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Defining, Assessing, and Promoting E-Learning Success: An Information Systems Perspective*

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ABSTRACT

This research advances the understanding of how to define, evaluate, and promote e-learning success from an information systems perspective. It introduces the E-Learning Success Model, which posits that the overall success of an e-learning initiative depends on the attainment of success at each of the three stages of e-learning systems development: system design, system delivery, and system outcome. To study this model, an online version of an undergraduate quantitative methods core course for business students is developed using a prototyping strategy. Four cycles of development are traced, each comprised analysis, design, implementation, testing, and enhancement. Findings from the study confirm the validity of using the proposed success model for e-learning success assessment. In addition, an action research methodology is also found to be a valuable impetus for promoting e-learning success through an iterative process of diagnosing, action planning, action taking, evaluating, and learning.

Subject Areas: Action Research, E-Learning Success Model, and Online Courses.

INTRODUCTION

Although considerable progress has been made, educators still have just begun tapping into the transforming power of the Internet. This research is a step toward more fully realizing the potential of the Internet for supporting learning. Its primary focus is an investigation of the success factors for designing, developing, and delivering e-learning initiatives. This leads to the introduction of the E-Learning Success Model as a guide for evaluation and refinement of these initiatives. An application involving online quantitative methods instruction is used to illustrate the usage of the model.

The term e-learning is often used interchangeably with distance education or distance learning. It is defined by the Instructional Technology Council (ITC,

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1998), as well as the National Center for Education Statistics (Waits & Lewis, 2003), as the process of extending learning or delivering instructional materials to remote sites via the Internet, intranet/extranet, audio, video, satellite broadcast, interactive TV, and CD-ROM.

According to the U.S. Department of Education's National Center for Education Statistics, 90% of public 2-year and 89% of public 4-year institutions offered distance education courses in 2000–2001 with enrollments of 1,472,000 and 945,000, respectively, out of a total enrollment of 3,077,000. Of these schools, 90% offered Internet courses using asynchronous computer-based instruction, and 88% indicated plans to start or increase use of the Internet as a primary mode of instructional delivery (Waits & Lewis, 2003). These statistics support the idea that Internet-based distance education is the most prevalent e-learning technology and that the Internet has brought dramatic changes to education in general and distance learning in particular. In view of this fact, the scope of e-learning in this article focuses primarily on Internet-based distance education.

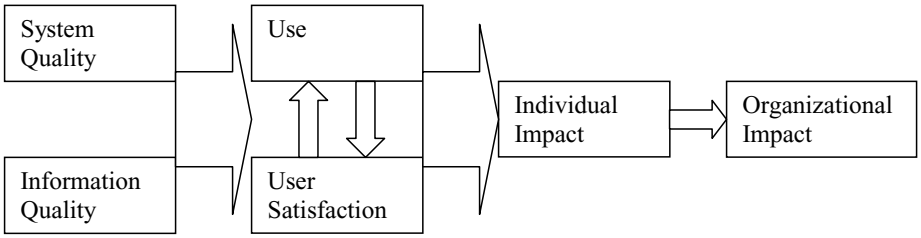
How should the success of e-learning be evaluated? Attempts to address this important question have resulted in a large volume of anecdotal studies assessing the impact of e-learning programs on various measures such as learning benchmarks (Pittinsky & Chase, 2000), learning opportunities (Jewett, 1998), learning styles (Byrne, 2002), learning environment (Jung et al., 2002.; Wang & Bagaka, 2003), learning outcomes (McClelland, 2001; Motiwallo & Tello, 2000; Teh, 1999), teaching practices (Owston & Wideman, 1998; Savenye, Olina, & Niemczyk, 2001), and cost-benefits (Lawhead et al., 1997; Smith, 2001).

These seemingly diverse views of what constitutes success in e-learning are not surprising given that research in this area is at a formative stage with the relatively recent recognition of the promises of e-learning. There is a need to integrate and formulate a holistic and comprehensive model for assessing and evaluating e-learning initiatives. Another shortcoming of these studies is that success measures are derived from assessing the results of the development effort only. There is also a need to broaden the viewpoint of program success from a result to a process or total quality perspective. This research addresses these needs.

Based on theories of a user-centered information systems development paradigm, this article develops and studies a model to guide the design, development, and delivery of successful e-learning initiatives. The validity of viewing e-learning program development from an information systems perspective is supported by recognizing that both of these efforts are fueled by a common goal of harnessing new technologies to better meet the needs of their users. In addition, a similar journey has been undertaken by information systems researchers in their attempt to identify factors that contribute to information systems success. We concluded that theories and knowledge accumulated since the early 1980s on the topic of information systems success can be beneficial in pursuing success in e-learning. Consequently, we adapt an information systems success model to e-learning. The resulting E-Learning Success Model serves not only as a measure for quality assurance in e-learning efforts, but also as a strategy for ensuring future success in the development and assessment of such initiatives.

