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What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction

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Abstract

E-learning is emerging as the new paradigm of modern education. Worldwide, the e-learning market has a growth rate of 35.6%, but failures exist. Little is known about why many users stop their online learning after their initial experience. Previous research done under different task environments has suggested a variety of factors affecting user satisfaction with e-Learning. This study developed an integrated model with six dimensions: learners, instructors, courses, technology, design, and environment. A survey was conducted to investigate the critical factors affecting learners' satisfaction in e-Learning. The results revealed that learner computer anxiety, instructor attitude toward e-Learning, e-Learning course flexibility, e-Learning course quality, perceived usefulness, perceived ease of use, and diversity in assessments are the critical factors affecting learners' perceived satisfaction. The results show institutions how to improve learner satisfaction and further strengthen their e-Learning implementation.

Keywords: Learner satisfaction; E-Learning; E-Learning management

1. Introduction

E-Learning is the use of telecommunication technology to deliver information for education and training. With the progress of information and communication technology development, e-Learning is emerging as the paradigm of modern education. The great advantages of e-Learning include liberating interactions between learners and instructors, or learners and learners, from limitations of time and space through

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the asynchronous and synchronous learning network model (Katz, 2000; Katz, 2002; Trentin, 1997). E-learning's characteristics fulfill the requirements for learning in a modern society and have created great demand for e-Learning from businesses and institutes of higher education. MIT's attempt to offer virtually all of its courses online has sent a signal to institutes on the strategic importance of e-Learning (Wu, Tsai, Chen, & Wu, 2006).

The e-Learning market has a growth rate of 35.6%, but failures exist (Arbaugh & Duray, 2002; Wu et al., 2006). Little is known about why some users stop their online learning after their initial experience. Information system research clearly shows that user satisfaction is one of the most important factors in assessing the success of system implementation (Delon & Mclean, 1992). In an e-Learning environment, several factors account for users' satisfaction. Those factors can be categorized into six dimensions: student, teacher, course, technology, system design, and environmental dimension (Arbaugh, 2002; Arbaugh & Duray, 2002; Aronen & Dieressen, 2001; Chen & Bagakas, 2003; Hong, 2002; Lewis, 2002; Piccoli, Ahmad, & Ives, 2001; Stokes, 2001; Thurmond, Wambach, & Connors, 2002). The researchers' suggestions are impractical, however, because so many factors make implementation and change nearly impossible.

The factors affecting e-Learning performance presented by previous researchers are basically from descriptive or analytical studies with certain dimensions. For parsimony and feasibility of practice, this study intends to identify critical factors ensuring a successful e-Learning design and operation from a holistic viewpoint and present guidelines for e-Learning management. The results presented in this manuscript can certainly help institutions adopt e-Learning technology by overcoming potential obstacles, and hence reduce the risk of failure during implementation. Furthermore, academia can use the findings of this study as a basis to initiate other related studies in the e-Learning area.

In the following sections, previous research, related literature and factors influencing learners' satisfaction in e-Learning environments are discussed. A research design based on an integrated model proposed by this study is described and examined. Finally, the results are analyzed and presented.

2. Prior studies of e-Learning

E-Learning is basically a web-based system that makes information or knowledge available to users or learners and disregards time restrictions or geographic proximity. Although online learning has advantages over traditional face-to-face education (Piccoli et al., 2001), concerns include time, labor intensiveness, and material resources involved in running e-Learning environments. The costly high failure rate of e-Learning implementations discussed by Arbaugh and Duray (2002) deserves attention from management and system designers.

Many researchers from psychology and information system fields have identified important variables dealing with e-Learning. Among them, the technology acceptance model (Ajzen & Fishbein, 1977; Davis, Bagozzi, & Warshaw, 1989; Oliver, 1980), and the expectation and confirmation model (Bhattacherjee, 2001; Lin, Wu, & Tsai, 2005; Wu et al., 2006) have partially contributed to understanding e-Learning success. These models tended to focus on technology. A summary of the literature relevant to all the factors vital to the activities of e-Learning, and affecting learners' satisfaction with e-Learning, is presented below in Table 1. Six dimensions are used to assess the factors, including student dimension, instructor dimension, course dimension, technology dimension, design dimension, and environment dimension.

Under the six dimensions previously identified, thirteen factors were involved. In the learner dimension those factors are learner attitude toward computers, learner computer anxiety, and learner Internet self-efficacy. The factors of instructor response timeliness and instructor attitude toward e-Learning were identified in the instructor dimension, and e-Learning course flexibility, e-Learning course quality in the course dimension. The technology dimension factors were technology quality and Internet quality. Finally, perceived usefulness and perceived ease of use were identified in design dimension and diversity in assessment and learner perceived interaction with others in the environmental dimension. These factors discussed by previous researchers cover nearly every aspect of e-Learning environments; however, they have never been integrated into one framework subject to examination for validation and relationship. This research develops such a framework including those factors shown in Fig. 1.

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Table 1
Related references about the critical factors that affect learners' satisfaction

Author(s)	Factors
Arbaugh (2000)	Perceived usefulness and perceived ease of use, flexibility of e-Learning, interaction with class participants, student usage, and gender
Piccoli et al. (2001)	Maturity, motivation, technology comfort, technology attitudes, computer anxiety, and epistemic beliefs, technology control, technology attitudes, teaching styles, self-efficacy, availability, objectivist and constructivist, quality, reliability, and availability, pace, sequence, control, factual knowledge, procedural knowledge, conceptual knowledge, timing, frequency, and quality
Stokes (2001)	Students' temperaments (guardian, idealist, artisan, and rational)
Arbaugh (2002)	Perceived flexibility of the medium, perceived usefulness and perceived ease of use, media variety, prior instructor experience, virtual immediacy behaviors, and interaction
Arbaugh and Duray (2002)	Perceived usefulness and perceived ease of use, perceived flexibility
Hong (2002)	Gender, age, scholastic aptitude, learning style, and initial computer skills, interaction with instructor, interaction with fellow students, course activities, discussion sessions, and time spent on the course
Thurmond et al. (2002)	Computer skills, courses taken, initial knowledge about e-Learning technology, live from the main campus of the institution, age, receive comments in a timely manner, offer various assessment methods, time to spend, scheduled discussions, team work, acquaintance with the instructors
Kanuka and Nocente (2003)	Motivating aims, cognitive modes, and interpersonal behaviors

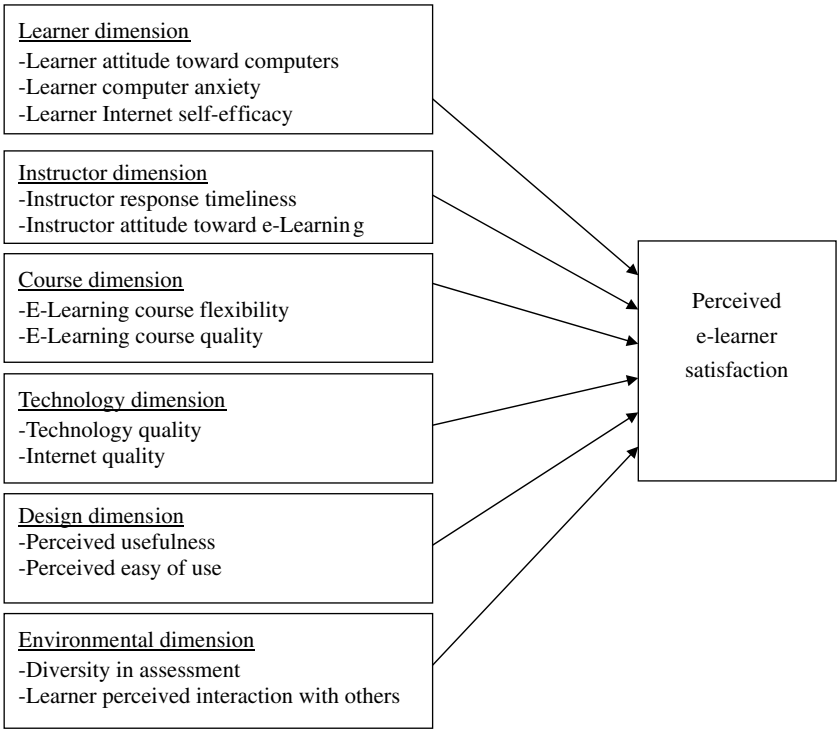

Fig. 1. Dimensions and antecedents of perceived e-Learner satisfaction.

