Chapter 1 Introduction

1.1 Background

The third generation (3G) mobile services can be used as an efficient learning tool. Mobile learning (M-learning) is an activity in which people carry out learning activities using a mobile device like a cell phone or a personal digital assistant (PDA). M-learning allows users to access learning material anytime and anywhere (Alexander, 2004; Clyde, 2004; Gay *et al*., 2001; Hill and Roldan, 2005; Liu *et al*., 2003; Trifonova and Ronchetti, 2003; Wagner, 2005). This new M-learning technology encourages users to attend a variety of learning activities, including to search for knowledge, participate in discussion groups and access informational contents online (Chang *et al*., 2003; Roschelle, 2003). M-learning compliments electronic learning (E-learning) by creating an additional access channel for mobile users with mobile devices. Because of the potential widespread use of 3G mobile devices, M-learning is likely going to be the next wave of any learning environment, such as museums (Goh and Kinshuk, 2004; Hsu *et al*., 2006; Tan and Liu, 2004).

The 3G networks are not yet commonly available, and M-learning is still in its infancy, with many aspects of mobile learning yet to be explored (Taylor, 2003). Previous studies have extensively addressed M-learning from technical

perspectives (Chang *et al*., 2003; Chen *et al*., 2003; Liu *et al*., 2003; Trifonova and Ronchetti, 2003; Zurita and Nussbaumw, 2004), but few empirical works are available on M-learning from a customer's standpoint. As a result, M-learning suppliers can provide quality M-learning to customers only by studying the customers carefully.

The primary goal of this work was to enhance our understanding of user acceptance of M-learning. This study addresses the ability to predict consumer acceptance of M-learning in terms of social influences (i.e. friends) as stipulated by the theory of reasoned action (TRA) and individual differences (i.e. perceived usefulness) as stipulated by the technology acceptance model (TAM). TRA is typically regarded as the best starting point for understanding the determinants and effects of individuals' intentions (Sheppard *et al.*, 1988), and has been applied in many settings (Choo *et al*., 2004; Hansen *et al*., 2004; Ryan, 1982; Ryan and Bonfield, 1975, 1980; Sheppard *et al*., 1988). Since TRA is designed to predict virtually all human behavior (Ajzen and Fishbein, 1980), it can be used to explore the determinants of customer behavior in using M-learning. Because M-learning technology is still immature, the crucial social influences that affect its adoption by users need to be explored. This study develops three social influences, namely "family members", "friends" and "experts". TAM is a model for explaining the user acceptance of novel technology, and has been theoretically and empirically justified (e.g., Devaraj *et al.*, 2002; Gong *et al*., 2004; Klopping and McKinney, 2004). Because M-learning technology is still in its development stage, the crucial motivational

variables that will affect its adoption by users need to be explored. This study developed two new constructs, namely “perceived mobility value” and “perceived enjoyment”.

The prospects for different elements of the two models were addressed herein in order to understand all determinants of user acceptance. The appropriateness of the theory of reasoned action and the technology acceptance model was examined using the LISREL (linear structural relationships) software application. Important fit indices, such as CFI (comparative fit index), RMSEA (root mean square error of approximation), and GFI (goodness-of-fit), were addressed. Undergraduate students in Taiwanese universities were asked to answer a self-administered questionnaire about their opinions of M-learning. Because of their familiarity with mobile devices, university students were chosen using an online survey for evaluating user acceptance of M-learning.

1.2 Motivates and Objectives of This Study

This dissertation aims to probe consumers’ perceptions of using M-learning, including TRA and TAM models, addressing different social influences, individual variables, perceived ease of use, perceived usefulness, attitude toward M-learning and behavioral intention. An online survey of M-learning was conducted to collect data for two reasons: first, most people have experience using the Internet; and second, many people have their own mobile devices. Since many studies have examined the relationships between different variables

of TRA or TAM, this study focuses on how new social influences or individual variables impact users' perceptions of M-learning.

1.3 Organizations of the Dissertation

This dissertation, including six chapters, is organized as follows. Chapter one is introduction, which describes the background of M-learning and previous researchers that are related to this issue. Chapter two is to review related literature about the theory of reasoned action (TRA) and the technology acceptance model (TAM). Chapter three describes the modified TAM model, the TRA mode and the hypotheses. Chapter four states the methodology. Chapter five reports the results of survey. Chapter six reaches conclusions and draws suggestions for future studies.

Chapter 2 Literature Review

2.1 Theory of Reasoned Action (TRA)

Behavior prediction has been one of the major purposes of psychological theories. Some of the more useful theories include the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975), the social cognitive theory (SCT) (Compeau and Higgins 1995; Hill *et al*., 1987) and TAM (Davis, 1989, 1993). Among them, the theory of reasoned action (TRA) is very useful in predicting a wide range of behavior (Sheppard *et al*., 1988; Madden *et al*., 1992), and many researchers used TRA to predict consumers' behavior (Fishbein and Ajzen, 1975; Ryan, 1982; Ryan and Bonfield, 1975, 1980).

A meta-analytic review of the TRA (Sheppard *et al*., 1988) validates that TRA has strong predictive utility across different areas such as business ethics (Chang, 1998; Randall, 1989), product purchasing (Choo *et al*., 2004; Hansen *et al*., 2004), coupon usage (Shimp and Kavas, 1984), Internet banking (Shih and Fang, 2004), sexual behavior (Gillmore *et al*., 2002; Sutton *et al*., 1999), and information technology (Wu, 2003). TRA is good at predicting virtually human behavior (Ajzen and Fishbein, 1980), thus it could be properly used to study the

determinants of customer behavior of M-learning.

TRA is based on three general concepts, namely social influence (SI), attitude (ATT) and behavioral intention (BI) (depicted in Fig. 1). TRA is based on the theory that variables affect behavioral intention indirectly through their impact on attitude and/or social influences (Bagozzi *et al*., 1992; Fishbein and Ajzen, 1975). In this study, social influences reflect an individual's perception that "most people who are important to the person think he or she should or should not perform the behavior in question" (Ajzen and Fishbein, 1980). The concept of social influences indicates the existence of social explanations, and is recognized as a critical construct in the TRA (Shih and Fang, 2004). Therefore, TRA can reasonably be considered to illuminate users' behavior of M-learning through social influences. TRA is mainly adopted to study the impact on social factors on user acceptance of M-learning.

ATT is defined as a person's general feeling about the desirability of using M-learning. BI measures the degree to which an individual would use the technology in the future, and is a linear function of two psychological variables: (1) a person's attitude toward performing a behavior, and (2) a person's social influences regarding the behavior (Ajzen and Fishbein, 1980).

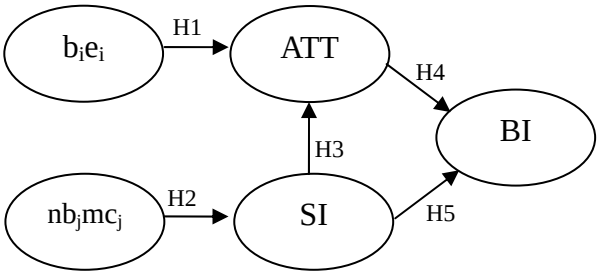


Figure 1 Theory of Reasoned Action Model

b_ie_i= behavioral beliefs and outcome evaluations, nb_jmcj= normative beliefs and motivation to comply, SI= social influence, ATT= attitude, BI= behavioral intention.

