
1	1.06	1.00	0.75				
2	0.99	0.89	0.80				
3	0.95	0.98	0.82				
4	0.92	0.93	0.80				
Attitude				0.93	3.78	1.58	48%
1	0.67	0.65	0.80				
2	0.87	0.80	0.78				
3	0.72	0.74	0.76				
4	1.43	1.52	0.69				
5	1.22	1.26	0.61				

Table 1: Unidimensionality and item properties of the Rasch model

Generally, relative large amount of variance in each of the scales was explained by the Rasch model, ranging from 42.6% in the performance expectancy scale to 60.3% in the social influence scale. The unexplained variance in the first contrast of each scale was all lower than 2, suggesting that no other meaningful dimensions were detected above and beyond the primary dimension extracted by the Rasch model. The unidimensionality of the scales was further corroborated by the point-measure correlation of the items. All the items showed moderate to strong correlation (0.53 – 0.82), indicating that no item functioned in an opposite direction to the Rasch dimension, but rather closely approximated the latent construct of each scale. The infit and outfit MNSQ values of the items in each scale were all within the ideal range of 0.6 – 1.4, with the exception of item AT4 in the attitude scale (e.g., Using mobile devices for language learning in the classroom is a good idea). This item had infit and outfit MNSQ values of 1.43 and 1.52 respectively. However, given that this item represents an important indication of the learners' attitude toward the use of mobile devices for language learning in the classroom, and that the outfit MNSQ value only marginally exceeds the upper bound of the recommended values of 0.5 – 1.5 for productive measurement (Linacre, 2002b), it was decided that the item be retained in the attitude scale. Item reliability and item separation for all the scales were higher than 0.90 and 0.30 respectively, demonstrating that the item difficulty levels would remain consistent given another group of respondents with similar characteristics, and that the sample size was sufficiently large to reproduce the item difficulty hierarchy.

The adequate unidimensionality and the good fit of the data to the Rasch model for all the scales enable the calibration of the person and item measures onto the same linear interval metric. The mean person measures (in logits) for the performance expectancy, effort expectancy, social

influence, facilitating condition, behavioral intention, and attitude scales were 1.88 (SD = 1.95), 1.91 (SD = 1.46), 2.29 (SD = 2.31), 1.84 (SD = 1.72), 3.64 (SD = 2.76), and 3.10 (SD = 2.11) respectively, while the mean item difficulty was set by default at zero. The mean person measures for the scales were all positive, suggesting that in general, participants had relatively favorable responses to all the scales, with behavioral intention having the most positive response, followed by attitude, social influence, effort expectancy, performance expectancy, and facilitating condition respectively.

The functioning of the response categories was examined by following Linacre's (2002a) guidelines. Table 2 presents statistics pertaining to the observations, average measures, outfit MNSQ and Andrich thresholds for the performance expectancy scale before and after collapsing. For a full presentation of the statistics regarding other scales, see Appendix B.

	Before collapsing				**After collapsing**			
	Observed counts	Average measures	Outfit MNSQ	Andrich threshold	Observed counts	Average measures	Outfit MNSQ	Andrich thresholds
Performance expectancy (PE)								
1	7	-0.54	3.25	NONE	44	-1.41	0.96	NONE
2	19	-1.08	0.58	-2.10	206	0.10	1.02	-2.43
3	18	-0.16	0.73	-0.26	739	1.45	1.00	-0.50
4	206	1.12	0.99	-1.84	476	2.84	0.99	2.93
5	739	2.33	0.98	0.42				
6	476	3.67	0.98	3.79				

Table 2: The rating scale functioning before and after collapsing for the PE scale

An initial examination of the response category functioning in each scale revealed that there was disordering of response categories in all six scales, evidenced by the observed counts lower than 10 (category one in performance expectancy, social influence, behavioral intention, and attitude scales), non-monotonic increase in the average category measures (performance expectancy and social influence scales), outfit MNSQ higher than 2 (performance expectancy scale), and non-monotonic advance of the step thresholds in the range of 1.4 – 5 logits (all six scales). In addition, the category probability curves showed that at least one category in each scale was flattened and overshadowed by others, which suggested that respondents might not be able to distinguish those categories from others (see Figure 2 for an example).