3. Variables and research model

Based on the previous research, a framework was designed to guide this study. Thirteen variables within six dimensions are discussed. Hypotheses for testing their relationships are also presented in this section.

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3.1. Learner dimension

Much research indicates that learner attitude towards computers or IT is an important factor in e-Learning satisfaction (Arbaugh, 2002; Arbaugh & Duray, 2002; Hong, 2002; Piccoli et al., 2001). The definition of learner attitude is learners' impression of participating in e-Learning activities through computer usage. E-Learning depends mainly on the use of computers as assisting tools. Instructors publish their materials on the platform and learners participate through computer networks. A more positive attitude toward IT, for example, when students are not afraid of the complexity of using computers, will result in more satisfied and effective learners in an e-Learning environment (Piccoli et al., 2001). Furthermore, Hannafin and Cole (1983) imply that attitude influences learning interest. Positive attitudes toward computers increase the chances of successful computer learning, and negative attitudes reduce interest. Therefore, this research considers learners' attitude towards computers an important factor in learning satisfaction. Hypothesis 1 will test this assumption.

Hypothesis 1. Learner attitude toward computers will positively influence perceived e-Learner satisfaction with e-Learning.

As Piccoli et al. (2001) show, computer anxiety significantly affects learning satisfaction in e-Learning. Computers are media tools in e-Learning environments and fears of computer usage would certainly hamper learning satisfaction (Piccoli et al., 2001). Anxiety results from mental pressure and is composed of trait anxiety and state anxiety (Cattell & Scheier, 1961). While trait anxiety is a stable and enduring internal personal characteristic, state anxiety results from the external environment (Spielberger, 1976). Previous research has shown that computer anxiety is a kind of state anxiety (Heissen, Glass, & Knight, 1987; Raub, 1981). It is "an emotional fear of potential negative outcomes such as damaging the equipment or looking foolish" (Barbeite & Weiss, 2004).

The higher the computer anxiety, the lower the level of learning satisfaction. Users' anxiety is different from attitude which represents beliefs and feelings toward computers (Heissen et al., 1987). Related research proposes that computer anxiety hampers individuals' attitudes and behaviors and the relationship between anxiety and learning effect cannot be neglected (Igbaria, 1990). The definition of computer anxiety in this research is the level of learners' anxiety when they apply computers in e-Learning. Hypothesis 2 is, therefore,

Hypothesis 2. Learner computer anxiety will negatively influence perceived e-Learner satisfaction with e-Learning.

Self-efficacy is individuals' inclination toward a particular functional aspect. It is an evaluation for effects and the possibility of success before performing a task (Marakas, Yi, & Johnson, 1998). Learners with high self-efficacy are more confident in accomplishing e-Learning activities and improving their satisfaction. Many studies explore influences of self-efficacy on users' recognition effects. Joo, Bong, and Choi (2000) point out that self-efficacy is an important factor in predicting effects of searching in network-based learning. Thompson, Meriac, and Cope (2002) also indicate that specific Internet self-efficacies significantly influence results when users perform online searches. Wang and Newlin (2002), from research on 122 students, conclude that students with higher self-efficacy are more inclined to adopt network-based learning and earn significantly better final grades. Internet self-efficacy is defined in this study as learners' ability to evaluate their ability to use the Internet to perform activities related to e-Learning.

Hypothesis 3. Learner Internet self-efficacy will positively influence perceived e-Learner satisfaction with e-Learning.

3.2. Instructor dimension

Previous research indicated that instructors' timely response significantly influences learners' satisfaction (Arbaugh, 2002; Thurmond et al., 2002). The rationale is that when learners face problems in an online course, timely assistance from the instructor encourages learners to continue their learning. Soon, Sook, Jung, and Im (2000) point out that instructors' failing to respond to students' problems in time has a negative impact on students' learning. Therefore, if an instructor is capable of handling e-Learning activities and responding to students' needs and problems promptly, learning satisfaction will improve (Arbaugh, 2002; Chickring & Gam-

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son, 1987; Ryan, Carlton, & Ali, 1999; Thurmond et al., 2002). Instructor response timeliness is defined as whether students perceive that instructors responded promptly to their problems.

Hypothesis 4. Instructor response timeliness will positively influence perceived e-Learner satisfaction with e-Learning.

The social influence model of technology proposed by Fulk, Schmitz, and Steinfield (1990) states that group members' or supervisors' attitudes toward technology affects individuals' perceptions. Individuals are expected to develop their own coordinated patterns of behavior by observing others' actions, behaviors, and emotional reactions (Fulk, 1993). Webster and Hackley (1997) and Piccoli et al. (2001) find that instructors' attitudes toward e-Learning or IT positively influence results of e-Learning since instructors are major actors in learning activities. Dillon and Gunawardena (1995) state instructors' attitudes toward distance learning should be considered in system evaluation in order to explicate online course user behaviors effectively and thoroughly. The definition for instructor attitudes toward e-Learning is learners' perception of their instructors' attitude toward e-Learning. Thus, Hypothesis 5 is stated below.

Hypothesis 5. Instructor attitudes toward e-Learning will positively influence students' perceived e-Learner satisfaction with e-Learning.

3.3. Course dimension

Due to e-Learning courses' flexibility in time, location, and methods, participation and satisfaction of e-Learning learners are facilitated (Arbaugh, 2002; Arbaugh, 2000; Berger, 1999; Leidner & Jarvenpaa, 1995). In addition, elimination of physical barriers enables more dynamic interaction that fosters establishment of constructive learning and opportunities for cooperative learning (Brandon & Hollingshead, 1999; Salmon, 2000). With no restrictions on time and space in e-Learning, students can communicate instantaneously, anytime, anywhere (Harasim, 1990; Leidner & Jarvenpaa, 1995; Taylor, 1996). Moreover, its virtuality eliminates awkwardness associated with face-to-face communication in traditional classrooms. Learners can express their thoughts without reticence and ask questions through discussion group or bulletin board systems (Finley, 1992; Harasim, 1990; Strauss, 1996). Currently, most e-Learning courses are in complimentary learning and continued education programs, and learners are mostly people on the job (Arbaugh & Duray, 2002; Ellram & Easton, 1999). The definition of e-Learning course flexibility is learners' perception of the efficiency and effects of adopting e-Learning in their working, learning, and commuting hours. Therefore,

Hypothesis 6. E-Learning course flexibility will positively influence perceived e-Learner satisfaction with e-Learning.

The quality of well-designed e-Learning programs is the precedent factor for learners when considering e-Learning. Quality is another important factor influencing learning effects and satisfaction in e-Learning (Piccoli et al., 2001). Under the constructive or cooperative learning model, interactive communications and media presentation provided by IT can help learners develop high-level thinking models and establish conceptual knowledge (Leidner & Jarvenpaa, 1995). The virtual characteristics of e-Learning, including online interactive discussion and brainstorming, multimedia presentation for course materials, and management of learning processes, assist learners in establishing learning models effectively and motivating continuous online learning (Piccoli et al., 2001). Therefore, the quality of e-Learning courses is also considered a significant factor in learner satisfaction.

