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Wen-Chieh Wu

Ming-Shiun Chen

Kuang-Hui Chiu

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# FACTORS OF EMPLOYEE'S E-LEARNING EFFECTIVENESS: A MULTI-LEVEL STUDY BASED ON SOCIO-TECHNICAL SYSTEMS THEORY

Wen-Chieh Wu[1], Ming-Shiun Chen[2], and Kuang-Hui Chiu[3]
Department of Business Administration
National Taipei University, Taipei, Taiwan
[1]sebwu@mail.ntpu.edu.tw; [2]mschen@mail.ntpu.edu.tw; [3]khchiu@mail.ntpu.edu.tw

## Abstract

Application of e-learning in enterprises provides the advantages of lower training cost, richer learning content, higher information consistency, and easier update of content. Despite the fact that enterprises have the intention to introduce e-learning, there is not a complete framework to which they can refer to ensure the benefits of e-learning for employee training or learning and understand which important factors affect employee's e-learning effectiveness. Relative to the difficulties of introducing e-learning in management practice, the academic achievements in this aspect also seem very limited. Most the existing papers are focused on discussion and survey of e-learning in school, and very few of them are dedicated to empirical research of e-learning in corporate environment. Besides, these studies discuss e-learning only at the technical or the individual level without a comprehensive investigation into the factors affecting e-learning effectiveness with multi-level theoretic framework.

This paper applies the socio-technical systems theory to review and integrate theories about employee e-learning from a macro view. To make up the insufficiency of related research, literature review and case research are conducted first. Based on the interview results, an analysis model is constructed to thoroughly explore factors affecting employee's e-learning effectiveness. Later, through a questionnaire survey on employees' adoption of e-learning and subsequent multi-level data analysis, hypotheses on the relationship of the influencing factors and the research model are verified.

Results show that e-learning effectiveness (usefulness of e-learning, continuance intention to use, and e-learning performance) is simultaneously or alternately affected by direct or moderating factors of the technical system and the social system at the work environment level and the individual level. Compared with the existing research, this paper uses a more comprehensive system view to construct the theoretical model and empirically verify it. The results can be a reference for future researchers and managers of e-learning in enterprises.

## Introduction

For enterprises, e-learning is not simply a training tool but also a performance enhancement tool. The Comparative Advantage Theory of Competition [1] proposes that an enterprise has more competitive advantage when the relative resource costs are lower and the relative resource-produced value is superior. Application of e-learning in a corporate environment can enhance employees' skills and knowledge and also motivate self-directed learning in organizational learning. On one hand, e-learning is not confined to geographical barriers. Employees can engage in self-directed learning, and learning resources can be repeatedly used. As the training cost is reduced, creation and accumulation of organizational knowledge can be achieved at a lower cost (lower relative resource cost). On the other hand, e-learning provides flexible learning materials and consistent information. The learning content is easy to update, and the enterprise's latest strategic goals can be instantly reflected. By embedding e-learning in knowledge management, enterprises can reshape the learning culture within the organization, facilitate externalization of tacit organizational knowledge, and accelerate knowledge acquisition, storage, and reuse. They can even share a portion of established learning content with suppliers or customers, utilizing e-learning as a strategic instrument to diffuse information of new products (superior relative resource-produced value).

However, in application of e-learning, domestic enterprises are less proactively than foreign enterprises. The main barriers include lack of professionals in e-learning, low e-business level, inability to estimate learning performance, lack of a long-term introduction plan, and lack of budgets for introduction. Even if they have the intention to introduce e-learning, but there is not a complete framework to which they can refer to ensure the benefits of e-learning for employee training or learning and understand which important factors affect employee's e-learning effectiveness. Relative to the difficulties of introducing e-learning in management practice, the academic achievements

in this aspect also seem very limited. Since e-learning was proposed, a considerable number of papers on related issues have been published. However, most of them are focused on discussion and survey of e-learning in school, and very few are dedicated to empirical research of e-learning in corporate environment. A corporate organization is a complicated system and differs significantly from schools in terms of environment and management. Employee training or learning is also extremely different from student learning at school. Therefore, there is really a need to conduct a deeper and more comprehensive research on employee e-learning to make up the insufficiency of research in this area.

DeRouin, Fritzsche, and Salas [2] conclude a review of studies on e-learning in organizations with some suggestions for future researchers: (1) For design, transfer, and implementation of e-learning in organizations, further theorization is necessary; (2) future research should be more centered on learners rather than technologies; (3) research on e-learning effectiveness should be more focused on e-learning in workplace. Most of the existing studies discuss e-learning with a sole focus on training effectiveness or at only the technical or the individual level without a comprehensive investigation into the theoretic framework and factors affecting e-learning. A corporate organization comprises of multiple interactive subsystems, including individual, task, technical environment, and social environment subsystems. Without a multi-level analysis, i.e. analysis of the technical level, individual level, organizational level, and etc., it is not possible to grasp a comprehensive view of applications of e-learning in corporate organizations from the system perspective. After reviewing literature associated with training transfer, Burke and Hutchins [3] proposed that systematic and multi-level consideration of corporate training is necessary and the socio-technical systems approach adopted in Kontoghiorghes [4] should be employed.

Therefore, the objective of this paper is to answer and explain **which work environment factors and individual factors affect employee's e-learning effectiveness**.