We begin by introducing the E-Learning Success Model and indicate how it can be operationalized in a specific context: an online course in quantitative methods for business operations. The model is then validated through four cycles

Figure 1: DeLone and McLean's (1992) original information systems success model.



of action research in this context. Results from this research are then presented and discussed. We conclude by characterizing the main contributions of this research to the literature on e-learning and suggesting directions for follow-up investigations.

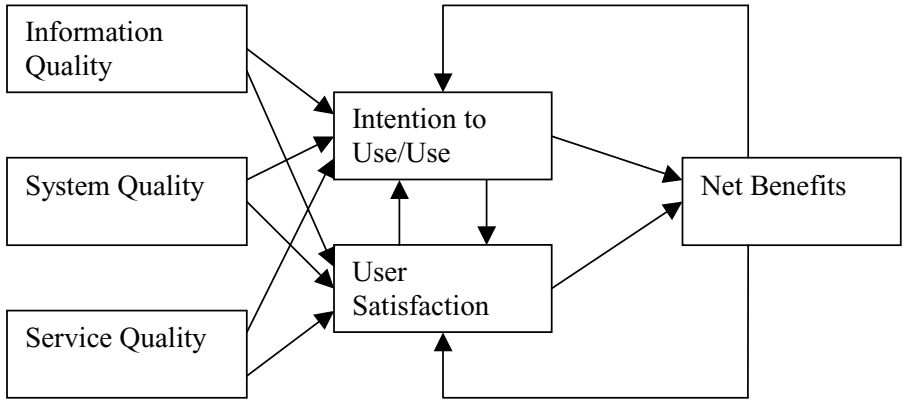
E-LEARNING SUCCESS MODEL

The E-Learning Success Model introduced here is adapted from DeLone and McLean's (2003) updated information systems success model which, in turn, is an extension of their original model (DeLone & McLean, 1992). From past literature on information systems success, DeLone and McLean identified six dimensions of success factors: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. These were incorporated into their original overall success model shown in Figure 1.

Not only did DeLone and McLean's original model succeed in furnishing an integrated view of information systems success, it also helped instill a process approach to information systems success. In the decade following its advent, the original model was referenced 285 times in refereed papers in journals and proceedings, signifying research that applied, validated, challenged, and critiqued it. From this literature, DeLone and McLean (2003) identified 16 empirical studies that rendered support for the associations among the six dimensions of success factors:

- Seddon and Kiew (1994)
- Goodhue and Thompson (1995)
- Taylor and Todd (1995)
- Jurison (1996)
- Etezadi-Amoli and Farhoomand (1996)
- Teng and Calhoun (1996)
- Igbaria and Tan (1997)
- Igbaria, Zinatelli, Cragg, & Cavaye (1997)
- Guimaraes and Igbaria (1997)
- Teo and Wong (1998)
- Gelderman (1998)
- Yuthas and Young (1998)

Figure 2: DeLone and McLean's (2003) updated information systems success model.



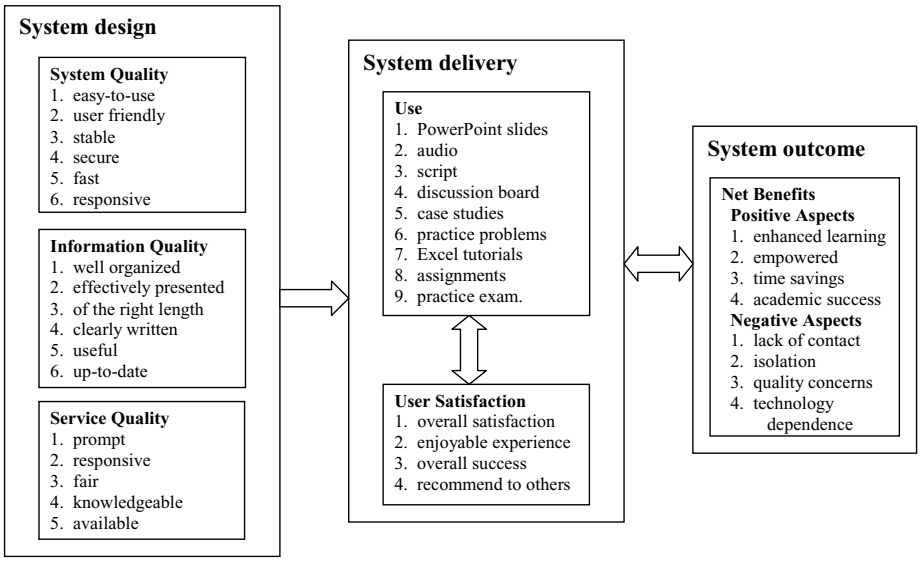
- Yoon, Guimaraes, and Clevenson (1999)
- Torkzadeh and Doll (1999)
- Weill and Vitale (1999)
- Wixom and Watson (2001)

