An Expanded Technology Acceptance Framework for E-Service Innovations: The Empirical Study on E-Learning

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Abstract. This study expands the traditional TAM by considering user's psychological concerns and background. It proposes the both influential paths from innovation characteristics and user individual factors to e-service innovation adoption and identifies the targeted consumer segments. This study developed the e-learning experimental websites and manipulated innovation characteristics to test the hypotheses. The results indicate significant effects of innovation characteristics and user individual factors on the intention to use the new e-learning service. The empirical results support the expanded conceptual framework for TAM with two pathways—one innovation characteristic-based and the other user perception-based—connecting to the acceptance of new technologies. Collectively, for predicting the adoption of e-service innovations, the expanded model is more effective than the traditional TAM. Based on this understanding, online service managers and institutions can further determine how to improve the initial adoption intention of e-service innovations.

Keywords: e-services, e-learning, TAM, innovation characteristics, individual factors, adoption

1. Introduction

It is widely recognized that the use of the Internet has transformed business processes. With the explosive growth in Internet use, many firms are incorporating Internet technology into their marketing and operations. The impact has been especially profound in the service area which has traditionally relied on close, personal contact between customers and employees [1]. E-services can lead to customer satisfaction, cost reduction, competitive advantage, market expansion, and firm growth [2, 3]. As a result, many service companies and organizations, including governments and universities, have devoted large amount of resources to the development of such systems.

However, like any other innovations, there are many barriers to customer adoption and obstacles to system implementation in e-services. Innovation adoption problems have been a long-standing issue in technology-enabled service research [4, 5, 6]. With the continuous growth of the e-service market, however, there is a lack of discussion on the integrated impacts between innovation characteristics and consumer behaviors in the adoption of new e-services. This study explores the influences from new e-learning system design and potential users that affect consumer acceptance of new e-learning options and, by extension, acceptance of technology-enabled services that require significant involvement of user efforts [7, 8]. With this improved framework, the study will then enable e-service providers to more effectively design innovations for acceptance by targeted customer segments.

2. Theoretical Background, Research Hypotheses, and Framework

Within the adoption literature, two widely used concepts have emerged. First, innovation characteristics, such as relative advantage, compatibility, complexity, observability, trialability, and perceived risk have been shown to predict adoption behaviours [9, 10, 11]. Second, a technology acceptance model (TAM) has then

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been developed to postulate the direct relationship between innovation characteristics and innovation adoption [12]. However, there have been challenges to these concepts. There is support in the literature for innovation characteristics influencing adoption behaviour, but the results have often been inconclusive or contradictory [9, 10, 11]. This study discusses the effects of six innovation characteristics on the adoption intention of new e-services. The hypothesis 1 is held as following:

H1-1: The innovation characteristics: (a)relative advantage, (b)compatibility, (c)observability, and (d)trailability are positively related to the adoption intention of new e-services.

H1-2: The innovation characteristics: (a)complexity and (b)perceived risk are negatively related to the adoption intention of new e-services.

Since people tend to adopt or not adopt an innovation based on the extent to which they perceive self-readiness, which is based on user's psychological concerns and background including ability, inertia, prior experience, need for personal interaction, and motivation [1, 12, 13, 14, 15]. This study considers that the individual factors of potential users are another major force influencing the adoption decision of new e-services. The hypothesis 2 is formulated as below:

H2-1: The individual factors: (a)ability, (b)prior experience, and (c)motivation are positively related to the adoption intention of new e-services.

H2-2: The individual factors: (a)inertia and (b) need for personal interaction are negatively related to the adoption intention of new e-services.

Based on the above hypotheses, this study expands the traditional TAM by separating the influential path to e-service adoption into two parts: innovation design characteristics and user individual factors. This study proposes an expanded adoption framework for new e-services as shown in Fig. 1.
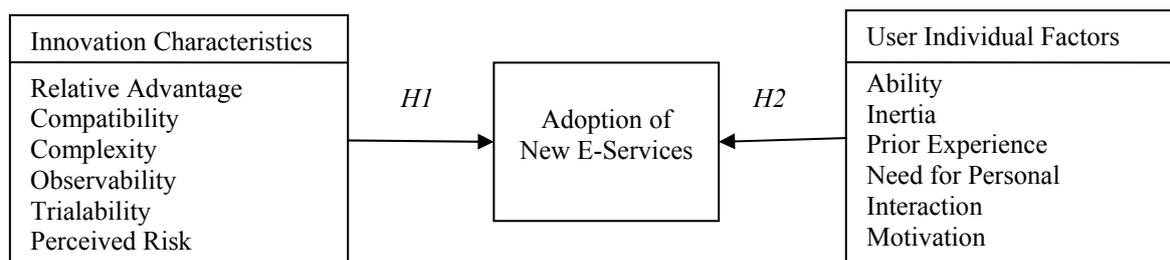