To answer the above-mentioned issue, we will follow the research procedure to answer the following questions: How to define employee's e-learning effectiveness? What are the main factors that affect employee's e-learning effectiveness? Of these factors, which are the factors at the work environment level? Which are the factors at the individual level? How do these factors affect employee e-learning?

To sum up, this paper aims to: (1) apply the Socio-technical Systems Theory to review and integrate theories about employee e-learning from a macro view and construct the research framework of this paper; (2) construct a multi-level analysis model and propose hypotheses, through literature review and case analysis; (3) verify the theoretic model and relationship between research variables through multi-source and multi-stage questionnaire survey and multi-level analysis of the data; and (4) propose conclusions based on empirical evidence and explain factors affecting individual employee's e-learning effectiveness and how to design and manage e-learning.

## Literature Review
### Employee e-learning and evaluation of its effectiveness

According to Cisco Systems, employee e-learning is to transfer various kinds of information and knowledge needed by individuals via the Internet in real-time; e-learning encompasses formal training, courses, information delivery, and interaction on the web, and also involves knowledge management and performance management. This definition explains the types and various forms of learning in enterprises, which are more applicable to enterprises (Institute for Information Industry, 2003). Based on the results of previous research [5] [6] [7] [8], we will focus on e-learning in a corporate context. Because most of the existing e-learning methods in corporate environment have relied on application of the Internet, we define "employee e-learning" as "an approach to transfer digital materials to employees via the Internet to help them continuously and autonomously engage in self-directed learning, receive training-related information, and participate in training activities".

Based on Newstrom's [9] procedural view as well as the summative and formative indexes of training effectiveness and the classical diffusion theory, we propose a three-level framework of employee's e-learning effectiveness, as shown in Figure 1. This framework reflects the performance evaluation levels of the above-mentioned views: the "reaction" and "learning" levels of Kirkpatrick's four levels of evaluation; the "training output" level of training transfer mentioned in Baldwin and Ford's research [10]; the "attitude" and "use" stages of the classical diffusion theory.
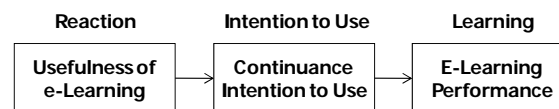


Figure 1 The three-level framework of employee's e-learning effectiveness

## Socio-technical systems and a multi-level theoretic framework

Falconer [11] points out that organizational learning involves multiple levels of an organization. In an integrative review of literature associated with training transfer, Burke and Hutchins [3] propose that a systematic and multi-level consideration of corporate training is necessary and the socio-technical systems approach adopted by Kontoghiorghes [4] should be employed. In this paper, we apply the socio-technical systems approach to review and integrate factors affecting employee's e-learning effectiveness from a macro view and construct a multi-level analysis model. The socio-technical systems theory was proposed by Trist, Emery, and et al. during 1950~60 [12] [13]. Because conventional organizational design methods were focused on the optimization of the technical aspect with little consideration of the social aspect, they were unable to explain why enterprises could not obtain expected results after introducing new technologies and facilities at a huge cost. The socio-technical systems concept was developed as a result [14] [15].

The socio-technical system consists of two interdependent subsystems, namely the social system and the technical system. The social system encompasses organizational culture, interpersonal relations, values, beliefs, motivations, interactive patterns, learning, and adaptability to changes. The technical system encompasses mechanical facilities, technical methods, and professional knowledge. The Socio-technical Systems Theory proposes that joint optimization of the social system and the technical system can lead to higher productivity, quality, and employee satisfaction [16] [17] [18].

In as early as the 1950s, psychologist Kurt Lewin proposed that individual behaviors are affected by two main factors, namely personal characteristics and the environment [19]. This view has inspired the management community to develop the view of individual-environment interaction and also explained that organization is essentially a multi-level phenomenon. All activities of an organization are affected by the organizational environment; creation of organizational knowledge is also affected by organizational contexts, such as interactive contexts, information contexts, and application contexts. Geels [20] applies the Socio-technical Systems Theory to conduct a series of innovative studies and proposed that socio-technical systems and the individual belong to different levels, and socio-technical systems can be called a socio-technical regime which consists of management activities and norms that affects individual activities.

However, in a multi-level framework, how do the technical system and the social system influence employee's e-learning effectiveness? Salmon [21] discusses e-learning in a book titled *e-Moderating*, emphasizing that digital technology is an important "moderator" in learning activities, as it is a condition and an environment that can assist learners in learning activities. Besides, individual applications of technology are also influenced by effects of social relations that exist between people, such as the reward system and power structure [22]. DeRouin et al. [2] point out that the extant empirical research on employee's e-learning effectiveness does not fully support a positive relationship between e-learning and learning effectiveness. They argue that there may be moderators between e-learning and learning effectiveness, so further exploration of the moderators is necessary. Therefore, we employ the socio-technical systems view to construct a multi-level analysis framework, with a focus on the effects of each subsystem at the individual level—employee's e-learning effectiveness.

## Case Study

According to Gable [23], case research method and survey research method have their respective strengths and weaknesses, so they can be complementary to each other. Attewell and Rule [24] suggest that case research should be conducted before survey research, because case research allows researchers to access the phenomena in the research environment and collect important perspectives to find causal relations or causes of a certain event. In this paper, 9 enterprises in Taiwan which have used e-learning for more than 6 months were selected. From each enterprise, one management executive and one user of e-learning were selected and given an open-ended interview. The interview records were organized according to previous literature to induce main factors in each level of the research framework and find the subsystem and analysis level that each factor belongs to. Finally, the relationship of these variables was investigated using the analyst triangulation method proposed by Patton [25]—using multiple analysts to review case findings. The result would be the basis for subsequent multi-level questionnaire survey.