Hypothesis 7. E-Learning course quality will positively influence perceived e-Learner satisfaction with e-Learning.

3.4. Technology dimension

Several researchers indicate that technology quality and Internet quality significantly affect satisfaction in e-Learning (Piccoli et al., 2001; Webster & Hackley, 1997). A software tool with user-friendly characteristics,

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such as learning and memorizing few simple ideas and meaningful keywords, demands little effort from its users. Users will be willing to adopt such a tool with few barriers and satisfaction will be improved (Amoroso & Cheney, 1991; Rivard, 1987). Therefore, the higher the quality and reliability in IT, the higher the learning effects will be (Hiltz, 1993; Piccoli et al., 2001; Webster & Hackley, 1997).

E-Learning may also involve learning and discussion using other equipment such as video conferencing (Isaacs, Morris, Rodriguez, & Tang, 1995). Therefore, both technology quality and Internet quality are important factors in e-Learning (Piccoli et al., 2001; Webster & Hackley, 1997). Moreover, empirical research undertaken by Webster and Hackley (1997) studied learning effects on the technology-mediated distance learning of 247 students. Quality and reliability of technology, as well as network transmission speed, were shown to impact learning effects. The definition of technology quality is the learners' perceived quality of IT applied in e-Learning (such as microphones, earphones, electronic blackboards, and so on). The definition for Internet quality is network quality as perceived by learners.

Hypothesis 8. Technology quality will positively influence perceived e-Learner satisfaction with e-Learning.

Hypothesis 9. Internet quality will positively influence perceived e-Learner satisfaction with e-Learning.

3.5. Design dimension

The technology acceptance model (TAM) focuses on predicting and assessing users' tendency to accept technology. TAM, proposed by Davis (1989), studies the relationships among three important variables, perceived usefulness, ease of use, and attitudes and intention in adoption. This theoretical framework is very appropriate for predicting learning satisfaction in e-Learning, and variables in TAM are shown to significantly influence learner satisfaction (Arbaugh, 2000; Arbaugh, 2002; Arbaugh & Duray, 2002; Atkinson & Kydd, 1997; Wu et al., 2006).

TAM identifies perceived usefulness as the degrees of work improvement after adoption of a system. Perceived ease of use is users' perception of the ease of adopting a system. Both factors influence users' attitudes toward a software tool and further affect individuals' beliefs and behaviors when adopting the tool. Applying this model to e-Learning, the presumption is that the more learners' perceive usefulness and ease of use in courses delivering media, such as course websites and file transmitting software, the more positive their attitudes are toward e-Learning, consequently improving their learning experiences and satisfaction, and increasing their chances for using e-Learning in the future (Arbaugh, 2002; Arbaugh & Duray, 2002; Pituch & Lee, 2006). Learner perceived usefulness in an e-Learning system is defined as the perception of degrees of improvement in learning effects because of adoption of such a system. Perceived ease of use in an e-Learning system is learners' perception of the ease of adopting an e-Learning system.

Hypothesis 10. Learner perceived usefulness of the e-Learning system will positively influence perceived e-Learner satisfaction with e-Learning.

Hypothesis 11. Learner perceived ease of use of the e-Learning system will positively influence perceived e-Learner satisfaction with e-Learning.

3.6. Environmental dimension

Proper feedback mechanisms are important to e-Learners. Thurmond et al. (2002) state that environmental variables such as diversity in assessment and perceived interaction with others influence e-Learning satisfaction considerably. The use of different evaluation methods in an e-Learning system causes users to think that a connection is established between them and the instructors, and their learning efforts are properly assessed. Therefore, this study assumes that if an e-Learning system provides more or diversified assessment tools and methods, users' satisfaction will increase because of feedback from the assessment. Diversity in assessment is defined as different assessment methods as perceived by learners.

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Hypothesis 12. Diversity in assessment will positively influence perceived e-Learner satisfaction with e-Learning.

Arbaugh (2000) suggests that the more learners perceive interaction with others, the higher the e-Learning satisfaction. In a virtual learning environment, interactions between learners and others or course materials can help solve problems and improve progress. Interacting electronically could improve learning effects (Piccoli et al., 2001). Many researchers agree that interactive instructional design is an essential factor for learning satisfaction and success (Hong, 2002; Jiang & Ting, 1998; Nahl, 1993; Schwartz, 1995).

According to Moore (1989), there are three kinds of interactions in learning activities: students with teachers, students with materials, students with students. Teaching styles, especially interactions between teachers and students, play a decisive role in learning activities (Borbely, 1994; Lachem, Mitchell, & Atkinson, 1994; Webster & Hackley, 1997). Without conspicuous interactions between teachers and students, learners are more prone to distractions and difficulty concentrating on the course materials (Isaacs et al., 1995). Because e-Learning can proceed in almost any place, it requires better concentration than in traditional face-to-face interactions (Kydd & Ferry, 1994). Interaction mechanisms in e-Learning environments should be properly designed to improve frequency, quality, and promptness of interactions which could affect learner satisfaction. For this study, the definition of learners' perceived interaction with others is learners' perception of the level of interactions between students and teachers, students and materials, and students and students.

Hypothesis 13. Learner perceived interaction with others will positively influence perceived e-Learner satisfaction with e-Learning.

Perceived e-Learner satisfaction is widely used in evaluating effects of learning environments and activities both academically and practically (Alavi, 1994; Alavi, Wheeler, & Valacich, 1995; Wang, 2003; Wolfram, 1994). Also, it is used as a key indicator of whether or not learners would continue to adopt a learning system (Arbaugh, 2000). This study intends to assess e-Learning effects through measuring learner satisfaction and investigate the preceding factors' influences on satisfaction. Perceived e-Learner satisfaction is, therefore, defined as the degree of perceived learner satisfaction towards e-Learning environments as a whole.

Based on the discussion in this section, the research model is presented in Fig. 1.

4. Research design

4.1. Measurement development and pilot test

We conducted a series of in-depth interviews with various experienced e-Learning learners to examine the validity of our research model. After that, we developed questionnaire items based on the previous literature and comments gathered from the interviews. Questionnaires were revised with help from experts (including academics and practitioners) with significant experiences in e-Learning. A 7-point Likert scale ranging from 1 as strongly disagree to 7 as strongly agree is used for the measurement.

A pretest for the reliability and validity of the instruments was conducted with five e-Learning experts, followed by a pilot test using 36 on-the-job MBA students who have experience with e-Learning. Some items were revised and deleted, according to the results from the pretest and pilot tests, to improve face and content validity, as well as reliability. The final version of the questionnaire is in Appendix A with its sources. Subjects who participated in the pilot test were excluded from the subsequent study.

4.2. The subjects and the procedure

E-Learner volunteers enrolled in 16 different e-Learning courses at two public universities in Taiwan participated in the study. A total of 645 surveys were distributed by email. The initial and follow-up mailing generated 295 usable responses, resulting in a response rate of 45.7%. This response rate from an unsolicited mailed questionnaire suggested that respondents found the topic interesting and relevant. Moreover, after

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conducting a non-response bias test on background data of samples from the two mailings, no significant difference in background was found. Table 2 summarizes the demographic profile and descriptive statistics of the respondents. The subjects were nearly evenly men and women, with only slightly more men responding than women. Nearly 50% of the participants were between 20 and 30 years old. One hundred and twenty-nine respondents (43.7%) were first time taking e-Learning, whereas 14 (4.8%) had taken four or more. Two hundred and thirty-two learners (78.6%) considered themselves to have intermediate level computer skills. Furthermore, the perceived learner satisfaction with e-Learning courses, according to the survey responses, was fairly high with a mean score of 5.2.

This research used Statistical Package for the Social Sciences version 10 (SPSS v.10.0) for the statistical analysis. Data were analyzed using stepwise regression analysis. We used 13 variables aforementioned as regressors, and perceived e-Learner satisfaction as regress.

