An enhanced technology acceptance model for e-learning systems in high-tech companies

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Abstract:-With the rapid change in working environment, there is a need to implement e-learning systems but their adoption requires a fully understanding of the user acceptance processes. The aim of the research is to propose a new construct, perceived control, to examine the applicability of the technology acceptance model (TAM) in explaining employees' decisions to accept e-learning. Based on a sample of 206 employees taken from twelve high-tech companies at Hsinchu Science Park in Taiwan, the results strongly support the extended TAM in predicting employees' behavioral intention to use e-learning.

Key-Words: -Technology acceptance model(TAM), perceived control, e-learning, computer self-efficacy

1 Introduction

E-learning has emerged from advances on information and communication technologies, and the World Wide Web. E-learning describes a wide set of applications and process that includes computer-based learning, online learning, virtual classrooms and digital collaboration.

Nowadays knowledge-based economy needs more knowledge workers who are capable of higher order thinking and can solve complex problems. This requires organizations to educate and train anyone, anytime, and from anywhere. E-learning systems can break the limitations of time and space and also creates many benefits, including reduced training costs, training time reduction, meeting business needs, retraining of employees, and customer support. No wonder it has become an increasingly critical issue [12, 20].

There is growing evidence of underutilized e-learning systems. The technology acceptance model (TAM), adapted from theory of reasoned model (TRA), has been used as the theoretical basis for many empirical studies of user technology acceptance. However, e-learning is a relatively new issue. Thus, existing variables of TAM cannot fully reflect e-learners' motives, requiring a search for additional intrinsic motivation factors [12, 13].

Learner control includes control of the content, sequence, and pacing. It can increase satisfaction and involvement with training [7]. E-learning employs technology that allows learners to choose the material that is most important to them and to move at their own pace through a flexible sequence of topics [18]. Thus, e-learning provides a unique opportunity for learner control and then learners will have stronger behavioral intentions to use e-learning. Therefore, it can infer that one has higher level of perceived control in using e-learning systems, then one has more behavioral intention to use e-learning. These issues have not yet been empirically examined in an e-learning context. Therefore, the aim of the study is to propose a new construct, "perceived control" to enhance understanding how an employee of high-tech companies will accept and use e-learning systems. Moreover, the research also examines that computer self-efficacy has a significant indirect effect on behavioral intention to use e-learning.

2 Theoretical development

Similar to prior research on TAM [10, 13], the "attitude" construct was removed to simplify the model. Fig.1 depicts the research model for the study, excluding actual behavior but expanding computer self-efficacy and perceived control. The two variables were integrated into TAM to adapt it for the empirical study of e-learning.

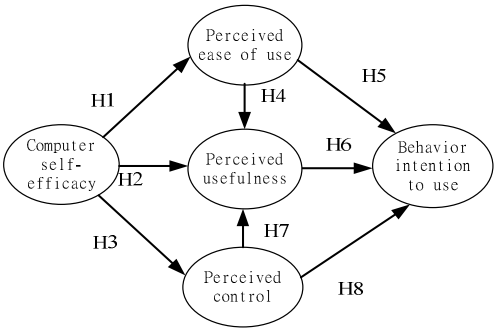

Fig.1 The research model.

2.1 Computer self-efficacy

Self-efficacy, the belief that one has the capability to perform a particular behavior, is an important construct in social psychology. In an IT usage context, computer self-efficacy represents an individual's perceptions of his or her ability to use computers in the accomplishment of a task, rather than reflecting simple component skills [2].

Significant influences of computer self-efficacy on perceived usefulness and perceived ease of use have been empirically validated [8, 12, 16]. The relationship between computer self-efficacy and perceived control has not yet been empirically validated. In e-learning context, one has high level of computer self-efficacy, and then one may expect that he or she can use the e-learning system very well. Thus, he or she may have more interesting in controlling the learning level, learning content, learning process, and interactive process of e-learning. This suggests that computer self-efficacy has a positive effect on perceived control of e-learning. Therefore, the research hypothesized:

H1: Computer self-efficacy will have a positive effect on perceived ease of use of e-learning.
H2: Computer self-efficacy will have a positive effect on perceived usefulness of e-learning.
H3: Computer self-efficacy will have a positive effect on perceived control of e-learning.