In particular, the associations between "use" and "individual impact," "system quality" and "individual impact," as well as "information quality" and "individual impact" are found to be statistically significant. In addition, Rai, Lang, and Welker (2002) conducted a confirmatory factor analysis and estimation of fit indices for the model. Their empirical evidence gave credence to the explanatory power of the model and validated the importance of using a multiconstruct-dependent measure of information systems success.

In light of the research progress and the emergence of e-commerce, DeLone and McLean (2003) extended and streamlined the original model by combining the individual and organizational impacts as one success dimension called "Net Benefits" and adding another quality dimension called "Service Quality." The result is an updated model particularly applicable for assessing information systems success in the Internet environment. Illustrated in Figure 2, the updated model retains the basic premise of the original model, that the nature of information systems success should be analyzed via multidimensional success dimensions that are interdependent in a process sense.

DeLone and McLean's updated success model forms the basis for our E-Learning Success Model, depicted in Figure 3. The E-Learning Success Model makes explicit the process approach to measuring and assessing success. The model also includes success metrics developed specifically for the e-learning context being investigated. The process approach posits that the overall success of e-learning initiatives depends on the attainment of success at each of the three stages of e-learning systems development: design, delivery, and outcome analysis. Success of the design stage is evaluated along three success factor dimensions: system quality, information quality, and service quality. Success of the delivery stage is evaluated along two success factor dimensions: use and user satisfaction. Finally, success

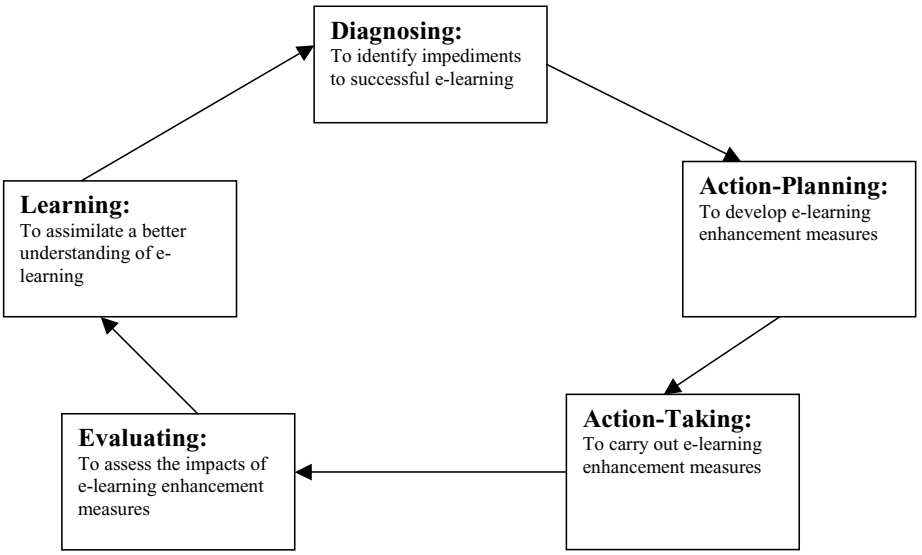
Figure 3: The E-Learning Success Model and sample metrics.



of the outcome stage is evaluated along the net benefits dimension. The arrows shown in the figure depict the interdependences within the three stages of success assessment. Success of system design is essential to the success of system delivery, which, in turn, affects the success of system outcome. The success of system outcome, however, has an impact on the success of subsequent system delivery, as indicated by the double arrow linking system delivery and outcome stages.

