e-Learning Success Model: an Information Systems Perspective

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Abstract: This paper reports the observations made and experience gained from developing and delivering an online quantitative methods course for Business undergraduates. Inspired by issues and challenges experienced in developing the online course, a model is advanced to address the question of how to guide the design, development, and delivery of successful e-learning initiatives based on theories of a user-centered information systems development paradigm.

The benefits of using the proposed model for e-learning success assessment is demonstrated through four cycles of action research after two action research cycles of pilot study. Findings from our empirical study confirm the value of an action research methodology for promoting e-learning success. The paper concludes with a discussion on the merits of the proposed model in furthering our understanding of how to define, assess, and promote e-learning success.

Keywords: e-learning success, e-learning assessment, action research, information systems success model

1. Introduction

The Internet has profoundly changed the way we communicate and interact with one another. Studies conducted by Pew Internet and American Life Project found that as of June 2005, 137 million Americans (or 68% of American adults) used the Internet, up from 63% one year ago (Fox, 2005). About 94 million Americans used the Internet for such daily activities as e-mailing, searching for information, getting news, checking the weather, instant messaging, and online banking, to name a few (Daily Internet Activities, 2005). The Internet has brought dramatic changes to education as well. As of 2003, 100% of public schools in the U.S. had Internet access, up from 98% in 2000. Ninety percent of public schools offered Internet courses using asynchronous computer-based instruction. Eighty-eight percent of public schools indicated plans to start or increase use of the Internet as a primary mode of instructional delivery (Waits & Lewis, 2003). The growth of distance learning is phenomenal when comparing the 1997-1998 statistics (Lewis et al., 1999) with those of 2000-2001:

- A 14% increase of the nation's public 4-year institutions offered distance learning courses (from 78% in 1997-98 to 89% in 2000-01);
- A 123% increase in enrollments in college-level, credit-granting distance learning courses (from 1.3 million in 1997-1998 to 2.9 million in 2000-2001; with 82% of the 2.9 million at the undergraduate level in 2000-2001);
- A 45% increase in the percentage of institutions using asynchronous Internet-based technologies as the most used distance learning technologies (from 60% in 1997-98 to 87% in 2000-01).

All these provide strong evidence that Internet-based technologies have transformed traditional in-class learning to a new way of learning called e-learning, defined by the Instructional Technology Council (ITC, 1998) as well as the National Center for Education Statistics (Waits and 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.

This paper reports the lessons learned and experience gained from developing and delivering an online quantitative methods course for business undergraduates. Inspired by issues and challenges experienced in developing the online course, a model is advanced to address the question of how to guide the design, development, and delivery of successful e-learning initiatives based on theories of a user-centered information systems development paradigm. The value of the model is demonstrated through four cycles of action research after two action research cycles of pilot study. Results from this empirical study are then presented and discussed. The paper concludes with a discussion on the merits of the proposed model in furthering our understanding of how to define, evaluate, and promote e-learning success.

Reference this paper as:
Lee-Post, A. "e-Learning Success Model: an Information Systems Perspective." *Electronic Journal of e-Learning Volume 7 Issue 1 2009, (pp61 - 70), available online at www.ejel.org*

2. Literature review

What constitutes success in e-learning? Attempts to address this question have resulted in a large volume of anecdotal studies assessing the success of e-learning initiatives on various measures such as learning benchmarks (Pittinsky & Chase, 2000), learning styles (Byrne, 2002), learning environment (Jung et al., 2002), learning outcomes (McClelland, 2001; Motiwallo & Tello, 2000; Teh, 1999), teaching practices (Savenye, et al., 2001; Owston & Wideman, 1998) and cost-benefits (Smith, 2001; Lawhead et al., 1997). Some of these studies are guidelines or "best practices" of e-learning that are developed from case studies (Byrne, 2002; Smith, 2001; Pittinsky & Chase, 2000; Lawhead et al., 1997). The most comprehensive guidelines are Pittinsky & Chase's 24 benchmarks in seven areas: institutional support, course development, teaching/learning, course structure, student support, faculty support, and evaluation and assessment (Pittinsky & Chase, 2000). The rest of the studies attempted to explore a variety of factors and intervening variables that might have an impact on the success of e-learning. As a result, it is difficult to understand and isolate success factors of e-learning as there is a lack of consensus of what constitutes success of e-learning.