## Conceptual Framework, Hypotheses, and Research Design

According to literature review and case study, employee's e-learning effectiveness can be divided into three levels, which are respectively dominated by three variables, including e-learning usefulness, continuance intention to use, and e-learning performance. As shown in Figure 2, the preceding

variables have direct effects on the succeeding ones. Hypotheses are inferred and proposed in the following paragraphs.
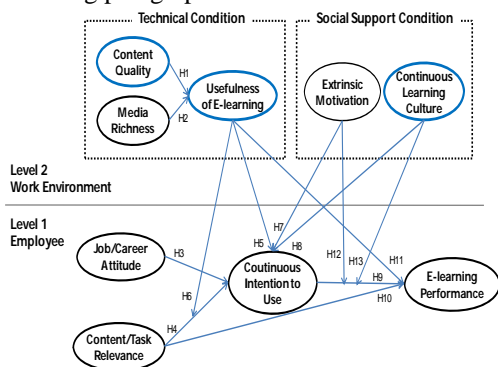


Figure 2 Conceptual framework

**E-learning usefulness**

It has been empirically validated that the perceived quality of an information system is an important factor that affects user satisfaction of the system [8] [26]. Lee [27] proposes that the information quality reflected on the needs of e-learning is focused on content quality, which includes content richness and update regularity. The case research result also shows that employees consider content richness and constant update of the learning materials as the determinants of the perceived usefulness of e-learning. The empirical evidence in Lee [27] also suggests that content quality is an important factor influencing perceived usefulness of e-learning. Therefore, we propose:

*Hypothesis 1:* Content quality of e-learning positively influences usefulness of e-learning.

According to the Media Richness Theory [28], media richness refers to using multiple and most appropriate digital media, including images, audios, and graphics to present learning content. Many studies of e-learning have revealed that application of a plurality of media [29] and interactive media [30] can draw learners' attention and effectively enhance their learning effectiveness. Studies of the Internet also point out that the rich information media embedded in websites can enhance satisfaction of website users (e.g., [31]). Therefore, we propose:

*Hypothesis 2:* Media richness of e-learning positively influences usefulness of e-learning.

**Continuance intention to use**

In a training context, "motivation" refers to the incentive that propels learners to be devoted to learning activities [32]. Intrinsic motivation is a key success factor of e-learning. Career attitude is a

form of intrinsic motivation [33]. Employees with a high career attitude have a better understanding of the needs to improve their work competence as well as the importance of acquiring job-required skills through training [34]. Managers interviewed in the case research also mentioned that employees who pay much attention to their career and job care about learning tasks given by their company and will accomplish them in time autonomously. Empirical evidence in Williams, Thayer, and Pond [35] suggests that career attitude and pre-training motivation are positively correlated. Therefore, we propose:

*Hypothesis 3:* Job/career attitude positively influences employee's e-learning continuance intention to use.

The Freedom to Learn Theory points out that learning content should be conformed to learning goals [36]. The Adult Learning Theory stresses that intention to learn is affected by the necessity of solving practical problems in life. The perceived effectiveness/value of training is derived from trainees' belief that application of the acquired skills can enhance their job performance. Higher job utility can lead to higher intention to receive training, and conformance of training content to job requirement is one of the most important values of training for trainees [3]. Wang [37] also mentions that learners' e-learning adoption intention is affected by appropriateness of e-learning content and tasks. Therefore, we propose:

*Hypothesis 4:* Content/task relevance positively influences employee's e-learning continuance intention to use.

Many empirical studies conducted on the basis of the classical Diffusion Theory have pointed out that users' positive attitude to a technical system (perceived as satisfactory and useful) can help increase their intention to continue using the system. In an empirical study of usage of services of a portal site, van Riel, Liljander, and Jurriens [38] found a strong and positive effect of overall satisfaction on users' intention to continue using the portal site. According to Keller [29], satisfaction of e-learning is one of the incentives for e-learning. Roca et al. [26] also discovered through a research of employee e-learning that increase of user satisfaction will positively influence employee's intention to continue using the e-learning system. In this paper, the construct of usefulness encompasses satisfaction, effectiveness, and efficiency, so we propose:

*Hypothesis 5:* Usefulness of e-learning

positively influences employee's e-learning continuance intention to use.

Technical systems play the role of an "e-moderator" [21]. Information systems can help increase learning efficiency and facilitate organizational learning [39] [40]. A useful e-learning system can provide a better system environment for learning, allowing employees with intrinsic motivations of content/task relevance to learn in a good environment and meet the demand for higher work efficiency. Learning content with a good job match can more effectively enhance employee's intention to learn when transferred by a better e-learning system. Hence, satisfaction of an e-learning system can reinforce the "motivation to use" induced by content/task relevance, propelling employees to have more intention to continue using e-learning. Based on the above discussion, the following hypothesis is proposed.

*Hypothesis 6:* Usefulness of e-learning reinforces the positive influence of content/task relevance on employee's e-learning continuance intention to use.