These constructs can be structured as follows:

BI = ATT+SI

where:

ATT = $\Sigma\, b_ie_i$ and SI = $\Sigma\, nb_jmc_j$

Attitude toward behavior is computed from $b_i \times e_i$, where b_i denotes the salient belief that performing an action leads to consequence *i*, and e_i represents an evaluation of consequence *i*. The social influence is calculated from $nb_j \times mc_j$, where nb_j denotes a normative perception of the opinions of reference group *j* about whether an individual should perform an action, and mc_j represents the user's motivation for complying with agent *j* (Chang, 1998; Choo *et al*., 2004; Miniard and Cohen, 1983).

Therefore, this study uses a TRA model to explain user behavior in using

M-learning in terms of the relationship between user attitudes toward behavior, and social influences. Additionally, the path from social influences to attitude is expected to exhibit a strong causal relationship, as revealed in other works (Chang, 1998; Choo *et al*., 2004; Hansen *et al*., 2004; Shimp and Kavas, 1984).

2. 2 Technology Acceptance Model (TAM)

TAM, originally presented by Davis (1989), is derived from TRA (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975). TAM is a behavioral model that describes the antecedents of the adoption of information technology (IT), and is considered a robust tool for measuring the adoption of new technology by users (Adams *et al*., 1992; Agarwal and Prasad, 1999; Chin and Todd, 1995; Davis, 1989; Davis *et al*., 1989; Doll *et al*., 1998; Igbaria *et al*., 1996; Segars and Grover, 1993; van der Heijden, 2003). Over the years TAM has been validated by various applications and extensions, including web-based information (Gong *et al*., 2004; Stoel and Lee, 2003; van der Heijden, 2003; Yi and Hwang, 2003), Internet banking (Chan and Lu, 2004; Kamel and Hassan, 2003; Wang *et al*., 2003) and electronic commerce (Devaraj *et al*., 2002; Henderson and Divett, 2003; Klopping and McKinney, 2004; van Dolen and de Ruyter, 2002). The M-learning technology is novel, and is therefore appropriate to be examined using the TAM model.

Figure 2 illustrates the TAM, which is derived from the TRA, and includes six constructs, namely external variables, perceived usefulness, perceived ease

of use, attitude, behavioral intention and actual usage. It shows that user behavior is determined by perceptions of usefulness and the ease of use of the technology (Adams *et al*., 1992; Davis, 1989; Davis *et al*., 1989; Mathieson, 1991). The concept of actual usage was eliminated from the revised TAM model, because M-learning technology is still at an early stage of development. This study investigates the future acceptance of the emerging M-learning technology, rather than its current usage. Actual usage is not a cogent measure of the value of M-learning, as indicated in previous studies (Gong *et al*., 2004; Lu *et al*., 2003; Yang, 2005). The following sections describe the constructs of TAM in detail, and its applicability to the present study.

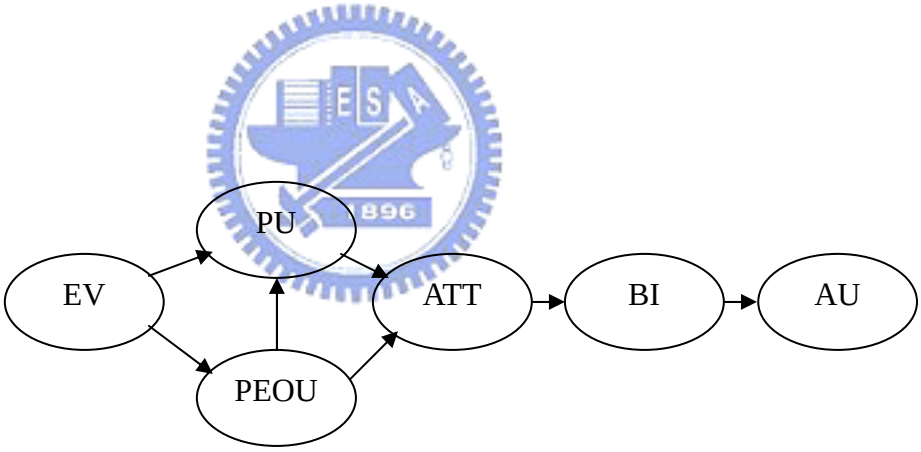


Figure 2 Technology Acceptance Model

Source: Davis et al. (1989, p.985)

EV= external variables, PU= perceived usefulness, PEOU= perceived ease of use, ATT= attitude, BI= behavioral intention, AU= actual usage.

2.2.1 Perceived Usefulness (PU) and Perceived Ease of Use (PEOU)

TAM posits that two particular behavioral beliefs, perceived usefulness (PU) and perceived ease of use (PEOU), are two fundamental factors for predicting user acceptance, and that the effect of external variables on intention are mediated by these two key beliefs (Adams *et al*., 1992; Davis, 1989; Davis *et al*., 1989; Mathieson, 1991). PU is defined as an individual's perception that using a new technology will enhance or improve her/his performance (Davis, 1989, 1993). Applying this definition to this research context, PU means the users' perception that using M-learning enhances their learning performance. A strengthening of this belief creates a positive attitude toward M-learning, thereby increasing the user's intention to use M-learning.

PEOU is defined as an individual's perception that using a new technology will be free from effort (Davis, 1989, 1993). Applying this definition in this research context, PEOU represents the perception that M-learning is easy to use. PEOU is hypothesized to be a predictor of PU. Moreover, both PU and PEOU are affected by external variables (Hu *et al*., 1999; Venkatesh, 2000; Venkatesh and Davis, 2000; Venkatesh *et al*., 2002; Wang *et al*., 2003). Furthermore, PU and PEOU have a positive effect on attitude. Unlike in TRA, the social influence is not a determinant of behavioral intention in TAM; instead, BI in TAM is affected only by PU and attitude (Davis, 1989).

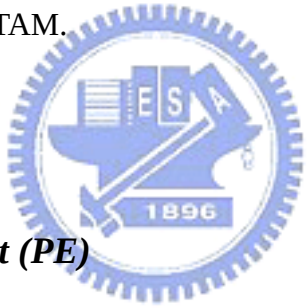
2.2.2 External Variables

Although TAM is a model applicable to a variety of technologies (Adams *et al*., 1992; Chin and Todd, 1995; Doll *et al*., 1998; Segars and Grover, 1993), it has been criticized for not providing adequate information on individuals' opinions of novel systems (Mathieson, 1991; Moon and Kim, 2001; Perea y Monsuwe *et al*., 2004). Davis (1989, p. 985) observed that external variables enhance the ability of TAM to predict acceptance of future technology. In other words, the constructs of TAM need to be extended by incorporating additional factors. Choosing additional factors depends on the target technology, main users and context (Moon and Kim, 2001). Wang *et al*. (2003) noted that variables relating to individual differences play a vital role in the implementation of technology. Additionally, empirical research based on TAM has discovered strong relationships between individual differences and IT acceptance (Agarwal and Prasad, 1999; Venkatesh, 2000). To understand user perception of M-learning, this study integrated two individual difference variables, namely "perceived mobility value" and "perceived enjoyment", into the proposed TAM model. These two constructs are described below.