We investigate the model in a particular e-learning context: the development and implementation of an online version of an undergraduate quantitative methods core course in business. Blackboard 5.0 is the platform for system delivery. For each of the model's six dimensions, Figure 3 also shows success metrics relevant to this specific e-learning context. These metrics may vary somewhat for other e-learning contexts. The system quality dimension measures desirable characteristics of the Blackboard environment such as ease of use, user friendliness, stability, security, speed, and responsiveness. The information quality dimension evaluates the course content on aspects such as organization, presentation, length, usefulness, and currency. The service quality dimension measures student–instructor interactions on attributes such as promptness, responsiveness, fairness, competency, and availability. The use dimension measures the extent to which the course elements are actually used, including PowerPoint slides, audio clips, lecture scripts, discussion boards, case studies, practice problems, Excel tutorials, assignments, and practice examinations. The user satisfaction dimension gauges opinions of the students about e-learning based on their experience with the course. This is rated on perceptions of satisfaction, enjoyment, success, and recommendability. The net benefits dimension captures positive aspects of e-learning in terms of learning enhancement, empowerment, time savings, and academic achievement, as well as negative aspects of e-learning in terms of lack of face-to-face contact, social isolation, quality concerns, and dependence on technology.

Figure 4: The five phases of action research.



ACTION RESEARCH METHODOLOGY

The E-Learning Success Model is validated through four cycles of action research. Action research is built on the assumption that complex social systems cannot be reduced for meaningful study. As a result, the goal of action research is to understand the complex process rather than prescribe a universal law. Following the spirit of action research, this study adheres to an iterative process involving five phases to gain understanding of what constitutes success in e-learning initiatives: diagnosing, action planning, action taking, evaluating, and learning (Susman & Evered, 1978). During the diagnosing phase, impediments to successful e-learning are identified. Measures to overcome these impediments are developed in the action-planning phase. These measures are then carried out in the action-taking phase. The resulting changes are examined in the evaluating phase to assess their impacts on the success of e-learning. During the learning phase, the lessons learned and experiences gained are assimilated toward a better understanding of e-learning. These five phases of action research as applied to this study are illustrated in Figure 4.

The first two cycles of action research were pilot tested for the success of a prototype e-learning system involving a single topic of study. In the absence of models specifically addressing e-learning success, DeLone and McLean's (1992) original information systems success model was adopted to guide the design, development, and testing of a distance learning module for the subject of facility location analysis. Moreover, the scope of investigation of the pilot study was the evaluation of a single e-learning module instead of an e-learning course or program. The use of system-wide success measures such as system quality and organizational impact would be beyond the scope of the pilot study. Therefore, the success of the

prototype e-learning system was evaluated on four success dimensions: information quality, use, user satisfaction, and individual impact. Findings from the pilot study helped launch a full-scale testing of the success of an online course during the remaining two cycles of action research. The use of a prototype is highly recommended in situations where there is a need for experimentation and learning before commitment of resources to development of a full-scale system (Alavi, 1984). In addition, prototyping shares the same characteristics as an action research methodology, both being iterative, rigorous, collaborative, and facilitative (Baskerville & Wood-Harper, 1998; Chiasson & Dexter, 2001). Prototyping involves iterations through analysis, design, implementation, testing, and enhancement. The five steps of prototyping are analogous to the five phases of diagnosing, action planning, action taking, evaluating, and learning in action research.

The first action research cycle was initiated upon approval of a proposal to develop an Internet-based distance learning environment for a quantitative methods course in operations management. A course feedback questionnaire was designed and administered after delivery of the module to 48 students during a 2-week period. Opinions gathered from these students indicated that a lack of enthusiastic reception to e-learning: ratings of the four success dimensions ranged from 3.4 out of 5 for information quality to 2.7 out of 5 for user satisfaction and individual impact dimensions. The findings from the first cycle of action research suggested that much attention would be needed to effect a change in students' indifferent attitudes toward e-learning (Lee-Post, 2002).

A second action research cycle was launched with a special focus on promoting the user satisfaction and individual impact dimensions. Seventy-two students from three sections of the core operations management quantitative methods course were informed at the beginning of the semester that the topic on facility location would be learned via an Internet-based distance learning environment. The values of e-learning were stressed at that time. In addition, a specific recommendation on using more examples to enhance the presentation of course materials was implemented. The same course feedback survey was administered to the students after the delivery of the revised module. Opinions of these students toward the e-learning module were analyzed. The test module was once again rated most highly in terms of its information quality (3.9 out of 5). More importantly, students' attitudes toward e-learning had improved: information quality rating improved from 3.4 to 3.9, user satisfaction rating jumped from 2.7 to 3.4, and individual impact rating increased from 2.7 to 3.2 (Lee-Post, 2003). The first two action research cycles confirmed the value of assessing e-learning success from an information systems perspective. Indeed, the pilot study set the foundation of the next two cycles of action research so that a full-scale investigation of all six success dimensions of the online course using the proposed E-Learning Success Model could be conducted.