Pre-training motivation has considerable effects on training outcomes. In an employee training and learning context, requirements of the management system are a form of extrinsic motivation [3]. Extrinsic motivation includes reward, promotion, pay raise, and higher scores in performance evaluation [34]. While content/task relevance provides a better job utility, extrinsic motivations provide a better career utility [4]. In the design of training, sufficient definition of the goals of the training can help learners understand what levels of learning achievement or job achievement are expected and has significant effects on the training outcomes (e.g., [41]). Many studies have pointed out that a stronger extrinsic motivation (such as when performance is incorporated) can increase employee's intention and opportunities to engage in learning activities. Therefore, we propose:

*Hypothesis 7:* Extrinsic motivations for e-learning positively influence employee's e-learning continuance intention to use.

Workplace factors also play an important role in employee training. Organizational culture influences employee behaviors inconspicuously. The culture of continuous learning serves as an extrinsic motivation to employees and can enhance their learning intention [42]. The evidences in some studies on training (e.g., [42]) or e-learning (e.g., [43]) all suggest that the continuous learning culture has positive influence on employee training or learning effectiveness. The case research result also indicates that many enterprises have already put a strong emphasis on learning and employee training or development before introduction of e-learning. In such organizational culture, most employees will more be more active in participating in various learning activities. Therefore, we propose:

*Hypothesis 8:* The continuous learning culture within an organization positively influences employee's e-learning continuance intention to use.

**E-learning performance**

The main difference between e-learning and conventional training models lies in application of digital technologies. Researchers of employee e-learning adopt the view of technology use and consider the uniqueness of technology use in employee e-learning, suggesting that "use" should be encompassed in the e-learning framework [44] [45]. Transfer of training via e-learning requires employees to use e-learning in a self-directed manner; otherwise, the learning effectiveness cannot be achieved. From the Freedom to Learn Theory, effective learning relies on spontaneous and full engagement of learners in learning activities. When learners attempt to discover new concepts, their intelligence can be enlightened, ability to acquire knowledge improved, and effectiveness of learning boosted [36]. Likewise, when employees have a higher intention to continue using e-learning and a stronger learning motivation, their learning performance can be positively influenced. This relationship has been empirically validated as significant by many researchers. Therefore, we propose:

*Hypothesis 9:* Employee's e-learning continuance intention to use positively influences e-learning performance.

In all training activities, training content is an important factor of learning effectiveness. Ford and Wroten [46] thus suggest that training effectiveness should be evaluated by the relevance of training program content to the job. From a learner perspective, whether a learning material is meaningful is determined by learners rather than the material itself. Meaningful learning emerges when the learning content complies with the learning goals [36]. According to Pintrich and Schrauben [47], a higher perceived task value (i.e. the belief in the expected value of a learning task) can result in a higher performance. Studies of training transfer also show that whether the training

content is readily usefulness affects the training outcome (e.g., [48]). Alliger, Tannenbaum, Bennett, Traver and Shotland [49] point out that trainees apply skills acquired from the training in their job only when they perceive the training content as practical. Therefore, we propose:

*Hypothesis 10:* Content/task relevance positively influences employee's e-learning performance.

The research of training transfer indicates that trainee's "reaction" to training, i.e. satisfaction, affects training outcomes (e.g., [10]). Studies based on the Theory of Reasoned Action (TRA) and Technology Acceptance Model (TAM) also have a similar argument—user's reaction to technology use affects user performance [44]. Besides, studies of the learning theories propose that learner control (i.e. learners control learning processes and methods according to individual needs and pace) is an important factor of learning effectiveness [50]. A better e-learning system can provide a better digital environment, allowing learners to exercise learner control (through functions such as providing learning history, note-taking, and connections to web resources) and increase their learning effectiveness. The empirical evidence in Johnson, Hornik, and Salas [51] suggests that technology usefulness has positive effects on e-learning outcomes. Therefore, we propose:

*Hypothesis 11:* Usefulness of e-learning positively influences employee's e-learning performance.

Hierarchy is normal in any organization, and many individual activities may be subject to the influence of the organizational system and the organizational environment. In a review of literature associated with e-learning in organizations, DeRouin et al. [2] point out that previous studies have not fully supported the positive relationship between e-learning and learning effectiveness. Besides, there may be important moderators between e-learning and learning effectiveness, so further exploration is required. We argue that the social supports from the organization, including "extrinsic motivation" and "continuous learning culture" are influential.

The Expectancy Theory of Motivation [52] proposes that motivation = expectancy × instrumentality × valence. In addition to intention to use e-learning, connecting goal settings and reward plans to e-learning performance can increase the instrumentality of e-learning and thus enhance the motivation for e-learners. Besides, while content/task relevance provides job utility,

extrinsic motivations provide career utility [4] and can elevate the value of e-learning behavior. Researchers of the Cognitive Evaluation Theory argue that extrinsic motivation and intrinsic motivation have interaction effects on behavior [53]. Therefore, we propose:

*Hypothesis 12:* Extrinsic motivation for employees reinforces the positive relationship between e-learning continuance intention to use and e-learning performance.