Given the relatively unsatisfied functioning of the response categories, the collapsing of the adjacent categories that exhibited disordering or closeness was conducted, following Bond & Fox's (2015) guidelines. Results of the collapsing were presented in the second half of Table 2. Generally, a five-category scale was derived for social influence, behavioral intention and attitude, and a four-category scale was derived for performance expectancy, effort expectancy and facilitating condition. The observed counts of category one in the social influence, behavioral intention and attitude scales were still lower than 10; however, the normal-like distribution of the observations across the categories (Linacre, 2002a), and the satisfactory values of other criteria rendered it less a matter of concern. All outfit MNSQ values lower than 2 coupled with the monotonic advance of the average category measures and step calibrations with the latter being in the range of 1.4 – 5 logits suggested adequate functioning of the response categories after collapsing. All the category probability curves showed that each category now emerged as a distinct peak, illustrating the most probable response category for a particular scale

(see Figure 2, for an example). In summary, via the Rasch measurement approach, all the scales demonstrated reasonably good psychometric properties, and therefore robust enough for inclusion in the path analysis.

The Rasch calibrated person measures were subjected to a path analytic model specifying the hypothesized relationships among the UTAUT constructs. Data from Rasch person measures differ from raw data inputted directly from scale scores in that they have been converted into log odd units with linear interval metrics, thus enabling the use of path analysis – a CTT-based statistical method. Descriptive statistics showed that the Mardia's normalized estimate of multivariate kurtosis (12.089) was higher than the cut-off value of 3, suggesting departure from the multivariate normal distribution of the data. Therefore, the maximum likelihood estimation with Bollen-Stine bootstrapping method (Bollen & Stine, 1992) was performed to evaluate the path model. Values of key goodness-of-fit indices indicated relatively acceptable model fit (χ^2 = 11.2, χ^2/DF = 3.7, p = .01; CFI = .99; TLI = .94; RMSEA = .10 [90% CI = .04, .16]; SRMR = .03). Adding a direct path from performance expectancy to use behavior and dropping the path from attitude to use behavior, as suggested by the modification indices, significantly increased model fit (χ^2 = 1.94, p = .59, χ^2/DF = .65; CFI = 1.00; TLI = 1.00; RMSEA = .00 [90% CI = .00, .08]; SRMR = .01). Goodness-of-fit indices within the ideal ranges and cut-off values supported the use of the modified UTAUT as an appropriate model for examining the acceptance and use of MALL by Vietnamese learners.

