Exploring Learner Perception of E-learning Effectiveness in the Workplace Learning Context Based on Diffusion of Innovations (DOI) Model

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The purpose of this study aims to examine adult learner's perception related to e-learning effectiveness. The model of diffusion of innovations (DOI) was used as the research framework and quantitative research methodology employing survey techniques was applied to collect the data. The targeted population identified in this study includes adult learners and Taiwanese civil service personnel who were selected as a convenience sample. The major findings and relevant factors are discussed.

Keywords: E-learning Effectiveness, Diffusion of Innovations, Attitudes towards E-Learning

Introduction

Due to the extensive utilization of advanced information and communication technologies (ICTs) in delivering learning and instruction, learning is no longer bounded by designated time and space as it was previously perceived. In addition, continuous lifelong learning has been regarded as a pivotal belief to ensure the economic success of individuals, organizations, and countries. As a result, the notion of lifelong learning has again found the niche in the contemporary information and knowledge-based era. Accordingly, driven by the demands for learning opportunities to fulfill the needs of resurgent lifelong learning, the practitioners in the fields of training and education are striving for a more flexible and adaptive learning approach. E-learning, subsequently, has witnessed an exponential growth throughout the world in recent years (Rosenburg, 2001). Although recent attention on e-learning has increased, it is important and necessary to devote more research efforts to evaluating e-learning (Phillips, Phillips, & Zuniga, 2000). It has been suggested by many studies that e-learning can effectively accommodate the variance in learners' needs, interests, and learning styles as well as empower individuals for adaptation and change (O'Malley, 1999; Rosenburg, 2001). But available evidence that suggests e-learning is as effective as traditional face-to-face learning typically results from studies within the university context; thus, it is doubtful whether these results are suitable in another cultural context, for non-university students and in vocational training rather than in the learning of academic subjects (Hughes and Attwell, 2003). While e-learning has been widely used for educational or training purposes, the concern related to its effectiveness in delivering the instruction remains one major concern for both learners and instructors and has led to many discussions about it in the knowledge industry (Shirley, 2001). For many e-learning investors, in particular in the industrial sectors, reports on the incomplete rate of training via e-learning can reach as high as 80%, and some even pose a speculation whether e-learning is appropriate for the workplace training (Bonk, 2004; Moshinskie, 2001). Thus, this study was designed with an attempt to understand learner's perceptions regarding whether e-learning is an effective approach for training.

Without any doubt, each learner is unique and different in their perceived expectations and outcomes when they approach learning. Based on the expectancy-value theory, the more valued outcomes learners expect, the more likely they will commit and devote themselves to the specific learning process (Hodges, 2004). Likewise, it is presumable that learners' adoption or participation in e-learning depends heavily on the perceptions of what they can achieve via such an innovative learning approach. To serve a better understanding of what factors concern one's adoption or participation in e-learning, an examination of learners' perceptions of e-learning effectiveness is indispensable. In other words, this study also attempts to help determine what factors are significant in explaining learners' perceptions concerning e-learning effectiveness. Built upon Rogers' model of diffusion of innovations (DOI) (Rogers, 1995), exploration of learners' perceptions of e-learning in terms of its effectiveness and examination of interactions between such perceptions and individual as well as contextual factors are addressed in the present study. In addition, further analyses were performed to discover what factors contribute to shaping learners' perceptions related to e-learning effectiveness. Therefore, the current research purposes were: (1) to investigate learners' perceptions about e-learning effectiveness in the Taiwanese workplace learning context; and (2) to determine the extent to which a group of identified variables deriving from DOI can explain learners' perceptions of e-learning effectiveness.

