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Influence of online learning skills in cyberspace

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Abstract

Purpose – This study aims to propose a conceptual structural equation model to investigate the relationships among e-learning system quality, e-learning readiness, e-learners' competency as well as learning outcomes, and to demonstrate the direct and indirect effect of e-learning system quality and e-learning readiness on learning outcomes from the perspectives of e-learners' competency.

Design/methodology/approach – A questionnaire was distributed to 379 full-time employees from ten technological companies in Taiwan who have had e-learning experience ($n = 379$). Data were analyzed by employing structural equation modeling.

Findings – Results reveal that both e-learning system quality and e-learning readiness have a direct and significant impact on e-learners' competency. However, e-learning system quality and e-learning readiness influence learning outcomes indirectly through e-learners' competency. In addition, e-learners' competency has direct and positive significant influence on learning outcomes.

Practical implications – Based on these findings, organizations in Taiwan that would like to implement e-learning with their employees should focus on improving individuals' online learning skills such as self-direction, meta-cognitive, and collaborative skills.

Originality/value – The findings created an understanding of what attributes of external and internal factors influence the outcome of e-learning in high tech companies. In terms of research contributions, the study extends previous researches by identifying the mediating effect of e-learning competency on the relationship between e-learning system quality, e-learning readiness and learning outcome. Organizations that would like to adopt e-learning to improve employees' knowledge and skills will be able to apply strategies based on the findings from the research.

Keywords Students, Electronic media, Learning, Quality, Internet

Paper type Research paper

Introduction

The rapid advancement of Internet and computer technology has not only influenced the way we live, but the way we learn. In addition to incorporating e-learning in formal educational settings, it is evident that there is an increasing number of adult learning institutes offering online programs for people returning to employment after career breaks (Herman and Kirkup, 2008). In addition, Frand (2000) points out that most adult learners nowadays are more comfortable working on a keyboard than writing in a spiral notebook, and are happier reading from a computer screen than from paper in hands. According to Prensky (2001), student behaviors have changed during the past

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decade, and thus the existing educational system and learning planning methodologies have to change accordingly in order to produce the expected outcomes.

Developed countries such as England, Germany, the US and others have gradually integrated information technology into educational settings as well as corporate settings to support teaching and learning since the 1980s (Herman and Kirkup, 2008; Starr and Milheim, 1996). In developing countries, such as Taiwan, e-learning has gained public awareness in recent years through its recognition of educational resources for school teaching, learning and corporate training. According to Lee *et al.* (2007), e-learning can be used as a supplemental learning tool for supporting conventional teaching (e.g. face to face instruction), or as a stand-alone means for facilitating individualized learning (e.g. distance education). Both methods aim to improve learners' learning efficiency and effectiveness.

There are a variety of factors influencing the outcomes of e-learning. As Chen *et al.* (2008) pointed out, the critical incidents that affect e-learning satisfaction are classified into four categories: administration, functionality, instruction and interaction. Past research indicates the factors influencing the outcomes of e-learning include learner characteristics, such as proactive personality and learning goal orientation (Kickul and Kickul, 2006), learning strategy (Santhanam *et al.*, 2008), learning motivation (Meissonier *et al.*, 2006), effective or appropriate e-learning environment (Gregg, 2007; Wangpipatwong and Papasratorn, 2007), technology acceptance, system quality (Chang and Tung, 2008) and so on. Moreover, within the field of learning behavior, there is considerable research concerning learners' attitudes (Sun and Willson, 2008), instructional technologies (Wang, 2008), learning resources (Ouyang and Zhu, 2008), learning environments (Leung and Fung, 2005), learning methods (Wen and Stefanou, 2007), group collaborations (Webb *et al.*, 2006) and course content (Bird, 2007; Young and Ku, 2008), among others. In addition, a number of studies have established a correlation between learning behaviors and learning outcomes (e.g. Koopmans *et al.*, 2006; Könings *et al.*, 2005; Leung and Fung, 2005; Rouibah *et al.*, 2009; Ho, 2009).