The third action research cycle involved offering the entire quantitative methods course in operations management online for the first time. Students passing an online readiness survey covering academic, technical, lifestyle, and learning readiness for e-learning were accepted into the online course. A course expectation survey was used to establish a baseline for various dimensions of success from both the online students and the traditional students. A try-out for e-learning

was offered to the traditional students in the mid-semester. The online course itself was assessed by the online students only at the end of the semester using a course satisfaction survey and a course evaluation survey.

The fourth action research cycle was conducted during the subsequent semester. The online course was redesigned based on feedback from the course satisfaction survey and its success was evaluated in this fourth cycle. Students were once again admitted based on the assessment of their online readiness. As before, two surveys were used to gauge students' perceptions of and satisfaction with e-learning.

The evaluating phase of each of these four action research cycles involved the use of survey instruments. A single course feedback survey was used in the first two cycles. These survey findings suggested that the test module was a success, but students' indifferent attitude toward e-learning was an issue. As a result, four survey instruments were used in the two subsequent cycles. The first two were designed to address and study students' attitudes: an online readiness survey and a course expectation survey. The others were used to measure various dimensions of success according to the E-Learning Success Model shown in Figure 3: a course satisfaction survey and a course evaluation survey.

To address students' average indifferences toward e-learning, an online readiness survey was used to separate students who indicated substantial readiness for the online course from those who were not well prepared. First designed and used in the third cycle, the online readiness survey aimed to ensure that students were not forced into an e-learning situation, but rather they were ready for and open to e-learning. The survey consisted of four parts measuring students' academic preparedness, technical competence, lifestyle aptitude, and learning preference toward e-learning. Academic preparedness was a self-reported measure consisting of a student's current GPA, course load, status, prerequisites performance, and prior online experience. The remaining three readiness measures were taken directly from a questionnaire designed by the University of Kentucky Distance Learning Technology Center. Using a 5-point scale (1 indicating least agreement and 5 indicating greatest agreement), they measure a student's response to statements concerning his/her computer setup and technical literacy (technical competence), study habits and communication patterns (lifestyle aptitude), and learning styles and values (learning preference). In general, a student who earned a B or above standing in the prerequisites and responded with at least a 4 on all three readiness measures (technical competence, lifestyle aptitude, and learning preference) was considered online-ready.

To study students' attitudes toward e-learning, a course expectation survey was used. Both the traditional and online students were asked to fill out the survey at the beginning of the semester. A base measure of students' attitudes and perceptions toward learning in general and e-learning in particular was thereby established. Their opinions about the most valuable learning elements were particularly useful in defining the success metrics for the information quality dimension. The course expectation survey consisted of four parts. Part one was designed to collect such student information as GPA, major, gender, Internet knowledge, and opinion of e-learning. Part two had 11 items to measure the perceived value of e-learning along various dimensions:

- Be actively involved in the learning process
- Address my questions and concerns
- Voice my opinion and viewpoints
- Understand the course materials
- Stimulate my interest in the subject
- Relate the subject matter to other areas
- Put effort into nonassessed work
- Control when and where to learn
- Learn the materials in less time
- Complete the assignments in less time
- Use written communication in learning.

Part three used 23 items to gauge the perceived value of various aspects in students' learning experiences:

- Seeing the professor
- Hearing the professor
- Understanding the professor
- Obtaining feedback from the professor
- Obtaining feedback from assessed work
- Guiding by clear learning objectives
- Guiding by detailed course outline
- Asking questions while learning
- Participating in student–student communications
- Presenting thoughts to class
- Presenting thoughts to professor
- Understanding textbook
- Understanding course material
- Applying course material
- Integrating course material
- Learning definitions
- Practicing problem solving
- Using written communications
- Completing assignments
- Taking practice examinations
- Reviewing course content
- Studying in groups
- Knowing current standing in class

Items in parts two and three were measured with a 5-point scale (1 indicating "strongly disagree" and 5 indicating "strongly agree"). Part four had open-ended

questions asking students to list barriers of e-learning and suggest recommendations to overcome these difficulties.

To evaluate the success of the online course, a course satisfaction survey and a course evaluation survey were used. Online students were asked to fill out these two surveys toward the end of the semester. These surveys were designed to measure the six success dimensions identified in Figure 3: system quality, information quality, service quality, use, user satisfaction, and net benefits.

The course satisfaction survey consisted of four parts. Part one asked students for their GPA, major, gender, opinion of e-learning, and met/unmet expectations. Part two had nine items to measure the use dimension and 14 items to measure the net benefits dimension of the model. Part three was designed to assess the information quality, service quality, system quality, and user satisfaction dimensions of the model. Each item in parts two and three was measured with a 5-point scale with 1 indicating "strongly disagree" and 5 indicating "strongly agree." Part four used open-ended questions to elicit suggestions for improvement.