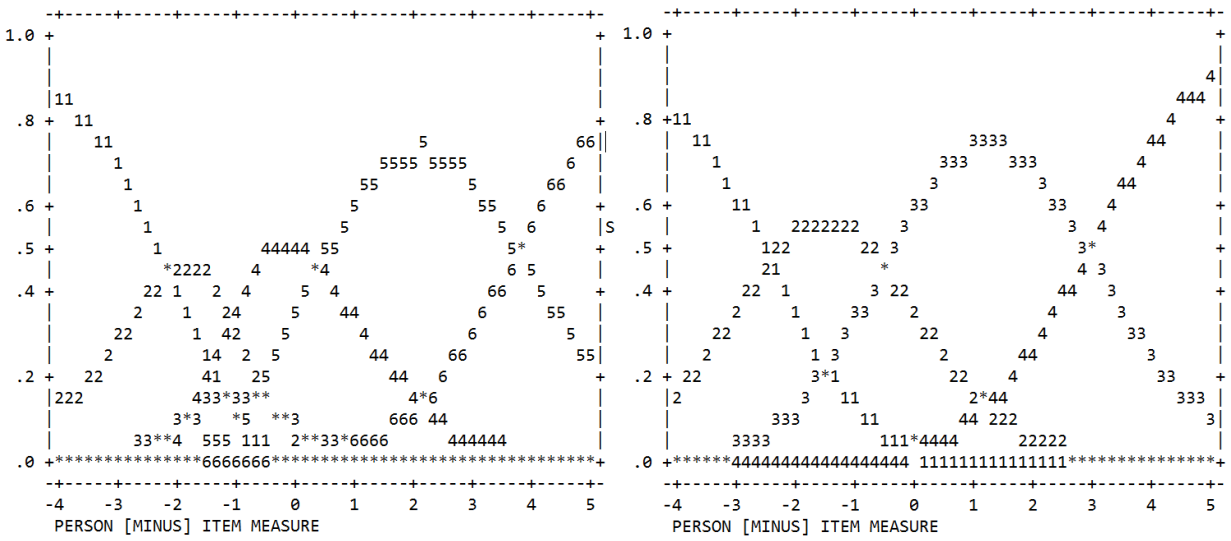


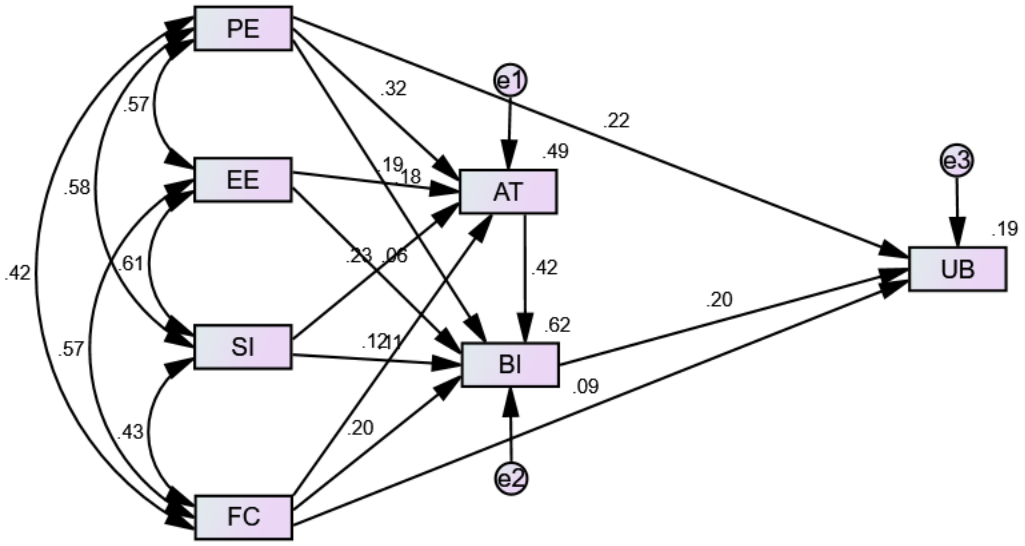
Figure 2: The category probability curves for the PE scale before and after collapsing

The standardized regression coefficients from performance expectancy, effort expectancy, social influence and facilitating condition to attitude were all significant ($p < .05$). Performance expectancy was the strongest predictor of attitude ($\beta = .32$), followed by social influence ($\beta = .23$), effort expectancy ($\beta = .19$) and facilitating condition ($\beta = .12$). The standardized regression weights from performance expectancy, social influence and facilitating condition to behavioral intention were significant ($p < .05$) with facilitating condition being the most powerful determinant ($\beta = .20$), followed by performance expectancy ($\beta = .18$) and social influence ($\beta = .11$). Attitude significantly predicted behavioral intention at $p < .001$ level ($\beta = .42$), while behavioral intention was a significant antecedent to use behavior at $p < .01$ level ($\beta = .20$). The direct path from performance expectancy to use behavior was also significant at $p < .001$ level ($\beta = .22$). However, the standardized regression weights from effort expectancy to behavioral intention and facilitating condition to use behavior were not significant. The proposed model accounted for 62% of the variances in the behavioral intention of Vietnamese learners to adopt MALL, and 19% of variances in their usage of MALL (see Figure 3).

The standardized direct, indirect, and total effects of the determinants on the use behavior were presented in Table 3. It can be seen in Table 3 that performance expectancy, via both direct and indirect effects, manifested itself to be a more powerful predictor of use behavior than behavioral intention. Performance expectancy also strongly predicted behavioral intention both directly and indirectly, ranked second only to attitude. Figure 4 represents the final model informed by the path analysis results.