Conceptual Framework

This study examined the learner's perception of e-learning effectiveness based on the DOI model. Based on the DOI model, five stages are used to illustrate the innovation decision process, including "knowledge," "persuasion," "decision," "implementation," and "confirmation." Before an innovation decision can be achieved, which often occurs in the first two stages, the DOI model illuminates that the greater perceived effectiveness of an innovation by the potential users, the more likely they would lean toward acceptance or an adoption decision of such an innovation (Rogers, 1995). Additionally, the perceived effectiveness of an innovation can be predicted from characteristics of decision-making units, prior conditions, perceived characteristics of the innovation, and attitudes towards the innovation based on the DOI model. These four constructs are then applied to the study examined the influences on learners' perceptions regarding effectiveness of e-learning. Figure 1 provides a schematic representation of this conceptual framework.
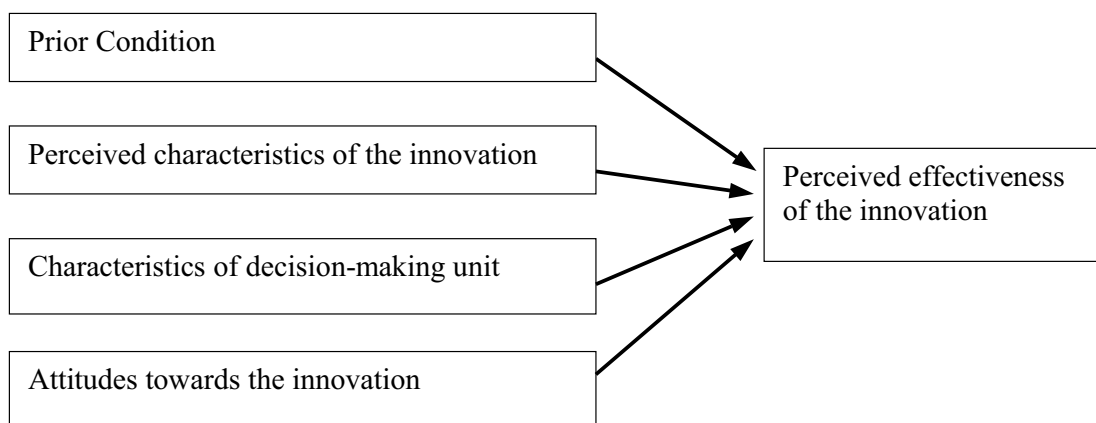
Figur.1 *Conceptual Framework Adapted from Rogers' DOI model*

As pinpointed by the DOI model, variables affecting the perceived effectiveness of the innovation, e-learning in this case, include (1) prior contextual conditions related to development of e-learning, such as the infrastructure, learning system (learning management system or courseware), ICT literacy, incentives, and learner support as well as reward systems, etc. (Anderson, 2002; Clark and Mayer, 2003; Mudge, 1999; Rosenberg, 2001); (2) characteristics of e-learning, such as openness, flexibility, interactivity, learner-in-control, and alternative ways of knowledge sharing and skill acquisition and so on (Burke and Gill, 2000; Clark and Mayer, 2003; Kapur and Stillman, 1997; Keller and Cernerud, 2002; Rosenberg, 2001; Scollin and Tello, 1999); (3) potential adopters' personal characteristics and their attitudes towards the innovation (Keller and Cernerud, 2002; Newton, 2003; Wagner and Flannery, 2004; Wilson and Stacy, 2004). The dependent variable in this study is the construct of "perceived effectiveness of e-learning" characterized by its effective, satisfied, and practical from the standpoints of learners targeted for investigation. Based on the conceptual framework depicted in Figure 1 hypotheses are formulated as follows:

  H1: The stronger learners confirm the prior contextual condition beneficial to development of e-learning, the higher learners' perceive effectiveness of e-learning.

  H2: The more positive characteristics of e-learning are confirmed by learners, the higher learners' perceive effectiveness of e-learning.

  H3: The more positive attitude learners have towards e-learning, the higher learners' perceive effectiveness of e-learning.

  H4: The personal characteristics of learners affect their perceived effectiveness of e-learning.