In addition, a standard course evaluation survey was given at the end of the course. This survey was designed and administered by the University's Distance Learning Technology Center and consisted of 36 questions. The survey was used primarily for content validity assessment. Questions were mapped to the six success dimensions and their ratings aggregated to form a single measure for each of the six success dimension. As both the course evaluation survey and the course satisfaction survey contain questions designed independently to evaluate the success of the online course, a more complete picture of the success evaluation is obtained from analyzing both surveys. Table 1 lists the items in the course satisfaction and course evaluation surveys used to measure the six success dimensions of the model.

RESULTS AND DISCUSSION

The course expectation survey was administered to 330 traditional students and 39 online students across two semesters. The responses from the survey indicated that "control when and where to learn" was consistently the number-one advantage offered by e-learning. Various statistical tests were performed comparing the characteristics of online against traditional students. Table 2 summarizes the results of the tests, showing that 11 of the 15 characteristics of online students were found to be statistically different from those of the traditional students.

Compared to traditional students, online students had higher GPAs, had taken more online courses, were nonbusiness majors, consisted of more females, would spend more time on the course, expected better performance in the course, had better technical competencies, and had more positive opinions of e-learning. The online students' higher GPA and more favorable reception of e-learning can be attributed to the prescreening process as these had indicated a high level of readiness in academic, technical, lifestyle, and learning preference toward online course participation. For the traditional students, their lack of enthusiastic reception of e-learning was evident not only from the findings of the first two cycles of action research, but also from the fact that only 9 out of 185 students (i.e., 5%) participated in the mid-semester try-out of fall 2003. Consequently, a key finding of this research is that designers and implementers of online courses need to be attentive to student

Table 1: Survey construct and measures.

Construct	Definition	Items in the Course Satisfaction Survey	Items in the Course Evaluation Survey
System Quality	The desirable characteristics of the Blackboard environment	3.2.1. easy-to-use 3.2.2. user friendly 3.2.3. stable 3.2.4. secure 3.2.5. fast	21. I was able to navigate through the course website to find what I needed to complete the course. 22. I was able to access course materials.
Information `Quality	The desirable characteristics of the course content	3.1.1. well organized 3.1.2. effectively presented 3.1.3. of the right length 3.1.4. clearly written 3.1.5. useful 3.1.7. up-to-date	1. The instructor outlined in reasonable detail course requirements and grading procedures. 9. The instructor organized the presentation of the course material in an effective manner. 24. Printed materials contributed to my understanding of the course content. 31. Course assignments contributed to my understanding of the course content.
Service Quality	The desirable characteristics of student-instructor interactions	3.2.6. responsive 3.1.6. meeting my needs	5. Grading in the course was fair and consistent. 6. Assignments were distributed fairly throughout the semester. 7. Graded assignments, test, etc., were returned promptly. 8. Graded assignments included helpful comments from the instructor. 10. The instructor demonstrated good knowledge of the subject matter. 11. The instructor could be contacted for consultation. 12. The instructor satisfactorily answered questions. 13. The instructor facilitated student participation in course activities. 25. E-mail contributed to my understanding of the course content.
Use	The extent to which the course elements are accessed	2.1.1. PowerPoint slides 2.1.2. Audio to accompany the slides 2.1.3. Script to accompany the slides 2.1.4. Discussion board questions	3. The assignments (supplemental reading, homework, reports, etc.) helped me to understand the subject. 26. Posted discussions contributed to my understanding of the course content. 27. PowerPoint (R) slide presentations contributed to my understanding of the course content. 28. Audiotaped presentations contributed to my understanding of the course content.

Table 1: (Continued)