Fig. 1 Research Framework

3. Methodology

3.1. Experimental Design and Pretest

A simulated English education web was developed for the subjects who are undergraduate students. The study adopted a between-subject factorial design. The key manipulations were the different levels (low/high) of six innovation characteristics for the e-learning experimental web pages. The study combined the six innovation characteristics to create 64 (2×2×2×2×2×2) treatment levels for the experiments.

A pilot study (n=53) was carried out to assure the clarity and understandability of the website design for various combinations of treatment levels of the innovation characteristics. Interviews were then conducted with subjects from several large universities in Taiwan. The experiment websites were shown to these respondents who were asked to describe the innovation characteristics of the e-learning service. The purpose of this pretest was to identify the experimental webpage design elements for low/high degrees of innovation characteristics.

3.2. Measures

The study relies primarily on validated items from prior research and adapted to the online context of this study. The reliability of the instrument was evaluated and shown as Table 1. All variable reliabilities were above 0.70 which showed a reasonable level of reliability for each variable [16]. Although Table 1 indicates

that some variables are more correlated with each other, an examination of the variance inflation factors indicates that the multicollinearity was not significant.

Table 1: Scale Reliabilities and Correlation Coefficient Matrix

	Cronbach's α (N of Items)	RA	CO	CX	OB	TR	PR	AB	INE	PE	PI	MO	AI
Relative Advantage (RA)	0.866 (3)	1.000											
Compatibility (CO)	0.805 (4)	.015	1.000										
Complexity (CX)	0.791 (3)	-.007	.025	1.000									
Observability (OB)	0.762 (3)	.002	.010	.007	1.000								
Trialability (TR)	0.783 (3)	-.013	.010	-.005	.007	1.000							
Perceived Risk (PR)	0.762 (3)	-.001	.004	-.011	.022	-.002	1.000						
Ability (AB)	0.856 (4)	.002	.086	.020	.051	.024	-.049	1.000					
Inertia (INE)	0.728 (3)	-.080	-.053	.108	-.130	-.089	.024	-.157	1.000				
Prior Experience (PE)	0.882 (3)	.144	.179	-.159	.104	.028	-.011	.131	-.093	1.000			
Need for Personal Interaction (PI)	0.966 (3)	-.138	-.139	.110	-.156	-.048	-.007	-.038	.097	-.117	1.000		
Motivation (MO)	0.860 (9)	.144	.183	-.102	.049	.005	.007	.330	-.176	.630	-.095	1.000	
Adoption Intention (AI)	0.849 (3)	.106	.233	-.242	.132	.106	.021	.217	-.234	.402	-.145	.529	1.000

3.3. Data Collection

The final sample consisted of 1301 undergraduate students from several large universities located in different areas in Taiwan. The sample included 737 (56.6%) women and 564 (43.4%) men. The selection of the respondent group was particularly relevant for the experimental context because college students are the potential or existing users of English learning websites in Taiwan.

4. Analysis Results

4.1. Manipulation Check

Analysis indicates that the manipulated effects of innovation characteristics were as expected. The *t*-test results indicate the significant mean difference of innovation characteristic perceptions of relative advantage (5.079 versus 3.062, $p = .000$), compatibility (5.065 versus 3.237, $p = .000$), complexity (4.854 versus 3.741, $p = .000$), observability (4.904 versus 3.537, $p = .000$), trialability (4.958 versus 3.362, $p = .000$), and perceived risk (4.827 versus 3.168, $p = .000$).

4.2. Hypothesis Testing

The next step was to test the significance of innovation characteristics and individual factors in this model. In model 1, the effects of the control variable (gender) and innovation characteristics on the adoption intention of the new e-learning service were assessed. In model 2, the effects of individual factors were combined into the adoption model. The regression results are listed in Table 2.