Research Methodology

In this study, an operational definition of e-learning is any learning condition that utilizes Internet-based technologies as the main instructional delivery mechanism or as supplements for other ways of instruction, such as face-to-face classroom teaching. The purposive non-probabilistic sampling method is used, and participants of this study consist of 220 trainees attending the training courses held by the Civil Service Development Institute in the summer of 2004. Each individual is asked to complete a self-administrated questionnaire. There are three sections in the questionnaire. Section1 includes an assessment of learners' perceptions of e-learning effectiveness and attitudes towards e-learning taking advantage of the semantic differential scale. In section 2,

respondents are asked to rate their opinions on prior conditions related to the development of e-learning and perceived characteristics of e-learning using 6-point Likert scale. Meanwhile, section 3 is developed to collect demographic information, such as gender, age, marriage status, educational level, geographical locations of inhabitation and workplace, organizational attributes of employment, use of computer and Internet technologies, and e-learning as well as distance learning experiences, etc. Furthermore, five experts and practitioners from the fields of e-learning, human resource development, and civil training and development are invited to help review the questionnaire items for its content validity.   The alpha values are also calculated to assess internal consistency and reliabilities of the scales. The results in Table 1 show that alpha coefficients are high and all above 0.85. This indicates that items are homogeneous and measuring the construct dimensions reliably (Hair, Anderson, Tatham, & Black, 1998).

Table 1. *Reliability Scores of the Instrument*

Construct	Cronbach's alpha (α)
Perceived Effectiveness of E-learning	0.9150
Prior Condition	0.8742
Attitudes towards E-learning	0.9438
Perceived characteristics of E-learning	0.8577

A total of 220 civil agents from different government offices are included for investigation. After a review of survey response to ensure correctness and completeness of the data, analysis is carried out using Statistical Package for the Social Science (SPSS) Version 10.0 for Windows. The profile of respondents represents 58.5% male compared to female (41.5%). By marriage status, most of them are married (84.9%). By age, respondents are grouped into 20-29 (4.5%), 30-39 (18.6%), 40-49 (41.8%), 50-59 (29.5%), and 60-69(5.5%).   By educational level, respondents that hold a college degree comprise of 66.8%, master degree at 27.3%, and doctoral degree at 5.5%. For qualification from higher or lower are represented by 0.5%. By organizational attributes of employment, 83.7% of respondents work at the central government offices, local government offices at 9.3%, government owned institutes at 2.8%, and public schools at 4.2%. Among those investigated, 35.7% have experiences in e-learning and 21.1% once engaged in distance learning in the past.

To achieve the research purposes and test the proposed hypotheses, descriptive statistics, nonparametric binominal tests, and different regression methods were used for the analyses of data. According to the gathered data, a nonparametric binominal test was used to examine the difference in degrees learners respond to whether prior contextual condition is advantageous to development of e-learning and e-learning has competitive advantages in terms of innovative characteristics. For testing hypotheses 1, 2, and 3, a simple regression was performed, and a multiple regression was carried out to examine hypothesis 4.   Additionally, the multicollinearity among independent variables is considered problematic because it may reduce any single independent variable's predictive power (Hair et al., 1998). To determine whether the multicollinearity exists, the tolerance value or variance inflation factors (VIFs) are frequently used. If the largest VIF value exceeds 5 (Snee, 1973) or exceeds 10 (Neter et al., 1985), or if the tolerance values are less than .20 in general, there indicates a serious multicollinearity problem of predictors. In this study, all relevant checks returned VIFs (from 1 to 3.120) below 5 and a tolerance value above .20 (from .321 to 1.000), indicating no serious multicollinearity present.

Results and Discussion

A. Descriptive Analyses
Mean and standard deviation (SD) scores are calculated to determine learners' perceptions of e-learning effectiveness and attitudes towards e-learning. The analyzed results are presented in Table 2.

Table 2. *Descriptive analyses of perceptions and attitudes (N=220)*

Construct	Item	Mean	SD
Perceived Effectiveness	Effective	4.27	1.09
	Satisfied	4.24	1.01
	Practical	4.41	1.01
Attitude (Cognitive)	Agreed	4.54	1.01
	Easy	4.34	1.13
Attitude (Affective)	Enjoyed	4.36	1.02
	Pleasant	4.35	1.16
Attitude (Potency)	Flexible	4.72	1.02
	Relaxed	4.46	1.01

According to what is stated in Table 2, respondents have a positive standpoint towards e-learning in terms of perceived effectiveness and attitudes since the mean values for each variable show more than average, at 3.5 and above. Looking at the prior condition and perceived characteristics of e-learning, analyses of means, standard deviations, and distribution of responses are calculated for the variables within these two constructs (Table3 & Table 4).