Construct	Definition	Items in the Course Satisfaction Survey	Items in the Course Evaluation Survey
		2.1.5. Case studies 2.1.6. Practice problems 2.1.7. Excel tutorials 2.1.8. Assignment problems 2.1.9. Practice exam	
User Satisfaction	The opinions of the students on e-learning	3.3.1. You are satisfied with the course 3.3.2. You enjoyed the learning experience 3.3.3. You believe the system is successful 3.3.4. You will recommend the course to others	19. The overall value of this course. 20. The overall quality of teaching by the primary instructor in this course.
Net Benefits	The overall benefits of e-learning	2.2.1. Be actively involved in the learning process 2.2.2. Address my questions and concerns 2.2.3. Voice my opinion and viewpoints 2.2.4. Understand the course materials 2.2.5. Stimulate my interest in the subject 2.2.6. Relate the subject matter to other areas 2.2.7. Put effort into nonassessed work 2.2.8. Control when and where to learn 2.2.9. Learn the materials in less time 2.2.10. Complete the assignments in less time 2.2.11. Use written communication in learning 2.2.12. Evaluate my learning progress 2.2.13. Evaluate my performance 2.2.14. Obtain feedback from my professor 1.11. Expected Grade 1.12. Before Opinion of e-learning 1.13. After Opinion of e-learning	15. The course strengthened my ability to analyze and evaluate information. 16. The course helped me to develop the ability to solve problems. 17. I gained an understanding of concepts and principles in this field. 18. The course stimulated me to read further in the area. 2. Expected Grade

Table 2: Statistical results of student characteristics.

Characteristics	Scale	Test	*p* value (one-sided)
GPA	1(<2) to 5(=4)	Wilcoxon rank sum test	.00002*
Course Load	1(=1) to 5(>4)	Wilcoxon rank sum test	1.00000
Online Courses Taken	1(=0) to 5(>3)	Wilcoxon rank sum test	.01757*
Business Major	1(=yes) to 2 (=no)	Proportion test	.03379*
Working	1(=yes) to 2 (=no)	Proportion test	.50000
Gender	1(=M) to 2 (=F)	Proportion test	.00407*
Classification	1(=Freshman) to 5(=Graduate)	Wilcoxon rank sum test	.46680
Required Course	1(=Required) to 3 (=Elective)	Fisher test	.00008*
Course Time	1(<1) to 6 (>7)	Wilcoxon rank sum test	.00000*
Disability	1(=yes) to 2 (=no)	Proportion test	.50000
Expected Grade	1(=E) to 5(=A)	Wilcoxon rank sum test	.00056*
Internet Use	1(=Never) to 5(=Always)	Wilcoxon rank sum test	.00001*
Computer Knowledge	1(=Poor) to 5(=Excellent)	Wilcoxon rank sum test	.03685*
Internet Knowledge	1(=Poor) to 5(=Excellent)	Wilcoxon rank sum test	.04154*
Opinion of E-Learning	1(=Negative) to 5(=Positive)	Wilcoxon rank sum test	.00000*

*The difference is statistically significant.

readiness. How to cultivate a more positive perception and readiness for e-learning from traditional students remains an issue to be resolved by further research.

Another interesting finding from the expectation study survey is about what students considered as valuable learning elements based on their past learning experience. Table 3 shows the five most valuable learning elements as perceived by the traditional and online students. Online and traditional students had different rankings for the top five most valuable learning elements, except for "understanding the course materials" being consistently the second most valued element. However, none of these elements are online unfriendly (i.e., elements that require extensive human touch or physical interactions). On the other hand, online-unfriendly elements such as "studying in groups" and "presenting thoughts to class" were consistently rated as the two least valuable elements by both groups of students. This suggests that e-learning holds great promise as a fundamental teaching tool. The question of how to fully embrace the educational promises of the Internet needs continuing exploration.

Both the course satisfaction and evaluation surveys give credence to the e-learning success model. The overall rating of each success dimension is obtained by averaging all respondents' ratings on the corresponding items of the survey. In Table 4, the mean of the average ratings for each success dimension is expressed as a percentage of the highest rating possible for that dimension. We observed that the ratings for all six dimensions in cycle 4 were higher than those in cycle 3, showing efforts made to improve the success dimensions of the online course were

Table 3: Five most valuable learning elements.

Traditional Students	Online Students
Understanding the professor	Completing assignments
Understanding the course materials	Understanding the course materials
Obtaining feedback from assessed work	Practicing problem solving
Obtaining feedback from professor	Reviewing course content
Completing assignments	Taking practice examinations

Table 4: Success measures of the online course.

	Satisfaction Survey			Evaluation Survey		
Success Dimension	Cycle 3	Cycle 4	*p*-value	Cycle 3	Cycle 4	*p* value
System design						
System quality	91.7%	94.7%	.0062*	96%	97%	.2817
Information quality	89.3%	92.5%	.0122*	83%	96%	.0170*
Service quality	90.7%	93.3%	.1476	84%	93%	.0351*
System delivery						
Use	68.2%	72.9%	.0675	76%	79%	.2341
User satisfaction	81.3%	93.8%	.0061*	85%	86%	.2500
System outcome						
Net benefits	75.5%	76.2%	.2442	81%	86%	.0054*

*The difference is statistically significant using a paired one-sided *t*-test.

indeed fruitful. In particular, between the two surveys, the improvement on all six success dimensions except the use factor was found to be statistically significant at a .05 level. Furthermore, the system design quality ratings were very encouraging, attaining a 90-plus percent average on both surveys in cycle 4.