These seemingly diverse and incoherent views of how best to evaluate e-learning are not surprising given that research in this area is at its formative stage with the recent recognition of the educational promises of Internet-based technologies. There is a need to integrate and formulate a holistic and comprehensive model for evaluating e-learning. 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 learning success from a result to a process perspective. The primary objective of this study is to address these needs.

3. e-Learning success model

This research proposes the use of an e-learning success model to guide the design, development, and delivery of e-learning initiatives. Our e-learning success model, as shown in Figure 1, is adapted from DeLone and McLean's information systems success model (DeLone and McLean 2003). Compiled from past literature on information systems success, six dimensions of success factors, namely, system quality, information quality, service quality, use, user satisfaction, and net benefit, are identified and incorporated into an overall success model. Not only did DeLone and McLean's model succeed in bringing together an integrated view of information systems success, but their model also helped instill a process approach to information systems success. DeLone and McLean (2003) identified 16 empirical studies that rendered support for the associations among the six dimensions of success factors. In addition, Rai et al., (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 multi-construct dependent measure of information systems success.

The validity of viewing e-learning initiatives' development from an information systems perspective is supported by recognizing that both of these efforts are fueled by a common goal to harness new technologies to better meet the needs of their users. In addition, a similar journey has been undertaken by information systems researchers on their attempts to identify factors that contribute to information systems success. Related theories and knowledge accumulated since the early 1980's can be beneficial in contributing to the pursuit of success in e-learning. Consequently, a second objective of this study is to examine the applicability of an information systems success model to e-learning initiatives' development and assessment.

Our 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 one success factor: use. Finally, success of the outcome stage is evaluated along two success dimensions: user satisfaction, and net benefits. 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.