However, beyond general assertions that the quality of the e-learning system, the e-learner's readiness and competency will lead to positive online learning outcomes, existing literature offers no testable theoretical model to explain this connection. As discussed above, this study attempts to look at factors that result in positive learning outcomes through the proposal and empirical validation of a theoretical model. The model incorporates four major dimensions, namely:

(1) E-learning system quality.

(2) The learner's e-learning readiness.

(3) The e-learner's competency.

(4) Learning outcomes.

A structural equation modeling approach is thus employed to test this model.

Theoretical foundation

E-learning system quality

Innovations in educational technology have provided room for more online cooperative learning behaviors in the past decade (Duffy and Cunningham, 1996). According to Pollack (2007), distance education is the use of new technologies to increase learning

and maximize collaboration between teachers and learners as well as among learners. In their study, Yli-Luoma and Naeve (2006) proposed a semantic e-learning method based on four phases of knowledge conversion: socialization, externalization, combination and internalization. They suggest that different emotions and behaviors may be induced during various e-learning phases. For example, the teacher-learner interaction in the socialization phase activates the exploratory learning behaviors.

Existing body of literature presents a number of studies confirming certain attributes of e-learning system result in higher learning motivation or better learning behaviors, such as reading, searching, browsing, or collaborating (Jung *et al.*, 2008; Given *et al.*, 2007; Finder *et al.*, 2006; Li and Rubin, 2004; Tong, 2009). Thus, it can be argued that e-learning system quality plays a critical factor in learning behaviors and learners' achievements.

E-learning readiness

Past researchers have investigated the use of technology in education as well as in corporate settings by analyzing the antecedents and outcomes of technology applications. For instance, Park and Wentling (2007) demonstrate that learners' computer attitudes influence their perceptions of the usability of the e-learning courses, and that such perceptions impact the degree of their skill developments, thus also the transfer of learning. Levin and Hansen (2008) argue that the learner's perceived values of utility determine the learner's attitudes toward course technologies, and that the learner's uses of course technology have a positive relationship with the learning outcomes.

Additionally, in their study, Sivo *et al.* (2007) find a strong and positive relationship among the students' attitudes towards web-based instructions, end-of-course grades, online frequency, and the students' future preferences to take web-based courses. Similar conclusions may also be identified in the work of Marcolin *et al.* (2000), Agarwal and Prasad (1997), and Lin *et al.* (2007). Existing literature presents a number of instruments measuring learners' readiness toward the use of technology in learning, such as Watkins (2005) and Parasuraman (2000).

E-learner competency

According to Watkins and Corry (2004), the online classroom is a new learning environment that offers an array of obstacles and opportunities that learners must attend to in order to continue to their success. Watkins and Corry argue that success in e-learning requires the integration of new strategies for using online technologies effectively in conjunction with traditional learning skills. They conclude that two sets of proficiencies were essential for e-learning success:

(1) Adapting old skills and habits from the traditional classroom for use in the online classroom.

(2) Developing and applying new e-learning skills and habits for the online classroom.

Mantyla (2000) claims that the twenty-first century learners play multiple active roles in learning and that twenty-first century trainers must verbalize the needs of the learners by providing:

- information on how to apply the learning concepts to a job;
- ways to effectively keep up with changes;
- proficiency in a job tasks and responsibilities time to learn;
- support in the learning process; and
- a motivational learning environment.

Tan (2003) identified four key elements of success of e-learners, namely time management, commitment and disciplines, motivation and pro-activeness, and positive attitudes.

Moreover, Sweeney (2001) suggests working adults who participate in e-learning to pay attention to the following issues in order to be successful e-learners. They are:

- allocating quiet time;
- discussing online learning schedule with their managers and/or co-workers;
- being considerate of others;
- setting realistic learning goals;
- being active participants;
- creating peer e-learning groups;
- accommodating oneself;
- reflecting on what they have learned;
- using all available resources; and
- sharing what they have learned.