Table 3. *Descriptive analyses of perceived characteristics（N=220）*

Item	Mean	SD	Agreed%	Disagreed%
Open more opportunity to people in need of learning	4.76***	.76	98.6%	1.4%
A more flexible learning approach	4.76***	.76	98.6%	1.4%
No decrease in learning interactions	4.13***	.85	80.9%	19.1%
Alternative ways for pursuing knowledge and skills	4.31***	.69	93.6%	6.4%
More learners' control for self-paced learning	4.50***	.81	94.5%	5.5%

*p<.1；** p<.05；*** p<.01

Table 4. *Descriptive Analyses of Prior Condition（N=220）*

Item	Mean	SD	Agreed%	Disagreed%
No problem of accessing equipments for e-learning	4.20***	.86	84.1%	15.9%
E-learning is recognized by the organization employed	4.07***	.89	79.5%	20.5%
I am capable of using the Internet for e-learning	4.23***	.82	84.5%	15.5%
Family and friends encourage me to engage e-learning	4.04***	.82	75.9%	24.1%
E-learning becomes more popular due to the related promotion (rewards…)	4.24***	.86	85.6%	16.4%
Existing e-learning systems seem easy-to-use to me	4.20***	.87	88.2%	11.8%

*p<.1；**p<.05；***p<.01

As revealed in the analysis outcome, respondents agree that those innovative characteristics embedded in e-learning, meaning they have actually perceived e-learning's unique attributes. As for the prior condition related to the development of e-learning, the respondents also confirm the existence of those contextual factors beneficial to its development. Moreover, the binomial analyses are performed to examine the difference between groups with agreed and disagreed opinions, and the results show that significant differences are found. This means learners significantly agree with those innovative characteristics and conditions regarding e-learning.

B. Relationship Analyses

Further, Pearson correlation is conducted to examine the relationship among the constructs listed in Table 5.

Table 5. *Correlation Analyses of All Constructs*

	Perceived Effectiveness (PE)	Attitude (AT)	Innovative Characteristics (IC)	Prior Condition (PC)
PE	--			
AT	0.905***	--		
IC	0.579***	0.623***	--	
PC	0.536***	0.566***	0.811***	

* p<.1；** p<.05；*** p<.01

Statistical evidences show that significant correlations exist between learners' perceptions of e-learning effectiveness and three construct variables, including attitudes towards e-learning, perceived characteristics of e-learning, and prior condition related to development of e-learning. In particular, the perceived effectiveness has a highest positive correlation with attitudes at .905. This can be confirmed what Rogers has contended that learners' perceived effectiveness and attitudes indeed belong to the same kind of mental activity, but construct of perceived effectiveness is more cognitive oriented and attitude construct is more affective oriented (Rogers, 1995).

Simple regression analyses are also performed among the constructs of PE, AT, IC, and PC (Table 6, Table 7, Table 8). The results of analyses confirm the interactions between perceived effectiveness of e-learning and prior contextual condition, characteristics of e-learning, and attitude towards e-learning, meaning hypotheses 1-4 were supported.

Table 6. *Regression analysis between AT and PE*

Predictive Variable	Dependent Variable: PE		
	Standardized Coefficients β	Tolerance	VIF
Attitude	0.905***	1.000	1.000
R^2	0.819		
Adjusted R^2	0.819		

* p<.1; ** p<.05; *** p<.01

    The result of Table 6 indicates that learners' attitude towards e-learning contributes significantly (F(1, 218)=988.875, p<.01) and predicts 81.9% of variation in learners' perceived effectiveness of e-learning. Similarly, as shown in Table 7 and 8, learners' perceived characteristics of e-learning contributes significantly (F(1, 218)=110.206, p<.01) and predicts 33.3% of variation in learners' perceptions of e-learning effectiveness; prior condition related to e-learning development contributes significantly (F(1, 218)=87.810, p<.01) and predicts 28.4% of variation in learners' perceptions of e-learning effectiveness.