5. Data analysis

As mentioned in the previous section, SPSS is used to analyze data for this research. A stepwise multiple regression analysis was used to prove the significance of the variables. To avoid violating the basic assumptions underlying the method of least squares used by the classical linear regression model, we conducted a P–P plot for assessing the assumption of normality. The plot showed that the quantile pairs fell nearly on a straight line. It is, therefore, reasonable to conclude that the data used in this research are approximately normal. Second, this research used the condition index (C.I.) to assess the multicollinearity among independent variables in the model. The value of 29.44 indicated no severe multicollinearity problem among the regressors. Finally, we used the Durbin-Watson statistic for detecting serial correlation. The value of 1.89 (less than 2) indicated the autocorrelation problem does not exist (Gujarati, 2003).

5.1. Reliability and validity analysis

As mentioned earlier, the questionnaires were presented to several experts to improve face and content validity. Reliability was examined using Cronbach's α values for each variable. As presented in Table 3, most of these, except for Internet quality, were above or close to 0.72, which is a commonly acceptable

Table 2
Subject demographic ($n = 295$)

Measure and items	Frequency	Percentage
Gender		
Male	159	53.9
Female	136	46.1
Age		
20–30	148	50.2
31–40	123	41.7
41–50	24	8.1
Learner prior experiences in e-Learning courses		
0	129	43.7
1	92	31.2
2	36	12.2
3	24	8.1
>4	14	4.8
Learner initial computer skills		
Novice	31	10.5
Intermediate	232	78.6
Expert	32	10.9

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Table 3
Descriptive statistics, correlation,[a] reliablilities[b] among study variables ($n = 295$)

Variables	Means	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Perceived e-Learner satisfaction	5.51	0.98	(.93)													
(2) Learner attitude toward the computers	4.89	0.81	.30	(.72)												
(3) Learner computer anxiety	2.24	1.20	−.22	−.40	(.86)											
(4) Learner Internet self-efficacy	0.85	0.12	.37	.44	−.40											
(5) Instructor response timeliness	4.44	1.46	.36	−.05	−.12	−.10	(n.a.)									
(6) Instructor attitude toward e-Learning	4.84	1.35	.41	.11	−.12	−.05	.41	(n.a.)								
(7) E-Learning course flexibility	5.03	1.29	.42	.17	−.11	.03	.12	31	(.87)							
(8) E-Learning course quality	4.70	1.16	.72	.15	.01	−.17	.32	.32	36	(.83)						
(9) Technology quality	5.31	0.92	.35	.18	−.19	.05	.33	.31	15	.29	(.83)					
(10) Internet quality	4.11	0.93	.19	.14	−.09	.04	.12	.14	.07	.16	.26	(.82)				
(11) Perceived usefulness	5.11	1.09	.58	.14	−.02	−.16	.37	.44	.32	.62	.43	.16	(.91)			
(12) Perceived ease of use	5.64	0.83	.49	.43	−.27	.15	.12	.25	.30	.32	.45	.24	.33	(.90)		
(13) Diversity in assessment	5.16	1.18	.41	.14	−.10	.08	.19	.19	.20	.26	.19	.08	.25	.33	(n.a.)	
(14) Learner perceived interaction with others	3.72	0.95	.29	−.04	.02	−.18	.38	.28	.16	.33	.26	.10	.30	.11	.15	(.80)

[a] Absolute values of Correlations above 0.12 are significant at $p < .05$ level.
[b] Reliablilities (Cronbach's α) are shown in parentheses. n.a., not applicable.

level. The reliability of each factor was as follows: perceived e-Learner satisfaction = 0.93; learner attitude toward computers = 0.72; learner computer anxiety = 0.86; learner Internet self-efficacy = 0.89; e-Learning course flexibility = 0.87; e-Learning course quality = 0.83; technology quality = 0.82; Internet quality = 0.50; perceived usefulness = 0.91; perceived easy of use = 0.90; learner perceived interaction with others = 0.80.

5.2. Pearson correlation analysis

Table 3 presents the means, standard deviations, and correlations between variables. The e-Learning course quality variable ($r = .72$, $p < .001$) has the highest correlation to the dependent variable. Other independent

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variables that significantly correlated with the dependent variable are: learner attitude toward computers ($r = .30$, $p < .001$); learner computer anxiety ($r = -.22$, $p < .001$); learner Internet self-efficacy ($r = .37$, $p < .001$); instructor response timeliness ($r = .36$, $p < .001$); instructor attitude toward e-Learning ($r = .41$, $p < .001$); e-Learning course flexibility ($r = .42$, $p < .001$); technology quality ($r = .35$, $p < .001$); Internet quality ($r = .19$, $p < .005$); perceived usefulness ($r = .58$, $p < .001$); perceived ease of use ($r = .49$, $p < .001$); diversity in assessment ($r = .41$, $p < .001$); learner perceived interaction with others ($r = .29$, $p < .001$). All the factors exhibited significant relationships with perceived e-Learner satisfactions.

5.3. Hypothesis testing

A stepwise multiple regression analysis was conducted to test the hypotheses. Thirteen influential variables derived from previous research were applied as independent variables, while perceived e-Learner satisfaction was used as a dependent variable. Table 4 presents the results of regression analysis. Among 13 independent variables, seven are considered to have critical relationships with learner satisfaction with p-values less than .05. Those factors are learner computer anxiety, instructor attitude toward e-Learning, e-Learning course flexibility, course quality, perceived usefulness, perceived ease of use, and diversity in assessment.

Hypotheses 1–3 examined the relationships between the learner dimension and perceived e-Learner satisfaction. Among them, the test only supports Hypothesis 2. Learner computer anxiety has a negative impact on perceived e-Learner satisfaction. Hypotheses 1 and 3 are not supported, with p-values greater than .05.

Hypotheses 4 and 5 examined the links between the instructor dimension and perceived e-Learner satisfaction. Instructor attitude toward e-Learning positively influences perceived e-Learner satisfaction while response timeliness is insignificant.

Hypotheses 6 and 7 examined the effects of the course dimension. E-Learning course quality has a strong, positively significant influence on e-Learners' satisfaction ($\beta = .50$, $p < .001$). The other variable, e-Learning course flexibility, also has a significant effect on e-Learners' satisfaction. Therefore, both Hypotheses 6 and 7 are supported.

Table 4
Results of stepwise multiple regression analysis ($n = 295$)

Independent variable	Dependent variable: perceived e-Learner satisfaction	
	β	t-value
Learner attitude toward computers	0.06	1.48
Learner computer anxiety	−0.14	−4.00***
Learner Internet self-efficacy	0.08	1.90
Instructor response time	0.06	1.40
Instructor attitude toward e-Learning	0.10	2.50*
E-Learning course flexibility	0.08	2.00*
E-Learning course quality	0.50	11.05***
Technology quality	−0.02	−0.54
Internet quality	0.01	0.21
Perceived usefulness	0.12	2.61**
Perceived ease of use	0.16	3.97***
Diversity in assessment	0.16	4.30***
Learner perceived interaction with others	0.02	0.49
F(d.f. 7, 287)	82.96***	
R^2	0.669	
Adjusted R^2	0.661	
C.I.	29.44	
Durbin-Watson	1.89	

Note: *$p < .05$; **$p < .01$; ***$p < .001$.

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Table 5
Summary of the results

Hypothesis	Independent variable	Significant
1	Learner attitude toward computers	No
2	Learner computer anxiety	Yes
3	Learner Internet self-efficacy	No
4	Instructor response timeliness	No
5	Instructor attitudes toward e-Learning	Yes
6	E-Learning course flexibility	Yes
7	E-Learning course quality	Yes
8	Technology quality	No
9	Internet quality	No
10	Learner perceived usefulness of the e-Learning system	Yes
11	Learner perceived ease of use of the e-Learning system	Yes
12	Diversity in assessment	Yes
13	Learner perceived interaction with others	No

Hypotheses 8 and 9 examined the relationship between the technology dimension and perceived e-Learner satisfaction. The results show that these two variables do not influence perceived e-Learner satisfaction significantly. Therefore, Hypotheses 8 and 9 are not supported.

