IS Success Model in E-Learning Context Based on Students' Perceptions

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ABSTRACT

This study utilized the Information Systems Success (ISS) model in examining e-learning systems success. The study was built on the premise that system quality (SQ) and information quality (IQ) influence system use and user satisfaction, which in turn impact system success. A structural equation model (SEM), using LISREL, was used to test the measurement and structural models using a convenience sample of 674 students at a Midwestern university. The results revealed that both system quality and information quality had significant positive impact on user satisfaction and system use. Additionally, the results showed that user satisfaction, compared to system use, had a stronger impact on system success. Implications for educators and researchers are reported.

Keywords: IS Success, E-Learning, User satisfaction, System use, System quality, Information quality

1. INTRODUCTION

Both undergraduate and graduate courses are experiencing a migration away from the traditional classroom and toward a greater emphasis for electronic delivery of content (Allen and Seaman, 2008). This trend cuts across all departments and schools in the university system but is especially critical in business schools, since the preparation of students for successful business careers will rely on the students' abilities to accurately assess the quality of and rapidly adapt to the changing systems that reflect radical technological advances. The Information Systems Success (ISS) model focuses attention on the information and system quality of specific IT systems. The expanded use of electronic means of course delivery results in different IT systems in which students develop various views of the system quality and information quality that may affect their educational outcomes.

In a graduate online information management course, feedback provided in the e-learning environment affected student satisfaction, the typical outcome measure for the ISS model (Rossin, et al., 2008). Feedback, in the context of an e-learning environment, is a measure of the information quality provided by the instructor during course delivery. In addition, the perceived balance of challenge and skill necessary to be successful in the course also affected the satisfaction with the course. The balance of challenge and skill necessary for the online delivery of the e-learning experience is a measure of the system quality. Information quality can also be electronically delivered and assessed by individuals with an information system being absent from the process. In a business environment, the information needs of managers in different functional areas are critical aspects during the evaluation of information and subsequently its quality (Beard and Peterson, 2003). For students, information needs may vary from course to course as well as among various homework assignment styles (e.g. quizzes, short-answer questions, and case studies). The concluding goal of this study ends with a discussion of how an information system can facilitate the delivery of the required information.

While the ISS model is used in many instances, a basic assumption of the model is one of voluntary use by the user. This assumption is incorrect in the context of university e-learning courses where usage of the system is required to complete the coursework. Usage of a non-voluntary system is not without its parallels in industry. The implementation of enterprise resource planning (ERP) systems for many companies requires the usage of these systems by employees.

This industry need has translated these requirements into ERP system courses (Davis and Comeau, 2004). Since the usage of e-learning systems in academic settings is not voluntary, the application and possible changes to the ISS model to an online course environment is a necessary and critical extension of the study of information systems. This study applies the ISS model to study e-learning systems (ELS) in the context of individual impact for a student online environment. The remainder of this article presents the ISS model with its standard constructs. The methodology used to assess the study is reviewed. The data analysis and results are then addressed. Finally, a discussion of the conclusions along with limitations are presented.

2. LITERATURE REVIEW

The ISS model (DeLone and McLean, 1992) is among the most influential theories in predicting and explaining system use, user satisfaction, and IS success (Halawi, McCarthy, & Aronson, 2008; Guimaraes, Armstrong, & Jones, 2009). The ISS model can be used to assess ELS success due to the solid theoretical foundation and the numerous, successful empirical studies.

The base ISS model consists of six constructs or dimensions: (1) system quality, (2) information quality, (3) systems use, (4) user satisfaction, (5) individual impact and (6) organizational impact. DeLone and McLean (1992) suggested these six dimensions of success are interrelated rather than independent. System quality and information quality separately and jointly affect both use and user satisfaction. Additionally, the amount of use can affect the degree of user satisfaction – positively or negatively – and vice versa. Use and user satisfaction are direct antecedents of individual impact; and lastly, individual performance should eventually have some organizational impact.

