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An empirical examination of factors contributing to the creation of successful e-learning environments

Richard D. Johnson[a,*], Steven Hornik[b], Eduardo Salas[b]

[a]School of Business, University at Albany, SUNY, Albany, NY 12222, USA
[b]University of Central Florida, USA

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Abstract

Although existing models of e-learning effectiveness in information systems (IS) have increased our understanding of how technology can support and enhance learning, most of our models do not take into account the importance of social presence. Thus, this study extends previous research by developing a model of e-learning effectiveness which adds social presence to other oft studied variables including application-specific computer self-efficacy (AS-CSE), perceived usefulness, course interaction, and e-learning effectiveness. Using data from 345 individuals, this model was validated through a field study in an introductory IS survey course. Results indicate that AS-CSE and perceived usefulness were related to course performance, course satisfaction, and course instrumentality. In addition, course interaction was related to course performance and satisfaction. Finally, social presence was related to course satisfaction and course instrumentality. Implications for research and practice are discussed.

Keywords: e-learning; Social presence; Perceived usefulness; Computer self-efficacy; Learning outcomes; Learning transfer; Causal models

1. Introduction

Organizations are currently spending over $250 billion dollars annually on training (American Society for Training and Development, 2004), of which over $16 billion is spent on technology-based training (Anonymous, 2006, December). In addition, millions of students are enrolling in web-based courses (Wirt et al., 2004), and growth rates in technology-based training are projected at 27% annually for the next several years (Kolbasuk McGee, 2004). An important form of technology-supported training is e-learning. E-learning refers to training initiatives which provide learning material, course communications, and the delivery of course content electronically through technology mediation (Eddy and Tannenbaum, 2003). Central to these initiatives are the technology mediation of course interactions and communications (Swan, 2003).

Previous research has found that these initiatives can be as effective as face-to-face (FtF) environments in delivering instruction (cf. Hiltz, 1994; Alavi et al., 1997; Hiltz and Wellman, 1997; Piccoli et al., 2001) and when learning differences do occur, they are often due to differences in learner motivation or instructional characteristics (Arbaugh, 2000a, 2001). In addition, these e-learning initiatives are thought to dramatically change how organizations conduct training (Horton, 2000; Salas et al., 2005; Welsh et al., 2003). Yet, evidence has suggested that as many as 80% of the employees drop out of these programs before completion (Flood, 2002) because they are inherently isolating. Therefore, it is important for researchers to begin systematically investigating these e-learning initiatives to "uncover principles and guidelines that can aid instructional designers in building sound [environments]" (Salas and Cannon-Bowers, 2001, p. 483).

Two such models which seek to do this are Alavi and Leidner's framework for technology-mediated learning (TML) research (Alavi and Leidner, 2001) and Piccoli et al.'s Model of Virtual Learning (2001). Alavi and

*Corresponding author. Tel.: +1 518 442 3020; fax: +1 518 422 4765.
E-mail address: rjohnson@uamail.albany.edu (R.D. Johnson).

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Leidner's framework argues that information technology and course design affect learning processes and outcomes, with the assumption that the most effective outcomes will occur when technology and pedagogy are integrated. The Model of Virtual Learning is related to the TML model, in that it also focuses on technology and pedagogy, but it also brings in the importance of student and instructor characteristics and skills. Together, these models argue that course pedagogy and design, learner characteristics, instructor characteristics, the technology used, and peer interactions each contribute to the effectiveness of learning outcomes.

Unfortunately, neither of these models addresses an important concern of learning researchers (i.e. the social context in which learning occurs). Unlike traditional FtF learning environments, technology inserts a layer of mediation between course interactions. This mediation creates a potential barrier to the social context of learning. Thus, e-learning environments "can be both highly interactive and simultaneously isolating because of the inherent difficulties of developing cohesiveness and true connectedness among students" (Stonebraker and Hazeltine, 2004, p. 210).

In addition, one of the most common complaints by those participating in e-learning environments is a lack of a shared learning environment and connections with their peers (Moore, 2002). To effectively learn, students must be able to leverage the technology to support these peer connections and social presence. Social presence is "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships" (Short et al., 1976, p. 65) and has been argued to be a central factor in the creation of the shared learning environments necessary for the most effective e-learning (Gunawardena, 1995; Gunawardena and Zittle, 1997; Richardson and Swan, 2003).

Therefore, the goal of this study was to expand on previous IS research frameworks to specifically address the importance of social presence. Given that course interactions in e-learning are mediated by information technology, we also reviewed the previous frameworks for additional variables which could most directly play a role in how students would leverage and use the technology in the course. These variables included application-specific computer self-efficacy (AS-CSE), perceived usefulness, and course interaction.