Learning outcomes

Past research indicates that certain online behaviors determine the outcomes of the student achievement (e.g. Hoskins and van Hooff, 2005; Sulcic and Lesjak, 2009). Specifically, Webber (2004) identified a link between orientations to learning and various outcomes of learning activities. In addition, Könings *et al.* (2005) found that learners' perceptions of a learning environment influence their subsequent learning outcomes, which consequently affect the quality of their learning achievements. Whisler (2005) states that the online interaction, including instructor-to-learner, learner-to-learner, learner-to-content, and learner-to-learning interface, is a critical component of learner satisfaction.

In fact, how learners learn to use technology (i.e. be familiarized with the learning environment) is also crucial to their learning outcomes. Lei (2004) compare learners' learning outcomes and perceived effectiveness with their e-learning behaviors as well as their computer attitudes, computer experiences, and demographic characteristics. The results showed that lengthy computer experience does significantly affect learners' achievement scores. In addition, learners appear to benefit from frequent online interactions with peers, instructors, or content material.

Research method

Research structure and hypotheses

Based on the reviewed literature, the relevant hypotheses of the model and questionnaire design are presented as follows. The research model is shown in Figure 1.

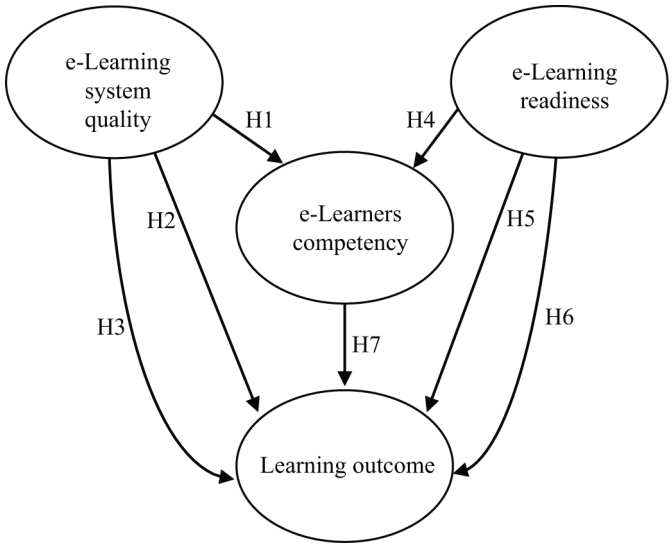

Figure 1.
Research model for structural equation modeling analysis

H1. E-learning system quality positively influences the online competency of the adult learners.

H2. E-learning system quality positively influences the learning outcomes of the adult learners.

H3. The impact of the adult learners' online competency on learning outcomes is stronger under the influences of e-learning system quality.

H4. E-learning readiness positively influences the online competency of the adult learners.

H5. E-learning readiness positively influences the learning outcomes of the adult learners.

H6. The impact of the adult learners' online competency on learning outcomes is stronger under the influences of their e-learning readiness.

H7. The online competency of the adult learners positively influences their learning outcomes.

Questionnaire design

The questionnaire is composed of five parts including: e-learning system quality, e-learning readiness, e-learner competency, learning outcomes and personal background (i.e. gender, age, and e-learning experience). The questions were answered using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Details of the dimensions are described as following:

E-learning system quality. This study adopts the three-factor model of IT quality dimension proposed by Medina and Chaparro (2007). The model includes the three most studied elements in the modern world:

(1) *The information quality*: refers to the appropriateness, update-ness, usefulness, accuracy, completeness, and relevance of the online course content.

(2) *The system quality*: refers to the friendliness, flawlessness, efficiency, and adaptability of the e-learning system.

(3) *The service quality*: refers to the tangible aspect of the system, which refers to staff reliability, responsibility, and empathy as well as the learners' confidence in online staff.

E-learning readiness. This study adopts the readiness survey, which was validated by Watkins (2005) to assist potential e-learners in assessing their readiness of e-learning. The instrument includes:

(1) *Technology access*: refers to access to hardware and software required for e-learning participation.

(2) *Online skills and relationships*: refers to basic computer and Internet skills in order to participate in e-learning, as well as to communicate with their peers and instructors.

(3) *Motivation*: refers to the learners' psychological states, which may predict the retention, persistence and success of e-learners.

(4) *Online audio/video*: refers to the capacity to learn while using e-learning technologies (for example two-way desktop video conferencing).