The results of model 1 indicate that the effects of the control variable and five innovation characteristics (except perceived risk) on the adoption intention are statistically significant. The results of five innovation

characteristics are similar to the traditional TAM [17, 18, 19]. Perceived risk has no significant influence, but still has the negative effect on the adoption intention of the e-learning service.

In model 2, the effects of the control, innovation characteristics, and user individual factors on the adoption intention of the new e-learning service were assessed. As Table 2 shows, the results from model 2 indicate that the effects of gender (β = -0.036, t-value = -1.591) and relative advantage (β = 0.030, t-value = 1.300) become weaker and insignificant when individual factors are incorporated as independent variables in the regression model. Compatibility, complexity, observability, and trialability still have significant effects on adoption for the new e-learning service, and *H1-1b*, *H1-1c*, *H1-1d*, *H1-2a* are supported. The significant effects of ability, inertia, prior experience, and motivation support *H2-1a, H2-1b, H2-1c*, and *H2-2a*. But need for personal interaction has insignificant negative influence (β = -0.026, t-value = -1.145) on the intention to use the new e-learning service. In addition, the changed values of R^2 and F in model 2 ($\triangle R^2$ = 0.218, $\triangle F$ = 89.887) are significantly larger than model 1. Collectively, these results provide evidence to support the both of innovation characteristics and user individual factors as the major predictors on the adoption of new e-services.

Table 2: The Regression Analysis for the Adoption Model of the New E-Learning Service

Dependent Variable: Adoption Intention of the New E-Learning Service	Model 1		Model 2		Hypothesis Testing
	Beta	*t*-value	Beta	*t*-value	
Control Variable: Gender	-0.063	-2.450**	-0.036	-1.591	
Innovation Characteristics (H1)					
Relative Advantage	0.109	4.258***	0.030	1.300	*H1-1a is not supported*
Compatibility	0.232	9.077***	0.136	5.988***	*H1-1b* is supported
Complexity	-0.244	-9.520***	-0.179	-7.915***	*H1-2a* is supported
Observability	0.129	5.061***	0.085	3.753***	*H1-1c* is supported
Trialability	0.103	4.040***	0.089	4.027***	*H1-1d* is supported
Perceived Risk	0.017	0.682	0.021	0.935	*H1-2b is not supported*
Individual Factors (H2)					
Ability			0.043	1.829*	*H2-1a* is supported
Inertia			-0.097	-4.194***	*H2-2a* is supported
Prior Experience			0.065	2.229**	*H2-1b* is supported
Need for Personal Interaction			-0.026	-1.145	*H2-2b is not supported*
Motivation			0.400	13.175***	*H2-1c* is supported
$\triangle R^2$	0.158		0.218		
$\triangle F$	34.653***		89.887***		

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$

5. Conclusion and Discussion

The results of the investigation indicate the significant effects of user individual factors including background and psychological perceptions on the intention to use the new e-learning system. The effects of innovation characteristics on adoption are weaker when individual factors are added to the model. Specifically, the effect of relative advantage becomes insignificant on the adoption. Compatibility, complexity, observability, and trialability have significant effects on adoption for the new e-learning service which is generally consistent with prior research about new technology adoption [17, 18, 19]. Notably, the examination of the associations between individual factors and adoption intention clearly indicates that these predictors, ability, inertia, prior experience, and motivation, can explain much of the variation in the

adoption intention of technology and service innovations. In other words, for predicting adoption of new services or technologies, the expanded model is better than the traditional TAM.

In this study, user's ability, prior e-service experience, and motivation have significantly positive effects on adoption intention. Inversely, inertia will inhibit innovation adoption intention. The significant effects of individual factors in this study reveal consumer readiness, knowledge, or use skills play important roles in innovation acceptance. With this insight, innovation developers can segment target markets based on the difference of adopters as well as increase potential user's driving forces including ability, experience, motivation, etc., and, in turn, innovation adoption through training or trial programs.

In line with the implications of many previous studies, an expanded conceptual framework for TAM with two pathways: one innovation characteristic-based and the other adopter's perception-based that connect the acceptance of new technologies were identified. Empirical results have provided support for both pathways. These adopter's individual factors can partially explain the divergent and even conflicting effects of innovation characteristics found in past research. Finally, this experimental study manipulated innovation characteristics to simulate new and various e-learning websites, also providing a methodological framework which can be used later to identify the influences on the e-service adoption from innovation designer and user perceptions.

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7. References

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