	Direct effects on		**Indirect effects on**		**Total effects on**	
	Use behavior	Behavioral intention	Use behavior	Behavioral intention	Use behavior	Behavioral intention
Performance expectancy	.22	.18	.06	.14	.29	.32
Effort expectancy		.06	.03	.08	.03	.14
Social influence		.11	.04	.10	.04	.20
Facilitating condition		.20	.05	.05	.14	.25
Behavioral intention	.20				.20	
Attitude		.42	.08		.08	.42

Table 3: Direct, indirect and total effects on the behavioral intention and use behavior



(PE: Performance expectancy; EE: Effort expectancy; SI: Social influence; FC: Facilitating condition; AT: Attitude; BI: Behavioral intention; UB: Use behavior)

Figure 3: The path model with standardized estimates

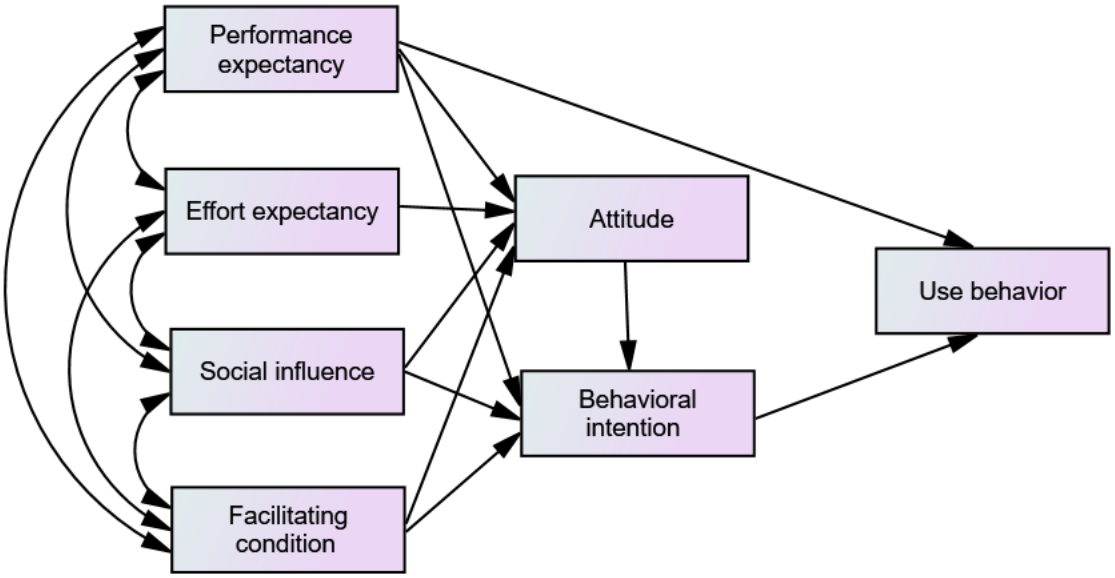


Figure 4: The final path model

6. Discussion

The widespread use of mobile devices (e.g., mobile phones, tablets) and the wider coverage of cellular networks have ushered in a new educational era wherein learning can be supported by the use of mobile devices. Mobile assisted language learning emerged from this backdrop and gained considerable traction from practitioners, teachers and educational researchers. While much research has been conducted on the application of various mobile technologies in language education, relatively little attention was given to learners' readiness as well as their attitude and intention to use mobile devices for language learning. To fill this gap, the present study set out to examine learners' attitude, behavioral intention, and usage of mobile devices for language learning in the context of Vietnam – a developing country where a search in the literature revealed no previous relevant studies. The modified UTAUT model (Dwivedi et al., 2019) was employed as the guiding research framework, while a Rasch-based path modeling approach was adopted for the analysis of Likert-type survey scale data.

Results of the Rasch rating scale analysis supported the psychometric properties of the scale items. All the infit and outfit MNSQ values, item reliability, item separation and the point-measure correlations of the items in each of the six scales pointed to the adequacy of the items in eliciting learners' responses to the modified UTAUT constructs. In addition, the collapsing of disordered categories conduced to a five-category response scale for social influence, behavioral intention and attitude constructs, and a four-category response scale for performance expectancy, effort expectancy and facilitating condition constructs, all having adequate rating scale functions. These results suggested that the questionnaire used in this study can be legitimately adopted for future UTAUT-based studies on mobile assisted language learning acceptance in the Vietnamese

context, though the rating scale categories should be modified to best elicit participants' responses.

The path analysis was performed with data derived from the Rasch-calibrated person measures to examine the hypothesized relationships among the modified UTAUT constructs. Results supported nine out of 12 hypotheses specified in the research model, while introduced one additional relationship. Table 4 summarized the results of the path analysis and the conclusions regarding the research hypotheses.