Perceived Mobility Value (PMV)

Perceived mobility value (PMV) denotes user awareness of the mobility value of M-learning. Mobility has three different elements including

convenience, expediency and immediacy (Seppälä et al., 2002; Seppälä and Alamäki, 2003). Mobility permits users to gain access to learning/information anywhere at anytime via mobile devices. In other words, mobility brings the ability to guide and support users in new learning situations when and where it is necessary. Previous studies found that mobile users valued efficiency and availability as the main advantages of M-learning, and these advantages are a result of the "mobility" of a mobile device (Chen *et al*., 2003; Hill and Roldan, 2005; Ting, 2005). Therefore, M-learning is valuable because of its mobility. Consequently, the perceived mobility value is a critical factor of individual differences affecting users' behaviors. This study treats perceived mobility value as a new variable in the TAM.



Perceived Enjoyment (PE)

Individuals engage in activities because these activities lead to enjoyment and pleasure (Teo and Lim, 1997). According to Davis *et al*. (1992), perceived enjoyment is defined as "the extent to which the activity of using the technology is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated". In this study, perceived enjoyment denotes the extent to which an individual finds the interaction of M-learning intrinsically enjoyable or interesting. Perceived enjoyment is seen as an example of intrinsic motivation, and it has been found to influence user acceptance significantly. Furthermore, research on the role of enjoyment suggested the

importance of enjoyment on users' attitudes and behaviors (Davis *et al*., 1992; Igbaria *et al*., 1995, 1996; Teo and Lim, 1997; Wanta and Gao, 1994; Wexler, 2001; Yi and Hwang, 2003). Hence, perceived enjoyment is addressed as a key factor for influencing user acceptance of M-learning.

Chapter 3 Research Model and Hypotheses

As noted above, each construct of the TRA and TAM has been clearly explained to reflect user acceptance of M-learning. As revealed in Fig. 1, the proposed TRA includes three external social influences, namely “family members”, “friends” and “experts”. These three constructs might significantly affect the existing TRA variables. Additionally, other relationships between the constructs proposed by the TRA model are also presented. To establish the proposed model, it was built on theoretical frameworks recommended in previous investigations. As shown in Fig. 3, the proposed TAM includes two external variables, namely “perceived mobility value” and “perceived enjoyment”. These two constructs may significantly affect existing TAM variables. In addition, other relationships between the constructs proposed by the original TAM are also presented (Davis *et al*., 1989; Venkatesh and Davis, 2000). To establish the two proposed models (as shown in Figs. 1 and 3), they were built on theoretical frameworks recommended in previous investigations. This study aims to confirm whether these two models successfully predict user acceptance of M-learning. The next section describes in detail all hypotheses concerning the relationships among the variables in the two models.

3.1 Theory of Reasoned Action

A major contribution of TRA is the specificity of attitudes and intentions to match behavior (Bobbitt and Dabholkar, 2001). The TRA states that a user's behavior is a function of the behavioral intention, which is "jointly determined by attitude and social influences" (Fishbein and Ajzen, 1975). Pervious studies proposed that family members, friends and experts strongly affect the behavior of users (Oliver and Bearden, 1985; Ryan, 1982; Ryan and Bonfield, 1980). Therefore, this study addressed the impact of these three social influences on user behavior, and posits that the opinions of family members, friends and experts significantly affect users' behavioral intentions. Furthermore, Fishbein and Ajzen noted that attitude and social influences might be linked to each other. Previous studies have found a strong positive correlation between attitude and social influences (Choo *et al.*, 2004; Miniard and Cohen, 1983; Shimp and Kavas, 1984). This study expects that the two constructs are significantly related. Individuals can be strongly influenced by family members, friends and experts, who may encourage or discourage them from performing specific actions (Fishbein and Ajzen, 1975; Randall, 1989). Restated, a consumer's intention to perform a certain behavior may be affected by the normative social beliefs and consumer's beliefs about the appropriateness. Therefore, the following hypotheses were tested:

H1. Behavioral beliefs and outcome evaluations has a positive effect on attitude.

H2. Normative beliefs and motivation to comply has a positive effect on social influence.

H3. Social influence has a positive effect on attitude.

H4. Attitude has a positive effect on behavioral intention.

H5. Social influence has a positive effect on behavioral intention.

3.2 Technology Acceptance Model

As revealed in Fig. 3, the proposed TAM includes two external variables, namely perceived mobility value" (Coursaris and Hassanein, 2002a, 2002b; Coursaris *et al*., 2003; Siau *et al*., 2001) and "perceived enjoyment" (Igbaria *et al*., 1996; Venkatesh, 2000; Venkatesh *et al*., 2002; Yi and Hwang, 2003). These two motivation constructs might significantly affect the existing TAM variables. Additionally, other relationships between the constructs proposed by the TAM are also presented (Davis *et al*., 1989; Venkatesh and Davis, 2000). The next section describes in detail all hypotheses concerning relationships among the variables in the model.

3.2.1 Perceived Mobility Value (PMV)

PMV has not been tested previously, but it relates to users' personal awareness of mobility value. Mobility enables users to receive and transmit information anytime and anywhere (Anckar and D'Incau, 2002; Chen *et al*., 2003; Coursaris and Hassanein, 2002a, 2002b; Coursaris *et al*., 2003; Hill and Roldan, 2005; Siau *et al*., 2001; Ting, 2005). Mobility associated with time-related needs encourages users to adopt mobile technology since enhanced accessibility is expected to affect dynamic interaction and high levels of engagement (Anckar and D'Incau, 2002, p. 48). Hence, users perceiving the value of mobility understand the uniqueness of M-learning and have a strong perception of its usefulness. Obviously, perceived mobility value has a positive effect on the perceived usefulness of M-learning. Therefore, this work treats perceived mobility value as a direct antecedence of perceived usefulness (PU).

H6. Perceived mobility value has a positive effect on perceived usefulness.

3.2.2 Perceived Enjoyment (PE)

The concept of perceived enjoyment (PE) adapted from Davis *et al*. (1992) means that users feel enjoyable from the instrumental value of using M-learning. Prior studies on technology acceptance behavior examined the effects of perceived enjoyment on perceived ease of use (Igbaria *et al*., 1996; Venkatesh, 2000; Venkatesh *et al*., 2002; Yi and Hwang, 2003). New technologies that are

considered enjoyable are less likely to be difficult to use.

H7. Perceived enjoyment has a positive effect on perceived ease of use.