The remainder of this paper is organized as follows. First, we present a brief overview of the e-learning environment along with the research model. Second, we present the constructs and hypotheses. Next, we discuss the research context and methods. Finally, we present the results, along with a discussion of the findings, implications, and directions for future research.

2. e-learning

2.1. The e-learning environment

As described earlier, e-learning initiatives are training or educational initiatives which provide learning material in online repositories, where course interaction and communication and course delivery are technology mediated. As with virtual learning environments (Wilson, 1996; Piccoli et al., 2001; Stonebraker and Hazeltine, 2004), the design of these courses can allow for greater learner control; learners are able to utilize the technology and communication tools to restructure the learning process in terms of timing, delivery, and accessibility.

The challenge is that learners must learn to leverage an environment which can be highly interactive but isolating, making the creation of a shared learning environment difficult (Stonebraker and Hazeltine, 2004). One of the central tenets to most learning theories is that learning is more effective when students are able to have effective interactions with course content, their peers, and their instructor (Vygotsky, 1978; Kozulin and Presseisen, 1995; Leidner and Jarvenpaa, 1995; Bransford et al., 1999; Mayer, 2003). Within an e-learning environment, interactions with content, peers, and the instructor can be difficult because these interactions are mediated via information technology. This mediation creates a fourth form of interaction with and through which learners must interact (Hillman et al., 1994). This mediation can make it more difficult for students to feel like they are part of a shared learning environment.

This lack of a shared environment occurs because e-learning appears to lack a shared learning space similar to that created in a traditional classroom (Picciano, 2002). Learners are left with fewer cues indicating that they are involved in a learning community and may instead view themselves as isolated individuals. With research suggesting that learning occurs best in a community (Hiltz, 1994; Bransford et al., 1999), the isolation experienced by these learners can reduce e-learning effectiveness.

Although it may appear that there is no social context similar to that created in a traditional classroom where instructor-to-student interactions, student-to-student discourse, and other social exchanges naturally occur (Picciano, 2002), we contend that a shared social context can be created in technological-mediated environments (Markus, 1994; Zack and McKinney, 1995). As communication occurs through course discussions, chat, etc., the social context is created and perceptions of social presence are created. Not surprisingly, education researchers have argued for the importance of social presence in the facilitation of the creation of a shared learning environment (cf. Gunawardena, 1995; Rourke et al., 1999; Richardson and Swan, 2003).

2.2. Research model

As discussed earlier, the focus of this study was to investigate the role of social presence, along with AS-CSE, interaction, and perceived usefulness. In addition, we were interested in three learning outcomes: course satisfaction, skill demonstration (e.g. course learning), and course instrumentality. Of these outcomes, e-learning researchers

typically assess course satisfaction and learning (cf. Arbaugh, 2000a, 2001; Piccoli et al., 2001; Richardson and Swan, 2003). Although these outcomes have long been of interest to organizations and training researchers (Van Buren and Erskine, 2002), a meta-analysis of the training literature has shown that they alone do not always effectively predict learning transfer (i.e. the extent to which an individual incorporates the learning into future behavior) (Colquitt et al., 2000). Thus, in addition to course satisfaction and learning, research should also assess student beliefs about the value of the training (e.g. course or training instrumentality).

Beliefs about instrumentality reflect judgments of whether or not the knowledge gained in the course can be used after training has ended and the motivation of the trainee to do so. In a meta-analysis instrumentality was found to predict learning transfer as well as or better than course performance (Alliger et al., 1997). In addition, previous research has found that individuals who are less satisfied with their experiences are less likely to enroll in future e-learning courses (Lim, 2001; Carswell and Venkatesh, 2002). Therefore, in this study we investigated three types of e-learning effectiveness: course satisfaction, course learning, and course instrumentality. The theoretical model is shown in Fig. 1.

3. Theoretical development

3.1. Application-specific computer self-efficacy

With course materials and interactions mediated via computing technology, it is important that individuals have the knowledge, comfort, and confidence to leverage the technology for maximum benefit. Thus, we believe that application AS-CSE should affect the effectiveness of e-learning. AS-CSE is an individual's belief in his or her ability to perform specific computer tasks (Compeau and Higgins, 1995b; Marakas et al., 1998). Individuals with higher AS-CSE are more confident in their interactions with computers and likely to utilize them more effectively than those with lower levels of AS-CSE.