(5) *Internet discussions*: refers to e-learners' skills in effectively communications with peer and instructions.

(6) *Importance to your success*: refers to additional characteristics of e-learning courses and workplace contexts reviewed by the learners prior to committing to an e-learning.

E-learner competency. This study adopts the e-learner competency model proposed by Birch (2001). The model consists of three factors:

(1) *Self-direction competency*: refers to e-learners' ability in self-advocacy, self-sufficiency, self-confidence.

(2) *Meta-cognitive competency*: refers to e-learners' higher-order thinking involving active control over the cognitive processes engaged in learning and self-evaluation process.

(3) *Collaborative competency*: refers to the skills needed when participating in synchronous or asynchronous online learning activities, which includes chat sessions, email exchanges, discussion threads, instant message and virtual classrooms.

Learning outcomes. This study adopts van Gelderen et al.'s (2005) three measures in assessing adult learners' outcomes of e-learning:

(1) *Goal achievement*: refers to the extent to which the self-perceived learning results of the e-learners are consistent with the expectations of the e-learners and the instructors.

(2) *Satisfaction*: refers to the extent to which the e-learners are satisfied with the e-learning system, their learning initiatives, as well as the strategies they take to learn or react online.

(3) *Skill development*: refers to whether the knowledge and skills learned online can be transferred to handle job-related tasks or real-life situations.

Sampling. The data used in this research consist of questionnaire responses from participants in ten technological companies at three science parks, which are located in Taipei city, Hsinchu city and Taichuang city in Taiwan. According to the size of individual science park, three companies were selected from Taipei science park, five from the Hsinchu science park, and two from Taichuang. The selection criteria included the number of fulltime employees exceeding 500, and length of e-training experiences. A total of 100 questionnaires were circulated at the human resource management department in each company. Thus a total of one thousand survey questionnaires were distributed. Among these, 387 surveys were returned and 379 were valid for analysis (valid return rate is 37.9 percent). Non-response analysis was conducted to ensure the absence of non-response biases. The results show that there is no difference between respondents and non-respondents. Table I shows the sample characteristics.

Analysis and results

Reliability and validity tests

Cronbach α reliability estimates were used to measure the internal consistency of these multivariate scales (Nunnally, 1978). In this study, the Cronbach α of each constructs was greater than 0.9227, which indicates a strong reliability for our survey instrument (Cuieford, 1965). Since the item-to-total correlations of each measures was at least 0.6535, the criterion validity of each scale in this study is considered to be satisfactory (Kerlinger, 1999). Table II shows the description statistics for each dimension.

Construct	Classification	Number	Percentage (%)
Gender	Male	210	55.4
	Female	169	44.6
Age	<30	58	15.3
	31-40	156	41.2
	41-50	108	28.5
	>50	57	15.0
E-learning experience	Yes	245	64.6
	No	134	35.4

Table I. Sample characteristics

Dimension	Number of items per dimension	Mean	Std. Dev.	Order	Cronbach's α
E-learning system quality	12	3.5314	0.3844	2	0.9319
E-learning readiness	27	3.4925	0.5243	4	0.9565
E-learner competency	11	3.5167	0.3651	3	0.9227
Learning outcomes	13	3.5675	0.3700	1	0.9251

Table II. Survey structure and description statistics for dimension

Both exploratory and confirmatory factor analyses were used to ensure that the instrument has reasonable construct validity. The result of the exploratory factor analysis and internal consistency analysis are showed in Table III. The confirmative factor analysis which consists of the convergent and discriminant validity was analyzed following Campbell and Fiske's (1959) criteria. Discriminant validity was examined by counting the number of times an item correlates higher with items from other factors than with items from its own factor (Aldawani and Palvai, 2002). Campbell and Fiske suggest that this number should be less than 50 percent. Results also show adequate discriminant validity. Jointly, the constructs in this study exhibit both convergent and discriminant validity.