DeLone and McLean (2003) proposed an updated ISS model and evaluated its usefulness in light of the dramatic changes in IS practice, especially the emergence and consequent explosive growth of web-based applications. Based on prior studies, the ISS model was updated by adding "service quality" measures as a new dimension and by grouping all the "impact" measures into a single impact or benefit construct called "net benefit" (DeLone and McLean, 2003). Thus, the updated model consists of six dimensions: (1) information quality, (2) system quality, (3) service quality, (4) use/intention to use, (5) user satisfaction, and (6) net benefits.

Within the e-learning context, learning activities are conducted through web-based applications. This makes an ELS both a communication and system phenomenon that lends itself to the updated ISS model. DeLone and McLean (2003) contend that web-based application processes fit well into their updated ISS model and the six success dimensions. We adopted DeLone and McLean's (2003) ISS model as part of the theoretical framework to develop an instrument for assessing the success of ELSs. ELS success will be maximized when learners perceive the systems are beneficial to their learning. However, since the ISS model is premised on a voluntary use assumption, research has often produced conflicting findings with respect to the relationships (Chen, Gillenson and Sherrell, 2002). One potential reason for this inconsistency might be the focus on a single theory that excludes consideration of other possible determinants. To evaluate this issue, we reviewed the information systems success literature and educational research and present that review in the order of dependent constructs and then the independent constructs.

2.1 System Use

System use is an important measure of system success (Chang and Cheung, 2001; DeLone and McLean, 1992; Lucas 1978; Van der Heijden, 2004). The system use construct has also been measured as a "possible to use" and an "intend to use" construct (DeSanctis, 1982). Delone and McLean (2003) suggest that the nature, quality, and appropriateness of system use are important outcomes, and a simple measure of time spent on the system is inadequate. System use is considered a necessary condition under which systems/technologies can affect individual (learning) performance. Such research highlights the importance of use for evaluating a system in terms of its success. System use, for this research, was defined as the extent and nature of using the ELS.

System use increases when the system is perceived as profitable and decreases if the system is perceived as not profitable (Ein-Dor, Segev and Steinfield, 1981). An ELS, in the context of course delivery, is mandatory in its use. From the student perspective, an ELS is not perceived as profitable or unprofitable. Students perceive system usage in terms of whether or not the ELS adds value to their learning experience. However, if students perceive the usage as adding value to their ability to improve performance in the course, the ELS will be perceived as successful. Thus, we hypothesize:

H1. Learners with a higher level of use are likely to agree that the ELS adds value to their learning experience.

2.2 User Satisfaction

User satisfaction is a measure of the successful interaction between an information system and its users. It is also defined as the extent to which learners believe the information system meets their needs (Ives, Olson and Baroudi, 1983). If a system meets the requirements of the users, their satisfaction with the information system will be enhanced (Bharati, 2003). Conversely, if the system does not provide the necessary information, they will become dissatisfied. Research findings (Lucas, 1978; Robey, 1979) provide evidence that heavily used systems are positively correlated to user satisfaction. In stark contrast, Schewe (1976) found no significant relationship between system use and user satisfaction; likewise, Lawrence and Low (1993) did not find this relationship to be significant. Similarly, Mawhinney (1990) found no relationship between user satisfaction and system use, and (Srinivasan, 1985) noted that the relationship is not always positive. For an ELS, usage and satisfaction with the ELS will not necessarily be related due to the focus and disparities that may be inherent in an online course environment.

Delone and Mclean (1992) studied articles that address the subject of user satisfaction in their research. They concluded that user satisfaction was widely used as a measure of IS success. However, while user satisfaction has been widely used as a surrogate for systems performance and IS success, critics have questioned its general applicability because of poor instruments that have been developed to measure satisfaction (Galletta and Lederer, 1989). As with ELS, when usage is not voluntary, measures of success should be based on educational outcomes (Gill, 2006). As a measure of educational outcomes, students can indicate the ELS success by the perceived value of their learning outcome. If students are satisfied with the system and its contribution to their learning, the ELS will be perceived as successful. Therefore, we hypothesize:

H2. Learners with a higher level of satisfaction are likely to agree that the ELS adds value to their learning experience.