In turn, this should affect course performance and beliefs about the course's utility. As previous research has shown, AS-CSE plays a key role in learning (cf. Compeau and Higgins, 1995a; Johnson and Marakas, 2000; Yi and Davis, 2003) through multiple processes including setting higher goals, persisting in the face of obstacles, and engaging in behaviors that increase performance outcomes (Bandura, 1997; Marakas et al., 1998; Johnson, 2005). In addition, individuals with lower efficacy estimations tend to have a more negative view of their environment, focus on the negative aspects of their environment, often to the neglect of the task at hand (Bandura, 1997).

Given the technological mediation of course activities in e-learning, AS-CSE should also play a key role in how students utilize the technology. For example, highly efficacious individuals should be more likely to successfully navigate the course environment and leverage the communication tools to their advantage. In turn, they should not only communicate more, but they should be able to use the technology to maximize the quality of the communication and learning. Consistent with the arguments of Bandura (1977, 1997) and Marakas et al. (1998), we argue that highly efficacious individuals will be able to focus their

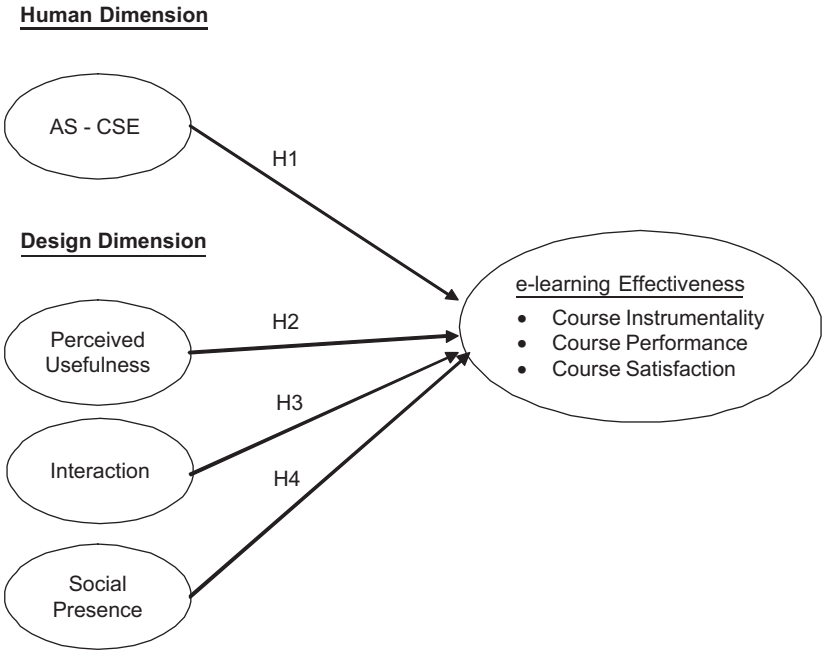

Fig. 1. Theoretical model.

efforts on the task itself instead of focusing on environmental characteristics and barriers. They should be able to apply greater cognitive resources on receiving and processing message content and learning. Thus, they should be in a better position to gain greater knowledge through the course and perform better on any knowledge assessment. Additionally by focusing more deeply on the information content, they should be more likely to see the value of the course content, motivating them to retain and use their course knowledge in the future.

Conversely, consistent with previous self-efficacy research (Bandura, 1977, 1997; Stumpf et al., 1987), we argue that less efficacious individuals will be more likely to focus their cognitive efforts on the negatives of the environment and the barriers they must overcome, instead of spending their time communicating and utilizing the technology to learn most effectively. In turn, because fewer resources are available for learning, they should not be able to learn as much as those with higher AS-CSE. Thus, the following hypotheses were investigated:

H1a. Individuals with higher AS-CSE will have higher perceptions of course instrumentality than individuals with lower AS-CSE.

H1b. Individuals with higher AS-CSE will perform better than individuals with lower AS-CSE.

In addition, within an e-learning environment, individuals with higher levels of AS-CSE should be more comfortable in the environment. Believing that they are able to succeed they should have more positive experiences, view the environment more positively and ultimately be more satisfied with their experiences (Judge et al., 1997). Evidence from multiple domains, including the computing domain, has found a positive relationship between efficacy estimations and satisfaction (Staples et al., 1999; Judge and Bono, 2001).

H1c. Individuals with higher AS-CSE will be more satisfied than individuals with lower AS-CSE.