2.2 Technology acceptance model(TAM)

Davis [4] proposed a TAM derived from the theory of reasoned action (TRA). It posits that two particular beliefs, namely perceived usefulness and perceived ease of use, are of primary relevance to computer/IT acceptance behaviors. Perceived usefulness is the degree to which a person believes that using a particular system would enhance his or her job performance. Perceived ease of use is the degree to which a person believes that using a particular system would be free of effort.

TAM implies that an e-learning system with a high level of perceived usefulness is one for which a user believes that there is a positive user-performance relationship, and there are many empirically evidences [4, 12, 13, 17]. Additionally, previous research has showed that individuals are more likely to use a new technology if they perceive that it is easy to use, and. there are many evidences to show that perceived ease of use will influence perceived usefulness [12, 13, 15]. Therefore, the research hypothesized:
H4: Perceived ease of use will have a positive effect on perceived usefulness of e-learning.
H5: Perceived ease of use will have a positive effect on the behavioral intention to use e-learning
H6: Perceived usefulness will have a positive effect on the behavioral intention to use e-learning

2.3 Perceived control

Learner control generally refers to "a mode of instruction in which one or more key instructional decisions are delegated to the learner" [19]. Learner control allows learners to determine their progress through a learning program, and to choose learning activities that suit their personal preferences and needs [14].

E-learning provides a unique opportunity for learner control and transforms the training paradigm from that of "teaching" to that of "learning" [1]. The provision of learner control may have several benefits. For instance, learner control can improve learning outcomes, increase satisfaction with training, and increase the amount of time trainees choose to spend on the instructional task [5].

Consequently, a new construct, perceived control, is proposed to enhance our understanding of a user's acceptance behavior. Perceived control was defined as the degree to which a person believed that he or she can control what and how to use a particular system. E-learning can delegate the learning decision to the user, and then user feels that e-learning system is more flexible and customize than traditional classroom learning. Thus user will have more behavioral intention to use e-learning. Therefore, it can infer that perceived control will have a positive effect on the behavioral intention to use e-learning.

Additional, the higher level of perceived control one acquires online, the higher level of perceived usefulness one gets from online learning, implying that perceived control will have a positive effect on the perceived usefulness in an e-learning context. Therefore, the research hypothesized:

H7: Perceived control will have a positive effect on perceived usefulness of e-learning.
H8: Perceived control will have a positive effect on the behavioral intention to use e-learning.

3 Methodology

3.1 measures

Computer self-efficacy was measured by four items adapted from [3, 12]. Items measuring perceived usefulness and perceived ease of use were taken from a previously validated inventory and modified to fit the specific technology. Measurement items for learner control were developed upon a review of related literature [4, 9, 18, 19]. Four statements specifically developed for this study measured perceived control. Finally, the items to measure behavioral intention to use were taken form previous application of TAM. The respondents indicated their agreement or disagreement with the survey instruments using a five-point Likert-type scale. Pre-testing of measures was conducted by selected users from e-learning field. The items were modified to make them relevant to the e-learning usage context.

3.2 Subjects

Data used to test the research model was obtained mainly from 12 high-tech companies at Hsinchu Science Park in Taiwan. Each company had employed e-learning and each respondent had experience in use it. Of the 320 surveys, 206 useful responses were returned. Thus, the response rate was 64.3%. The respondents averaged 33 years in age and had 8 years of experience in computer. The sample consisted of 52% female and 48% male. Thirty-eight percent had completed one college or university degree.

4 Data analysis and results

4.1 Analysis of measurement validity

Measurement validity in terms of reliability and construct validity was evaluated. Reliability of the instrument was evaluated using Cronbach's alpha. All the values were above 0.7(see Table 1), exceeding the common threshold value recommended by Nunnally[11] .