2.3 System Quality

System quality is the individual perception of a system's performance. From an e-learning perspective, the system quality is measured in terms of both the hardware available to the user and the various software applications designed for their intended use and needs. While the user is not aware of the network requirements of an ELS, e-learning often requires network to network communication that necessitates Internet access. High quality ELSs demonstrate the following characteristics: availability, usability, realization of user expectations, ease of learning, and response time (Halawi, McCarthy and Aronson, 2008; Guimaraes, Armstrong and Jones, 2009).

In accordance with its focus on learning, a successful ELS is generally characterized as user friendly and effective in providing useful feedback to learners. Although some attractive features that apply to other systems, such as scalability, standardization, and security have been mentioned (Sakaguchi and Frolick, 1997), the success of an ELS is judged by learning effectiveness.

In terms of the relationship between system quality and system use, some studies (Seddon and Kiew, 1994; Etezadi-Amoli and Farhoomand, 1996; Teo and Wong, 1998; Wixom and Watson, 2001) confirmed a direct relationship between system quality and the individual worker's decision-making performance, job effectiveness, and quality of work. Job effectiveness is difficult to measure for an ELS due to the potential remote nature of the participants. Diverse connection quality between participants may affect the individual’s ability to use the ELS. This is especially true when participation is voluntary and usage or activity statistics would become important indicators of success (Gill, 2006). However, when participation is involuntary, educational outcomes or participant perceptions of the system’s ability to promote their learning should be used as a measure of success.

In terms of the relationship between system quality and user satisfaction, researchers have long employed user satisfaction with their systems as a surrogate measure for success (Rai, Lang and Welker, 2002; Guimaraes, Staples and McKeen, 2003; Guimaraes, Armstrong, and O'Neal 2006). DeLone and McLean (2003) identified system quality as an important characteristic of the user perception to use information technology. This then leads to a direct positive impact on user satisfaction. With mandatory use of the ELS, user satisfaction is more critical and a larger hurdle to overcome for the system to be considered successful. Thus, the authors propose the following two hypotheses.

H3. The system quality will positively impact the use of ELS.

H4. The system quality will positively impact learner satisfaction.

2.4 Information Quality

Information quality traditionally refers to measures of system output, namely the quality of the information that the system produces primarily in the form of reports. The desired characteristics include accuracy, precision, currency, reliability, completeness, conciseness, relevance, understandbility, meaningfulness, timeliness, comparability, and format (Swaid and Wigand 2009). The main measures used in the information quality construct for ELSs are slightly different. The focus is more on information accuracy, completeness, relevance, content needs, and timeliness. These aspects are largely controlled by various entities that include IT departments and the learning organizations responsible for assembling the ELS requirements.

Information quality captures e-learning content issues. Providing students with learning information is the basic goal of a course web site (Bhatti, Bouch and Kuchinsky, 2000). Deciding what content to place on a web site is extremely important. Lin and Lu (2000) addressed the issue of how user acceptance is affected by features and accurate information. Huizingh (2000) distinguished content from design and operationalizes both concepts by using objective and subjective measures to capture features as well as perceptions. Perkowitz and Etzioni (1999) explored the importance of updated information with the notion of adaptive web sites. Student satisfaction is also affected by the feedback received in a course (Rossin, et al., 2008), and the feedback can be viewed as an element of information quality.

Course information quality is a crucial variable that affects the success of ELSs. According to Moore (1991), course information “expresses the rigidity or flexibility of the program's educational objectives, teaching strategies, and evaluation methods” and the course information describes, “the extent to which an education program can accommodate or be responsive to each learner's individual needs.” Course information has two structural elements – course objectives and course infrastructure. Course objectives are specified in the course syllabus, including but not limited to: topics to be learned, workload in completing assignments, class participation expectations in the form of online conferencing systems, and group project assignments. Course infrastructure is concerned with the overall usability of the course website and organization of course material into logical and understandable components. These informational elements, needless to say, affect the satisfaction level, system use and learning outcomes (Eom, Ashill and Wen, 2006). We theorize that the quality of course information will strongly correlate to user satisfaction and system use. Thus, we hypothesize:

H5. Information quality will positively impact ELS use.

H6. Information quality will positively impact learner satisfaction.

