Acceptance of Mobile Learning: a Respecification and Validation of Information System Success

Chin-Cheh Yi, Pei-Wen Liao, Chin-Feng Huang, and I-Hui Hwang

Abstract—With the proliferation of mobile computing technology, mobile learning (m-learning) will play a vital role in the rapidly growing electronic learning market. However, the acceptance of m-learning by individuals is critical to the successful implementation of m-learning systems. Thus, there is a need to research the factors that affect users' intention to use m-learning. Based on an updated information system (IS) success model, data collected from 350 respondents in Taiwan were tested against the research model using the structural equation modeling approach. The data collected by questionnaire were analyzed to check the validity of constructs. Then hypotheses describing the relationships between the identified constructs and users' satisfaction were formulated and tested.

Keywords—m-learning, information system success, users' satisfaction, perceived value.

I. INTRODUCTION

MOBILE technologies are a future in e-learning technologies [1]. M-learning has been gaining appeal among younger generations who have grown up using portable video game devices and wireless technology. In this sense, m-learning appeals not only to those who need learning portable, but to those who have grown up with a cognitive disposition towards using mobile devices whether or not they have the need for true portability in their learning [1].

The term m-learning is coined to describe the convergence of mobile technologies with e-learning. The development of m-learning products and the provision of m-learning opportunities are expected to be rapidly expanding. In business, for example, the importance of m-learning has been raised as many companies look into mobile technologies to support mobility of their Knowledge Management (KM)

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activities. The use of ICT facilitates knowledge sharing and cooperative learning among KM participants [3] [4].

DeLone and McLean's model of information system success has received much attention amongst researchers [5]. This study provides the first empirical test of an adaptation of DeLone and McLean's model in the user-developed application domain. In a recent paper, DeLone & McLean discussed many of the important IS research efforts that apply, validate, challenge and propose enhancements to their original model, and proposed an updated DeLone & McLean IS success model[6]. With the prosperity of e-commerce systems, IS researchers have turned their attention to developing, testing and applying e-commerce systems success measures [7] [8] [9].

Although m-learning is generally considered to increase the performance of learners by making learning accessible, no research has been done in relation to m-learning success factors from the learner's perspective. The users are knowledgeable about what factors in Information System (IS) are affecting their satisfaction [10]. Studying m-learning success from the users' perspective is critical to understand the value and efficacy of management actions and investment in m-learning.

The main purpose of this study was to respecify and validate a multidimensional m-learning system success model based on the IS success and marketing literature. This paper is structured as follows. First, this study reviews the development of IS success models, discusses the primary debates on Seddon's[11]Perceived Usefulness and DeLone & McLean's [5][6] IS Use constructs, and considers the challenges and difficulties facing DeLone & McLean's model[6]. Second, based on prior studies, a research model of e-commerce system success and a comprehensive set of hypotheses are proposed. Next, the methods, measures and results of this study are then presented. Finally, the results are discussed in terms of their implications for research and managerial activity.

Focusing on technology aspects of m-learning, no research has been done in m-learning success factors from the users' perspective. The objective of this study is to investigate key determinants of m-learning success perceived by users.

II. LITERATURE REVIEW

A. M-learning

M-learning is the exciting art of using mobile technologies to enhance the learning experience. Mobile phones, PDAs, Pocket PCs and the Internet can be blended to engage and

motivate learners, any time and anywhere[1]. M-learning (or Mobile Learning) describes an array of ways that people learn or stay connected with their learning environments - including their classmates, instructors, and instructional resources - while going mobile.

[12]the last years the popular emphasis on anytime and anywhere has determined the need of a new kind of e-learning, named m-learning (mobile learning), meant to take advantages from mobile computing devices (mobile laptops, PDAs, mobile phones, etc.), which are becoming more and more pervasive. Devices utilized include: Mobile Phones, PDAs (such as a Palm or Pocket PC) - or the combination of the two in a Smart Phone (such as a Treo or Blackberry or Apple iPhone) - and digital audio players such as an iPod. This can redefine on the job training for someone who accesses a lesson literally just in time while faced with a new challenge and they have to turn to their mobile device for instant answers. This is a form of e-learning where mobility matters and the connectedness while wandering away from a desktop or laptop plugged into a wired connection extends the usefulness and timeliness of the lesson and learning experience - perhaps shared with other mobile learners[1].