Many studies on organizations have found that organizational culture plays the role of a situational enhancer for employee behaviors [54]. This is a strategic focus, which means that behavioral signals will be formed under the atmosphere of the organizational culture, revealing which tasks are "important" in the organization [55]. It has been pointed out in many studies that the continuous learning culture in the work environment is an important variable affecting trainee's learning. Continuous learning culture provides employees with specific goals, allowing them to realize that "learning is important" in the work environment. Thus, the strategic focus that stresses learning performance improvement through e-learning will make employees more dedicated to e-learning activities. Besides, according to the Social Learning Theory and subjective norms, learning in an organization with a continuous learning culture and with co-learning companions or with subjects to learn or imitate from can increase employees' learning motivation. Employees' increased attention to learning achievement will ultimately result in better learning performance. Therefore, we propose:

*Hypothesis 13:* The continuous learning culture within an organization reinforces the positive relationship between e-learning continuance intention to use and e-learning performance.

**Participants, Procedures, and Measures**

The research scale was developed according to previous empirical studies and modified on the basis of related theories. To verify the proposed hypotheses and the overall model, we invited 258 enterprises from related reports and data provided by industrial associations which have introduced an e-learning system and are using it to provide technical knowledge to a considerable number of employees.

The questionnaire was collected in three stages, starting from Dec 2008 and spanning for about four and half months. In the first stage, responses of managerial questionnaire in which items of media richness and extrinsic motivation

were asked from e-learning managers of 58 enterprises.

The second stage: Three months later, 766 responses of users' questionnaire in which most items of research variables were asked from e-learning users were collected from the mentioned 58 enterprises. The third stage: One more month later, all responses were further asked with questionnaire of items for "e-learning performance".

Among the 58 enterprises, however, 28 enterprises did not have insufficient sample scale of users' questionnaires. Responses from employees in these 28 enterprises, 136 in total, were all excluded. Besides, there were 28 incomplete responses, 5 responses with missing or incomplete answers, and 10 responses from employees who did not use e-learning in the past three months. After these responses were excluded, a total of 587 valid employee responses from 29 enterprises were obtained.

All measures (with 3-6 items) of constructs were modified from measures of former empirical studies and findings from case studies in this research. The results of validity and reliability analysis are presented in Table 1. For the e-learning user questionnaire, confirmatory factor analysis (CFA) was performed to verify the convergent validity of the measurement tool. For the e-learning managerial questionnaire, the sample sizes of "media richness" and "extrinsic motivation" were too small, so CFA was not suitable. Therefore, principal component analysis of exploratory factor analysis (EFA) was conducted to verify the construct validity of the questionnaire. Besides, according to the factor analysis results, all the constructs were tested for reliability.

## Data Analysis and Results
### Aggregation Statistics and Hypotheses Testing Results

This research was designed to conduct a multi-level analysis. Because many variables were induced from data of many individuals, theoretically, there should be a certain degree of consistency or consensus between individuals. Therefore, consistency between individuals in the perception of a specific phenomenon is a key criterion that determines whether a group variable can be generated. Besides, variance of the variable should be tested by explaining the group variable and measuring the mean reliability at the group level. We conducted the test by measuring $r_{wg}$ (within group agreement), intra-class correlation coefficient ($ICC_{(I)}$), and reliability at the group level ($ICC_{(II)}$). The results show that all the $r_{wg}$ values are greater than the 0.6 threshold suggested by James [56]. The mean $r_{wg}$ values are as follows:

content quality (0.727), usefulness of e-learning (0.737), and continuous learning culture (0.768).

Table 1 Factor analysis and reliability analysis results

### (1) Confirmatory factor analysis result

| Construct & Items | Factor Loading | t value | CR (AVE) | Construct & Items | Factor Loading | t value | CR (AVE) |
|---|---|---|---|---|---|---|---|
| **Content/Task Relevance** CJ1 | 0.82 | 24.98 | | **Usefulness of E-learning** EU1 | 0.95 | 22.67 | |
| CJ2 | 0.79 | 24.90 | 0.93 | EU2 | 0.97 | 26.97 | 0.85 |
| CJ3 | 0.98 | 22.31 | (0.71) | EU3 | 0.94 | 24.11 | (0.79) |
| CJ4 | 0.95 | 24.98 | | EU5 | 0.82 | 14.53 | |
| | | | | EU6 | 0.78 | 13.99 | |
| **Job/Career Attitude** JC1 | 0.75 | 18.06 | | **Continuous Intention to Use** | | | |
| JC2 | 0.74 | 19.29 | | CI1 | 0.78 | 25.74 | 0.86 |
| JC3 | 0.82 | 16.60 | 0.89 | CI2 | 0.89 | 25.49 | (0.68) |
| JC4 | 0.71 | 16.93 | (0.73) | CI3 | 0.91 | 23.70 | |
| JC5 | 0.72 | 19.74 | | | | | |
| JC6 | 0.78 | 16.65 | | | | | |
| **Content Quality** CQ1 | 0.72 | 23.05 | | **E-learning Performance** EP1 | 0.90 | 24.49 | |
| CQ2 | 0.98 | 23.20 | 0.88 | EP2 | 0.77 | 20.45 | 0.95 |
| CQ3 | 0.91 | 20.83 | (0.75) | EP3 | 0.95 | 28.88 | (0.78) |
| CQ4 | 0.81 | 22.11 | | EP4 | 0.86 | 24.78 | |
| **Continuous Learning Culture** CL1 | 0.92 | 22.28 | | **Computer Self-Efficacy** CS1 | 0.90 | 27.30 | |
| CL2 | 0.97 | 26.18 | | CS2 | 0.83 | 25.75 | 0.90 |
| CL3 | 0.91 | 23.74 | 0.88 | CS3 | 0.98 | 23.52 | (0.75) |
| CL5 | 0.81 | 15.82 | (0.69) | CS4 | 0.85 | 23.00 | |
| CL6 | 0.72 | 18.42 | | | | | |