There is a causal relationship between perceived enjoyment and attitude. When users feel that M-learning is enjoyable, the stimulus of happiness in turn enhances their perception of M-learning. Venkatesh (2000) found that perceived enjoyment indirectly influences users on adoption. Other research showed that attitudinal outcomes, such as happiness, pleasure, and satisfaction, result from the enjoyable experience (Childers *et al*., 2001; Moon and Kim, 2001; van der Heijden, 2003; Yu *et al*., 2005). These findings indicate that enjoyment highly correlates with the users' positive attitudes.

H8. Perceived enjoyment has a positive effect on attitude.

3.2.3 Perceived Ease of Use, Perceived Usefulness, Attitude, and Behavioral Intention

TAM delineates the causal relationships between perceived usefulness (PU), perceived ease of use (PEOU), attitude and behavioral intention (BI) to explain users' acceptance of technologies. PEOU is hypothesized to be a predictor of PU. Additionally, attitude is determined by two salient beliefs, namely PU and PEOU (Davis, 1989). Finally, BI is determined by PU and attitude.

The Influence of PEOU on PU

TAM posits a strong direct link between PEOU and PU. If all other factors are equal, users are likely to consider a technology to be more useful if they perceive that it is easier to use (Brown and Licker, 2003; Bruner II and Kumar, 2005; Davis *et al*., 1989; Gefen, 2003; Hu *et al*., 1999; Igbaria and Iivari, 1995; Stoel and Lee, 2003; van der Heijden, 2003; Venkatesh, 2000; Venkatesh and Davis, 2000; Venkatesh *et al*., 2002; Wang *et al*., 2003; Yu *et al*., 2005). Therefore, PEOU is likely to have a direct effect on the PU of the construct.

H9. Perceived ease of use has a positive effect on perceived usefulness.

The Influence of PEOU and PU on Attitude

The attitude toward using a given technology is the overall evaluation that predicts a user's likelihood of adopting that emerging technology. Past research indicates that attitude is influenced by both PEOU and PU components (Childers *et al*., 2001; Davis, 1989, 1993; Dabholkar and Bagozzi, 2002; Mathieson, 1991; O'Cass and Fenech, 2003; Stoel and Lee, 2003; van der Heijden, 2003; Yu *et al*., 2005). Thus, that attitude is positively influenced by PU and PEOU is proposed herein.

H10. Perceived ease of use has a positive effect on attitude.

H11. Perceived usefulness has a positive effect on attitude.

The Influence of PU and Attitude on BI

In TAM, BI is influenced by both PU and Attitude. This relationship has been examined and supported by many prior studies (Adams *et al*., 1992; Davis, 1989, 1993; Davis *et al*., 1989; Gefen, 2003; Hu *et al*., 1999; Stoel and Lee, 2003 ; Venkatesh and Davis, 1996, 2000). Therefore, this study presents the following hypotheses.

H12. Perceived usefulness has a positive effect on behavioral intention.

H13. Attitude has a positive effect on behavioral intention.

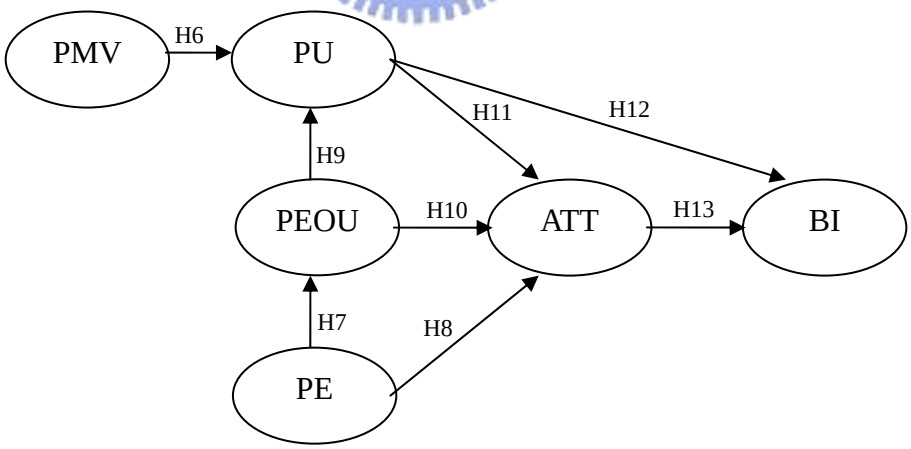


Figure 3 Proposed Extended TAM Model

PMV= perceived mobility value, PE= perceived enjoyment, PU= perceived usefulness, PEOU= perceived ease of use, ATT= attitude, BI= behavioral intention.

Chapter 4 Methodology

4.1 Study Context and Sample

Undergraduate and graduate students in two Taiwan universities were asked to evaluate their perception of M-learning by completing an online survey. All respondents were guaranteed confidentiality of their individual response. An embedding program was added to the electronic survey to check for missing responses. As a result, 313 usable questionnaires were obtained, of which 47.3% (*N*=148) were from male respondents, and 52.7% (*N*=165) from female respondents. The majority of the respondents, 85.6% (*N*=268), were between 20 and 24 years of age, and 99% (*N*=310) possessed mobile devices. The experience of using mobile devices ranged from 0 to 15 years, with a mean of 6.61 years.

4.2 Questionnaire Design

The items used to construct each variable were mainly adopted from previous studies, as shown in Table I and Table II, to assure content validity.

Appropriate items were designed to measure three social influences, namely family members, friends and experts. Two new individual constructs, namely perceived mobility value and perceived enjoyment also examined. Participants were asked to evaluate statements using a 5-point Likert-type scale ranging from strongly disagree (1) through neutral (3) to strongly agree (5). The questionnaire consisted of 28 items addressing all constructs.

Table I Research Variables for TRA model

Variable	Description	Type	Items	Source	Questionnaires
b_ie_i	Behavioral beliefs and outcome evaluations	Independent	3	Ryan (1982); Ryan and Bonfield (1975); Shimp and Kavas (1984); Wu (2003)	(b_1e_1) Using M-learning has more advantages and it is important to me. (b_2e_2) Using M-learning will fit my lifestyle and it is important to me. (b_3e_3) Using M-learning will fit well with how I use it and it is important to me.
nb_jmc_j	Normative beliefs and motivation to comply	Independent	3	Ryan (1982); Ryan and Bonfield (1975); Shimp and Kavas (1984); Wu (2003)	(nb_1mc_1) Family members would suggest that I use M-learning and I want to do what they want. (nb_2mc_2) My friends would suggest that I use M-learning and I want to do what they want. (nb_3mc_3) Experts would suggest that I use M-learning and I want to do what they want.
SI	Social influence	Independent/ Dependent	3	Ryan (1982); Ryan and Bonfield (1975); Shimp and Kavas (1984); Wu (2003)	(SI1) Family members important to me would think that using M-learning would be a good idea. (SI2) My friends important to me would think that using M-learning would be a good idea. (SI3) Experts persuasive to me would think that using M-learning would be a good idea.
ATT	Attitude	Independent/ Dependent	3	Bagozzi et al. (1992); Hu et al. (1999)	(ATT1) In my opinion it would be very desirable to use M-learning. (ATT2) I would like to use M-learning. (ATT3) I hold a positive evaluation of M-learning.
BI	Behavioral intention	Dependent	3	Bagozzi et al. (1992); Hu et al. (1999)	(BI1) I intend to use M-learning when it becomes available. (BI2) If I were asked to express my opinion of M-learning, I intend to say something favorable. (BI3) In the future, I intend to use M-learning routinely.