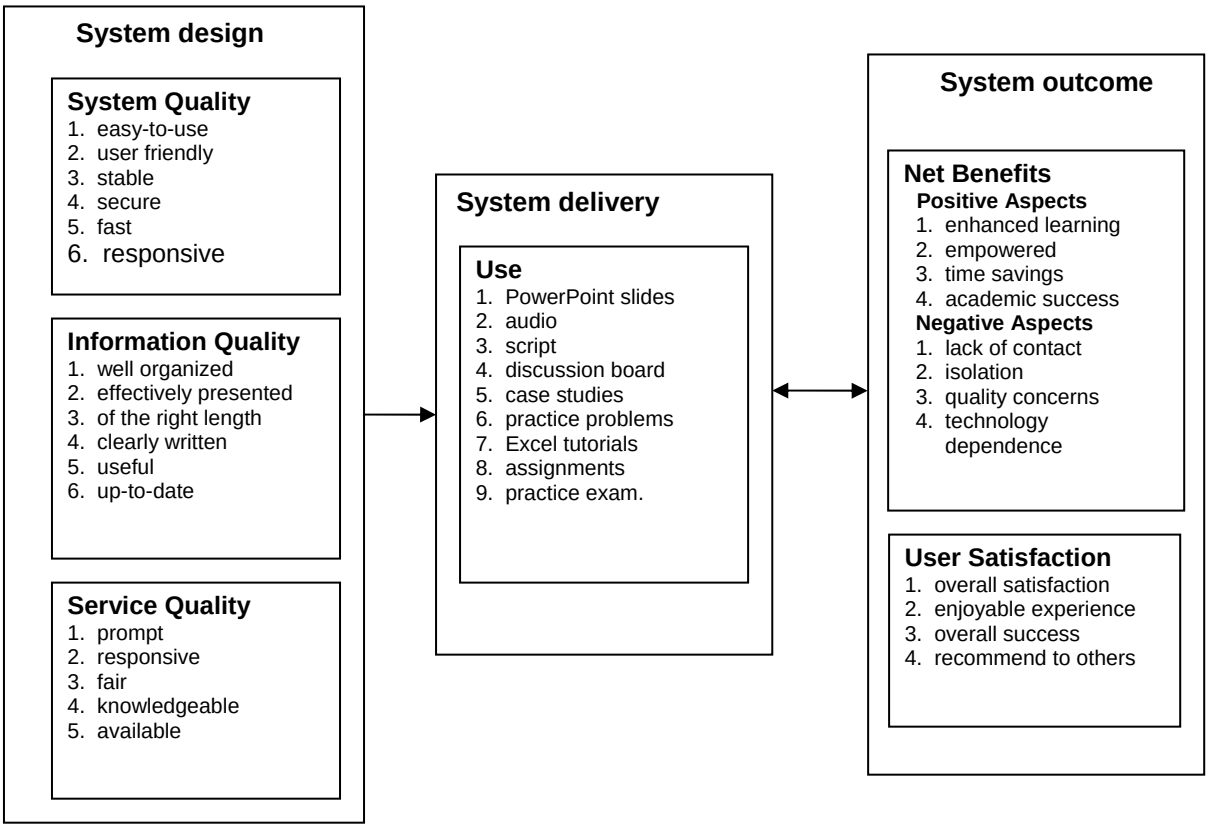

Figure 1: e-learning success model

4. Methodology

The value of using the proposed model for e-learning success assessment is demonstrated using an action research methodology. Action research was introduced by Kurt Lewin in the 1940s to study social psychology and social changes at the University of Michigan's Research Center for Group Dynamics (Lewin, 1947). Lewin's work established the reputation of action research as a "science of practice" that is best suited for studying complex social systems by introducing changes into practice and observing the effects of these changes (Argyris et al., 1985). The fundamental contention of action research is 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 prescribing a universal law (Bakerville, 1999). The complex nature of learning is summed up eloquently by Meyer (2002):

> *The problem with most research studies on learning is the difficulty of isolating factors so that their impact (if any) can be identified and understood, separate from the action of other factors in the environment. Unfortunately for researchers, learning is both complex and occurs in very rich environments. It is doubly difficult to unravel influences from the individual's personality, values, brain, background (family, school, friends, work), and, of course, the educational environment (classroom, teacher acts, pedagogical choices, tools). (p.24)*

Consequently, action research lends itself well as the methodology of choice to this study.Following the spirit of action research, this study adopts an iterative process involving five phases to gain understanding of how to enhance e-learning success: diagnosing, action-planning, action-taking, evaluating, and learning (Susman & Evered, 1978). The diagnosing phase identifies impediments to successful e-learning initiatives so that measures to overcome these impediments can be developed in the action-planning phase. The action-taking phase then carries out the measures developed. The evaluating phase examines resulting changes from the actions taken to assess their impact on the success of e-learning. The learning phase assimilates lessons learned and experiences gained

towards a better understanding of e-learning success. These five phases of action research as applied to this study are illustrated in Figure 2.