In one sense m-learning has been around for longer than e-learning, with the paperback book and other portable resources, but technology is what shapes today's usage of m-learning. Technology now allows us to carry vast resources in our pockets and access these wherever we find convenient. Technology also allows us to interact with our peers instantaneously and work together remotely in ways never before possible. Differences between m-learning and e-Learning are shown on Fig. 1 [2].
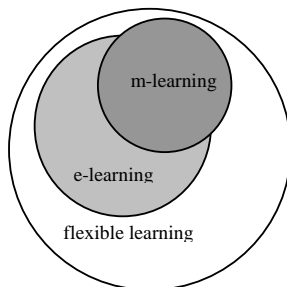

Fig. 1 Differences between M-learning and E-Learning

B. Information System (IS) Model

DeLone & McLean's comprehensive review of different IS success measures concludes with a model of interrelationships between six IS success variable categories [5]. The categories of the taxonomy are System Quality, Information Quality, IS Use, Users' Satisfaction, Individual Impact and Organization Impact (Fig. 2). They found that the success of an IS can be represented by the quality characteristics of the IS itself (system quality); the quality of the output of the IS (information quality); consumption of the output of the IS (use); the IS users' response to the IS (users' satisfaction); the effect of the IS on the behavior of the user (individual impact); and the effect of the IS on organizational performance (organizational impact)
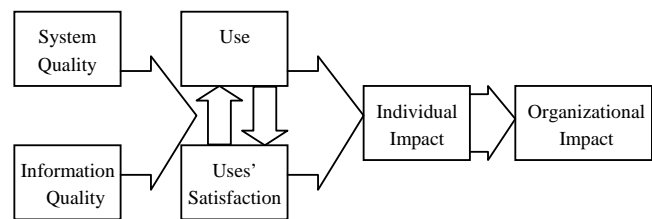
[13].

Fig. 2 DeLone & McLean's (1992) model

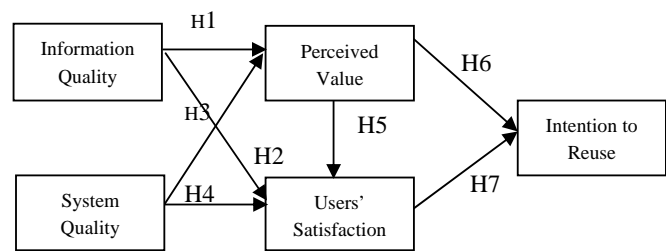*C. Research Model and Hypotheses*

Fig. 3 The research model of m-learning systems success

Based on the results, [14] developed m-learning users' satisfaction model. The model includes six determinants of users' satisfaction in m-learning: Content Relevance, Content Assurance, System Usability, System Assurance, Service Commitment and Membership Community. Several prior studies in the field of marketing also suggested that Perceived Quality, Information Quality and Service Quality were antecedents of overall customers' satisfaction [15][16][17].

Which in turn is a direct driver of Intention to Reuse/Repurchase[18]. As [19] suggests, when Perceived Value is low, customers will be more inclined to switch to competing businesses in order to increase Perceived Value, thus contributing a decline in Loyalty (Intention to Reuse/Repurchase).

The quality–value–loyalty linkage is consistent with prior work on consumers' behaviour [16] [18]. [20] also suggests that the quality–value–loyalty chain is an issue in need of more empirical research. There also exists empirical support for the effect of Perceived Value on Users' Satisfaction [21] [22] [23]. Anderson & Srinivasan suggest that a dissatisfied customer is more likely to search for information on alternatives and more likely to yield to competitor overtures than a satisfied customer[19]. Furthermore, past research has indicated that Satisfaction is a reliable predictor of Intention to Reuse/Repurchase [24]. Thus, this study tests the following hypotheses:

H1: Information Quality will positively affect Perceived Value in the m-learning context.

H2: System Quality will positively affect Perceived Value in the m-learning context.

H3: Information Quality will positively affect User Satisfaction in the m-learning context.

H4: System Quality will positively affect Users' Satisfaction in the m-learning context.

H5: Perceived Value will positively affect Users' Satisfaction in the m-learning context.