The mandatory usage of the ELS prompted a reevaluation of prior ISS model research in which system usage has affected user satisfaction and vice versa. An empirical result of increased system usage based on increased user satisfaction must be viewed as spurious since, regardless of how satisfied (or dissatisfied) the students are with the ELS, the increased usage may be mandated by the course content. Brown, et al. (2002) pointed out that in a mandatory setting, user attitude toward the system, not their usage, is a better representation of satisfaction with the system. Hypothesizing the reverse relationship, an increase in user satisfaction cannot result in increased system usage. This is again the result of the mandatory nature of the ELS in the context of course delivery. Students can be very dissatisfied (or satisfied) with the ELS and yet, due to course requirements, still be required to maintain a certain level of system usage. This reevaluation, coupled with inconsistent findings in prior research (Baroudi, Olson and Ives, 1986; Cheney and Dickson, 1982; Srinivasan, 1985; Lawrence and Low, 1993) for these relations, prompted the removal of these relationships from consideration in our model.

Based on the above-mentioned literature review and hypotheses, we propose the following research model depicted in Figure 1.

3. METHODOLOGY

3.1 Instrument Development

To develop the survey instrument, the literature was reviewed for existing items that could be used. The items used to operationalize the constructs in Figure 1 were carefully adapted and reworded from past research to relate specifically to the context of e-learning. All items used a 7-point Likert scale ranging from 1 – "strongly disagree" to 7 – "strongly agree." The instrument items for information quality, system quality, usage, and user satisfaction were adapted from prior studies using the ISS Model (McGill, Hobbs and Klobas, 2003; Rai, Lang and Welker, 2002). The measures for ELS success were developed by the authors.

3.2 Samples and Data Collection

The developed ELS survey was administered over a three week period in the fall semester of 2007 at a Midwestern public university. The students involved took courses across multiple educational settings. In virtually all courses, e-learning was not optional for the individuals involved, and all students selected were enrolled in at least one online course. Students received an invitation to take the survey when they logged into the course during the survey period. The entire population of 2,788 students was requested to participate in the study. Of that population, 674 surveys were returned resulting in a 24.17 percent response rate (See Appendix A). The students came from a variety of majors. The majors representing the two largest student population groups were education at 27 percent and business at 20 percent. The rest of the respondents come from other majors, such as nursing, engineering, and fine arts. The distributions of the students by their classifications (undergraduate and graduate) showed a similar pattern to the national distribution. For example, the majority of students were undergraduate (over 80 percent), while graduates consisted of about 17 percent (National Center for Education Statistics, 2008).

More than three quarters of the students indicated that they were taking only online classes that semester. With respect to the number of courses that students were taking, 38 percent of the respondents indicated that they had one course, 37 percent of the students reported that they had two courses, 13 percent of the students had three courses, and 12 percent had four or more courses.

The ELS used in this study is referred to as the Online Instructor Suite (OIS). OIS is a bundle of six locally developed applications that comprise a course management system for online course materials. Unlike other course software packages (e.g., Blackboard, WebCT), OIS does not manage content; instructors can develop online course content using any web content editing application (e.g. FrontPage, Dreamweaver). The OIS applications (Course Manager, GradeA, UTest, Forum, Calendar, DropBox, and Chat) are similar to BlackBoard.