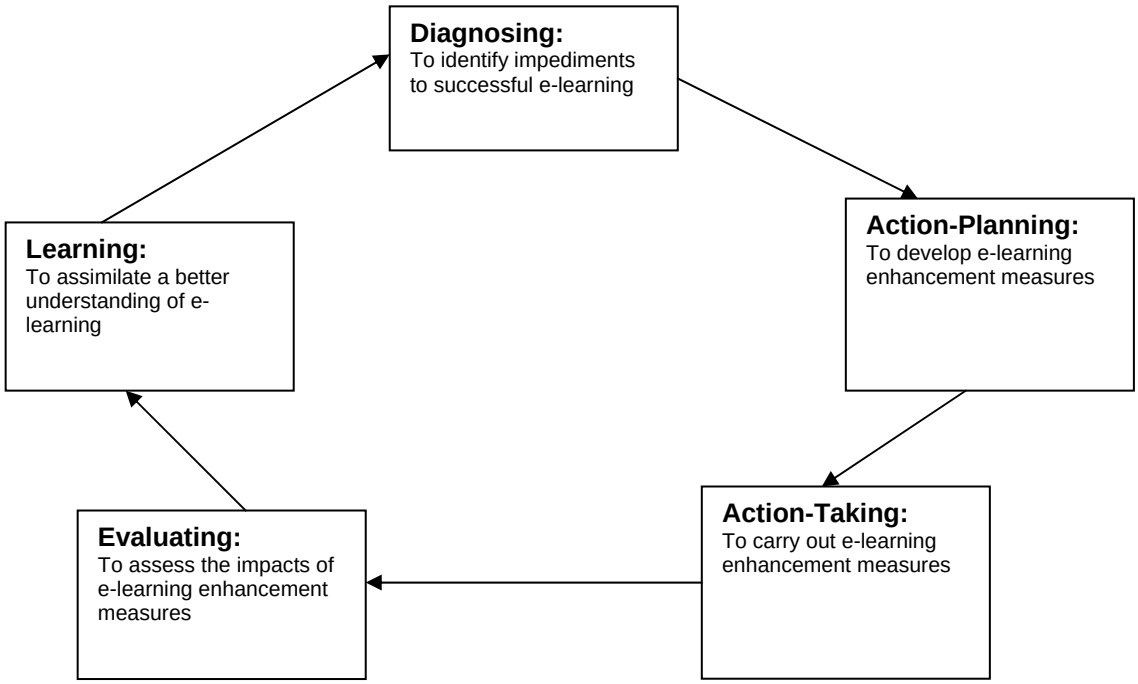

Figure 2: The five phases of action research

5. First cycle of action research

The first cycle began after the approval of a proposal to develop an online quantitative methods course for business undergraduates. A major problem to successful development and delivery of this course was the lack of a full understanding of students' needs and attitudes towards e-learning. The plan was to investigate students' receptiveness of e-learning using a pilot study. The pilot study involved designing an e-learning module on facility location analysis. Forty-eight students from two sections of the quantitative methods course then used this module in an Internet-based environment. These students filled out a course feedback survey to evaluate the module upon its completion. Opinions gathered from the students indicated that other than the flexibility of being able to learn anywhere anytime there was little learner satisfaction with e-learning (Lee-Post, 2002).

6. Second cycle of action research

A second action research cycle was launched with a special focus on gaining students' acceptance of e-learning. Seventy-two students from three sections of the 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 gathered from these students showed that their attitudes towards e-learning had improved, indicating that getting students ready for online learning was instrumental in gaining a more positive reception of e-learning (Lee-Post, 2003).The pilot study conducted during the first two cycles of action research is akin to prototyping in information systems development. Because of the experimental and explorative nature of e-learning initiatives, the use of a prototype e-learning module is critical in deciphering students' learning needs and how those needs can be met in an e-learning environment. Moreover, issues experienced in developing the prototype can be proactively addressed before resources are committed to further develop the remaining modules of the online course.

7. Next four cycles of action research

The next four action research cycles were conducted with the goal of investigating the usefulness of the e-learning success model. The entire quantitative methods course was offered online using Blackboard 5.0 as the platform for system delivery. The system quality dimension measures

desirable characteristics of the Blackboard environment such as ease-of-use, user friendliness, stability, security, and responsiveness. The information quality dimension evaluates the course content on aspects such as organization, presentation, length, and clarity. The service quality measures instructor-student 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, Excel tutorials, practice problems and assignments. The user satisfaction dimension gauges opinions of the students about e-learning based on their experience with the course. The net benefits dimension captures the positive aspects of e-learning in terms of learning enhancement, empowerment, time savings, and academic achievement, as well as the negative aspects of e-learning such as lack of face-to-face contact, social isolation, quality concerns and dependence on technology. The online course was assessed by students at the end of each action research cycle using a course evaluation survey. This survey was designed and administered by the University's Distance Learning Technology Center and consisted of thirty six questions. Questions were mapped to the six success dimensions and their ratings aggregated to form a single measure for each of the six success dimension. Table 1 lists the items in the course evaluation survey used to measure the six success dimensions of the model.Reliability of the survey was evaluated using Cronhach Alpha. Table 1 also shows the alpha values for each of the six constructs. All six constructs are showing an alpha of 0.7 or above indicating that the mapping of items from the course evaluation survey to the six success dimension is appropriate.

Table 1: Survey construct and measures

Construct	Definition	Items in the Course Evaluation Survey
System Quality (α=0.9)	The desirable characteristics of the Blackboard environment	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 (α=0.8)	The desirable characteristics of the course content	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. 10. The instructor demonstrated good knowledge of the subject matter.
Service Quality (α=0.7)	The desirable characteristics of student-instructor interactions	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. 11. The instructor could be contacted for consultation. 12. The instructor satisfactorily answered questions. 13. The instructor facilitated student participation in course activities. 25. Email contributed to my understanding of the course content.
Use (α=0.7)	The extent to which the course elements are accessed	24. Printed materials contributed to my understanding of the course content. 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. Audio taped presentations contributed to my understanding of the course content. 29. Video taped presentations contributed to my understanding of the course content. 31. Course assignments contributed to my understanding of the course content.
User Satisfaction (α=0.9)	The opinions of the students on e-learning	19. The overall value of this course. 20. The overall quality of teaching by the primary instructor in this course.
Net Benefits (α=0.8)	The overall benefits 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.

