

Modification and Revalidation of the M-Learning Acceptance Model

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Abstract

This paper aims to further test and validate the psychometric properties of an instrument developed by Abu-Al-Aish and Love (2013) that measures the acceptance of mobile learning by students in higher education. The original instrument is based on the Unified Theory of Acceptance and Use of Technology and has six factors: (1) performance expectancy, (2) effort expectancy, (3) social influence (lecturers), (4) quality of service, (5) personal innovativeness, and (6) behavioral intention. It was the researchers' goal to examine the measurement properties and factor structure of the M-Learning Acceptance model after it was revised to investigate Japanese college students' acceptance of mobile technologies for informal English-language learning. The original instrument has a 5-point rating scale; however, due to cultural differences, all Likert-like scale items were changed to a 4-point rating scale. The instrument was translated into the Japanese language. After conducting a pilot study, the modified paper-based instrument was administered to college students enrolled in required English-learning courses at a private mid-size university in Japan. Over 900 students completed the instrument. Results of an exploratory and a confirmatory factor analysis conducted with SPSS and M-Plus confirm that the model is a valid instrument with sound psychometric properties.

Keywords: acceptance and use of technology; foreign-language learning; mobile technology; higher education

Introduction

In today's globalized economy, the English language has emerged as the *lingua franca* of both business and government. Across the globe, it has been estimated that over 1 billion people are studying English as either a foreign or second language (Howson, 2013). In many countries, English language instruction is required as part of formal education; however, many individuals are studying English outside of formal education and traditional classrooms. Many instructors have integrated technology into language learning lessons in order to support teaching and learning in different environments. Today, language courses at higher education institutions are offered in a variety of learning environments: campus-based, hybrid, flipped or online classrooms.

Technology offers several benefits to students of language including access to learning materials and authentic content. In addition, technology has made it easier to connect with native speakers and other learners of the language students are attempting to learn. Mobile technologies, in

particular, have shown to increase exposure to the target language (Demouy, Jones, Kan, Kukulska-Hulme, & Eardly, 2016). Furthermore, mobile technologies are well suited to the task of informal learning due to device characteristics (Sung, Chang, & Liu, 2016) and the degree to which they have become integrated in the lives of users (Chen, 2013; Jones, Scanlon, & Clough, 2013; Kukulska-Hulme, 2010).

In Japan, mobile technology is ubiquitous, especially among university students. Therefore, a number of studies have been conducted in Japan on the use of these devices for the purpose of mobile-assisted language learning (MALL). Yet, the majority of these research projects have focused on formal settings. This study intends to fill this gap in the literature. It aims to provide a modified instrument with good psychometric properties that measures Japanese college students' acceptance of mobile technologies in order to support formal English-language learning in informal learning environments.

Literature Review

Informal Learning

Informal learning is defined as the process of learning that takes place outside of a formal classroom without a teacher or prescribed curriculum (Laurillard, 2009). This learning can occur incidentally without the learner's conscious effort or through a program of self-directed study (Stevens & Shield, 2009). In recent years, information and communication technologies, especially mobile devices, have increased the opportunity for individuals to engage in informal learning.

According to a 2009 survey conducted in the United Kingdom, 94% of respondents participated in informal learning in the previous three months and 74% of those surveyed used some form of technology to facilitate this learning (Hague & Logan, 2009). Language learning is an area of study where knowledge is often acquired in an informal environment. In fact, everyone acquires her or his first language informally with little explicit instruction. Second and foreign languages are also studied in informal environments either out of necessity when immigrating, visiting, or working in another country, or for enjoyment as a hobby. Like other forms of informal learning, language study can be facilitated by the use of technology, which provides students with unlimited access to content in the target language.

Mobile-Assisted Language Learning

Throughout the world, mobile technologies such as smartphones and tablet computers have become ubiquitous in the lives of users. According to the Pew Research Center (Poushter, 2016), the rate of smartphone ownership has increased dramatically in since 2013, even in emerging economies such as Brazil and Chile. Due to the ubiquitousness of these devices and their unique characteristics such as portability and computing power (Sung et al., 2016; Viberg & Grönlund, 2012), mobile technologies have increasingly been utilized for educational purposes. The field of language learning is one of the most frequently studied aspects of mobile learning (ML) (Kukulska-Hulme, 2013). Researchers investigating MALL have examined a number of applications of the technology to second-language acquisition including, peer learning and

vocabulary acquisition on the social media platform Line (Liu & Wu, 2016; McCarty, Sato, & Obari, 2016) and learning English idioms on the messaging application WhatsApp (Şahan, Çoban, & Razi, 2016).