Hypotheses	**Findings**
H1 Performance expectancy has a positive significant effect on behavioral intention to use MALL	Supported
H2 Effort expectancy has a positive significant effect on behavioral intention to use MALL	Rejected
H3 Social influence has a positive significant effect on behavioral intention to use MALL	Supported
H4 Facilitating condition has a positive significant effect on behavioral intention to use MALL	Supported
H5 Facilitating condition has a positive significant effect on the use behavior of MALL	Rejected
H6 Performance expectancy has a positive significant effect on the attitude toward MALL	Supported
H7 Effort expectancy has a positive significant effect on the attitude toward MALL	Supported

H8	Social influence has a positive significant effect on the attitude toward MALL	Supported
H9	Facilitating condition has a positive significant effect on the attitude toward MALL	Supported
H10	Attitude significantly mediates the effect of performance expectancy, effort expectancy, social influence, and facilitating condition on behavioral intention to use MALL	Supported
H11	Attitude has a positive significant effect on the use behavior of MALL	Rejected
H12	Behavioral intention has a positive significant effect on the use behavior of MALL	Supported
Additional relationship:	Performance expectancy has a positive significant effect on the use behavior of MALL	

Table 4: Summary of the research findings

Among the constructs examined in the modified UTAUT model, attitude toward MALL was found to be the most powerful predictor of learners' behavior intention, and to partially mediate the effects of all the exogenous variables on behavioral intention. This finding joined Botero et al. (2019) in lending further empirical support to Dwivedi et al. (2019) position that opting attitude out of the original UTAUT model by Venkatesh et al. (2003) significantly diminished the predictive power of the model. Unlike Dwivedi et al. (2019), however, it was found in this study that attitude did not directly influence the use behavior of the learners; rather its effect on the use behavior was fully mediated by learners' behavioral intention to use MALL. These findings implied that once learners became aware of the effectiveness of mobile devices and the

ease with which they could use them for language learning, as well as the availability of the technical and organizational supports and the influence from others, they would form a positive attitude toward and subsequently the intention to use MALL.

Performance expectancy was found to be the most powerful predictor of students' attitude toward the use of MALL. This finding concurred with Botero et al. (2019) study on MALL acceptance and other studies on mobile learning in general (Briz-Ponce et al., 2017; Yeap et al., 2016), thus further consolidating the role of this construct in the UTAUT model. However, contrary to the general literature on the UTAUT model (Botero et al., 2019; Dwivedi et al., 2019; Venkatesh et al., 2003; Yueh et al., 2015) where performance expectancy is theorized to have no direct effect on the use behavior, it was found in the current study that performance expectancy not only influenced the use behavior indirectly via attitude and intention, but also directly predicted the usage of mobile devices for language learning. A potential explanation for this finding was that participants in the current study might have successfully applied mobile learning to improve language performance in certain aspects, and therefore directly related their MALL usage to MALL usefulness. In fact, the experience of success in language learning as articulated above was investigated in previous studies as satisfaction in learning (Joo, Lee, & Ham, 2014; Joo, Lim, & Kim, 2011; Sun, Tsai, Finger, Chen, & Yeh, 2008). Generally, these studies found that perceived usefulness directly affected learners' level of satisfaction, which in turn, fostered their intention to continue the use of technologies in learning. Though not included in the original and the modified UTAUT models, either as a core construct or a moderating variable, satisfaction in learning may be specified as a quantifiable construct in an extended UTAUT model to better understand the use of mobile devices in language learning in future studies.

Effort expectancy was found to have no direct effect on behavior intention. Rather, its effect on behavior intention was fully mediated by attitude. This finding was in line with Yeap et al. (2016) and Briz-Ponce et al. (2017), but diverged from Botero et al. (2019). Given the various factors, such as gender, experience, and age that mediated the roles of this construct (Šumak & Šorgo, 2016), and the caveats by Venkatesh et al. (2003) that the role of effort expectancy dwindled over time, the results regarding effort expectancy in the current study should be treated with caution. Incorporating relevant moderating variables into the UTAUT model may yield a better interpretation of the roles of effort expectancy in future studies.