8. Results

Analyses of responses to the course feedback survey completed in the pilot study during the first two action research cycles revealed that students believed e-learning better enabled them to "Control where and when to learn" and "Learn materials in less time". Consequently, each topic in the quantitative methods course was developed to ensure learning flexibility and efficiency. Using the prototype e-learning module as a blueprint, course materials in each topic were presented in various media formats: PowerPoint slides, audio clips, and lecture scripts. Students' understanding of the course materials was demonstrated through a number of activities including discussion boards, case studies, practice problems, and assignments.

Another finding from the pilot study was that students' indifferent attitudes towards e-learning would be a major barrier to successful development of e-learning initiatives. Recognizing that e-learning was not for everybody, students were accepted into the online course only if they were online-ready: those who earned a B or above standing in the prerequisites and responded with at least a 4 using a 5-point scale on all three readiness measures: technical competence, lifestyle aptitude, and learning preference.

The success of the online course was evaluated along six success dimensions during the last four action research cycles using a course evaluation survey. A comparison of the ratings of the six success dimensions analyzed from the survey responses is reported in Table 2. The overall rating of each success dimension is obtained by averaging all respondents' ratings on the corresponding items of the survey. The mean of the average ratings for each success dimension is expressed as a percentage of the highest rating possible for that dimension. A target rating of 85% was sought for all six success dimensions.

Table 2: Success measures comparison

Success Dimension	3rd Cycle	4th Cycle	5th Cycle	6th Cycle
System design				
System quality	96%	97%	81%	95%
Information quality	88%	95%	80%	86%
Service quality	82%	92%	81%	89%
System delivery				
Use	65%	78%	65%	89%
User satisfaction	85%	86%	73%	90%
System outcome				
Net benefits	78%	83%	67%	88%

We observed that (1) the ratings for all six dimensions were higher in cycle 4 than cycle 3; (2) the ratings for the system design dimension were highest in cycle 4; (3) the ratings for all six dimensions were lowest and below the 85% target in cycle 5; (4) the ratings for the system delivery and system outcome dimensions were highest in cycle 6; and (5) the ratings for all six dimensions reached the 85% target in cycle 6. The changes in ratings for all six dimensions were resulted from efforts made to improve the success dimensions of the online course. The usefulness of our e-learning success model in this regard will be detailed in the next section.

9. Model utility

Recall that our e-learning success model calls for a process approach to effectively design, develop, and deliver an e-learning initiative. The process approach to e-learning success is essentially a continuous improvement process seeking to raise ratings of six success dimensions including system quality, information quality, service quality, use, user satisfaction, and net benefits in three stages: system design, delivery, and outcome. The interdependences within the three stages, as shown in Figure 1, imply that attempts to improve a success rating should start with raising the three quality ratings in the design stage first and proceed to boosting the use rating in the delivery stage, then followed by improvements in the user satisfaction and net benefits ratings in the outcome stage.

The online course was first evaluated using the proposed model in cycle 3. Among the six success dimensions in cycle 3, service quality, use, and net benefits were below the target 85% rating. As a result, service quality enhancements to improve instructor-student interactions were made in cycle 4. Specifically students were reminded in the syllabus as well as the announcement page of the course website that emails would be responded to within 48 hours. The use dimension was monitored during

cycle 4 leading to a number of improvements impacting the net benefits dimension: (1) errors in the materials were corrected; (2) extra sets of practice exercises were selected to prepare students for a more difficult set of assignment problems; and (3) students were encouraged to dialog with one another through the discussion board. Consequently, cycle 4's ratings for all six dimensions are higher than those of cycle 3, showing efforts made to improve the system design and delivery stages of the online course followed through onto the outcome stage.