Analysis of the structural equation model

The structural equation modeling approach is a multivariate statistical technique for testing structural theory (Tan, 2001). This approach incorporates both observed and latent variables. The analysis for the present study was conducted using LISREL 8.52 and utilizing the maximum likelihood method. In the proposed model (Figure 1), the e-learning system quality and e-learning readiness are considered exogenous variables, and learning outcome is considered an endogenous variable. The e-learner's competency serves as both an endogenous variable (to e-learning system quality and e-learning readiness) and exogenous variable (to learning outcome).

The individual questionnaire items were aggregated into specific factor groups. The following four rules were utilized for the hypotheses' structure:

Dimension	Factor	Percentage of variance	Cumulative %	Item-to-total correlations	Cronbach's α
E-learning system quality	Information quality	27.672	78.364	0.6861	0.7326
	System quality	25.483		0.6674	0.7582
	Services quality	25.210		0.6673	0.7557
E-learning readiness	Motivation	14.530	74.340	0.7300	0.8634
	Internet discussions	14.221		0.6936	0.8693
	Online skills and relationships	14.022		0.7038	0.8682
	Importance to your success	12.408		0.6820	0.8711
	Technology access	10.791		0.7298	0.8634
	Online audio/video	8.369		0.6825	0.8717
E-learner competency	Self-direction competency	29.641	76.464	0.6788	0.7609
	Meta-cognitive competency	24.988		0.7022	0.7371
	Collaborative competency	21.835		0.6624	0.7771
Learning outcomes	Skill development	24.786	72.521	0.6887	0.7248
	Goal achievement	23.916		0.6535	0.7614
	Satisfaction	23.819		0.6597	0.7531

Table III.
Factor analysis and internal consistency values for the questionnaire

(1) Each observed variable has a nonzero loading on the latent factor within the structure, but have a loading of zero towards other latent factors.
(2) No relationship among measurement errors for observed variables.
(3) No relationship among the residuals of latent factors.
(4) No relationship among residuals and measurement errors.

The reliability results are illustrated in Table IV.

The final SEM model analysis is presented in Figure 2. The absolute fit measures (GFI = 0.95, AGFI = 0.93 and RMSEA = 0.0.046) indicate that the structural model either meets or exceeds recommended levels, and thus represents a satisfactory fit for the sample data collected. The Chi-square statistic divided by the degrees of freedom also indicates a reasonable fit at 1.81. It can be concluded that the proposed model maintains good construct validity (see Table V for the statistics of the fit test of the model). Based on Figure 2, five out of seven hypothesized relationships (*H1, H3, H4, H6*, and *H7*) show statistical significance.

Discussion

Based on the analysis performed above, a number of observations can be made. First of all, it is shown that both e-learning system quality and e-learning readiness have a direct and significant effect on e-learners' competency, as such, the validity of *H1* and *H4* is demonstrated. The results thus support the observation that two dimensions, namely: service, system and information quality of e-learning systems; and the self-perceived e-learning readiness of the adult learners, positively affect the development of their e-learning competency. Recent research, such as Yau *et al.* (2003), Kim and Kim (2008), Halawi *et al.* (2007) and Tan *et al.* (2009), have similar results.

The analysis also shows that the e-learning competency has a direct and significant effect on learning outcome, establishing *H7* as valid. Results show that adult learners'

Dimensions	Factors	Observed indicator reliability
E-learning system quality	Information quality	0.63
	System quality	0.60
	Services quality	0.58
E-learning readiness	Motivation	0.63
	Internet discussions	0.56
	Online skills and relationships	0.57
	Importance to your success	0.53
	Technology access	0.61
	Online audio/video	0.52
E-learner competency	Self-direction competency	0.61
	Meta-cognitive competency	0.67
	Collaborative competency	0.56
Learning outcomes	Skill development	0.60
	Goal achievement	0.63
	Satisfaction	0.56