Because mobile devices allow learners to access authentic content and educational materials at any time and in any environment, they are particularly suited to facilitate informal language learning. However, the nature of informal learning, which often occurs incidentally, makes it a particularly difficult phenomenon to study. Researchers have used several methodologies to examine usage and perceptions of informal MALL. For example, Kayaoğlu, Sağlamel, and Kobul (2017) utilized semi-structured interviews to ascertain students' perceptions of the use of mobile phone to deliver vocabulary lessons in translation courses. Demouy, Kan, Kukulska-Hulme, and Eardley (2015) reported the use of a mixed methodology, which consisted of a quantitative survey instrument and semi-structured interviews, to study mobile language learners' motivation and practice. Chen (2013) tracked students' usage of tablet computers through daily reports and investigated attitudes towards the technology by conducting semi-structured interviews. Barrs (2011) relied solely on a questionnaire to ascertain his students' access to smartphones and use of those devices for language learning. While these studies provide valuable insight into the practice of informal MALL, the lack of an extensive and valid instrument has limited researchers' understanding of the subject.

Conceptual Framework

The conceptual framework used in this study is the Technology Acceptance Model (TAM). The TAM was developed to aid in the prediction of technology acceptance based on the constructs of perceived usefulness, perceived ease of use, attitudes, and behavioral intention. In the 30 years since the original model was developed, a large body of research has been created which has resulted in the development of numerous variations of the original TAM.

The TAM 2, TAM 3, and the Unified Theory of Acceptance and Use of Technology (UTAT) function as general models. The UTAT was an effort to review and synthesize eight models that have been used to study technology acceptance including theory of reasoned action, technology acceptance model (TAM), motivation model, theory of planned behavior (TPB), combined TAM and TPB, model of personal computer utilization, innovation diffusion theory, and social cognitive theory. Several technology-specific models have been proposed for e-learning (e.g., Drennan, Kennedy, & Pisarski, 2005; Ma & Yuen, 2011; Tarhini, Hone, Liu, & Tarhini, 2017), learning management systems (e.g., Ngai, Poon, & Chan, 2007; Sánchez & Hueros, 2010), and ML (e.g., Abu-Al-Aish & Love, 2013; Hao, Dennen, & Mei, 2017).

Abu Al-Aishi and Love's (2013) M-Learning Acceptance model was based on the UTAT and includes six constructs: (1) performance expectancy, (2) effort expectancy, (3) social influence (lecturers), (4) quality of service, (5) personal innovativeness, and (6) behavioral intention. Results of Abu Al-Aishi and Love' study indicate that performance expectancy, effort expectancy, social influence, quality of service, and personal innovativeness were all significant in determining behavioral intention to use ML.

Performance expectancy. Performance expectancy is the extent to which an individual believes that usage of a technology will facilitate the achievement of a given outcome (Venkatesh, Morris, Davis, & Davis, 2003). In the UTAUT performance expectancy replaced the previous constructs of perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations and is the most significant determinant of behavioral intention (Venkatesh et al., 2003). Several studies, including Wang, Wu, and Wang (2009) and Chaka and Govender (2017), have demonstrated that performance expectancy was highly predictive of behavioral intention to use ML. Abu-Al-Aish and Love (2013) suggested that the flexibility and speed of learning afforded by mobile technologies affected students' perceptions of this construct and demonstrated that it had a direct influence on behavioral intention in ML.

Effort expectancy. Effort expectancy is the extent to which a technology is perceived as easy to use. This construct replaced the constructs of ease of use and complexity which were used in earlier acceptance models (Venkatesh et al., 2003). Previous research has shown that factors such as age, gender, and experience can affect perceptions of this construct (Abu-Al-Aish & Love, 2013). Research of ML acceptance with university students has shown that these subjects often find mobile devices easy to use (Dashtestani, 2013; Ducate & Lomicka, 2013). One reason for this may be the familiarity these individuals have with these devices because of personal use.

Social influence (lecturer). Social influence is the extent to which an individual feels that others want him or her to use a particular technology. Social influence replaced the constructs of subjective norm, societal factors, and image, which were used in previous models of acceptance and adoption (Venkatesh et al., 2003). Research in social influence has examined the effect of both superiors and peers on technology acceptance (Igbaria, Schiffman, & Wieckowski, 1994). Due to the influence that educators exert on students to adopt new technologies, Abu-Al-Aish and Love (2013) included lecturer influence as a construct in their model of ML acceptance. Research conducted by Hao et al. (2017) in a Chinese university setting found that social influence plays a positive role in behavioral intention to adopt ML.