Goodness of fit index (GFI)= 0.910
Adj. goodness of fit index (AGFI) = 0.889
Root mean squared residual (RMR) = 0.0497
Root mean squared error approximation (RMSEA) = 0.0749
Comparative Fit Index (CFI) = 0.925
Chi-square (d.f.) =1583.04 (499)
Estimated Non-centrality Parameter (NCP) = 736.498
90 Percent Confidence Interval for NCP = (644.402 ; 836.129)

### (2) Exploratory factor analysis result

| Factor | Items | Factor Loading | Factor Loading |
|---|---|---|---|
| **Extrinsic Motivation** | EM1 | 0.905 | |
| | EM2 | 0.901 | |
| | EM3 | 0.826 | |
| | EM4 | 0.791 | |
| | EM5 | 0.732 | |
| **Media Richness** | MR1 | | 0.945 |
| | MR2 | | 0.940 |
| | MR3 | | 0.811 |
| KMO=0.908 (p<0.001) | | eigenvalue | eigenvalue |
| Total Varence 81.036% | | 3.143 | 2.530 |

### (3) Reliability analysis result

| Users' Questionnaire | | Managers' Questionnaire | |
|---|---|---|---|
| **Varibal** | **Cronbach's $\alpha$** | **Varibal** | **Cronbach's $\alpha$** |
| Content/Task Relevance | 0.899 | Media Richness | 0.871 |
| Job/Career Attitude | 0.819 | Extrinsic Motivation | 0.865 |
| Content Quality | 0.847 | | |
| Continuous Learning Culture | 0.871 | | |
| Usefulness of E-learning | 0.839 | | |
| Continuous Intention to Use | 0.889 | | |
| E-learning Performance | 0.901 | | |
| Computer Self-Efficacy | 0.907 | | |

Table 2 Hypotheses testing result
(1) The effects on usefulness of e-learning

| Independent | Dependent: Usefulness of E-learning | |
|---|---|---|
|  | Model A1 | Model A2 |
| Content Quality | 0.677 *** | 0.467 * |
| Media Richness |  | 0.425 * |
| R² | 0.458 | 0.595 |
| ΔR² |  | 0.137 * |
| F | 16.901 *** | 13.936 *** |

*p<0.05；**p<0.01；***p<0.001

(2) The effects on continuance intention to use

| Independent | Dependent: Continuous Intention to Use | | | | |
|---|---|---|---|---|---|
|  | Model B1 Null Model | Model B2 Control | Model B3 Employee | Model B4 Work Environment | Model B5 Interaction effects |
| **Level 1** |  |  |  |  |  |
| (Constant) | 5.058 *** | 5.058 *** | 5.060 *** | 5.070 *** | 5.066 *** |
| Computer Self-Efficacy |  | -0.029 | -0.029 | -0.004 | -0.003 |
| Job/Career Attitude |  |  | 0.281 * | 0.264 * | 0.263 * |
| Content/Task Relevance |  |  | 0.555 *** | 0.582 *** | 0.586 *** |
| **Level 2** |  |  |  |  |  |
| Usefulness of E-learning |  |  |  | 0.546 ** | 0.518 ** |
| Continuous Learning Culture |  |  |  | 0.225 ** | 0.210 ** |
| Extrinsic Motivation |  |  |  | 0.153 | 0.151 |
| **Cross-Level** |  |  |  |  |  |
| Usefulness of E-learning × Content/Task Relevance |  |  |  |  | 0.298 ** |
| Between-Group Residual Variance | 0.138 *** | 0.152 *** | 0.162 *** | 0.114 *** | 0.106 *** |
| Within-Group Residual Variance | 1.122 | 1.003 | 0.570 | 0.481 | 0.480 |
| R²_within-group |  |  | 0.49 |  |  |
| R²_between-group |  |  |  | 0.17 | 0.23 |
| Model deviance | 1749.43 | 1722.19 | 1440.80 | 1378.14 | 1370.67 |

*P<0.05；**P<0.01；***P<0.001

(3) The effects on e-learning performance

| Independent | Dependent: E-learning Performance | | | | |
|---|---|---|---|---|---|
|  | Model C1 Null Model | Model C2 Control | Model C3 Employee | Model C4 Work Environment | Model C5 Interaction Effects |
| **Level 1** |  |  |  |  |  |
| (Constant) | 4.668 *** | 4.667 *** | 4.671 *** | 4.670 *** | 4.670 *** |
| Computer Self-Efficacy |  | -0.030 | 0.014 | 0.013 | 0.015 |
| Continuous Intention to Use |  |  | 0.441 *** | 0.435 *** | 0.435 *** |
| Content/Task Relevance |  |  | 0.394 *** | 0.410 *** | 0.398 *** |
| **Level 2** |  |  |  |  |  |
| Usefulness of E-learning |  |  |  | 0.442 *** | 0.448 *** |
| Continuous Learning Culture |  |  |  | 0.159 | 0.158 |
| Extrinsic Motivation |  |  |  | 0.273 * | 0.149 |
| **Cross-Level** |  |  |  |  |  |
| Continuous Intention to Use × Continuous Learning Culture |  |  |  |  | -0.007 |
| Continuous Intention to Use × Extrinsic Motivation |  |  |  |  | 0.212 * |
| Between-Group Residual Variance | 0.134 *** | 0.136 *** | 0.167 *** | 0.095 *** | 0.089 *** |
| Within-Group Residual Variance | 1.020 | 0.958 | 0.305 | 0.306 | 0.307 |
| R²_within-group |  |  | 0.69 |  |  |
| R²_between-group |  |  |  | 0.29 | 0.34 |
| Model deviance | 1699.43 | 1684.21 | 899.98 | 880.64 | 891.11 |