Hypotheses 10 and 11 examined the effects of the design dimension and perceived e-Learner satisfaction. Learner perceived usefulness of the e-Learning system ($\beta = .12$, $p < .01$) and perceived ease of use ($\beta = .16$, $p < .001$) have a positively significant influence on perceived e-Learner satisfaction. Both Hypotheses 10 and 11 are supported by this test.

Hypotheses 12 and 13 examined the links between the environmental dimension and perceived e-Learner satisfaction. Diversity in assessment has a positive influence on e-Learners' satisfaction. However, learner perceived interaction with others in Hypothesis 13 is insignificant and failed to be supported. Table 5 summarizes the results of all hypotheses testing.

6. Discussion

From stepwise multiple regression analysis, seven variables are proven to have critical relationships with e-Learner satisfaction, namely learner computer anxiety, instructor attitude toward e-Learning, e-Learning course flexibility, course quality, perceived usefulness, perceived ease of use, and diversity in assessment. The results suggested that 66.1% (adjusted $R_2 = 66.1\%$, F-value $= 82.96$, $p < .001$) of the perceived e-Learner satisfaction's variance can be explained by those seven critical variables. The strength of the model indicates there is a reasonable level of representativeness in the selected predictor variables. Symbolically, a prediction formula of the model can be presented as follows:

$$\mathrm{ES} = (\mathrm{CA})w_1 + (\mathrm{IA})w_2 + (\mathrm{CF})w_3 + (\mathrm{CQ})w_4 + (U)w_5 + (\mathrm{EOU})w_6 + (\mathrm{DA})w_7.$$

In the formula, ES is the e-Learner satisfaction; CA is the learner computer anxiety; IA is the instructor attitude toward e-Learning; CF is the e-Learning course flexibility; CQ is the course quality; U is the perceived usefulness; EOU is the perceived ease of use; DA is the diversity in assessment; and w_1, w_2, w_3, w_4, w_5, w_6, and w_7 are empirically determined weights.

6.1. Learner dimension

Although the results of this research failed to completely correspond to previous findings (Arbaugh, 2002; Arbaugh & Duray, 2002; Hong, 2002; Piccoli et al., 2001), a review of the education and training in computer and Internet use can explain the difference. In many countries, including the USA and Taiwan, every college student is required to take at least one introductory computer course to enhance computer literacy and computing skills. Computer courses are even in high school curriculum. So clearly computer

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illiteracy no longer exists in college students. Because the mentality of treating computers as a necessary tool has matured, users' attitude, efficacy or skills should no longer be considered an issue in the e-Learning environment.

Although students' perception of computers is similar to general citizens' view of cars today, anxiety might still exist with certain users. This research ascertains that learner anxiety toward computers is one of the vital factors in perceived e-Learner satisfaction. The results correspond to some related research (Barbeite & Weiss, 2004; Igbaria, 1990; Piccoli et al., 2001). From an information-processing perspective, the higher the anxiety aroused, the more task performance decreased (Kanfer & Heggestad, 1997). Since e-Learning has to use computers and communication networks, participants handle technology intensively. The attitudes of individuals well adapted to technology would be more positive and their anxiety lower. On the other hand, once fears of computers do not emerge, that barrier to e-Learning is reduced and the abilities to use e-Learning effectively improve. Therefore, to increase user satisfaction and further improve the effectiveness of e-Learning, it is important to strengthen education and training to give students better understanding of computers and related technology.

6.2. Instructor dimension

Our findings corroborate those of Smeets (2005); Piccoli et al. (2001) and Webster and Hackley (1997). Instructors' attitudes toward e-Learning have a significant effect on e-Learners' satisfaction. Instructors play key roles in students' learning processes in either traditional face-to-face teaching environments or in remote learning environments. The effects of learning activities and students' satisfaction are influenced by instructors' attitudes in handling learning activities. For example, a less enthusiastic instructor or one with a negative view of e-Learning education shall not expect to have students with high satisfaction or motivation. The effectiveness of e-Learning will be discounted according to the instructor's attitude.

Since not every instructor is interested in teaching online, institutions should select instructors carefully. Teaching online differs from face-to-face education. Professional expertise should not be the sole criterion in selecting online instructors. Attitude toward using computer and network technology in delivering education and training will impact students' attitudes and affect their performance. Although response timeliness from instructor did not prove to be statistically significant, no-response or unreasonable delays in responding to students' requests definitely will not contribute to student success. In an e-Learning environment, students, especially those with part time or full time jobs, may be either too busy to watch response timeliness or are more considerate of instructors' busy schedules. However, a timely response to students' questions or requests is certainly beneficial to students.

6.3. Course dimension

Course flexibility and quality are both proven to be significant in this research. Flexibility of an e-Learning course is a strong indication of student satisfaction. This result corresponds to Arbaugh (2002) and Arbaugh and Duray (2002) findings that e-Learning course flexibility played an important role in perceived e-Learners' satisfaction. In contrast to traditional classroom learning, e-Learning is not constrained by space, time and location; therefore, students have a high degree of flexibility and many self-paced learning opportunities. From an operational viewpoint, especially to students in continuing education, the opportunity to effectively balance their jobs, family, and work-related activities with e-Learning is the first priority when considering such an education. Institutions with online learning should explore the advantage of this virtual environment and design courses with maximum flexibility to accommodate students' needs.

Of all independent variables, course quality has the strongest association with satisfaction. It includes overall course design, teaching materials, interactive discussion arrangements, etc. For higher satisfaction, the course scheduling, discussion arrangement and types, and course materials must be properly prepared, and the e-Learning instructional expertise and technical assistance must be also in place. In our observations, most e-Learning systems have built-in help pages or FAQ (frequently asked questions) about system usage for novice e-Learners should problems ever occur during their learning process. A well-

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designed delivery process, with appropriate assistance to students for solving their curriculum and technical difficulties, can decrease e-Learners' uncertainty and frustration with e-Learning, further leading to better learning experiences. Hence, e-Learning course quality influences perceived e-Learner satisfaction very significantly.

6.4. Technology dimension

No factor in the technology dimension has a significant effect on e-Learner satisfaction. From interactions with students and observations of the technology in use today, it is reasonable to claim that the technologies used in e-Learning environments are fairly mature. Most e-Learning systems are constructed in a high-speed network environment where software and hardware are superior to those of non-e-Learning environment for parallel processing of multimedia streaming data. For example, the National Information Infrastructure (NII) in Taiwan provides an ideal networking environment for e-Learning. As discussed in earlier sections, the insignificant effect exhibited in this research doesn't suggest that technology is not important; it simply implies that technology used in the e-Learning environment is satisfactory to students. Since they did not experience technical difficulties or poor Internet quality during the learning process, it is difficult for respondents to exhibit their concerns. A few years ago, Professor Carr (2003) stated that information technology did not matter. His statements mislead many readers because, in fact, improper technology or no technology definitely matters. In e-Learning environments, poor technology with slow response time or frequent technical difficulties will definitely discourage learners and discourage students from taking online courses.