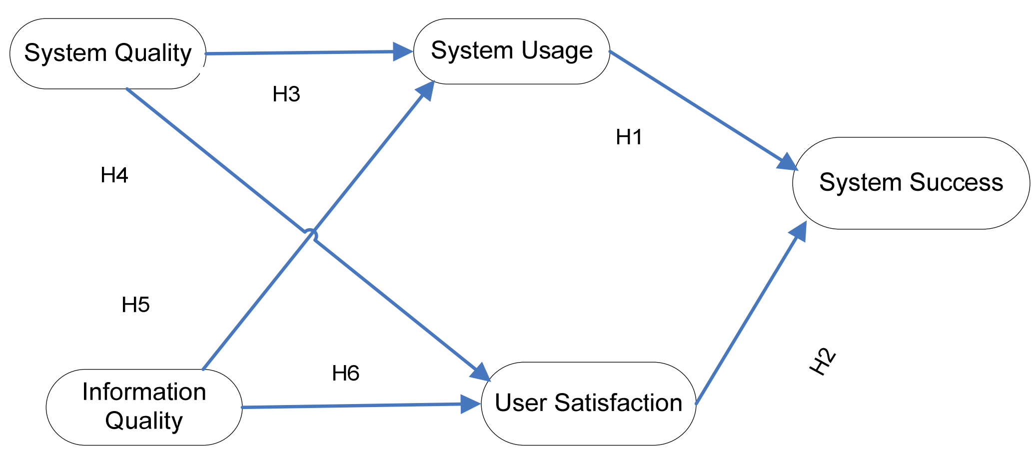

Figure 1 – Research Model

There are four OIS applications that are designed to ensure system quality. Course Manager is the "heart" of the software package. It controls the user database and general properties used by all other modules. Course Manager can seamlessly import rosters from another server, database or text file, and allows instructors to divide students in sections of a same class and groups, among other features. GradeA is a spreadsheet-based gradebook that is easy to use yet powerful. GradeA provides instructors with a flexible way to create gradebooks that are securely accessible by students over the web. UTest lets the instructor administer tests over the Internet easily. It includes an array of features that provide flexibility and security to online tests. Tests can be taken using a standard browser or using the UTest Secure Browser, and grades can be automatically sent to GradeA for publishing in the gradebook. DropBox is an upload/download area where students can store files and submit assignments for grading. The instructor interface retrieves files from the server for viewing, changing and grading.

The rest of the OIS applications are designed to improve information quality. Forum is an asynchronous discussion space that can be used to increase interactivity among students and the instructor. A class forum is divided into discussions and topics, and instructors have full control over the entire area through an interface that allows them to read, create, reply to and grade students' posts. Calendar tracks important dates, announcements, test times, and other information that can be shared among all members of a group or class. Anything instructors enter in Calendar will appear in each student's personal calendar page. Students can add or remove items using a Web interface. Chat is a synchronous communication tool for OIS classes. This allows instructors and students to communicate with each other in real-time.

3.3 Statistical Procedure

A confirmatory factor analysis (CFA) approach to the data analysis was taken using the LISREL software package version 8.80. A two-step approach was taken for validating the research model. The initial step was construction of the measurement model in which the hypothesized scale items were loaded onto the independent constructs of *System Quality, Information Quality, System Use, User Satisfaction* and *ELS Success*. Factor loadings were checked against the guidelines provided by Comrey and Lee (1992). Modification indices were checked for cross loading and correlation of scale items. Four fit indices were used to assess the goodness of fit for the measurement model. The first three indices, Normed Fit Index (NFI), Comparative Fit Index (CFI), and Non-Normed Fit Index (NNFI), were expected to exceed 0.9 to indicate a good fit. The last index, the Root Mean Square Error of Approximation (RMSEA), should be less than .08 for a model of 'near fit'. An analysis of a more stringent standard presented by Hu and Bentler (1999) indicated that the NNFI and CFI should exceed a .95 criteria and the RMSEA should not exceed .06 to be considered a 'close fit'. Three of the four indices proposed by Hu and Bentler (1999) should meet these standards to indicate a close model fit. Additionally, SPSS computed the frequencies, means, standard deviation, reliability coefficients and Cronbach's Alphas for each construct (See Appendix B for means and standard deviations.)

A structural model was then developed from the resulting measurement model constructs. LISREL version 8.80 was again used to test the structural model and validate the proposed hypotheses. Model fit was assessed using the same criteria as the measurement model. Acceptance of the hypotheses was contingent upon achieving a .05 level of significance on the appropriate path coefficients. Details of the results are presented in the next section.

4. DATA ANALYSIS

4.1 Measure of Constructs Reliability and Validity

SPSS was initially used, with final validation conducted using LISREL, to implement the following steps for measuring the reliability and validity of the model. The item-total correlation was computed for each item using items belonging only to the same construct. The minimum acceptable value to keep a scale item with the latent construct is 0.5 (Hair, et al., 2006). More stringent reliability coefficients of 0.70 or higher have also been recommended (Nunnally 1978). In addition to the item-total correlations, Cronbach's alphas were computed for each construct. The result of the SPSS analysis was the identification, and subsequent removal, of two items (SU3 and US1) that did not load properly on their intended constructs. The two scale items were sequentially removed with noticeable improvements to Cronbach's Alpha and the corrected item-total correlations. The final model showed that all items demonstrated corrected item-total correlations above the 0.65 level with Cronbach's alpha above 0.80 for all constructs.