Quality of service. Abu-Al-Aish and Love (2013) based their definition of quality of service on research in human computer interaction (Kuan, Bock, & Vathanophas, 2008) and usability research (DeLone & McLean, 1992; Rai, Lang, & Welker, 2002). Quality of service is related to customer satisfaction and perceptions of reliability, response, content, and security (Abu-Al-Aish & Love, 2013). One aspect of service quality is the degree of support provided by organizations or within the infrastructure of technology to facilitate its use. This concept is contained within the construct of facilitating conditions in the original UTAUT (Venkatesh et al., 2003). Research by Lim and Khine (2006) have demonstrated that the presence of poor facilitating conditions can act as a barrier to technology integration. In informal ML situations, perceptions related to this construct are complicated by the fact that service may be provided from several sources such as the mobile device service provider or the designer of an application used for learning. Nevertheless, quality of service has shown to be a significant predictor of students' acceptance of ML (Abu-Al-Aish & Love, 2013).

Personal innovativeness. Innovativeness is the degree to which an individual is willing to try and adopt new technologies (Rogers, 2003). While not included as a construct in the UTAUT (Venkatesh et al., 2003), the use of personal innovativeness in technology adoption and acceptance

is supported by a large body of theoretical and empirical research (Agarwal & Prasad, 1998). Research conducted by Fagan, Kilmon, and Pandey (2012) showed that personal innovativeness was a key determiner of student acceptance of virtual reality simulations for learning. Abu-Al-Aish and Love (2013) demonstrated that personal innovativeness was predictive of ML acceptance. However, a more recent study by Hao et al. (2017) found that personal innovativeness only presented an indirect influence on behavioral intention to use ML.

Methodology

Setting and Sample

The study was conducted at a private university in Japan. The university has an annual enrollment of over 32,000 students and offers undergraduate and graduate degrees in 16 colleges. In order to graduate, undergraduate students in economics, information science, and engineering programs must successfully complete at least two years of EFL courses and achieve a passing Test of English for International Communication (TOEIC) score.

One thousand two hundred and eighteen students enrolled in 59 required first- and second year undergraduate-level English-as-a-foreign-language (EFL) courses majoring in economics, information science, and engineering were invited to participate in the study. The majority of participants self-identified as Japanese (99.4%). Over 70% of students were male and 26.6% were female, and their ages ranged from 18-36 ($M = 19.03$).

Respondents were majoring in the following disciplines: economics (42.0%), information science (31.1%), and international economics (26.9%). The majority of students were freshmen (48.5%) or sophomores (49.8%); however, a few students identified as juniors (1.6%) or seniors (0.1%). Participants owned a variety of mobile devices: mobile phone or smart phone (98.8%), MP3 player (61.6%), handheld game console (51.8%), e-book reader (21.1%), and tablet (17.6%).

Instrument

The instrument developed by Abu-Al-Aish and Love (2013) was modified with the permission of the authors in order to investigate student acceptance of mobile technologies for informal English-language learning. The instrument includes six constructs: (1) performance expectancy, (2) effort expectancy, (3) lecturers' influence, (4) quality of service, (5) personal innovativeness, and (6) behavioral intention. The original instrument included 26 items; however, the authors eliminated three items during the validation process: items 4, 15, and 17.

The researchers made minor word changes to the scale items in order to: (1) adapt the scale to fit the focus of this research study, and (2) to validate the factor structure and psychometric properties of the original scale. References to ML or ML systems were replaced with the term *mobile devices*, and the term *informal English-language learning* was added to items on the PE, EE, LI, and BI subscales (Table 1). Additionally, the rating scale was revised. Because of Japanese culture, the original 5-point Likert scale was changed to a 4-point rating scale, 1-*strongly disagree* to 4-*strongly agree*. Due to the unique culture and power structure in Japan, it is very likely for Japanese

students to choose a *neutral* response on survey items because they wish to avoid confrontation and do not wish to offend their instructors (Carless, 2012; Wang, Hempton, Dugan, & Komives, 2008).

Researchers frequently use a 5- or 7-point scale for Likert-type items (Crocker & Algina, 1986; Gall, Borg, & Gall, 1996; Kerlinger & Lee, 2000). Some psychometricians, however, point out that a 4-point scale eliminates bias, increases the scale's reliability, and forces survey participants to express an opinion, therefore avoiding a neutral response (Cronbach, 1946; Pearson & Carey, 1995). Researchers found there was no statistically significant difference in responses of two groups who complete a survey with and without a neutral response (Mercer & Durham, 2001).