6.5. Design dimension

Perceived usefulness and ease of use have been applied to marketing and information technology areas for investigating new products or systems. In this research, perceived usefulness by learners significantly influences their satisfaction. This result is consistent with previous research that illustrates both usefulness and ease of use are critical factors in the context of information systems (Karahanna, Straub, & Chervany, 1999; Davis et al., 1989). Further, this research echoes that of Arbaugh (2002) and Arbaugh and Duray (2002). They indicate that within a context of continuing education, learners generally get raises, promotions, bonuses, etc. for good performance. This implies a high level of perceived usefulness toward higher education. E-Learning is an alternative to working people. In our study, most of the respondents (78.6%) considered themselves to have intermediate computer skills and professional knowledge. An e-Learning system provides useful content and helps prepare students for future career advancement. Hence, the higher the perceived usefulness of an e-Learning system, the more satisfaction learners had.

Perceived ease of use also has a significant impact on e-Learner satisfaction. Users' notion of ease of use is an important antecedent to perceptions of satisfaction. Davis, Bagozzi, and Warshaw (1992, p. 1115) stated "the easier a system is to use, the less effort required to carry out a given task". An e-Learning system's ease of use makes it possible for individuals to devote their attention to learning the course materials instead of spending additional effort learning the instrument. Consequently, a higher learning satisfaction should exist.

6.6. Environment dimension

Out of the two factors involved in environmental dimension, diversity in assessment has a significant impact on perceived e-Learner satisfaction. As illustrated by Thurmond et al. (2002), when diversified evaluation methods exist to assess effectiveness of e-Learning, students' activities and processes might be corrected or improved through multiple feedbacks to achieve better performance. A variety of assessment methods enable instructors to canvass learning effects from different aspects so that instruction may be more effective. As for students, diversified assessment methods motivate them to exhibit their best efforts in different evaluation schemes so as to proceed with e-Learning activities seriously and effectively. Hence, higher learning satisfaction occurred.

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7. Conclusions

Online e-Learning is an alternative to traditional face-to-face education. Many institutions implement e-Learning to meet students' needs, especially those of non-traditional students with full time jobs. Since e-Learning is conducted using the Internet and World Wide Web, the learning environment becomes more complicated. Students' initial perceived satisfaction with technology-based e-Learning will determine whether they will use the system continually. This research identifies critical factors influencing e-Learners' satisfaction. An integrated model developed from previous studies consisting of thirteen factors in six dimensions is presented to guide research.

With a 45.7% response rate, a total of 295 valid questionnaires were collected. A stepwise multiple regression analysis was conducted to study the data. The results indicated that learners' computer anxiety, instructor attitude toward e-Learning, e-Learning course flexibility, e-Learning course quality, perceived usefulness, perceived ease of use, and diversity in assessment are the critical factors affecting learners' perceived satisfaction. Together, these seven factors are able to explain 66.1% of the variance of user satisfaction.

Not surprisingly, "course quality" is the most important concern in this e-Learning environment. Course content should be carefully designed and presented sparingly. Technological design plays an important role in students' perceived usefulness and ease of use of a course and will have an impact on students' satisfaction.

Although it is appropriate to adopt formative evaluation as assessment criteria in e-Learning, courses must be designed in coordination with assessment to achieve the best results. The administrative strategy should properly identify different assessment schemes to evaluate learning effects more diversely. In addition to instructors' evaluations of student performance, self-assessment or even peer assessment could be incorporated in the systems, enabling students to monitor their own achievements. Qualitative schemes may also be implemented to complement quantitative schemes.

Flexibility is viewed as an important factor in e-Learning satisfaction. One of many advantages of online education is its flexibility in which learners choose the most suitable learning methods to accommodate their needs. At all times, system administrators should ensure all system functionalities are available. Periodic assessment of system performance and loading will provide better and uninterrupted operational environments to enhance student satisfaction with e-Learning.

According to this study, learners' anxiety also hampers their satisfaction. Helping students build their confidence in using computers will make e-learning more enjoyable. A fundamental computer course could be a prerequisite to better prepare students. Lastly, this study finds that instructors' attitudes toward e-Learning positively influence students' satisfaction. When instructors are committed to e-Learning and exhibit active and positive attitudes, their enthusiasm will be perceived and further motivate students. In light of this, school administrators must be very careful in selecting instructors for e-Learning courses. Certain instructor training might be very helpful.

This study provides insights for institutions to strengthen their e-Learning implementations and further improve learner satisfaction. An unsatisfactory perception will hamper students' motivation to continue their distance education. The seven critical factors cannot be neglected when implementing a successful e-learning environment.

Although this research represents a careful and systemic effort to incorporate elements of e-Learning, it is not without limitations. First, the research proposes an integrated model covering a variety of factors influencing e-Learners' satisfaction; it might not be comprehensive due to the limitations of time and resources. Second, this work focuses on metrics from a specific digital learning system. The variance in different systems is not further investigated. Third, the dependent variable of this study is a single indicator, perceived e-Learner satisfaction. Some researchers suggest that learning performance and student scores could also be considered dependent variables (Alavi, Yoo, & Vogel, 1997; Leidner & Fuller, 1997; Piccoli et al., 2001; Vogel, Davison, & Shroff, 2001). Future research might incorporate more variables and examine variance across different learning systems. Fourth, the statistical methods used in this study are based on traditional assumptions; thus our results are established with these assumptions as a base. Finally, this research used stepwise multiple regression analysis to test the significance of variables. In the future, other statistical methods such as SEM (e.g., LISREL, EQS, PLS), or neural network may be employed to explore cause/effect relationship among variables.

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Appendix A. Questionnaire items and sources

Independent variables	Items	Sources
Learner dimension		
Learner attitude toward computers	I believe that working with computers... 1. is very difficult (R) 2. is very complicated (R) 3. requires technical ability (R) 4. let me feel psychological stress very greatly (R) 5. can be done only if one knows a programming language such as Basic (R) 6. is only advisable for people with a lot of patience (R) 7. makes a person more productive at his/her job 8. is for young people only (R) (Likert's scale 1, strongly disagree; 7, strongly agree)	Gattiker and Hlavka (1992)
Learner computer anxiety	1. Working with a computer would make me very nervous 2. I get a sinking feeling when I think of trying to use a computer 3. Computers make me feel uncomfortable 4. Computers make me feel uneasy and confused (Likert's scale 1, strongly disagree; 7, strongly agree)	Barbeite and Weiss (2004)
Learner Internet self-Efficacy	I feel confident... 1. starting the internet program 2. connecting to the internet homepage that I want 3. finishing the internet program during connection 4. downloading necessary materials from the Internet 5. linking to desired screens by clicking 6. going to previous pages by using "back" function 7. going to next pages by using "forward" function 8. scrolling around the monitor screen 9. using Internet search engines such as yahoo, yam (Taiwan), sina (Taiwan) 10. locating necessary information on the Internet for a specific topic 11. selecting the right search terms for Internet search. 12. printing materials from the Internet. 13. finishing the Internet program (0, not at all confident; 0.5, moderately confident; 1, totally confident)	Joo et al. (2000)
Instructors dimension		
Instructor response timeliness	I received comments on assignments or examinations for this course in a timely manner. (Likert's scale 1, strongly disagree; 7. strongly agree)	Thurmond et al. (2002)
Instructor attitude toward the technology	Compared to traditional classrooms, how useful do you think your instructor considers web-based learning using this type of technology? (Likert's scale 1, strongly disagree; 7, strongly agree)	Webster and Hackley (1997)

(*continued on next page*)