However, more attention is needed to ensure success in system delivery and outcome analyses. In particular, both the use and net benefits dimensions still have considerable room for improvement. To maximize the use dimension, focus can be placed on improving the information quality of highly used elements including assignments, practice problems, and practice examinations to further enhance learning. In addition, rather than measuring the use dimension through the self-reported means, actual usage figures from access logs can be employed. To maximize the net benefits dimension, the measurement can go beyond the current student/user level to cover the department and university levels in characterizing a more complete picture of the success outcomes. In other words, means to conceptualize success dimensions into operational constructs need to be broadened.

An important finding from the satisfaction study survey was the desire for a human touch, as expressed by online students when asked for suggestions to improve the online course:

- see other students' comments
- able to chat with other students
- more interactions with other students
- optional class time

Even though the first three of these could be technologically enabled, this result suggests that the Internet may never fully replace human instructors in teaching and learning, even when sufficient readiness exists. The question confronting educators is how to strike a balance between traditional and e-learning so that the transforming power of the Internet in defining and shaping new learning opportunities will not be overlooked as a complement to the value of the human touch.

In summary, our study demonstrates the value of assessing success in e-learning initiatives from an information systems perspective. At the outset, the use of a prototyping system development strategy was found to be instrumental to the successful development of an online course. The resulting online course was developed through an iterative process of analysis, design, implementation, testing, and enhancement. This iterative process was guided by four cycles of action research designed to investigate what constitutes success in e-learning and how it should be evaluated. An e-learning success model was found to be useful in defining, assessing, and promoting e-learning success.

CONCLUSIONS

A primary contribution of this research is in furthering our understanding of how to define, assess, and promote e-learning success. To this end, success in e-learning is defined as a multifaceted construct that can be assessed along six dimensions including system quality, information quality, service quality, use, user satisfaction, and net benefits occurring in three stages. The first stage is to attain system design success by maximizing the three quality dimensions. The second stage is to attain system delivery success by maximizing the use and user satisfaction dimensions. The final stage is to attain system outcome success by maximizing net benefits dimension. Each success dimension is quantified as a single numeric measure by aggregating the ratings of its set of attributing factors obtained via survey instruments. The overall success of e-learning can then be evaluated for each dimension. A low score for any success dimension signifies a deficiency in that area and efforts can be devoted accordingly to rectify the deficiency.

In addition, our study confirms the validity of using an action research methodology as an impetus for success dimension improvement. The research methodology is particularly useful in studying an issue as complex as the one attempted here. Rather than attacking the research issue in its entirety at the outset, action research encourages organizing the issue into manageable cycles. Findings from these cycles then converge to a full understanding of the issue itself and how it should be addressed.

Furthermore, our study indicates that a critical factor of e-learning success is the online readiness of the students. The screening of students for online courses is based on assessing their responses to four readiness measures: academic preparedness, technical competence, lifestyle aptitude, and learning preference toward e-learning. An online-ready student is characterized by a high rating on all four readiness measures. Students' online readiness is found to have a definite impact on their successful course performance and e-learning satisfaction.

Four issues and challenges are revealed by our study. First, students' indifferent attitude toward e-learning needs to be addressed so that students can be better

prepared for new ways of learning through the Internet. Second, the educational promises of the Internet have not been fully embraced nor exploited in e-learning. A more extensive investigation of how to harness the power of the Internet to enhance learning is needed. Third, a more holistic, scientific, and systemic approach to conceptualize the success dimensions into operational constructs should be explored to further the applicability and usefulness of the proposed e-learning success model. Finally, there is a concern that e-learning initiatives are perceived as fads. A balance is needed in promoting e-learning as a means to deliver real improvements in quality education, not as a means to automate education.

With respect to the success model itself, future research should focus on validating the associations among the various success dimensions. More importantly, the system design factors are antecedents of the remaining system delivery and system outcome factors. As the system design factors are defined by three quality dimensions, the relationship between quality and program success needs to be discovered and investigated first.

More research is needed to explore the applicability of the success model to other areas of e-learning besides the higher education setting. There have already been studies attempted to extend and respecify the success model to evaluate e-commerce success (Molla & Licker, 2001) and student information systems (Rai et al., 2002). Further testing and validating of the proposed model in various settings will be beneficial to the continued growth of this important research area.

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