Table II Research Variables for TAM model

Variable	Description	Type	Items	Source	Questionnaires
PE	Perceived Enjoyment	Independent	3	Moon and Kim (2001); Yi and Hwang (2003); Yu et al. (2005)	(PE1) M-learning would make me feel good. (PE2) M-learning would be interesting. (PE3) I would have fun using M-learning.
PMV	Perceived mobile value	Independent	4	newly created by this research	(PMV1) I know that mobile devices are the mediums for M-learning. (PMV2) It is convenient to access M-learning anywhere at anytime. (PMV3) Mobility makes it possible to get the real-time data. (PMV4) Mobility is an outstanding advantage of M-learning.
PU	Perceived usefulness	Independent/ Dependent	3	Davis (1989, 1993); Venkatesh and Davis (1996); Yang (2005)	(PU1) Using M-learning would save me much time. (PU2) M-learning would enhance my effectiveness in learning. (PU3) Overall, M-learning would be useful.
PEOU	Perceived ease of use	Independent/ Dependent	3	Davis (1989, 1993); Venkatesh and Davis (1996); Yang (2005)	(PEOU1) Using M-learning would not require a lot of my mental effort. (PEOU2) My interaction with M-learning would be clear and understandable. (PEOU3) M-learning would be easy to use.
ATT	Attitude	Independent/ Dependent	3	Bagozzi et al. (1992); Hu et al. (1999)	(ATT1) In my opinion it would be very desirable to use M-learning. (ATT2) I would like to use M-learning. (ATT3) I hold a positive evaluation of M-learning.
BI	Behavioral intention	Dependent	3	Bagozzi et al. (1992); Hu et al. (1999)	(BI1) I intend to use M-learning when it becomes available. (BI2) If I were asked to express my opinion of M-learning, I intend to say something favorable. (BI3) In the future, I intend to use M-learning routinely.

Chapter 5 Results

A confirmatory factor analysis was conducted using LISREL 8.51 to test the two models. The hypothesized relationships among the variables in each model were analyzed, and parameters were estimated with maximum likelihood. Covariances among manifest variables of the theory of reasoned action are presented in Table III, and those of the technology acceptance model are presented in Table Ⅳ. The proposed structural equation model was then tested for each model. As revealed in Table Ⅴ, the overall goodness of fit of each model was verified with seven fitness measures, namely comparative fit index (CFI), goodness-of-fit (GFI), adjusted goodness-of-fit (AGFI), normalized fit index (NFI), non-normalized fit index (NNFI), Critical N (CN) and root mean square error of approximation (RMSEA). From Table Ⅴ, it shows that all model-fit-indices exceeded the acceptance levels suggested by the previous research, and the results indicate that both the two models had very good fit with the data gathered. Goodness of fit indices show that the TRA model fitted the data well (i.e. CFI=0.98, GFI=0.95, RMSEA=0.034), and the model clearly explains the user acceptance of M-learning as expected (i.e. Choo *et al.*, 2004; Sheppard *et al.*, 1988). Additionally, goodness of fit indices show that the TAM

model fitted the data well (i.e. CFI=0.99, GFI=0.95, RMSEA=0.019). Hence, TAM effectively explains the user perception of M-learning (i.e. Moon and Kim, 2001; van Dolen and de Ruyter, 2002; Yi and Hwang, 2003). TRA and TAM can clearly explain or predict customer behavior regarding M-learning. Previous research addressed the absolute fit of the model(s) and also discussed which model provides the best fit to the data (Gentry and Calantone, 2002). This study does not compare the two models, because it supports the theoretical application of TRA and TAM for examining user acceptance of M-learning. Both models accurately predict human behavior relating to new technology, and do not need to be compared further.

Table III Covariance among the Research Variables for the TRA

	b_1e_1	b_2e_2	b_3e_3	nb_1mc_1	nb_2mc_2	nb_3mc_3	SI1	SI2	SI3	ATT11	ATT2	ATT3	BI1	BI2	BI3
b_1e_1	0.26														
b_2e_2	0.13	0.23													
b_3e_3	0.10	0.11	0.27												
nb_1mc_1	0.06	0.08	0.08	0.29											
nb_2mc_2	0.07	0.07	0.07	0.19	0.26										
nb_3mc_3	0.07	0.07	0.07	0.18	0.19	0.34									
SI1	0.06	0.07	0.08	0.12	0.14	0.12	0.28								
SI2	0.07	0.07	0.09	0.12	0.13	0.18	0.18	0.35							
SI3	0.06	0.07	0.08	0.11	0.12	0.15	0.16	0.22	0.33						
ATT1	0.04	0.04	0.03	0.03	0.04	0.03	0.04	0.04	0.03	0.29					
ATT2	0.07	0.06	0.06	0.07	0.07	0.07	0.05	0.05	0.05	0.09	0.30				
ATT3	0.05	0.06	0.05	0.07	0.05	0.08	0.05	0.06	0.06	0.08	0.16	0.27			
BI1	0.07	0.06	0.05	0.05	0.05	0.06	0.04	0.05	0.06	0.04	0.12	0.12	0.25		
BI2	0.06	0.07	0.07	0.05	0.04	0.04	0.04	0.04	0.04	0.06	0.09	0.09	0.10	0.26	
BI3	0.05	0.04	0.05	0.06	0.05	0.06	0.05	0.05	0.04	0.07	0.08	0.08	0.06	0.10	0.25

Table Ⅳ Covariance among the Research Variables for the TAM

	PE1	PE2	PE3	PMV1	PMV2	PMV3	PMV4	PEOU1	PEOU2	PEOU3	PU1	PU2	PU3	ATT1	ATT2	ATT3	BI1	BI2	BI3
PE1	0.33																		
PE2	0.19	0.29																	
PE3	0.14	0.15	0.26																
PMV1	0.06	0.06	0.06	0.30															
PMV2	0.07	0.06	0.06	0.15	0.38														
PMV3	0.05	0.06	0.06	0.16	0.15	0.30													
PMV4	0.06	0.05	0.06	0.14	0.15	0.17	0.28												
PEOU1	0.06	0.06	0.05	0.06	0.05	0.05	0.06	0.40											
PEOU2	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.17	0.30										
PEOU3	0.04	0.04	0.03	0.07	0.05	0.05	0.05	0.18	0.14	0.29									
PU1	0.06	0.06	0.06	0.09	0.08	0.09	0.08	0.06	0.07	0.07	0.24								
PU2	0.04	0.04	0.03	0.05	0.07	0.08	0.08	0.04	0.03	0.03	0.11	0.33							
PU3	0.02	0.03	0.02	0.08	0.07	0.07	0.08	0.05	0.04	0.05	0.12	0.14	0.21						
ATT1	0.09	0.09	0.07	0.06	0.07	0.07	0.07	0.09	0.08	0.07	0.08	0.12	0.09	0.30					
ATT2	0.10	0.08	0.07	0.07	0.08	0.07	0.06	0.07	0.06	0.06	0.08	0.10	0.07	0.17	0.27				
ATT3	0.05	0.04	0.04	0.07	0.08	0.07	0.06	0.04	0.04	0.03	0.08	0.12	0.09	0.12	0.12	0.25			
BI1	0.06	0.06	0.04	0.08	0.08	0.08	0.09	0.06	0.04	0.06	0.08	0.09	0.07	0.10	0.09	0.10	0.26		
BI2	0.05	0.06	0.03	0.07	0.08	0.08	0.08	0.05	0.05	0.04	0.07	0.09	0.08	0.12	0.12	0.10	0.12	0.24	
BI3	0.06	0.07	0.06	0.07	0.07	0.07	0.07	0.06	0.04	0.06	0.05	0.07	0.06	0.09	0.08	0.06	0.11	0.12	0.25