The instrument was translated into Japanese by a native Japanese speaker with high language proficiency as measured by the Test of English for International Communication. The translation was verified by two other individuals with a high language proficiency in both English and Japanese as measured by the TOEIC.

Table 1
Original and Modified Scale Items

	Original Scale Item	Modified Scale Item
<u>Performance Expectancy</u>		
PE1	I find m-learning useful for my studies.	I find mobile devices to be useful for informal English study.
PE2	Using m-learning would enable me to achieve learning tasks more quickly.	Using mobile devices would enable me to complete informal English learning tasks more quickly.
PE3 [R]	Using m-learning in my studying would not increase my learning productivity.	Using mobile devices would not increase my informal English-language learning productivity.
PE5 [R]	Using m-learning would not improve my performance in my studies.	Using mobile devices for informal English-language learning would not improve my performance.
<u>Effort Expectancy</u>		
EE1	I would find an m-learning system flexible and easy to use.	I find mobile devices for informal English-language learning flexible and easy to use.
EE2	Learning to operate an m-learning system does not require much effort.	Learning to operate a mobile device for informal English-language learning does not require much effort.
EE3	My interaction with an m-learning system would be clear and understandable.	My interaction with mobile devices for informal English-language learning would be clear and understandable.
EE4	It would be easy for me to become skillful at using an m-learning system.	It would be easy for me to become skillful at using mobile devices for informal English-language learning.

Learners' Influence

LI1	I would use m-learning if it was recommended to me by my lecturers.	I would use mobile devices for informal English-language learning if my instructors recommended it to me.
LI2	I would like to use m-learning if my lecturers supported the use of it.	I would like to use mobile devices for informal English-language learning if my instructors supported the use of it.
LI3 [R]	Lecturers in my Department have not been helpful in the use of m-learning.	Instructors in my department have not been helpful in the use mobile devices for informal English-language learning.

Quality of Service

QoS1	It is important for m-learning services to increase the quality of learning.	It is important for m-learning services to increase the quality of learning.
QoS2	I would prefer m-learning services to be accurate and reliable.	I would prefer m-learning services to be accurate and reliable.
QoS4	It is important for m-learning to focus on the speed of browsing the internet and obtaining information quickly.	It is important for m-learning to focus on the speed of browsing the internet and obtaining information quickly.
QoS6	It is preferable that m-learning services are easy to navigate and download.	It is preferable that m-learning services are easy to navigate and download.

Personal Innovativeness

PIInn1	I like to experiment with new information technologies.	I like to experiment with new information technologies.
PIInn2	When I hear about a new information technology I look forward to examining it.	When I hear about a new information technology I look forward to examining it.
PIInn3	Among my peers, I am usually the first to try out a new innovation in technology.	Among my peers, I am usually the first to try out a new innovation in technology.

Behavioral Intention

BI1	I plan to use m-learning in my studies.	I plan to use mobile devices for informal English-language learning.
BI2	I predict that I will use m-learning frequently.	I predict that I will use mobile devices for informal English-language learning frequently.
BI3	I intend to increase my use of mobile services in the future.	I intend to increase my use of mobile devices for informal English-language learning in the future.
BI4	I will enjoy using m-learning systems.	I will enjoy using mobile devices for informal English-language learning.

BI5	I would recommend others to use mobile learning systems.	I would recommend others to use mobile devices for informal English-language learning.
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Note. [R] denotes reverse-scored items.

Before the instrument was distributed to the population, a pilot test was conducted in order to determine the internal reliability of the instrument and its subscales. The internal reliability coefficient for the instrument was satisfactory ($\alpha = 0.86$), and most of the coefficients for the subscales (PInn $\alpha = 0.87$; BI $\alpha = 0.84$; LI $\alpha = 0.67$; EE $\alpha = 0.66$; QoS $\alpha = 0.65$) were acceptable with the exception of the PE subscale ($\alpha = 0.28$).

After the data collection phase, Cronbach alpha coefficients were calculated for the scale and its subscales. The reliability was high for the following: Overall ($\alpha = .86$), BI ($\alpha = 0.88$), PInn ($\alpha = 0.77$), and EE ($\alpha = 0.71$). The reliability for the QoS ($\alpha = 0.63$) and LI ($\alpha = 0.53$) subscales were moderate, and the reliability for the PE subscale ($\alpha = 0.19$) was low.