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Appendix A. *(continued)*

Independent variables	Items	Sources
Course dimension		
E-Learning course flexibility	1. Taking this class via the Internet allowed me to arrange my work for the class more effectively. 2. The advantages of taking this class via the Internet outweighed any disadvantages 3. Taking this class via the Internet allowed me to spend more time on non-related activities 4. There were no serious disadvantages to taking this class via the Internet 5. Taking this class via the Internet allowed me to arrange my work schedule more effectively 6. Taking this class via the Internet saved me a lot of time commuting to class 7. Taking this class via the Internet allowed me to take a class I would otherwise have to miss 8. Taking this class via the Internet should allow me to finish my degree more quickly (Likert's scale 1, strongly disagree; 7, strongly agree)	Arbaugh (2000)
E-Learning course quality	1. Conducting the course via the Internet improved the quality of the course compared to other courses. 2. The quality of the course compared favorably to my other courses 3. I feel the quality of the course I took was largely unaffected by conducting it via the Internet.	Arbaugh (2000)
Technology dimension		
Technology quality	I feel the information technologies used in e-Learning ... 1. are very easy to use 2. have many useful functions 3. have good flexibility 4. are easy to obtain	Amoroso and Cheney (1991)
Internet quality	1. I feel satisfied with the speed of the Internet 2. I feel the communication quality of the Internet is not good (R) 3. I feel the fee to connect to the Internet is very expensive (R) 4. I feel its easy to go on-line (Likert's scale 1, strongly disagree; 7, strongly agree)	(self-development)
Design dimension		
Perceived usefulness	1. Using web-based learning system would enhance my effectiveness in the program. 2. Using web-based learning system would improve my performance in the program 3. I would find web-based learning system useful in the program 4. Using web-based learning system in the program would enhance my productivity (Likert's scale 1, strongly disagree; 7, strongly agree)	Arbaugh (2000)

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Appendix A. *(continued)*

Independent variables	Items	Sources
Perceived ease of use	1. It would be easy for me to become skillful at using web-based learning systems 2. Learning to operate web-based learning systems would be easy for me 3. I would find it easy to get a web-based learning system to do what I want it to do 4. I would find web-based learning systems easy to use (Likert's scale 1, strongly disagree; 7, strongly agree)	Arbaugh (2000)
Environmental dimension		
Diversity in assessment	This e-Learning course offered a variety of ways of assessing my learning (quizzes, written work, oral presentation, etc.) (Likert's scale 1, strongly disagree; 7, strongly agree)	Thurmond et al. (2002)
Learner perceived interaction with Others	1. Student-to-student interaction was more difficult than in other courses (R) 2. Class discussions were more difficult to participate in than other courses (R) 3. I learned more from my fellow students in this class than in other courses 4. The instructor frequently attempted to elicit student interaction 5. Interacting with other students and the instructor using a web-based learning system became more natural as the course progressed 6. I felt that the quality of class discussions was high throughout the course 7. It was easy to follow class discussions 8. Classroom dynamics were not much different than in other courses 9. Once we became familiar with the web-based learning system, it had very little impact on the class (R) (Likert's scale 1, strongly disagree; 7, strongly agree)	Arbaugh (2000)
Dependent variable	**Items**	**Sources**
Perceived e-Learner satisfaction	1. I am satisfied with my decision to take this course via the Internet 2. If I had an opportunity to take another course via the Internet, I would gladly do so 3. My choice to take this course via the Internet was a wise one 4. I was very satisfied with the course 5. I feel that this course served my needs well 6. I will take as many courses via the Internet as I can 7. I was disappointed with the way this course worked out (R) 8. If I had it to do over, I would not take this course via the Internet (R) 9. Conducting the course via the Internet made it more difficult than other courses I have taken (R) (Likert's scale 1, strongly disagree, 7 strongly agree)	Arbaugh (2000)

Note: (R) reverse coded.

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References

Ajzen, I., & Fishbein, M. (1977). Attitude–behavior relations: a theoretical analysis and review of empirical research. *Psychological Bulletin, 84*, 888–918.

Alavi, M. (1994). Computer-mediated collaborative learning: an empirical evaluation. *MIS Quarterly, 18*(2), 159–174.

Alavi, M., Wheeler, B. C., & Valacich, J. S. (1995). Using IT to re-engineer business education: an exploratory investigation of collaborative e-Learning. *MIS Quarterly, 19*, 293–312.

Alavi, M., Yoo, Y., & Vogel, E. R. (1997). Using information technology to add value to management education. *Academy of Management Journal, 40*(6), 1310–1333.

Amoroso, D. L., & Cheney, P. H. (1991). Testing a causal model of end-user application effectiveness. *Journal of Management Information Systems, 8*(1), 63–89.

Arbaugh, J. B. (2000). Virtual classroom characteristics and student satisfaction with internet-based MBA courses. *Journal of Management Education, 24*(1), 32–54.

Arbaugh, J. B. (2002). Managing the on-line classroom: a study of technological and behavioral characteristics of web-based MBA courses. *Journal of High Technology Management Research, 13*, 203–223.

Arbaugh, J. B., & Duray, R. (2002). Technological and structural characteristics, student learning and satisfaction with web-based courses – An exploratory study of two on-line MBA programs. *Management Learning, 33*(3), 331–347.

Aronen, R., & Dieressen, G. (2001). Improvement equipment reliability through e-Learning. *Hydrocarbon Processing*, 47–57.

Atkinson, M., & Kydd, C. (1997). Individual characteristics associated with World Wide Web use: an empirical study of playfulness and motivation. *DATA BASE for Advances in Information Systems, 28*(2), 53–62.

Barbeite, F. G., & Weiss, E. M. (2004). Computer self-efficacy and anxiety scales for an Internet sample: testing measurement equivalence of existing measures and development of new scales. *Computers in Human Behavior, 20*, 1–15.

Bhattacherjee, A. (2001). Understanding information systems continuance: an expectation confirmation model. *MIS Quarterly, 25*(3), 270–351.

Berger, N. S. (1999). Pioneering experiences in distance learning: Lessons learned. *Journal of Management Education, 23*, 684–690.

Borbely, E. (1994). Challenges and opportunities in extending the classroom and the campus via digital compressed Video. In R. Mason & P. bacsich (Eds.), *ISDN: Applications in education and training* (pp. 65–82). London: Institution of Electrical Engineers.

Brandon, D. P., & Hollingshead, A. B. (1999). Collaborative learning and computer-supported groups. *Communication Education, 48*(2), 109–126.

Carr, Nicholas G. (2003). IT doesn't matter. *Harvard Business Review*(May), 41–49.

Cattell, R. B., & Scheier, I. H. (1961). *The meaning and measurement of neuroticism and anxiety*. New York: Ronald Press.

Chen, W. L. C., & Bagakas, J. G. (2003). Understanding the dimensions of self-exploration in web-based learning environments. *Journal of Research on Technology in Education, 34*(3), 364–373.

Chickring, A. W., & Gamson, Z. F. (1987). Seven principles for good practice in undergraduate education. *AAHE Bulletin, 39*(7), 3–6.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982–1003.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology, 22*(14), 1111–1132.

Delon, W., & Mclean, E. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research, 3*(1), 60–95.

Dillon, C. L., & Gunawardena, C. N. (1995). A framework for the evaluation of telecommunications-based distance education. In D. Sewart (Ed.). *17th world congress of the international council for distance education* (Vol. 2, pp. 348–351). Milton Keynes, UK: Open University.

Ellram, L. M., & Easton, L. (1999). Purchasing education on the Internet. *Journal of Supply Chain Management, 35*(2), 11–19.

Finley, M. (1992). Belling the bully. *HR Magazine, 37*(3), 82–86.

Fulk, J. (1993). Social construction of communication technology. *Academy of Management Journal, 36*, 921–950.

Fulk, J., Schmitz, J., & Steinfield, C. W. (1990). A social influence model of technology use. In J. Fulk & C. Steinfield (Eds.), *Organizations and communication technology* (pp. 117–141). Newbury Park, CA: Sage.

Gattiker, U. E., & Hlavka, A. (1992). Computer attitudes and learning performance: Issues for management education and training. *Journal of Organizational Behavior, 13*(1), 89–101.

Gujarati, D. N. (2003). *Basic econometrics* (4th ed.). McGraw-Hill, NY: McGraw-Hill/Irwin.