The effect of facilitating condition on the usage of MALL was found to be fully mediated by learners' behavioral intention. This represented a departure from both the original and the modified UTAUT models as well as previous studies (Botero et al., 2019; Moran et al., 2010; Tan, 2013) in that there was no direct effect of facilitating condition on the use behavior. A plausible explanation could be that the availability of organizational supports (e.g., the equipment of mobile devices and broadband wireless networks) and technical supports (e.g., an assistant to help with the use of mobile devices) was perceived to be important by the participants, but was unfortunately limited in the study context. In other words, even though students in the study conceived of facilitating condition as an important factor, the limited access to high-speed wireless networks and the absence of a technical assistant prevented them from using mobile devices to learn a foreign language on a continuous and regular basis. This may partly explain why the proposed model accounted for 62% of variances in the behavioral intention but only 19% of variances in the use behavior. The finding also implies that while all determinant variables in the UTAUT model have positive effects on learners' attitude and subsequently their intention to use MALL, it is probably the facilitating condition that plays an

important role in learners' actual usage of the system, particularly in the contexts of underdeveloped and developing countries where insufficient budget for educational sectors may deprive learners of access to that affordance.

7. Limitations and conclusions

The study has several limitations. First, although the research findings offer favorable evidence for the utility of the UTAUT model in examining MALL acceptance in Vietnam, whether this model can yield equally promising results in other contexts remains to be explored. Second, this study is cross-sectional in nature; the changing attitude and behavior of the learners over time were therefore not modeled. Future studies may exploit this gap by measuring and modeling learners' attitude, intention and behavior as well as other determinant variables at different points in time to see how experience and satisfaction with the system affect learners' continued use. Third, this study did not set out to compare learners' adoption of MALL in and out of the classroom. Given the ubiquity and portability of mobile devices and the increasingly prevalent applications of mobile technologies in educational contexts, it would be interesting to see how learners adopt them in classroom activities and for at-home language practice. This also highlights the fact that the role of teachers in orienting learners toward appropriate use of mobile devices for language learning in and out of the classroom was not considered in this study. Although the teachers' role might have been subsumed into the social influence construct, explicitly modeling the effects of this factor on learners' attitude, intention and behavior might increase the explanatory power of the model. Finally, just as classical path analysis assumes error-free measurement of the variables, Rasch-based path analysis does not take the measurement errors of person measures into account. Future studies may address this issue by

incorporating Rasch-model into a full structural equation model or using a combination of Rasch plausible values and path analysis as in Mok, Kennedy, and Zhu (2013).

Despite the aforementioned limitations, this study produced promising findings. Generally, the findings supported the use of the modified UTAUT model as an appropriate framework for examining the acceptance and use of MALL. Out of the 12 hypotheses proposed in the research, only three (e.g., effort expectancy → behavioral intention, facilitating condition → use behavior, and attitude → use behavior) were not supported. This offers new perspectives into the role of facilitating condition on learners' actual use of MALL in the context of a developing country, and appeals to more empirical evidence on the role of effort expectancy in the UTAUT model. Moreover, results of the study further cemented the role of attitude in explaining learners' acceptance of mobile devices in language learning. These aspects must be taken into account prior to and during the application of mobile devices in language learning, either at an institutional or individual level.

Finally, from a measurement perspective, this study has successfully made use of the Rasch rating scale model to transform ordinal data from survey scale responses into interval data for the analysis of the path model. This opens up a promising possibility for future studies in the field that has hitherto been dominated by the classical latent variable modeling approaches, and that needs a more rigorous statistical approach to the analysis of survey scale data.

Appendix A: The modified UTAUT survey items

Items	Questions
Performance expectancy (Chang et al., 2012; Chavoshi & Hamidi, 2019; Mohammadi, 2015; Sabah, 2016)	
PE1	Using mobile devices helps maintain and enhance my motivation and interest in language learning.
PE2	Using mobile devices can enhance the language learning environment and experience.
PE3	Using mobile devices can improve my language learning performance in class.
PE4	Using mobile devices can improve the effectiveness of language learning outside the class
PE5	I find it useful to use mobile devices for language learning.
Effort expectancy (Botero et al., 2019; Chang et al., 2012)	
EE1	Using mobile devices to learn a foreign language is easy for me.
EE2	I find it convenient to use mobile devices for listening practice.
EE3	I find it convenient to use mobile devices for speaking practice.
EE4	I find it convenient to use mobile devices for reading practice.
EE5	I find it convenient to use mobile devices for writing practice.
EE6	It is easy for me to find and use mobile apps for learning a foreign language.
EE7	It is easy for me to learn to use a mobile device.
Social influence (Botero et al., 2019; Chavoshi & Hamidi, 2019)	