Two success dimensions remained below an 85% rating at the end of cycle 4, namely use and net benefits. Accordingly, e-learning enhancements were sought to raise the use dimension after improvements in system quality and information quality were made in cycle 5. Specifically the Blackboard environment was upgraded from version 5.0 to 6.0 featuring a more secured log in procedure. A website containing practice exercises put together by the textbook publisher was added to the existing course website on Blackboard. The textbook publisher's website provided students with immediate feedbacks via onscreen buttons such as "link to text", "show hints", "show answer". When the use dimension was monitored during cycle 5, it was realized that the design changes were ineffective as students found that the more secured log in procedure for Blackboard was cumbersome. At the same time students were required to log in a second time to access practice problems from the publisher's website. Consequently, cycle 5's ratings were the lowest along all six dimensions when compared to those of any four action research cycles.

The poor ratings of cycle 5 signaled that an overhaul of the system design was imminent. A special training media presentation was made to familiarize students with the secure log in procedure of Blackboard. Students were no longer required to log on the publisher's website to access practice problems. Instead students could attempt practice exercises from the course website directly. These practice exercises were graded immediately with "show answers" feedbacks. In addition, assignment problems were graded with instructor's comments. When the use dimension was monitored, system delivery improvements were further enhanced to boost system outcome measures. One such improvement was giving students a second chance in attempting the practice exercises and assignment problems. Students could improve their grade by submitting a corrected version of the practice exercises and assignment problems in response to the feedbacks and instructor's comments. Consequently, cycle 6's ratings on all six dimensions were not only higher than that of cycle 5 but they also exceeded the 85% baseline.

10. Model limitations and extension

While our model is useful for instructors to measure and evaluate e-learning success, it assumes instructors are skilled system developers and enthuastic e-learning adopters. In addition, the model's student-centered perspective relies only on students' e-learning experience as feedback for e-learning improvements. Consequently we extend the current model by taking into account both the instructors' and institutional perspectives. An extended model incoporating these perspectives is shown in Figure 3.

The extended model calls for institutional supports for instructors, in particular for those who are e-learning skeptics. Some critical institutional supports include, first, a sound technical infrastructure such as campus-wide high-speed Internet access, and an institutional learning management systems like WebCT or BlackBoard should be provided. Second, ongoing instructors' workshops should be organized to allow training and sharing of e-learning best practices. Third, e-learning developmental support in the form of technical and pedagogical aids should be established to facilitate instructors' e-learning adoption. Fourth, technical support should be in place to address any issues that arise in e-learning delivery and access. Fifth, incentives such as grants, awards and other forms of recognition should be placed to encourage e-learning practices.

The extended model also calls for an evaluation of e-learning institutional outcomes so that the impacts of e-learning can be assessed on the institutional level as well. Specific measures for institutional outcome can be cost saving, increased enrollment, higher rankings, increased endowment, etc. Our extended model provides a more comprehensive view of e-learning success – that students, instructors, and institutions all have roles to play.