Table IV. Observed indicator reliability of factors

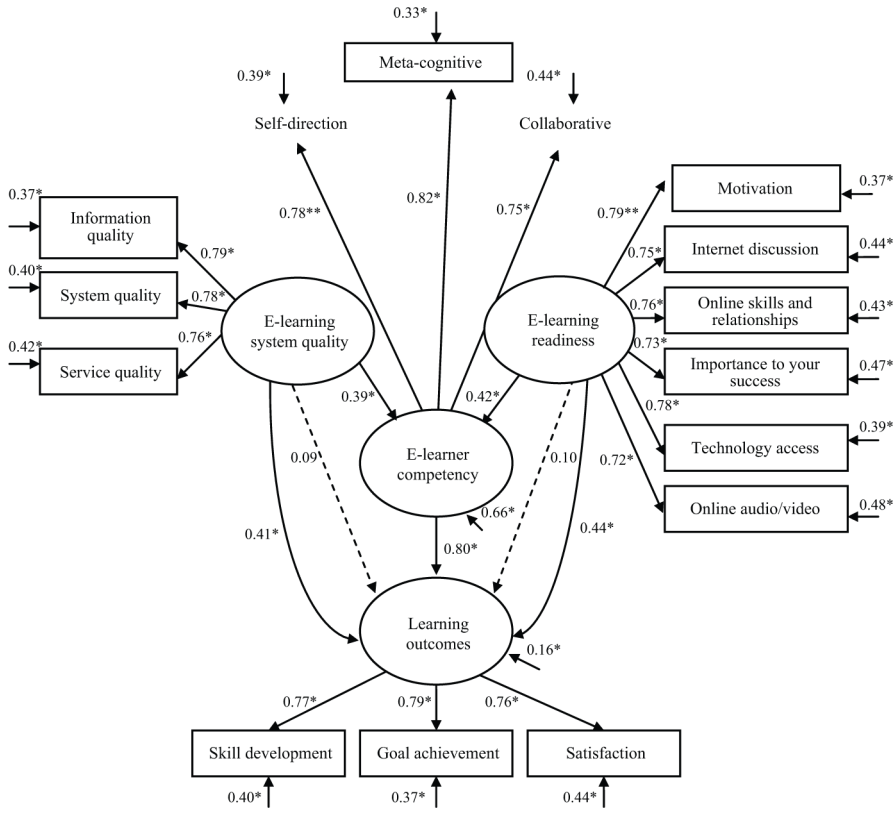

Figure 2.
Research model for structural equation modeling analysis

Note: *$p < 0.05$ ($|t| > 1.96$); **$p < 0.01$ ($|t| > 2.58$)

e-learning competency results in improved skill development, goal achievement, and satisfaction levels, an observation in support of work done by Wan *et al.* (2008). In their study, Wan *et al.* (2008) confirm that learners' prior experience with information communication technology and virtual competence were two influential factors that affected e-learning and had a positive influence on its outcomes. However, Hayashi *et al.* (2004) found that online skills has no significant relationship with learning outcomes; nevertheless, for learning to occur, social presence has shown to have an effect in different virtual learning environments, which is partly supportive of the findings of the present study.

The analysis has shown that neither the quality of e-learning system nor adult learners' e-learning readiness has a direct and statistically significant effect on learning outcome. *H2* and *H5* are thus rejected. The failure of both hypotheses are partially supported by the observation made by Lin *et al.* (2007) that IT investment and acceptance show no direct influence on adult learners' learning outcome. The finding of their study indicates that well-designed systems and competent learners do not directly result in better performance. Only if certain learning behaviors are performed can better outcomes be achieved.

Measures	Indicators
Absolute fit measures	Chi-Square with 84 Degrees of Freedom = 151.78 (P = 0.00) Goodness of Fit Index (GFI) = 0.95 Root Mean Square Error of Approximation (RMSEA) = 0.046 P-Value for Test of Close Fit (RMSEA < 0.05) = 0.69 Expected Cross-Validation Index (ECVI) = 0.59 90 Percent Confidence Interval for ECVI = (0.51; 0.69) ECVI for Saturated Model = 0.63 ECVI for Independence Model = 17.60 Adjusted Goodness of Fit Index (AGFI) = 0.93
Incremental fit measures	Normed Fit Index (NFI) = 0.98 Non-Normed Fit Index (NNFI) = 0.99 Comparative Fit Index (CFI) = 0.99 Incremental Fit Index (IFI) = 0.99 Relative Fit Index (RFI) = 0.97
Parsimonious fit measures	Parsimony Normed Fit Index (PNFI) = 0.78 Parsimony Goodness of Fit Index (PGFI) = 0.66 Critical N (CN) = 281.05 Normed chi-square 151.78/84 = 1.81