Table 1

Crombach's alpha and average variance extracted (AVE)

Variables	α	AVE
Perceived usefulness	0.88	0.67
Perceived ease of use	0.70	0.53
Perceived control	0.84	0.59
Behavioral intention to use	0.83	0.69
Computer self-efficacy	0.86	0.67

To evaluate discriminant validity, it is expected that the loadings of all items within a construct should be high on that construct, indicating high convergent validity, and low on the others. A factor analysis was applied to examine the convergent and discriminant validity. A principal component factor analysis was performed and five constructs were extracted. As shown in Table 2, there were no cross-loading items. Additionally, items intended to measure the same construct exhibited prominently higher factor loadings on a single construct than on other construct, suggesting adequate convergent and discriminant validity [11].

Additionally, Table 1 also indicated the constructs' strong convergent validity, since they each had an average variance extracted (AVE) of more than 0.5, which is suggested threshold [6]. Table 3 listed the correlation matrix, with the inter-construct correlations off the diagonal and the square root of AVE on the diagonal. Since all the diagonal elements were greater than corresponding off-diagonal elements. Hence, the results indicate that discriminant and convergent validity of the measures were reasonable.

Table 2

Factor analysis results: principal component extraction

	Factor				
	1	2	3	4	5
Perceived usefulness (PU)					
PU1	**0.86**	-0.02	0.04	0.02	0.18
PU2	**0.83**	0.18	0.17	0.15	-0.06
PU3	**0.85**	0.12	0.09	0.19	0.08
PU4	**0.73**	0.11	0.13	0.24	0.34
Computer self-efficacy(CSE)					
CS1	0.12	**0.78**	0.13	0.01	0.11
CS2	0.07	**0.86**	0.16	0.08	0.06
CS3	0.24	**0.74**	0.14	-0.02	-0.05
CS4	0.00	**0.88**	0.06	0.11	0.10
Perceived control(PC)					
PC1	0.11	0.15	**0.63**	-0.06	0.31
PC2	0.15	0.10	**0.83**	-0.02	0.10
PC3	0.18	0.17	**0.81**	-0.02	0.16
PC4	-0.01	0.11	**0.82**	0.18	0.13
Perceived ease of use(PEOU)					
PEOU1	0.31	0.37	-0.08	**0.53**	0.24
PEOU2	0.09	-0.01	0.07	**0.87**	0.05
PEOU3	0.20	0.04	0.02	**0.79**	-0.01
Behavioral intention to use(BI)					
BI1	0.14	0.06	0.35	0.02	**0.81**
BI2	0.19	0.10	0.21	0.13	**0.84**

Table 3

Correlations of Construct and square root of AVE

	PU	PEOU	PC	BI	CSE
PU	**0.82**				
PEOU	0.44	**0.82**			
PC	0.31	0.12	**0.77**		
BI	0.38	0.24	0.52	**0.73**	
CSE	0.30	0.26	0.33	0.23	**0.83**

Note: Diagonal elements were the square root of Average Variance Extracted

4.2 Test of the Structural Model and Hypotheses

The hypothesized relationships were test using the path analysis of Lisrel 8.54. All seven common goodness-of-fit indexed as shown in Table 4 exceeded their respective common acceptance levels. These suggest that the research model exhibited a good fit with the data.

Table 4

Goodness-of-fit measures of research model

Goodness-of-fit measure	Recommended value	Model statistic
Chi-square/degree of freedom	≦3.00	0.15
Goodness-of-fit index (GFI)	≧0.90	1
Adjusted goodness-of-fit index (AGFI)	≧0.80	1
Normalized fit index (NFI)	≧0.90	1
Nonnormalized fit index (NNFI)	≧0.90	1
Comparative fit index (CFI)	≧0.90	1
Root mean square residual (RMSR)	≦0.10	0.011

Properties of the casual paths, including standardized path coefficients, P-values, and variance explained for each equation in the hypothesized model are presented in Figure 2. As expected, computer self-efficacy had a significant positive on perceived ease of use (beta=0.26, P<0.05), perceived usefulness (beta=0.23, P<0.05), and perceived control (beta=0.33, P<0.05). Therefore, hypotheses H1, H2, and H3 were supported. The total effect of computer self-efficacy on behavioral intention to use was 0.23.