H6: Perceived Value will positively affect Intention to Reuse in the m-learning context

H7: Users' Satisfaction will positively affect Intention to Reuse in the m-learning context

III. RCH METHODOLOGY

A. Measures

The data cited Foundation for Information Industry in 2008 for Taiwan's industry education and training for key industries and digital learning the status of the investigation into the database. Respondents' object sets to the Taiwan region (not including the outlying islands and offshore islands region). Investigation mother in 2008 will be published in the magazine 1000 manufacturing, 500 services, 100 for the financial industry reference for the investigation. A total of 350 valid questionnaires.

To ensure the content validity of the scales, the items selected must represent the concept about which generalizations are to be made. Therefore, the items used to measure Information Quality, System Quality, Perceived Value, Users' Satisfaction and Intention to Reuse. The measures was conducted by users and experts selected from the m-learning field. Accordingly, the items were further adjusted to make their wording as precise as possible. Likert scales (1-5), with anchors ranging from Strongly Disagree to Strongly Agree, were used for all construct items.

B. Subjects

There are 350 questionnaires. E-learning has to import 59%, 32% was not imported. The service sector accounts for 30 percent, the financial sector accounted for 10 percent, manufacturing accounted for 60 percent.(Table I)

TABLE I
THE CHARACTERISTICS OF THE RESPONDENTS

Item	Frequency	Percent
Import E-learning situation		
Imported	209	59%
not imported	112	32%
Assessment	29	8.3%
Industry		
Service industry	105	30%
Financial sector	35	10%
Manufacturing	210	60%

IV. DATA ANALYSIS AND RESULTS

A. Measurement Model

Reliability and convergent validity of the factors were estimated by composite reliability and average variance extracted (see Table II).

The composite reliabilities can be calculated as follows: (square of the summation of the factor loadings)/{(square of the summation of the factor loadings) + (summation of error variables)}. The interpretation of the resultant coefficient is similar to that of Cronbach's alpha, except that it also takes into account the actual factor loadings rather than assuming that each item is equally weighted in the composite load determination. Composite reliability for all the factors in the measurement model was above 0.90. The average extracted variances were all above the recommended 0.50 level [25], which meant that more than one-half of the variances observed in the items were accounted for by their hypothesized factors.

The study uses Wang's Development of the Scale[26]. After examining the modification indices, five items, including item IQ, SQ, PV, US and IR (see Appendix), were eliminated due to cross factor loadings.

B. Structural Model

TABLE II
RELIABILITY, AVERAGE VARIANCE EXTRACTED AND DISCRIMINANT VALIDITY

Factor	CR	IQ	SQ	PV	US	IR
IQ	0.97					
SQ	0.96	0.72				
PV	0.98	0.71	0.90			
US	0.99	0.90	0.72	0.72		
IR	0.97	0.69	0.65	0.71	0.72	

Diagonal elements are the average variance extracted. Off-diagonal elements are the shared variance.

A similar set of fit indices was used to examine the structural model (see Table II). Comparison of all fit indices with their corresponding recommended values provided evidence of a good model fit ($\chi^2 = 189.77$ with df = 46, AGFI = 0.859, NNFI = 0.975, CFI = 0.983, IFI = 0.983, RMSEA = 0.080). Thus, this study could proceed to examine the path coefficients of the structural mode.

Convergent validity can also be evaluated by examining the factor loadings from the confirmatory factor analysis (see Table 3). Hair et al.'s recommendation, factor loadings greater than 0.50 were considered to be very significant [25]. All of the factor loadings of the items in the research model were greater than 0.90. Thus, all factors in the measurement model had adequate reliability and convergent validity.

TABLE III
FACTOR LOADINGS, T VALUES AND ERROR TERMS

Construct and item	Factor loading	t-value	Error terms
Information Quality			
IQ1	0.96	*	0.09
IQ2	0.98	48.83	0.04
System Quality			
SQ1	0.95	*	0.09
SQ2	0.98	46.25	0.05
Perceived Value			
PV1	0.96	*	0.08
PV2	0.98	51.66	0.04
PV3	0.98	51.94	0.03
Users' Satisfaction			
US1	0.98	*	0.04
US2	0.97	53.55	0.07
Intention to Reuse			
IR1	0.91	*	0.16
IR2	0.98	37.01	0.05
IR3	0.98	37.43	0.04

*t-values for these parameters were not available because they were fixed for scaling purposes.