Data Collection

The instrument was distributed to Japanese students during Spring 2015 Semester at a private university during their mandatory English courses after obtaining approval from an Institutional Review Board. Faculty members who taught English courses in the Economics Department and speaking and listening courses in the Information Science Department were approached to distribute the survey instrument in class. Nine instructors who chose to participate received printed copies of the translated survey instrument and cover letter; they distributed the survey to 1,218 students enrolled in 59 English-language courses. The cover letter included the purpose of the research, procedure to complete the survey, and students' rights as participants. Students were asked to complete the survey outside of class and return it within one week. The survey took approximately 15 minutes to complete. The response rate was 80.2%.

Statistical Assumptions and Analysis

The initial sample size in this study was 977 participants; however, five cases had one-third of the data missing and were deleted. Several other cases contained missing data, and these cases were estimated by using mean substitution. After the initial data estimation, this assumption was met. The examination of z scores revealed 81 outliers; all outliers within the range of $z = \pm 3.00$ were deleted from the data.

In order to examine for linearity, several bivariate scatterplots were generated and examined. All of the scatterplots revealed abnormalities between the variables due to the items being a 4-point Likert scale; therefore, this was a violation of the assumptions. The Pearson correlation coefficients were examined in a correlation matrix in order to determine if multicollinearity existed. The three highest correlation coefficients detected in the matrix were items 19 and 20 (0.81), items 10 and 11 (0.68), and items 22 and 23 (0.63). The collinearity diagnostic demonstrated that four variance proportions were above 0.5; however, none of the condition indices were combined with more than one high number in the variance proportions. Additionally, none of the VIFs were greater

than 3.23. This leads to the conclusion that no multicollinearity existed between any of the dependent variables. Each of the dependent variables was an independent measure, therefore, ruling out singularity. Frequencies were calculated, and descriptive statistics were generated after recoding three negative items. Analyses, including exploratory and confirmatory factor analyses, were conducted with SPSS and M-Plus.

Results and Discussion

The construct validity was examined using an exploratory factor analysis with SPSS. The Maximum Likelihood extraction with an Equamax rotation was used. An initial examination of the data revealed six dimensions with Eigenvalues greater than 1 and explained 59.16% of variance. The percentages of variance for the six subscales are as follows: BI (28.90%), PI_{nn} (8.14%), Li (6.97%), EE (5.65%), PE (4.89%), and QoS (4.61%). The examination of the scree plot of the initial retraction (Figure 1) verified the existence of six dimensions.

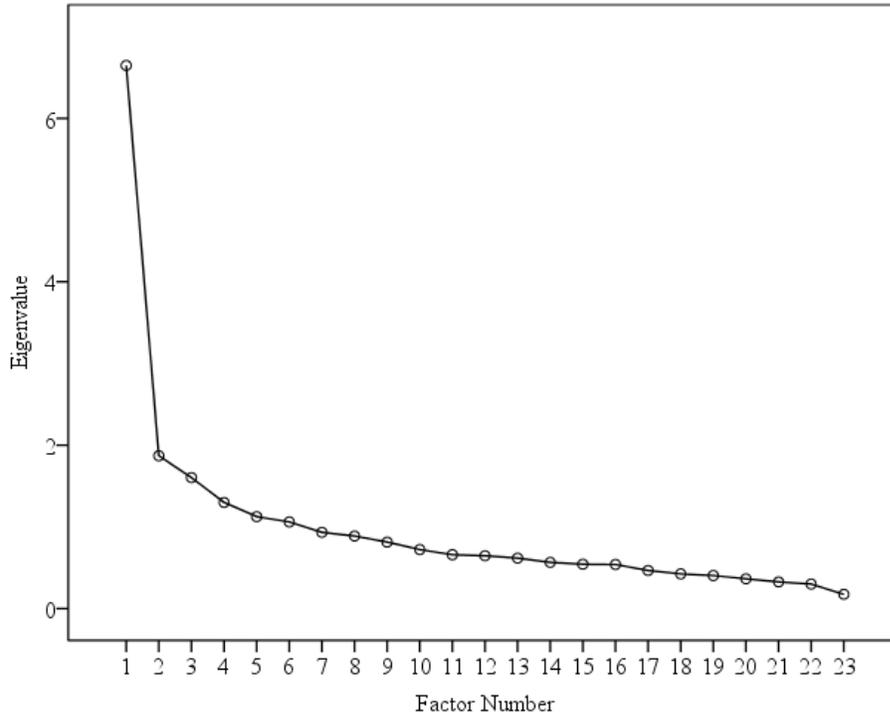


Figure 1. Scree plot of the initial factor extraction.