*P<0.05；**P<0.01；***P<0.001

Estimated on the basis of the Model B1 in Table 2, ICCI$_{(I)}$ of "continuance intention to use" is 0.110; estimated on the basis of Model C1 in Table 2, ICC$_{(I)}$ of "e-learning performance" was 0.116. Both ICC$_{(I)}$ values are greater than the 0.059 standard proposed by Cohen (1988). Besides, all the ICC$_{(II)}$ values are greater than the 0.6 standard proposed by Glick [57].

The result of Model A2 presents content quality and media richness are significantly related to usefulness of e-learning, providing support to H1 and H2.

The result of Model B5 with HLM analysis presents all predictors, except computer self-efficacy and extrinsic motivation, are significantly related to continuous intention to use. The result supports H3 to H6 and H8, but does not support H7.

Finally, the result of Model C5 with HLM analysis presents all predictors are significantly related to e-learning performance, except computer self-efficacy, continuous learning culture, extrinsic motivation and the interaction of continuous intention to use and continuous learning culture. The result supports H9 to H12, but does not support H13.

## Conclusions and Suggestions
### Research conclusions

**Usefulness of an e-learning system is an important determinant of employee's intention to use e-learning and learning effectiveness:** e-learning encompasses management of transfer of knowledge and is also a part of the learning environment. A well-designed e-learning system can not only enhance employees' intention to use the system but also help them obtain learning effectiveness. This finding is consistent with conclusions of many studies on technology use and e-learning. However, through a multi-level research framework, we explore the moderating role of technology at the work environment level. The finding indicates that employees' continuance intention to use induced by the job value incentive (content/task relevance) can amplify the effects of a good e-learning system. Our empirical evidence also supports Salmon's [21] argument about the moderator of e-learning in *e-Moderating*.

**The quality and media richness of e-learning content are key indicators in user evaluation of the usefulness of an e-learning system:** What kind of e-learning system is a satisfactory learning system is a focal issue in many existing studies. Through literature review, we induced the development process of this research domain. In early years, the research of e-learning technologies was focused on system quality and service quality of the supporting systems. Later, researchers began to shift their

focus onto information quality, i.e. quality of e-learning materials. In recent years, compared with the system aspect, researchers paid more attention to the content aspect, i.e. sufficiency, richness, and presentation of the learning content. Therefore, many recent researchers have employed the Media Richness Theory proposed by Daft and Lengel [28] to propose the importance of content richness and use of multimedia in e-learning.

**Content/task relevance is imperative for the design of e-learning content:** In addition to the quantity (content) and quality (media richness) of e-learning materials, "content/task relevance" based on the perceived job value can induce employees' e-learning continuance intention to use. Many enterprises may purchase more generalized learning materials when introducing e-learning due to consideration of material development time and cost. Because some of these learning materials may have no direct relevance to employees' regular tasks, employees may not consider e-learning as an immediately necessary activity. Whether in previous studies of training transfer or this study, the empirical evidence suggests that relevance of learning content to tasks can induce motivation for continuous learning and more substantial learning outcomes.

**The continuous learning culture reinforces motivation:** Many studies of organization theories have pointed out that "culture" affects employee behaviors inconspicuously. From the learning perspective, the Social Learning Theory provides a foundation for this argument. Learning from others in the group to change individual behaviors is a non-mandatory behavior induced from the culture. However, in the review of training transfer literature, Cheng and Ho [33] only discovered that continuous learning culture influences post-training behavior transfer and did not probe into its effect on learning motivation. The empirical finding in this paper supports that the continuous learning culture reinforces learners' motivation to learn.

**Extrinsic motivations reinforce learning:** Previous studies have shown that compared with intrinsic motivations, extrinsic motivations are less influential to learning motivation. This finding is also supported in this paper. However, while scholars contemplate on whether there are important situational factors that may reduce the effects e-learning on learning performance, our research results have provided some clues. Employees' performance in e-learning is certainly influenced by their intention to learn. However, extrinsic motivations serve as an effective "situational" factor that enhances employees' learning motivation and learning performance.

**An answer to the Self-Determination Theory: a continuum of e-learning motivation is formed according to self-determination levels.** Continuance intention to use is affected by factors including job/career attitude, content/task relevance, usefulness of e-learning, extrinsic motivation, and continuous learning culture. Among these factors, extrinsic motivation does not exhibit a significant influence on continuance intention to use in this paper. Ryan, Connell, and Deci [58] first developed the Self-determination Theory and proposed in the subsequent research that motivation is a continuum of self-determination levels which reflect the perceived locus of causality. Motivations in the highest level are intrinsic motivations (enjoy doing it) and extrinsic motivations including autonomous motivation (worth doing) and controlled motivation (supposed to do it; must do it). The controlled motivation comes from reward and threat and may thus reduce autonomy and motivational needs. In our investigation into the factors affecting continuance intention to use, we found several types of motivations as follows: usefulness of e-learning—enhance intrinsic motivation (enjoy doing it); job/career attitude and content/task relevance—enhance autonomous motivation (worth doing); continuous learning culture—enhance controlled motivation (supposed to do it); extrinsic motivations—enhance controlled motivation (must do it). Among these motivations, the must-do-it controlled motivation comes from extrinsic motivations rather than voluntary motivations, so it can hardly induce employees' enduring intention to engage in e-learning.