Perceived ease of use had a significant positive effect on perceived usefulness (beta=0.38, P<0.05) and behavioral intention to use (beta=0.10, P<0.1). Thus, hypotheses H4 and H5 were supported. 28% of the variance in perceived usefulness was explained by computer self-efficacy, perceived ease of use, and perceived control. Perceived usefulness had a significant positive effect on behavioral intention to use (beta=0.19, P<0.05). Thus, hypotheses H6 was supported.

Finally, perceived control had a positive effect on perceived usefulness (beta=0.22, P<0.05) and behavior intention to use (beta=0.45, P<0.05). Therefore, hypotheses H7 and H8 were supported.

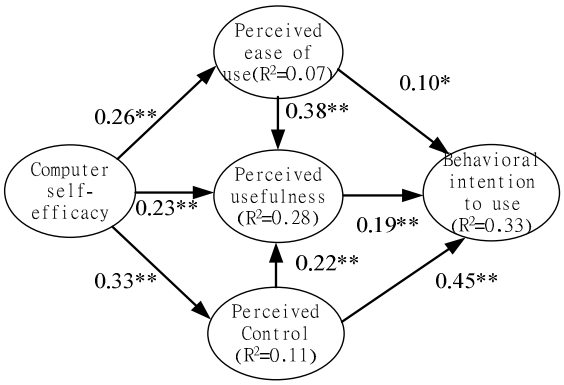

Figure 2 Model Testing Result:

*P<0.1; **P<0.05

Table5

The direct, indirect, and total effect of dominants on behavioral intention to use

	Direct effect				Indirect effect				Total effect			
	PEOU	PU	PC	BI	PEOU	PU	PC	BI	PEOU	PU	PC	BI
CSE	0.26	0.13	0.33			0.17		0.23	0.26	0.30	0.33	0.23
PEOU		0.38		0.10				0.07		0.38		0.18
PU				0.19								0.19
PC		0.22		0.45				0.04		0.22		0.49

5 Discussion

Computer self-efficacy appeared to be a significant determinant of perceived ease of use, perceived usefulness, and perceived control. Users who have higher computer self-efficacy are likely to have more positive perceived usefulness, perceived ease of use, and perceived control beliefs.

Perceived ease of use and perceived usefulness both have significant positive effects on behavioral intention to use of e-learning. These finding also supports prior research. However, perceived control was found to be the most significant factor affecting user's acceptance of e-learning. This suggests that user's belief of control is a crucial antecedent to her or his perceptions of usefulness and behavioral intention to use e-learning.

Thus, an important acceptance criterion is whether or not the e-learning system provides flexible, customize, and personalize content, process, and pace.

6 Conclusions

Using the extended model as a theoretical framework, this study help practitioners and researchers better to predict how users will respond to e-learning. Major contributions are:

1. These results show that how perceived control influences user's attitudes toward using e-learning: e-learning system must be flexible, optimizing, and customize.
2. Perceived control has the most significant direct and total effect on behavioral intention to use e-learning.
3. TAM has been extended in an e-learning context.
4. Computer self-efficacy had a positive effect on perceived ease of use, perceived usefulness, and perceived control.

7. Limitations

The findings of this research must be considered of its limitations. First, the questionnaire approach is not free of subjectivity in the respondent. Second, this study measures all the constructs at one point in time. Therefore, causality cannot be inferred. Finally, the findings are obtained from some high-tech companies in Taiwan. Thus, caution needs to be taken when generalizing our findings.

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