Hannafin, J. J., & Cole, D. D. (1983). An analysis of why students select introductory high school computer coursework. *Educational Technology, 23*(4), 26–29.

Harasim, L. (1990). On-line education: An environment for collaboration and intellectual implication. In L. Harasim (Ed.), *On-line education: Perspectives on a new environment* (pp. 133–169). New York: Praeger.

Heissen, R. K., Jr., Glass, C. R., & Knight, L. A. (1987). Assessing computer anxiety: development and validation of the computer attitude rating scale. *Computer in Human Behavior, 3*(1), 49–59.

Hiltz, S. R. (1993). *The virtual classroom: Learning without limits via computer networks*. Norwood, NJ: Ablex.

Hong, K. S. (2002). Relationships between students' and instructional variables with satisfaction and learning from a Web-based course. *Internet and Higher Education, 5*, 267–281.

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Igbaria, M. (1990). End-user computing effectiveness: A structural equation model. *OMEGA, 18*(6), 637–652.

Isaacs, E. A., Morris, T., Rodriguez, T. K., & Tang, J. C. (1995). A comparison of face-to-face and distributed presentations. In R. R. Katz, R. Mack, L. Marks, M. B. Rosson, & J. Nelson (Eds.), *Proceedings of the association for computing machinery (ACM) special interest group on computers and human interaction (CHI) 95 conference* (pp. 354–361). New York: ACM Press.

Jiang, M., & Ting, E. (1998). *Course design, instruction, and students' online behaviors: A study of instructional variables and student perceptions of online learning*. In Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA, April 13–17, 1988.

Joo, Y. J., Bong, M., & Choi, H. J. (2000). Self-efficacy for self-regulated learning, academic self-efficacy, and Internet self-efficacy in web-based instruction. *Educational Technology Research and Development, 48*(2), 5–17.

Kanfer, R., & Heggestad, E. D. (1997). Motivational traits and skills: a person-centered approach to work motivation. *Research in Organizational Behavior, 19*, 1–56.

Kanuka, H., & Nocente, N. (2003). Exploring the effects of personality type on perceived satisfaction with web-based learning in continuing professional development. *Decision Education, 24*(2), 227–245.

Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adopting across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly, 23*(2), 183–213.

Katz, Y. J. (2000). The comparative suitability of three ICT distance learning methodologies for college level instruction. *Educational Media International, 37*(1), 25–30.

Katz, Y. J. (2002). Attitudes affecting college students' preferences for distance learning. *Journal of Computer Assisted Learning, 18*, 2–9.

Kydd, C. T., & Ferry, D. L. (1994). Case study: Managerial use of video conferencing. *Information & Management, 27*, 369–375.

Lachem, C., Mitchell, J., & Atkinson, R. (1994). ISDN-based videoconferencing in Australian tertiary education. In R. Mason & P. Bacsich (Eds.), *ISDN: Applications in education and training* (pp. 99–113). London: Institution of Electrical Engineers.

Leidner, D. L., & Jarvenpaa, S. L. (1995). The rse of information technology to enhance management school education: a theoretical view. *MIS Quarterly, 19*, 265–291.

Leidner, D. E., & Fuller, M. (1997). Improving student learning of conceptual information: GSS supported collaborative learning vs. individual constructive learning. *Decision Support Systems, 20*(2), 149–163.

Lewis, C. (2002). Driving factors for e-Learning: an organizational perspective. *Perspectives, 6*(2), 50–54.

Lin, Cathy S., Wu, S., & Tsai, R. J. (2005). Integrating perceived playfulness into expectation-confirmation model for web portal context. *Information & Management, 42*, 683–693.

Marakas, G. M., Yi, M. Y., & Johnson, R. D. (1998). The multilevel and multifaceted character of computer self-efficacy: Toward clarification of the construct and an integrative framework for research. *Information System Research, 9*(2), 126–163.

Moore, M. G. (1989). Three types of interaction. *The American Journal of Distance Education, 3*(2), 1–6.

Nahl, D. (1993). Communication dynamics of a live interactive television system for distance education. *Journal of Education for Library and Information Science, 34*(3), 200–217.

Oliver, R. L. (1980). A cognitive model for the antecedents and consequences of satisfaction. *Journal of Marketing Research, 17*, 460–469.

Piccoli, G., Ahmad, R., & Ives, B. (2001). Web-based virtual learning environments: a research framework and a preliminary assessment of effectiveness in basic IT skill training. *MIS Quarterly, 25*(4), 401–426.

Pituch, K. A., & Lee, Y. K. (2006). The influence of system characteristics on e-learning use. *Computers & Education, 47*, 222–244.

Raub, A. C. (1981). Correlates of computer anxiety in college students. Unpublished doctoral dissertation, University of Pennsylvania.

Rivard, S. (1987). Successful implementation of end-user computing. *Interfaces, 17*(3), 25–33.

Ryan, M., Carlton, K. H., & Ali, N. S. (1999). Evaluation of traditional classroom teaching methods versus course delivery via the World Wide Web. *Journal of Nursing Education, 38*(6), 272–277.

Salmon, G. (2000). Computer mediated conferencing for management learning at the open university. *Management Learning, 31*, 491–502.

Schwartz, R. A. (1995). The virtual university. *American Society for Engineering Education Prism, 5*(4), 22–26.

Smeets, E. (2005). Does ICT contribute to powerful learning environments in primary education? *Computers & Education, 44*, 343–355.

Soon, K. H., Sook, K. I., Jung, C. W., & Im, K. M. (2000). The effects of Internet-based distance learning in nursing. *Computers in Nursing, 18*(1), 19–25.

Spielberger, C. D. (1976). The nature and measurement of anxiety. In C. S. Spielberger (Ed.), *Cross-cultural anxiety*. Washington, DC: Hemisphere/Wiley.

Stokes, S. P. (2001). Satisfaction of college students with the digital learning environment. Do Learners' temperaments make a difference? *Internet and High Education, 4*, 31–44.

Strauss, S. G. (1996). Getting a clue: communication media and information distribution effects on group process and performance. *Small Group Research, 27*(1), 115–142.

Taylor, J. (1996). The continental classroom: teaching labor studies on-line. *Labor Studies Journal, 21*, 19–38.

Thompson, L. F., Meriac, J. P., & Cope, J. G. (2002). Motivating online performance: the influences of goal setting and Internet self-efficacy. *Social Science Computer Review, 20*(2), 149–160.

Thurmond, V. A., Wambach, K., & Connors, H. R. (2002). Evaluation of student satisfaction: determining the impact of a web-based environment by controlling for student characteristics. *The American Journal of Distance Education, 16*(3), 169–189.

Trentin, G. (1997). Telematics and on-line teacher training: the POLARIS project. *Journal of Computer Assisted Learning13*, 261–270.

Vogel, D. R., Davison, R. M., & Shroff, R. H. (2001). Socio-cultural learning: a perspective on GSS-enabled global education. *Communications of the AIS, 7*, 1–39.

Wang, Y. S. (2003). Assessment of learner satisfaction with asynchronous electronic learning systems. *Information & Management, 41*, 75–86.

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Wang, A. Y., & Newlin, M. H. (2002). Predictors of web-student performance: the role of self-efficacy and reasons for taking an on-line class. *Computers in Human Behavior, 18*, 151–163.

Webster, J., & Hackley, P. (1997). Teaching effectiveness in technology-mediated distance learning. *Academy of Management Journal, 40*(6), 1282–1309.

Wolfram, D. (1994). Audio-graphics for distance education: a case study in students attitudes and perceptions. *Journal of Education for Library and Information Science, 35*(3), 179–186.

Wu, J. P., Tsai, R. J., Chen, C. C., & Wu, Y. C. (2006). An integrative model to predict the continuance use of electronic learning systems: hints for teaching. *International Journal on E-Learning, 5*(2), 287–302.

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