Table Ⅴ Fit indices for the Two Models

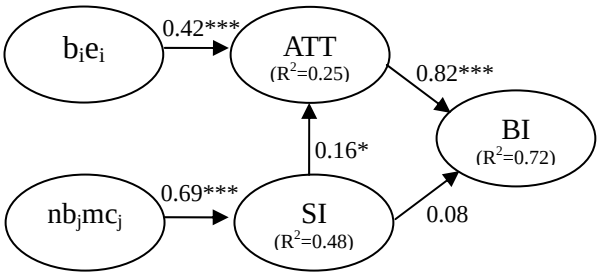
Fit indices	Suggested value	Source	the extended TRA model	the extended TAM model
comparative fit index (CFI)	CFI > .95	Bentler, 1995	0.98	0.99
goodness-of-fit (GFI)	GFI > .9	Hu and Bentler, 1999	0.95	0.95
adjusted goodness-of-fit (AGFI)	AGFI > .9	Hu and Bentler, 1999	0.93	0.93
normalized fit index (NFI)	NFI > .9	Bentler and Bonnet, 1980	0.93	0.92
non-normalized fit index (NNFI)	NNFI > .9	Bentler and Bonnet, 1980	0.98	0.99
Critical N (CN)	CN > 200	Hu and Bentler, 1999	333.37	351.81
root mean square error of approximation (RMSEA)	RMSEA < .05	Hu and Bentler, 1999 McDonald and Ho, 2002	0.034	0.019

5.1 Results of the Theory of Reasoned Action

The TRA results (depicted in Fig. 4) show that all the paths reached statistical significance, apart from the link between social influence and behavioral intention. The results confirm the findings of the earlier work, showing correlations between all but one of the key variables. The findings supported hypotheses H1, H2, H3 and H4, but not H5. The *t*-value of a parameter indicates the strength of the relationship the parameter represents. The higher the t-value is, the stronger the relationship is. Only the link between social influence and behavioral intention was not significant (t = 1.16), but social influences strongly impact attitude (t = 2.05), revealing that social influences affected behavioral intention only indirectly. Therefore, users did not react to behavior without considering their own thoughts and

opinions. These results confirm those of previous studies that the effect of attitudes on behavioral intention is stronger than that of social influences on behavioral intention (Gentry and Calantone, 2002; Oliver and Bearden, 1985; Ryan and Bonfield, 1980). The analytical results also show that the strength of family members (t = 15.30), friends (t = 17.50) and experts (t = 14.30) strongly affected M-learning users (Oliver and Bearden, 1985; Ryan, 1982; Ryan and Bonfield, 1980). Social influences clearly play a crucial effect on user behavior.

An individual faced with a new technology needs to consult other people, and take recommendations from family members, friends and experts. A person generally has a similar thinking style and language to his family members and friends. A user whose family members and friends have the positive opinion on M-learning is likely to follow the same step. Hence, the views of one's family members and friends become critical indices (Gentry and Calantone, 2002; Oliver and Bearden, 1985; Ryan and Bonfield, 1980). Family members and friends directly impact a user's impression on M-learning, and can cause users to change their opinions. Conversely, consumers in modern times have too much information to absorb at once, and therefore need some trustworthy judgment. Experts' perspectives on M-learning can strengthen users' confidence in the service due to their strong influence. Thus, experts play a significant role in the TRA model (Oliver and Bearden, 1985; Ryan, 1982).



Note:

The figure shown in the edge connecting any two nodes represents the number of unit increase in the dependent variable if the causing variable increases by one unit.

R^2 represents the proportion of the variance of the variable that could be explained by its causing variables

* significant at a .05 level

** significant at a .01 level

*** significant at a .001 level

Figure 4 Path Coefficients of TRA Model

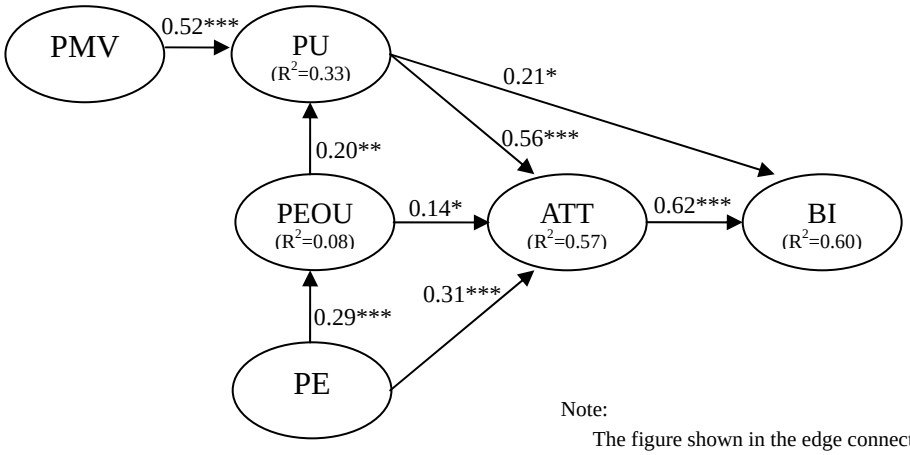
b_ie_i= behavioral beliefs and outcome evaluations, nb_jmcj= normative beliefs and motivation to comply, SI= social influence, ATT= attitude, BI= behavioral intention.

5.2 Results of the Technology Acceptance Model

All direct paths in TAM were significant (depicted in Fig. 5), so H6, H7, H8, H9, H10, H11, H12 and H13 were all supported. The *t*-value of a parameter indicates the strength of the relationship the parameter represents. The higher the t-value is, the stronger the relationship is. Figure 5 indicates that although PU (t = 6.98) and PEOU (t = 2.07) significantly affect attitude,

the effect of PU is stronger than that of PEOU, which is in agreement with previous findings (Gentry and Calantone, 2002; O'Cass and Fenech, 2003; Stoel and Lee, 2003; van der Heijden, 2003; Yu *et al*., 2005). The results indicate that users' perception of usefulness is more important than their perception of ease of use in influencing their attitude of using M-learning. In addition, H9 was supported, showing that PEOU is likely to have a direct effect on the PU of the construct, which again is consistent with previous research (e.g., Brown and Licker, 2003; Davis *et al*., 1989; Gefen, 2003; Yu *et al*., 2005). Therefore, the perceived ease of use of M-learning encourages an individual to regard M-learning as a useful technology.