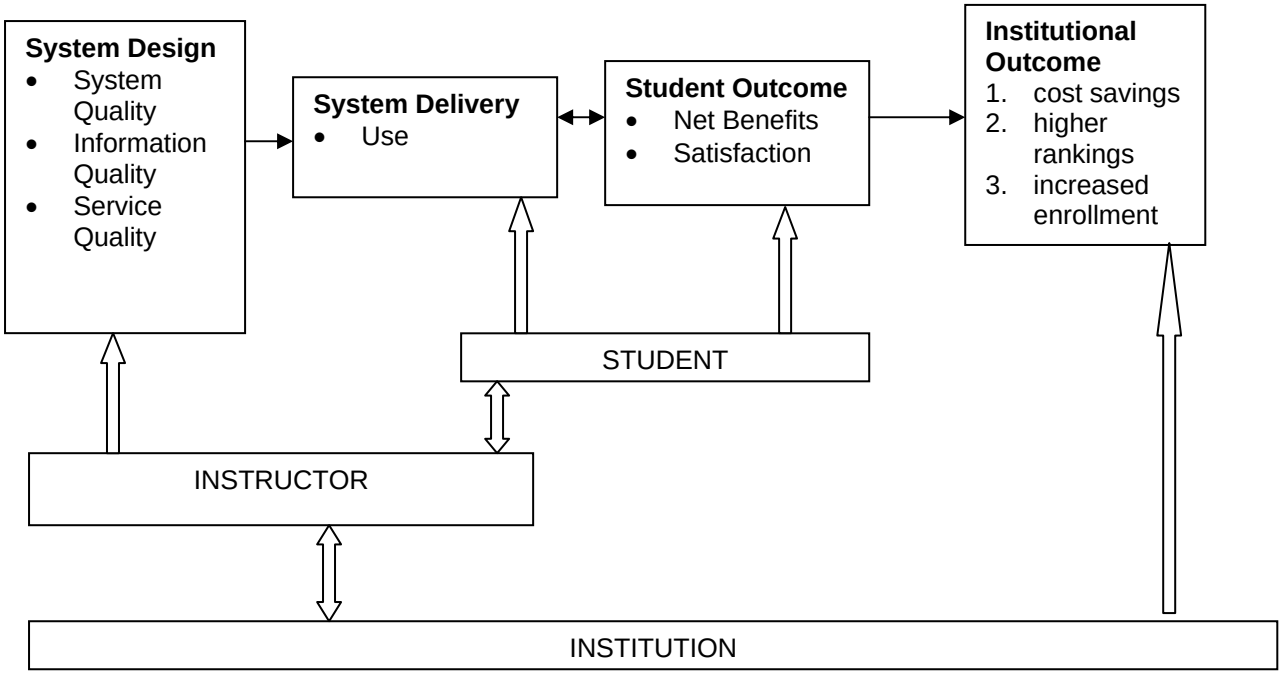

Figure 3: Extended e-learning sucdess model

11. Observations

In summary, our study demonstrates the value of assessing e-learning success from an information systems perspective. Specifically, the following observations are made from the development and continual improvement in designing, developing and delivering the online course.

- The first step to ensure successful development and delivery of e-learning initiatives is to understand students' learning needs and attitudes towards e-learning through pilot studies. In so doing, issues in designing and developing e-learning initiatives can be identified and addressed adequately before their actual delivery.
- A critical factor of e-learning success is the online readiness of the students. Online readiness should be assessed along four readiness measures: academic preparedness, technical competence, lifestyle aptitude, and learning preference toward e-learning.
- The overall success of an e-learning initiative is dependent on the attainment of success at each of the three stages of e-learning systems development, namely, system design, system delivery, and system outcome.
- The success of the system design stage is dependent on the attainment of three success factors: (1) system quality; (2) information quality; and (3) service quality.
- The success of the system delivery stage is dependent on the attainment of success of the system design stage and one success factor: use.
- The success of the system outcome stage is dependent on the attainment of success of the system delivery stage as well as two success factor: (1) net benefits; and (2) user satisfaction.
- An action research methodology is an impetus for success dimension improvement. 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.
- A common interface allowing a seamless access to all course design elements is an important system design feature.
- Success metrics that are relevant to a specific e-learning context should be defined and quantified to a desirable target level of performance. For example, the user satisfaction success metric in our empirical study is defined as the students' opinions on e-learning. It is measured by two indicators on a 4-point scale: (1) the overall value of the course; and (2) the overall quality of teaching. A target rating of 85% is deemed desirable.

- Course improvements should be made by following a process approach to systematically raising the three quality ratings in the design stage first and proceed to boosting the use rating in the delivery stage, then followed by improvements in the user satisfaction, and net benefits ratings in the outcome stage.
- Institutional supports are critical to promote and facilitate e-learning adoption among instructors.
- Institutional outcome should be incorporated as the seventh success dimension in extending the current success model to encompass an institutional perspective.

12. Conclusion

This research moves us a step closer in harnessing the power of Internet-based technologies to enhance learning. We demonstrated the applicability of an e-learning success model to guide the design, development, and delivery of e-learning through four action research cycles. 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 multi-faceted 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 dimension. The final stage is to attain system outcome success by maximizing net benefits and user satisfaction dimensions. Each success dimension is quantified as a single numeric measure by aggregating the ratings of its set of attributing factors obtained via a course evaluation survey instrument. 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.

Although the findings of the current study are drawn from one undergraduate quantitative methods course, there is no reason to doubt that the e-learning success model proposed here cannot be applied to other disciplines and graduate level of courses as well. In addition, to broaden the current student-centered perspective, an extended e-learning success model is proposed that gives recognition to the role that students, instructors, and institution play in making e-learning a success. Future testing and validating of both the proposed and the extended model will be beneficial to the continued growth of this important research area.

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