Twenty items were analyzed for construct validation and reliability as described above. A CFA using SEM was performed on the final measurement model. All scale items were loaded on their indicated latent construct. All coefficients were higher than the more stringent standard of .70 with the exception of SQ1 (0.67). The goodness-of-fit indices reviewed earlier were used to assess the validity of the measurement model. The NFI, CFI and NNFI all exceeded the .95 criteria for the model to be considered a close fit. The RMSEA was in the range of a near fit for the model. The results of the assessment of the reliability and validity of measures are reported in Table 1. The model fit statistics from the SEM measurement model analysis are reported in Table 2.

4.2 Structural Model

The structural model testing the research model and hypotheses met the more stringent standard of 0.95 for the NFI, NNFI, and CFI fit indices to indicate a model of close fit (Table 2). The RMSEA resulted in a value of 0.07, which indicated a model of near fit. With three of the four fit indices meeting the standard for close fit, the model is deemed an adequate test for the hypotheses.

.RESULTS

All hypotheses presented in the research model, H1 through H6, achieved a significance level of 0.01. The standardized path coefficients and the hypotheses status are

Construct	Item	Loadings					Corrected item-total correlations
		SQ	IQ	SU	US	SS	
System Quality	SQ1	0.67					0.658
	SQ2	0.87					0.833
	SQ3	0.89					0.814
	SQ4	0.85					0.775
	SQ5	0.78					0.731
Information Quality	IQ1		0.90				0.863
	IQ2		0.89				0.853
	IQ3		0.92				0.892
	IQ4		0.89				0.867
	IQ5		0.82				0.794
Systems Usage	SU1			0.92			0.724
	SU2			0.79			0.724
User Satisfaction	US2				0.89		0.847
	US3				0.95		0.847
System Success	SS1					0.90	0.878
	SS2					0.95	0.907
	SS3					0.95	0.910
	SS4					0.83	0.820
Cronbach's Alpha		0.91	0.95	0.83	0.92	0.95	

Table 1: Reliability and Validity

represented in Figure 2. The path coefficient for H2 (user satisfaction to system success) had the strongest effect on system success. It was the most significant factor with a t-value of 31.25 and standardized path coefficient of 0.94. The explained variance for system success was excellent (R^2 = 0.96).

Both system quality and information quality had a significant positive effect on user satisfaction and system use. While system quality had a slightly stronger effect on user satisfaction (with path coefficient of 0.48) compared to information quality (with path coefficient of 0.45), the nearly balanced path coefficients coupled with the high level of

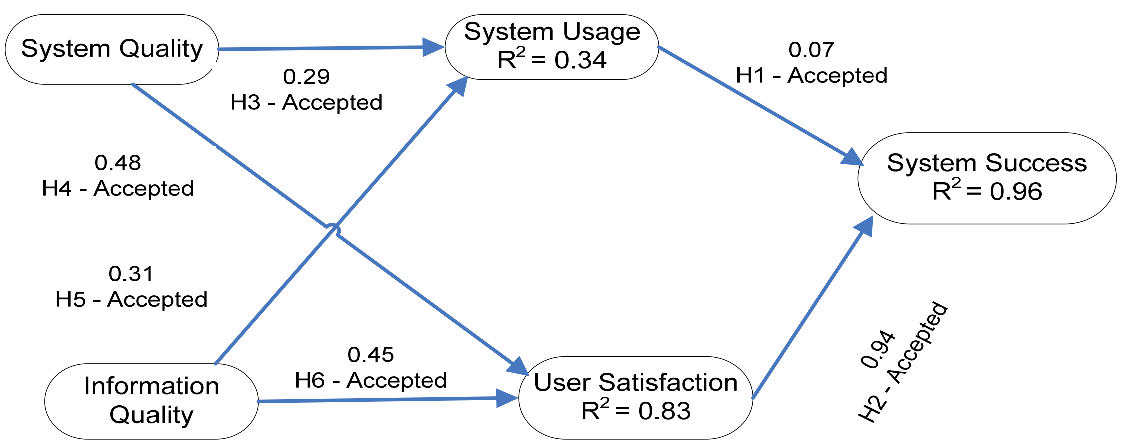

Figure 2 - Model Results

	N	Chi^2	df	RMSEA	NFI	CFI	NNFI
Measurement Model	674	539.35	125	0.070	0.99	0.99	0.99
Structural Model	674	544.17	128	0.070	0.99	0.99	0.99