Most factor loadings on the subscales were satisfactory. The exceptions were items 5, 6, and 12; these items had either very low or complex loadings and may need slight revisions. Because the constructs hold up, this analysis provides evidence that the Japanese version of this instrument is a valid measure for college students' acceptance of mobile devices for the use in informal foreign-language learning. It also confirms that the model can predict students' acceptance of mobile technologies. A summary of the factor loadings is provided in Table 2.

Table 2
Factor Loadings for Items in all Subscales

Item	PE	EE	LI	QoS	PIInn	BI
1	0.57	–	–	–	–	–
2	0.77	–	–	–	–	–
3	0.35	–	–	–	–	–
5*	0.18	–	–	0.39	–	–
6*	–	0.31	–	0.36	–	–
7	–	0.74	–	–	–	–
8	–	0.33	–	–	–	–
9	–	0.68	–	–	–	–
10	–	–	0.60	–	–	–
11	–	–	0.97	–	–	–
12*	–	–	0.04	0.12	–	–
13	–	–	–	0.45	–	–
14	–	–	–	0.52	–	–
16	–	–	–	0.33	–	–
18	–	–	–	0.47	–	–
19	–	–	–	–	0.88	–
20	–	–	–	–	0.82	–
21	–	–	–	–	0.42	–

22	-	-	-	-	-	0.61
23	-	-	-	-	-	0.70
24	-	-	-	-	-	0.64
25	-	-	-	-	-	0.60
26	-	-	-	-	-	0.60

Note. *Items with low or complex loadings.

A confirmatory factor analysis was conducted to determine fit of the revised model. The results of a confirmatory factor analysis with M-Plus indicated that the model had acceptable fit. The criteria and standards used to judge model fit for the following model (see Hu & Bentler, 1999) included the Comparative Fit Index (CFI), Steiger's Root Means Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). CFI values above 0.95 indicate very good fit and those at or above 0.90 indicate reasonable fit (Bentler, 1990), RMSEA values below 0.05 indicate a very good fit and those at or below 0.10 indicate a reasonable fit (Steiger, 1990), and SRMR values below 0.05 indicate a very good fit (Hu & Bentler, 1999). This constellation of fit statistics conforms to recommended strategies for evaluation of the fit of structural models (Hu & Bentler, 1999).

A one-factor model was hypothesized and fit based on prior literature. The fit of the one factor model was acceptable, $\chi^2(224) = 848.790, p < .001$, CFI = 0.905, RMSEA = 0.057. This model reflected the data and theory so no further models were tested. In summary, the internal reliability results and retest stability of the six factors confirm that the data obtained have satisfactory consistency of measurement. Other researchers may use the revised instrument to measure students' acceptance of mobile technologies.

Conclusion

It was the goal of the study to validate a modified version of the M-Learning Acceptance model. Although the results of the confirmatory factor analysis indicate it is a valid instrument with sound psychometric properties, three of the 23 scale items should be revised in order to address their low or complex loadings. The original M-Learning Acceptance model (Abu-Al-Aish & Love, 2013) focused on ML in general in formal settings. The modified version can be used by researchers to evaluate the acceptance of mobile technology of adult learners who use these technologies to study a foreign language outside of the classroom.

While this study focused on the Japanese university context and a specific area of study, the modified instrument can be utilized in a variety of settings and environments in order to measure and predict learners' acceptance of mobile technology. Future research may focus on testing and retesting the reliability and validity of the model in different settings and learning environments.

The instrument is now available in English and Japanese, but it could be translated into other languages to assist researchers to measure learners' acceptance of mobile technologies whose native language is neither English nor Japanese.

Some limitations need to be pointed out. First, the study was geographically limited in that the data were collected at one institution in Japan. This fact may have introduced bias. In future studies, researchers may include multiple sites and students of different academic status and with a variety of academic majors. Second, the data were collected at a private university. Students at this private university may have a higher socioeconomic status and a higher achievement compared to students who attend public universities. Researchers may replicate the study at a public university to verify whether satisfactory consistency of measurement is possible in a different context. Third, while students' participation was voluntary and anonymous, there may be concerns about the power structure between students and instructors (Creswell, 2014). Particularly in Japan, teachers are highly valued and respected; therefore, they are in high power positions which may have influenced the results. Last, all data were self-reported due to the nature of the study.

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