Properties of the causal paths including standardized path coefficients, t-value and variance explained for each equation in the hypothesized model were presented in Fig. 4. As expected, Information Quality, System Quality all had significant positive influences on both Perceived Value and Users' Satisfaction. Thus H2, H3 were supported (γ =0.91, respectively).

Information Quality exhibited a stronger effect than system Quality in influencing Users' Satisfaction. And system Quality exhibited a stronger effect than Information Quality in influencing Perceived Value. In addition, the effects of Perceived Value on Users' Satisfaction and Intention to Reuse were also significant. H6 was supported (β = 0.45, respectively). Finally, Users' Satisfaction appeared to be a significant determinant of Intention to Reuse. H7 was supported (β = 0.49).(See Fig. 4)
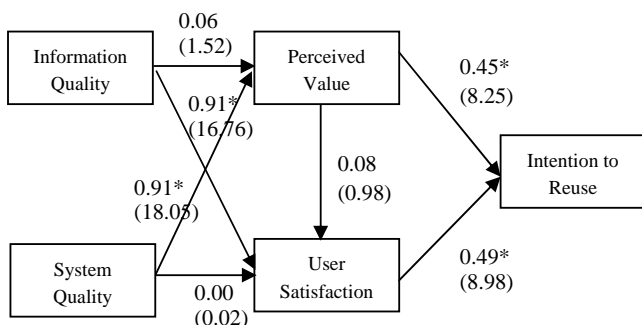

Fig. 4 Hypotheses testing results

The direct and total effect of Users' Satisfaction on Intention to Reuse was 0.49. However, the total effect of Perceived Value on Intention to Reuse was 0.45. Information Quality no

impact Perceived Value. System Quality no impact User Satisfaction. Perceived Value no impact User Satisfaction. (How about: There is not nearly the impact of Information Quality on Perceived Value.)

But the variables have indirect effect: Information Quality→ Users' Satisfaction→ Intention to Reuse. System Quality→ Perceived Value→ Intention to Reuse. The direct, indirect, and total effects of Information Quality, System Quality, Perceived Value and Users' Satisfaction on Intention to Reuse were summarized in Table IV.

TABLE IV
THE DIRECT, INDIRECT AND TOTAL EFFECT OF VARIABLES DEPICTED

	Direct effect			Indirect effect			Total effect		
	PV	US	IR	PV	US	IR	PV	US	IR
IQ		0.91	--	--	--	1.40		0.91	1.40
SQ	0.91		--	--	--	0.41	0.91		0.41
PV	--		0.45	--	--		--		0.45
US	--	--	0.49	--	--	--	--	--	0.49

V. CONCLUSION

As different computing environment requires the different criteria for quality measures, the previous research on IS effectiveness performed in the traditional data processing environment cannot be used directly in the newly formed environment, namely m-learning. Built upon previous concepts on Information Quality and System Quality, this study developed information system success on m-learning.

This model includes the following factors that influence users' satisfaction: Information Quality, System Quality, Perceived Value, Users' Satisfaction, and Intention to Reuse. The variables have indirect effect: Information Quality→ User Satisfaction→ Intention to Reuse, System Quality→ Perceived Value→ Intention to Reuse.

This study reconciled the respecified e-commerce success model with DeLone & McLean's Perceived Usefulness measure. The study used in the new areas (m-learning), updated IS model. This study also helps the users in selection of an m-learning.

APPENDIX

Information Quality
IQ1 The m-learning system provides the precise information you need.
IQ2 The information content meets your needs.
System Quality
SQ1 The m-learning system is user friendly.
SQ2 The m-learning system is easy to use.
Perceived Value
PV1 The product/service of the m-learning system is a good value for money.
PV2 The price of the product/service of the m-learning system is acceptable.
PV3 The product/service of the m-learning system is considered to be a good

Users' Satisfaction

US2 The m-learning system is of high quality.

US3 The m-learning system has met your expectations.

Intention to Reuse

IR1 Assuming that you have access to the m-learning system, you intend to reuse it.

IR2 You will reuse the m-learning system in the future.

IR3 You will frequently use the m-learning system in the future.

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