Table 2: SEM Fit

explained variance for user satisfaction (R^2 = 0.83) indicate that both information and system quality were highly correlated to user satisfaction.

With respect to system usage, information quality (0.31) had a slightly stronger effect on system use than system quality (0.29). However, the explained variance of system usage (0.34) was much lower than that of user satisfaction. This indicated that there may be other factors or variables required in the explanation of system usage.

6. DISCUSSION AND CONCLUSION

This paper extended the ISS model to measure ELS success. Both system quality and information quality indirectly impact ELS success, predominantly through user satisfaction. To increase student satisfaction and ultimately affect ELS success, it is important for instructors to make available an ELS that provides students with needed, relevant, up-to-date information through a user friendly and interactive system. Given the high degree of explanation for user satisfaction (R^2 = 0.83), the ISS model can be said to be an effective initial model for evaluating an ELS environment. Even though the surveyed population was using a mandated ELS, high system quality and information quality of an ELS are necessary for high levels of user satisfaction. This strongly relates to the ELS success.

While it is gratifying to recognize that user satisfaction strongly relates to ELS success, the relatively low explanation of system use (R^2 =0.34) coupled with the low path coefficient (0.07), although positive and significant, indicates that a further extension of the model may be necessary. There are some potentially confounding issues that may further explain some of the less significant findings of the research model in general and system usage specifically. With respect to the system quality impact on explaining system usage, the focus of the survey was on the ELS that all students were using for their online courses. While this provided a common point of reference for completing the surveys, multiple hardware, software and network issues outside the control of the ELS may also have influenced student usage. Specific issues influencing student use that would affect system quality but were not evaluated by the survey include, but are not limited to browser selection, network connection points (dial-up versus campus network versus cable), and operating system on the computer used. These system quality issues could create a wide range of time for students to wait before they received the same information necessary to be successful in the course and could therefore impact their perception of ELS success. In addition, given potential time constraints due to workload, students could potentially be using the system the same amount of time and yet receive different levels of quality due to specific issues that are outside the control of the ELS and the instructor.

The approach taken is an IS perspective, but the use of the Community of Inquiry (COI) model could also be useful in analyzing the results. The COI model (Garrison, Anderson and Archer, 2000) is a three component model that includes a cognitive, social and teaching presence that results in the final educational experience. In the ISS model perspective, the final educational experience can be viewed as user satisfaction or even system success. The measurement impact on the educational experience is purely characteristic of the system and information quality of the ELS. The COI model urges a more integrative role of both the student and teacher through a balance in each of the three presences of computer mediated communication. An increased understanding of the educational experience may occur through an understanding of how students construct meaning through sustained communication (Cognitive presence), project personal characteristics (Social presence), and realize personal meaning (Teaching presence). The COI model may help educators to understand the environment created by the ELS that facilitates the online learning experience.

In addition to the technology issues and COI model perspective, another potential aspect that may affect system usage is the skills the students bring to the e-learning environment. First-time students in an e-learning course may be substantially different in their system usage than those students who are more experienced and adept at minimizing their system usage while maximizing the learning from that usage. These skills may also extend to the self-efficacy of the students in their ability to organize their work and address issues with the course interface, namely their personal laptop, university computer or home desktop.

7. LIMITATIONS AND FUTURE RESEARCH

This study was exploratory in nature and thus had a few limitations that should be recognized. The use of self-reported scales to measure the study variables raises the possibility of common method variance. Student subjects are often viewed as a limitation but are ideal for this environment. The inclusion of both graduate and undergraduate students allows a possible extension for the comparison of a more experienced versus inexperienced study. This type of study could also be cross-referenced by a comparison of a subject group taking only online courses with a subject group taking only one online course. Additionally, the moderating factors of gender and age are other avenues of investigation for further insights into ELS success.