Furthermore, behavioral intention was primarily affected by usefulness (t = 2.06) and attitude (t = 5.56), which implies that both usefulness and attitude are critical factors. The results indicate that attitude is indeed a mediator between beliefs and user intention (Gentry and Calantone, 2002; van der Heijden, 2003; Yu *et al*., 2005).



Note:

The figure shown in the edge connecting any two nodes represents the number of unit increase in the dependent variable if the causing variable increases by one unit.

R^2 represents the proportion of the variance of the variable that could be explained by its causing variables

* significant at a .05 level

** significant at a .01 level

*** significant at a .001 level

Figure 5 Path Coefficients of TAM Model

The proposed framework includes the hypothesis that perceived mobility value and perceived enjoyment are predictors of using M-learning. As expected, the significant positive relationships among the constructs confirm these hypotheses. The perceived mobility value significantly increases an individual's awareness of usefulness (t = 6.94). The more a user appreciates the value of mobility, the more the user will perceive that M-learning is useful. Hence, this study supports the contention that PMV plays an important role in user perceptions of M-learning, which is consistent with other works (Chen *et al*., 2003; Coursaris and Hassanein, 2002a, 2002b;

Coursaris *et al*., 2003; Siau *et al*., 2001; Ting, 2005). The significant link between perceived enjoyment and perceived ease of use (t = 3.92) implies that a user who enjoys using M-learning will find it to be easy to use. This result supports H7, and is consistent with those of previous studies. Moreover, perceived enjoyment has a direct effect on attitude (t = 4.80), which supports H8. Enjoyable experiences do result in positive attitudes. This result underlies the importance of perceived enjoyment in influencing user acceptance of a new technology (Davis *et al*., 1992; Igbaria *et al*., 1996; Teo and Lim, 1997; Wanta and Gao, 1994; Wexler, 2001; Yu *et al*., 2005).

This study proposes two models to understand customers' behavior of M-learning, namely the theory of reasoned action model and the technology acceptance model. Both TRA and TAM provide a very strong foundation for studying user acceptance. Most users who encounter the emerging M-learning technology believe that it would enhance learning performance and bring convenience. Unfortunately, however, the M-learning technology has not been widely investigated from the customer's point of view. This investigation not only studied users' perception of M-learning, but also observed factors that affect users' thoughts. Social influences and individual differences were addressed from customer perspectives. The TRA model considers social influences, while TAM considers individual factors. The structures of the two models were consistent with prior research. Furthermore, two new constructs, namely perceived mobility value and perceived enjoyment, are the key determinants of behavioral intention. This

study also examined the suitability of two social psychological theories for predicting personal behavior in M-learning. Analytical results show that the two proposed models successfully predicted user acceptance of M-learning. That is, the user is affected by both social factors, as measured in TRA and individual differences, as measured in TAM. The analytical results of TRA demonstrate that family members, friends and experts significantly affect user attitudes. The factors of individual differences in TAM effectively explain user behavior.

Chapter 6 Conclusions and Limitations

6.1 Conclusions

M-learning is increasingly being adopted by individual customers, and it is believed that the enhanced communication ability and real-time data availability increase efficiency and flexibility of learning life. Service providers and researchers need to understand how customers perceive M-learning, in order to attract users. By explaining user intention, this study not only presents user perspectives of M-learning, but also considers the factors that attract users to the emerging technology. Therefore, the findings of this study have several implications for M-learning providers and researchers interested in M-learning.

First, the theory of reasoned action model needs to be run to determine customers' opinions of new technology. As researchers noted, the theory of reasoned action model is good at predicting user behavior. The theory of reasoned action model enables researchers to measure the effect of social influences. In the study, the theory of reasoned action model exhibited the good fit of user perception of M-learning. Second, this study found that the opinions of family members, friends and experts are key determinants of user

perception of M-learning. The predictive power of the three added constructs shows that the new social influences are imperative. These relevant people' positive attitudes toward M-learning enhance user acceptance. The result indicates that service providers would promote M-learning, and create opportunities for customers to chat with these relevant persons, enabling positive opinions of M-learning to spread rapidly by word of mouth. Further research is needed to examine the role of additional influences within the theoretical structure. Third, this study found that perceived usefulness (PU) and perceived ease of use (PEOU) are key determinants of user perception of M-learning. However, PU affects individual's attitudes more than PEOU does. Although customers need a simple way to use M-learning, perceived usefulness is critical. In addition to designing a straightforward way to utilize the M-learning technology, providers should also endeavor to maximize the usefulness of M-learning. Fourth, this study has shown the importance of perceived mobility value (PMV) to an individual's acceptance of M-learning. The most significant feature of mobile technology is mobility, which enables customers to access learning information at anytime and anywhere. Mobility allows M-learning to become an important channel for obtaining learning material. Therefore, advantages of mobility are crucial to users. Fifth, individuals who perceive the M-learning technology as being pleasant will also find that using M-learning is simple to use, and they also have a positive attitude toward M-learning. The fact that it is enjoyable is significant to attract users. Sixth, in order to predict user acceptance of M-learning, this study adds two external constructs, perceived enjoyment and perceived

mobility value. The predictive power of these two added constructs shows that the new variables are imperative.

6.2 Limitations

As other new technologies become available for digital libraries and museums, TRA and TAM can be employed to predict and to explain the acceptance of the new technologies. When applying TRA or TAM in another context, the external variables for that context have to be found and examined carefully to ensure that TRA or TAM is a viable model for that context. Furthermore, the subjects of this study are students, who are relatively homogeneous as compared with the general population. Population in general may vary substantially in terms of their acceptance of a new technology. For example, the adolescents' perception, interest and attitude toward M-learning would be different from those of elderly. TRA or TAM can be employed to compare the differences as well as the similarities of accepting a technology among various groups of populations.