SI1	People who are influential to me believe that I should use mobile devices for language learning.
SI2	People who are important to me believe that I should use mobile devices for language learning.
SI3	I use mobile devices for language learning if my instructors support and recommend it.
SI4	My friends' recommendation influences my decision to use mobile devices for language learning.
Facilitating conditions (Botero et al., 2019; Lai et al., 2017; Tan, 2013; Venkatesh et al., 2003)	
FC1	I have easy access to a mobile device.
FC2	I can have easy and regular access to internet, via Wi-Fi or mobile data, on my mobile devices.
FC3	I can have access to many mobile apps to learn foreign languages on my mobile devices.
FC4	I have the required knowledge and skills to use mobile devices for language learning.
FC5	I can get technical support if I have problems learning foreign languages on mobile devices.
FC6	I know a convenient place where I can get access to Wi-Fi for language learning on mobile devices.

Behavioral intention (Botero et al., 2019; Chavoshi & Hamidi, 2019; Hao et al., 2017; Mohammadi, 2015; Sabah, 2016; Tan, 2013)	
BI1	I intend to use/ continue to use mobile devices for language learning.
BI2	I guess I would use mobile devices to learn foreign languages more regularly in the future.
BI3	I have a plan to use mobile devices to learn foreign languages more regularly.
BI4	I will recommend my friends to use mobile devices to learn foreign languages.
Attitude (Botero et al., 2019; Thomas et al., 2013)	
AT1	Using mobile devices to learn a foreign language is a good idea.
AT2	I would like to use mobile devices to learn foreign languages
AT3	Using mobile devices to learn a foreign language is fun.
AT4	Using mobile devices for language learning in the classroom is a good idea.
AT5	Using mobile devices for language learning outside the classroom is a good idea.

Appendix B: The rating scale functioning before and after collapsing for the effort expectancy, social influence, facilitating condition, attitude, and behavioral intention scales

	Before collapsing				After collapsing			
	Observed counts	Average measures	Outfit MNSQ	Andrich threshold	Observed counts	Average measures	Outfit MNSQ	Andrich thresholds
Effort expectancy								
1	25	-0.72	0.88	NONE	25	-0.95	1.00	NONE
2	116	-0.29	1.13	-2.37	614	0.30	1.02	-3.92
3	128	0.03	0.76	-0.20	801	1.96	0.95	0.86
4	370	0.84	1.02	-0.60	611	3.51	1.07	3.05
5	801	1.80	0.96	0.52				
6	611	2.90	1.04	2.65				
Social influence								
1	7	-2.43	0.82	NONE	7	-2.94	0.91	NONE
2	44	-1.15	1.38	-4.36	126	-0.94	1.32	-5.62
3	82	-0.26	1.19	-1.37	237	0.71	0.87	-0.88
4	273	0.96	0.84	-0.86	604	2.84	0.84	0.96
5	604	2.87	0.85	1.08	162	5.27	1.03	5.54
6	162	5.18	1.02	5.51				
Facilitating condition								
1	17	-1.41	0.98	NONE	17	-2.17	1.11	NONE
2	50	-0.23	1.17	-1.80	472	0.39	1.03	-4.03

3	90	0.23	0.96	-0.62	878	1.82	0.96	0.52
4	332	0.74	0.97	-0.83	391	3.42	0.99	3.51
5	878	1.56	0.93	0.17				
6	391	2.86	0.98	3.08				
Behavioral intention								
1	6	-1.73	1.10	NONE	6	-1.38	1.43	NONE
2	30	-1.18	1.43	-4.63	64	-1.22	1.01	-5.94
3	34	-0.41	0.73	-0.85	201	1.16	1.01	-1.06
4	201	1.23	1.00	-1.29	603	3.37	0.86	1.11
5	603	3.25	0.84	1.08	298	5.99	0.95	5.88
6	298	5.74	0.93	5.69				
Attitude								
1	6	-2.85	1.32	NONE	6	-3.14	1.18	NONE
2	23	-0.06	1.70	-2.89	23	0.13	1.57	-3.01
3	43	0.24	0.99	-0.63	216	0.92	0.98	-1.92
4	173	1.05	0.95	-0.66	780	2.58	0.89	0.48
5	780	2.27	0.91	0.16	440	4.49	0.95	4.45
6	440	4.00	0.98	4.02				

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