Table 7. *Regression analysis between IC and PE*

Predictive Variable	Dependent Variable: PE		
	Standardized Coefficients β	Tolerance	VIF
IC	0.579***	1.000	1.000
R^2	0.336		
Adjusted R^2	0.333		

* p<.1; ** p<.05; *** p<.01

Table 8. *Regression Analysis between PC and PE*

Predictive Variable	Dependent Variable: PE		
	Standardized Coefficients β	Tolerance	VIF
PC	0.536***	1.000	1.000
R^2	0.287		
Adjusted R^2	0.284		

* p<.1; ** p<.05; *** p<.01

    With respect to the influences of the construct of characteristics of decision-making unit, a multiple regression analysis is conducted and the results are summarized in the following Table 9.

Table 9. *Regression Results between Learners' Characteristics and PE*

Predictive Variable: Learners' Characteristics	Dependent Variable: PE		
	Std. Coefficients β	Tolerance	VIF
Age	0.180	0.321	3.120
Gender	0.007	0.531	1.883
Marriage status	-0.139	0.758	1.319
Position level	0.019	0.547	1.828
Educational level	-0.243**	0.753	1.328
Position title	0.113	0.665	1.503
Organizational attributes	-0.066	0.845	1.183
ICT competence	0.033	0.649	1.542
Place of using computers	-0.164*	0.772	1.296
Frequency of Internet use	-0.057	0.667	1.500
Place of using Internet	-0.077	0.717	1.395
Years as a civil agents	0.024	0.389	2.572
E-learning experiences	0.000	0.757	1.321
Distance learning experiences	-0.085	0.801	1.249
Self-owned computer	0.098	0.596	1.678
Self-owned Internet access	-0.153	0.575	1.738
Help for ICT problem	0.150	0.787	1.270
R^2	0.170		
Adjusted R^2	0.060		

*p<.1; ** p<.05; *** p<.01

    The analysis concludes that F(17, 128)=1.547 is significant at p=0.089<.1 indicating that there exists at least one significant predictor. Adjusted R^2 value of 0.06 indicates that the model can explain that about 6% of

the variance in learners' perceptions of e-learning effectiveness can be predicted by the construct of learners' characteristics. Further, the result shows educational level and place of using computers are key factors impacting learners' perceived e-learning effectiveness. To those adult learners who have lower educational level and always use computers in the workplace show more positive perceptions of e-learning effectiveness.

After evaluating the results, it can be concluded that all construct variables proposed by the DOI model are confirmed to be the significant predictors influencing the perceived e-learning effectiveness of adult learners in current study.

Conclusion

The primary goal of this study is to understand learners' perceptions of e-learning effectiveness. Secondly, based on the model of DOI, there is also an aim to identify factors contributing influences to such a perceived e-learning effectiveness of adult learners under investigation. The results of a survey of 220 civil agents working in different government offices indicate that learners do perceive e-learning as effective, practical, and satisfied regardless of previous experiences in e-learning. As stated earlier, the application of e-learning is concluded as effective as traditional face-to-face learning in studies mostly conducted in the higher education context. The current study further evidenced its effectiveness also in the workplace context based on examination of adult learners' perceptions and attitudes towards e-learning.

Moreover, in examining the influence of attitudes towards e-learning, perceived characteristics of e-learning, prior condition related to development of e-learning, and characteristics of individual learners on the perceived e-learning effectiveness, it is found that all four construct variables are positively related to the perceived effectiveness as illustrated by the DOI model (Rogers, 1995). Although all predictor variables were confirmed affecting learners' perceived effectiveness of e-learning, the personal background variable comparing to three other variables seems less important in influencing the perceived effectiveness. In summary, potential users of e-learning actually recognize e-learning as an effective way of pursuing learning. They also have a positive attitude towards e-learning in general. It is hoped that the outcomes of this study can help provide some valuable information, as depicted in the analyses of individual as well as contextual constructs, when developing strategies for diffusing e-learning innovation by specifically considering learners' perceptions.

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