**Transfer tools for e-learning materials, employee learning motivation, and e-learning content are equally important for learning performance.** Although the mediating role of intention to use between use responses and use benefits has been pointed out in many existing studies, its mediating effect is not significant in this study. To obtain substantial learning effectiveness, usefulness of e-learning (i.e. material transfer tool), continuance intention to use (i.e. employee learning motivation), and content/task relevance (i.e. material content) are equally important. Extrinsic motivations are important social supports. In addition to the above-mentioned three factors, social supports for "enhancing" learning can be provided. Extrinsic motivations such as rewards and performance appraisals are important "catalyzers". The evidence of the moderating role of extrinsic motivations explains why extrinsic motivations are important but not significantly influential in empirical tests.

**The factors of the technical system and the social system simultaneously or alternately influence individual responses, motivations, and behaviors:** E-learning is a series of activities, in which employees go through reactions, motivations,

and learning behaviors. Factors of the technical system and factors of the social system may simultaneously or alternately influence employee's learning in these sequential activities. Many pervious studies of e-learning investigate improvement of e-learning with consideration of factors a single level. However, our research finding indicates that factors of the technical system factors and factors of the social system should be simultaneously considered, as suggested by the Socio-Technical Systems Theory, so as to clarify which factors are important, how and when these factors affect individual learning behaviors under a complete system framework. Organizations involve multi-level phenomena, which cannot be neglected in system research. In social science studies, especially organizational behaviors, the essential multi-level phenomena within the organization and explanation of these phenomena are more and more emphasized. Through a multi-level survey and analysis, we have once again confirmed that the effects on employee activities within the organization come from multiple levels. For organizational learning activities, systematic thinking with consideration of interaction effects of factors from multiple levels is necessary.

## Management implications

**A "useful" e-learning system defined by users:** There is no denying that constructing a good "digital environment" for learning is necessary. Employees may feel very frustrated whether they are required or self-directed to use a not very useful e-learning system. Besides, the usefulness of an e-learning system is defined by users. Therefore, e-learning managers must realize and even investigate employees' needs for the learning content, responses to the system quality, and suggestions on system improvement.

**Learning activities that can enhance work efficiency and integrate career development:** Learning activities must be connected to the goals of learning. In workplaces, the most direct goal of learning is to enhance work efficiency. Hence, e-learning content should be "customized" as much as possible to provide content needed by each individual user. For instance, new employees need to acquire knowledge of the work processes and methods in a short time, managers need to learn effective leadership and communication skills, and technicians need to know latest innovations and industrial information. Employees can be attracted to continue using an e-learning platform only when they can acquire appropriate learning content from it. Besides, employees who are more concerned about self-development and career plans will have a stronger intention for autonomous learning.

Therefore, reinforcing the linkage between learning activities and career development is a must. The amount of learning content for each level of employees should be effectively planned. Besides, what learning content that employees need to acquire at each career stage should also be made clear. Therefore, when employees make future plans, they will also take into account the requirement of learning activities into their plan of work life.

**Develop a culture that promotes learning:** A far-sighted strategic leader will convey and form common values by shaping their organizational culture. Certainly, organizational culture cannot be shaped overnight. In the long-run, it can be an intangible power that influences employees' thinking and behavior in inconspicuous ways. The learning culture involves the value that "learning is necessary" and "learning is a part of work life". This value is shared by employees, who will provide support to one another to accomplish the "task" of learning. Effective construction of a learning culture should start from top to bottom in an organization. If executives emphasize learning, lower ranking employees will realize that learning is important.

**Provide rich, constantly updated, and "planned" learning content**: For users of e-learning systems, constant update of e-learning content is more important than content richness. In the development of e-learning content, managers should plan materials like school curricula. They should plan progressive learning content from the perspective of learners and provide suggestions on learning pace. In our case research, most of the interviewed managers mentioned that they should gradually transform their role as a content provider into a content or course planner. In nowadays, the information technologies advance in a fast speed. Application of multimedia is no longer costly, and software and hardware environments for e-learning are very mature. Effective use of presentation methods for each type of course content can help increase learners' learning intention and effectiveness.

## Limitations and suggestions for future researchers

Due to the constraint of research needs, a non-random sampling method—purposive sampling was adopted. As a result, there was limitation on generalization of the theories. Besides, to avoid common methods variance, extrinsic motivations were assessed by executives. This design prevented us from verifying whether the extrinsic motivations were motivations perceived by employees. With consideration of the survey difficulty and large differences in e-learning

content between enterprises, employees' e-learning performance was assessed by subjective measures rather than objective test measures. There are still numerous issues of e-learning in organizations that should be empirically investigated. Subject to the constraints of research time and cost, we could only select factors affecting learning effectiveness at the individual level from previous literature and verify the effects of these factors. Thus, future researchers are advised to investigate the difference between different stages of e-learning introduction, difference in learning effectiveness between employees at different positions, factors affecting the above-mentioned differences, and issues related to behavior transfer through observational learning.

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