Note: $^{*}p < 0.001$ ($|t| > 3.29$)

Table V.
Fit test of the model

Finally, statistical analysis shows the mediate effect of e-learner competency on learning outcomes. *H3* and *H6* thus are proven to be valid. Such a finding is in line with the work done by Meissonier *et al.* (2006) in which they identified that motivation and self-disciplines of students are the main drivers of e-learning outcomes. In other words, only through proper learning behaviors, such as the intention to learn or self-regulation to be persistent in learning, can better learning outcome be achieved. Similar results can be found in studies conducted by Chang and Tung (2008), and Wangpipatwong and Papasratorn (2007) that online collaboration, knowledge exploration and construction, and learners' computer efficacy are critical factors of students' behavioral intentions (or learning preference) to use the online learning courseware, which consequently affect the actual behavior as well as the outcome of their learning.

Conclusion

Findings and managerial implications

This study has focused on the discussion and analysis of e-learning system quality, e-learning readiness, e-learner competency, and learning outcomes of adult learners at ten technological companies in Taiwan. Specifically, the study was designed to determine the effect of the learners' e-learning readiness and self-perceived e-learning system quality on the perception of their online learning competency. In turn, the effects of the adult learners' online competency on their learning outcomes were also examined. An empirical investigation using structural equation modeling shows that both the learners' perceived quality of e-learning system and their e-learning readiness are positive and important aspects in accommodating better goal achievement and skill development as well as higher learning satisfaction.

However, it must be highlighted that the self-perceived system quality and e-learning readiness do not directly result in better learning outcomes. Rather, these factors serve as catalysts to stimulate or influence the development of e-learners' online learning competency (Hung and Cho, 2008). Appropriate e-learner competency, in turn, serves as the channels for better outcomes of learning. Therefore, e-learning system quality and adult learners' e-learning readiness can thus be seen as a part of a larger chain, where e-learner competency form the middle ring which links those factors with learning outcomes of e-learners (Bouhadada and Laskri, 2008; Lu and Yeh, 2008; Siemsen, 1993).

In conclusion, the study can suggest that managers of technological companies may improve their employees' learning outcomes in an e-learning environment by fostering proper online learning competency, such as promoting better self-directed learning habits, meta-cognitive skills, and online collaborative behaviors to accommodate the needs of the adult learners' with different levels of e-learning readiness. Training managers of technological companies can also provide well-designed e-learning systems that match the content of learning subjects and fit the preferences of the learners. Furthermore, managers and trainers are reminded that e-learning systems quality and adult learners' learning readiness are supported by appropriate e-learning competency, without which better learning outcomes cannot occur.

Limitations

While the empirical data collected have largely supported the proposed model, it is necessary to point out the limitations of this research. Even though the responding individuals consisted of well-informed and active e-learning learners of the participating technological companies, the existence of possible biases or personal differences for e-learning cannot be discounted (e.g. different learning styles, the speed of learning of the participants and so on). Furthermore, it is evident that the platforms, content, and hardware equipment used can differ among these companies in different areas (e.g. suburban areas), countries, or even those in the same urban area universities offering dissimilar e-learning models (e.g. Dahl and Vossen, 2008; Lu and Yeh, 2008; Hu *et al.*, 2008; Sivakumar and Robertson, 2004). Therefore, the current data collected from the particular organizations in Taiwan may not be fully representative of other scenarios.

Future research

Although the data collected from the adult learners at 10 technological companies in Taiwan have largely supported the proposed model, it is somewhat limited in numbers as well as in industrial type (i.e. high tech companies). Thus, it is recommended that the future studies test the model with a larger sample size or in a different industrial setting (e.g. financial services sector). Secondly, since the research method is primarily based on quantitative analysis, it would be beneficial that future studies conduct interviews with the adult learners as well as human resource personnel of the surveyed companies to gain in-depth information that could confirm the quantitative results.

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