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Appendix-Questionnaires

各位受訪者，您好！

➢ 這是一份關於消費者對於未來行動學習的認知學術研究，主要目的是為了從顧客面瞭解對未來行動學習的看法與意見。本問卷對於消費者面的認知與反應相當重要。感謝您百忙之中填答的寶貴意見！您的填答僅供學術研究使用，絕對保密。再一次感謝您的支持與協助。

敬祝　萬 事 如 意

國立交通大學 管理科學系 黃仁宏 博士

研究生 林育如 敬上

- 第一部分：

行動設備(Mobile devices)：意指個人便利攜帶的行動設備，包括：手機、PDA(“個人數位助理”或稱”掌上型電腦”)等等，泛指具有”行動”特性的設備。

- 請問您對於未來的行動學習(Mobile learning)看法，其”行動學習”一詞說明如下：

行動學習(Mobile learning)：意指在未來能夠藉由個人行動設備，接收外來訊息或資訊進而達到學習的目的。

問卷內容為詢問您關於對未來行動學習的看法。

【問卷開始】閱讀完上面說明之後，請您針對問卷表達意見與感受。

		非常不同意	不同意	普通(無意見)	同意	非常同意
		1	2	3	4	5
1	我認為使用行動學習的過程中，會讓我得到快樂。	☐	☐	☐	☐	☐
2	我認為使用行動學習會是令人愉快的。	☐	☐	☐	☐	☐
3	我認為行動學習是有樂趣的。	☐	☐	☐	☐	☐
4	在使用行動學習的過程中，我可能會忘記時間的流逝。	☐	☐	☐	☐	☐
5	在使用行動學習過程中，我可能會察覺不到外在干擾的噪音。	☐	☐	☐	☐	☐

		非常不同意	不同意	普通(無意見)	同意	非常同意
6	在使用行動學習的過程中，我可能會忘記我應該去做的事情。	□	□	□	□	□
7	學習如何使用行動學習並不需要耗費我太多心力。	□	□	□	□	□
8	對我而言，我可以很輕易地靈活運用行動學習的各種功能。	□	□	□	□	□
9	我認為我與行動學習之間的互動是易懂的且可理解的。	□	□	□	□	□
10	整體而言，我認為使用行動學習是容易的。	□	□	□	□	□
11	我認為行動學習對於生活上是有貢獻的。	□	□	□	□	□
12	我認為行動學習提供了許多資訊或學習的選擇。	□	□	□	□	□
13	使用行動學習會使我省下許多時間。	□	□	□	□	□
14	整體而言，我覺得行動學習是有用的。	□	□	□	□	□
15	我會喜歡使用行動學習。	□	□	□	□	□
16	我認為使用行動學習會是令人滿意的。	□	□	□	□	□
17	對我而言，使用行動學習會使生活更便利。	□	□	□	□	□
18	我對行動學習抱持正面的評價。	□	□	□	□	□
19	我認為使用行動學習是很值得的。	□	□	□	□	□
20	未來如果環境允許，我有意願去使用行動學習。	□	□	□	□	□
21	當我被問到有關行動學習的看法，我會給予稱讚的意見。	□	□	□	□	□
22	在未來日子裡，我有意願定期地使用行動學習。	□	□	□	□	□
23	我知道行動學習是透過行動裝置為媒介。	□	□	□	□	□
24	我認為行動學習的主要優勢就是行動性。	□	□	□	□	□

		非常不同意	不同意	普通(無意見)	同意	非常同意
25	在任何時間任何地點都使用行動學習，讓我覺得很方便。	□	□	□	□	□
26	我會使用行動學習的原因是因為行動性的價值。	□	□	□	□	□
27	行動性的特質使得能獲取即時資訊這件事情變成可能。	□	□	□	□	□
28	我認為行動性的存在會增加我接觸行動學習的慾望。	□	□	□	□	□

- 第二部分：

- 請問您對於未來行動學習的評估，與他人(事)是否會影響您對行動學習的看法：

> 他人(事)：意指對本身具有重要性之人(事)，包括：家人、好朋友、男(女)朋友或配偶、專家意見、與大眾媒體。

【問卷開始】閱讀完上面說明之後，請您針對問卷表達意見與感受。

		非常不同意	不同意	普通(無意見)	同意	非常同意
		1	2	3	4	5
29	對我來說，使用行動學習能節省我的時間，是一件很重要的事情。	□	□	□	□	□
30	對我來說，使用行動學習具有許多優點，是一件很重要的事情。	□	□	□	□	□
31	對我來說，使用行動學習能配合我的生活方式，是一件很重要的事情。	□	□	□	□	□
32	對我來說，使用行動學習跟我如何使用它，兩者能相互配合得很好，是一件很重要的事情。	□	□	□	□	□
33	對我來說，學習行動學習是容易的，是一件很重要的事情。	□	□	□	□	□
34	對我來說，操作行動學習的過程是容易的，是一件很重要的事情。	□	□	□	□	□

		非常不同意	不同意	普通(無意見)	同意	非常同意
35	家人建議我使用行動學習，而且我也願意這麼做。	□	□	□	□	□
36	我的好友建議我使用行動學習，而且我也願意這麼做。	□	□	□	□	□
37	我的女(男)朋友或配偶建議我使用行動學習，而且我也願意這麼做。	□	□	□	□	□
38	專家建議我使用行動學習，而且我也願意這麼做。	□	□	□	□	□
39	大眾媒體建議我使用行動學習，而且我也願意這麼做。	□	□	□	□	□
40	家人會認為使用行動學習是有用的。	□	□	□	□	□
41	家人會認為使用行動學習是很好的主意。	□	□	□	□	□
42	家人會認為我應該使用行動學習。	□	□	□	□	□
43	我的好朋友會認為使用行動學習是有用的。	□	□	□	□	□
44	我的好朋友會認為使用行動學習是很好的主意。	□	□	□	□	□
45	我的好朋友會認為我應該使用行動學習。	□	□	□	□	□
46	我的女(男)朋友或配偶會認為使用行動學習是有用的。	□	□	□	□	□
47	我的女(男)朋友或配偶會認為使用行動學習是不錯的主意。	□	□	□	□	□
48	我的女(男)朋友或配偶會認為我應該使用行動學習。	□	□	□	□	□
49	對我有說服力的專家會認為使用行動學習是有用的。	□	□	□	□	□
50	對我有說服力的專家會認為使用行動學習是很好的主意。	□	□	□	□	□
51	對我有說服力的專家會認為我應該使用行動學習。	□	□	□	□	□
52	具有公信力的大眾媒體會認為使用行動學習是有用的。	□	□	□	□	□
53	具有公信力的大眾媒體會認為使用行動學	□	□	□	□	□

		非常不同意	不同意	普通(無意見)	同意	非常同意
	習是很好的主意。					
54	具有公信力的大眾媒體會提倡我使用行動學習。	□	□	□	□	□

其他部分：本部分要請您填寫個人資料，僅供學術統計分析之用，內容絕對保密，請放心填答。

1.性別：(1)□男　　(2)□女
2.年齡：(1)□16-20 歲　(2)□21-25 歲　(3)□26-30 歲　(4)□30 歲(含)以上
3.是否至少擁有一種行動設備(手機、PDA 等)： (1)□是，擁有 ___ 台行動裝置 (2)□否
4.目前，我每天使用行動設備(手機、PDA 等)的次數： (1)□0-5 次　(2)□6-10 次　(3)□11-15 次　(4)□16-20 次　(5)□21(含)以上
5.到目前為止，我使用行動設備已經有大約 _____ 年的時間。
6.Email：　_____（若您想得知研究結果歡迎填上，可自由填寫）

對本研究或問卷有任何指正，歡迎 e-mail 至 taro513@yahoo.com.tw 或 taro513.ms91g@nctu.edu.tw

本問卷到此結束，感謝您的協助與填答。謝謝！

Vita

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