A goal of continuing research would be an exploration of how the ISS model would be supplemented in order to more accurately reflect the E-learning environment. Potential models for exploring ELS success would include a renaming of the ISS dimensions to better reflect the ELS along with the additions of human factors, technology issues, and the COI model perspectives that can moderate or mediate the current system-specific model. An instance of this modification would be changing the information quality dimension in the ISS model to course content quality. As indicated above, the information quality of the ELS is organized around two structural elements – course objectives and course infrastructure. Student expectations for course success are highly dependent on the instructor's ability to clearly and concisely communicate the course objectives. The course infrastructure depends on the options, layout and consistency of presentation provided by the ELS, in this case the OIS, and is not dependent on the instructor. The course content quality may be affected by both the course objectives, which are instructor controlled, and the course infrastructure, as presented by the OIS. The system quality would then need to be differentiated from the course infrastructure dimension. The system quality dimension may be relabeled as network quality with measurements that more fully explore how the users of the ELS modify their behavior to more efficiently access the ELS. In the case of our study, students may have the option to access the ELS from home (via dial-up) with a degraded network quality or from a campus network where access and efficiency are much improved. This separation could be explored since the OIS is a software application, and therefore functions consistently, but may appear to function differently due to the network used by the students to access the OIS.

Following the improvements suggested through the review of ISS model research (DeLone and McLean, 2003), two additional constructs of service quality and net benefits can be explored. Service quality in the context of an ELS model and in this particular study would encompass both the responsiveness of the instructor and the technology support provided by the university hosting the OIS. The inability of students to access the OIS from outside the university network may affect the perceived service quality due to their choice of connection and not the actual service quality of technical support or the responsiveness of the instructor. Finally, the net benefits of using the system can be further expounded upon by incorporating the different modules used in the OIS and measuring the quality of their contribution to the students' learning experience.

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Appendix A Demographics

Variable	Frequency	Percentage
Gender:		
Male	176	26.1
Female	494	73.3
Missing	4	0.6
Classification:		
Freshman	24	3.6
Sophomore	71	10.5
Junior	162	24.0
Senior	297	44.1
Graduate	116	17.2
Missing	4	0.6
Taking only online classes		
Yes	510	75.7
No	160	23.7
Missing	4	0.6
Number of courses taking		
1	259	38.4
2	248	36.8
3	86	12.8
4	29	4.3
5 or more	50	7.4
Missing	2	0.3

Appendix B: Descriptive Statistics for Scale Items

Construct	Item	Description	Mean	Std. Dev.
System Quality	SQ1	The system is always available.	5.508	1.428
	SQ2	The system is user-friendly.	5.719	1.193
	SQ3	The system provides interaction between users and the system.	5.661	1.160
	SQ4	The system has attractive features that appeal to users.	5.479	1.175
	SQ5	The system provides high-speed information access.	5.732	1.134
Information Quality	IQ1	The system provides information that is exactly what you need.	5.454	1.230
	IQ2	The system provides information that is relevant to learning.	5.778	1.042
	IQ3	The system provides sufficient information.	5.667	1.128
	IQ4	The system provides information that is easy to understand.	5.614	1.195
	IQ5	The system provides up-to-date information.	5.740	1.107
Systems Usage	SU1	I frequently use the system.	6.102	1.010
	SU2	I depend upon the system.	5.825	1.260
	SU3*	I only use the system when it is absolutely necessary for learning.	3.920	1.800
User Satisfaction	**US1***	I do not have a positive attitude or evaluation about the way the system functions.	3.100	1.773
	US2	I think the system is very helpful.	5.550	1.180
	US3	Overall, I am satisfied with the system.	5.591	1.220
e-Learning System Success	SS1	The system has a positive impact on my learning.	5.527	1.190
	SS2	Overall, the performance of the system is good.	5.628	1.140
	SS3	Overall, the system is successful.	5.629	1.130
	SS4	The system is an important and valuable aid to me in the performance of my class work.	5.789	1.140

* Items in bold were deleted.

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