3.2. Perceived usefulness

Perceived usefulness is the degree to which an individual believes that the technology will enhance his or her performance (Davis, 1989). In e-learning, technology can provide value in several ways. First, the technology can be more useful when it expands either the quality or quantity of information which students are able to access (e.g. additional course content, audio or video files, peer-to-peer information sharing, etc.).[1] A second way in which technology can be useful is by helping students manage and control the learning process. One of the arguments behind the use of e-learning is that learners have increased flexibility and convenience in training and taking courses; time and place constraints are removed. In addition, e-learning allows for greater flexibility over the learning process, placing greater control in the hands of the learner and allowing increased learner control over the pace, flow, and interactions (Wydra, 1980).

Although learner control has been argued to create the potential for greater learning, results have been mixed, with some studies finding that greater learner control leads to better outcomes (Ellerman and Free, 1990; Freitag and Sullivan, 1995) and others finding either no differences or lower outcomes (Ross and Rakow, 1981; Piccoli et al., 2001). One of the reasons for these mixed results is that the individuals completing the course may not see the value of the technology to support their learning.

If individuals believe that the technology provides them with better information or increased learning control, they may be more likely to use the technology for course interaction (e.g. participating in discussions, chatting, or emailing). In addition, they may also be more likely to leverage the technology to control their environment through activities such as categorizing different components of the learning (i.e. notes, videos, handouts, etc.). Also with technology enabling flexibility for learners to pace the learning at a level at which comfortable, learners may see that they are able to exert greater control over the learning environment. For example, learners can use the technology to review previously covered material or to move more quickly through material they are comfortable with. In turn, this greater ability to leverage the technology should lead to increased performance as well as an increased belief in the value of the course to the learning.

Conversely, the risk exists that unless learners see the value in the technology to support access to important course information, to support learning and to provide more control over the learning process, they may be less likely to use the technology (Hornik et al., 2007). This in turn may lead to a reduction in the perceived value of the course to the learner (e.g. reduced course instrumentality) as well as reduced learning and performance. Thus the following hypotheses were investigated.

H2a. Individuals who perceive the technology to be more useful will have higher perceptions of course instrumentality than individuals who perceive the technology to be less useful.

H2b. Individuals who perceive the technology to be more useful will perform better than individuals who perceive the technology to be less useful.

Finally, perceptions of usefulness should also be related to affective reactions to the learning environment. Psychological models of intentions such as the Theory of Planned Behavior (Ajzen, 1988) have argued that salient beliefs about behaviors influence affective responses toward those behaviors. Within the IS community, evidence has suggested that perceptions of usefulness are related to both e-learning and system satisfaction (Arbaugh, 2000b;

[1]We would like to thank one of the anonymous reviewers for bringing this point to our attention.

Devaraj et al., 2002). For learners, the more useful the technology is in supporting the learning and social processes of learning, the more positively they should view their learning experience. Thus, the following hypothesis was investigated:

H2c. Individuals who perceive the technology to be more useful will be more satisfied than individuals who perceive the technology to be less useful.

3.3. Interaction

Interaction is the exchange of information between the various stakeholders in the course (e.g. peers, instructors, and other support staff). One of the concerns of many corporate training experts is that management will perceive training as simply the transfer of electronically encoded information and develop programs that do not capitalize on the value of interaction, instead of acknowledging that successful e-learning initiatives require practice, feedback and interaction with multiple stakeholders (Welsh et al., 2003). Interaction allows individuals to share information, to receive feedback and to more readily evaluate progress (Piccoli et al., 2001). In addition, many theories of learning specify the centrality of interaction between peers and content, arguing that this is the most natural and effective way to learn (cf. Hiltz, 1994; Gunawardena, 1995; Leidner and Jarvenpaa, 1995).

For example, when using asynchronous communication tools such as discussion threads, ongoing student responses allow individual learners to post comments, review comments made since they previously posted, and respond to these comments. Over time this interaction should lead to deeper and broader information processing, more knowledge transfer, and deeper learning than would occur if learning were done in isolation. Through the use of synchronous communication tools such as chat, learners can gain immediate feedback and evaluation of their comments and questions.

Thus, it should not be surprising that increased interaction in distributed learning arrangements has been related to increased learning and performance (Gunawardena et al., 1997; Alavi et al., 2002; Hiltz et al., 2002; Schmidt and Ford, 2003). In addition, through increased information sharing and processing, learners will be more likely to see the value in not only the material, but also in how the environment supports the sharing of information via peer interactions. Thus, the following hypotheses were investigated:

H3a. Individuals who interact more will have higher perceptions of course instrumentality than individuals who interact less.

H3b. Individuals who interact more will perform better than individuals who interact less.

In addition, as individuals' interactions increase, they should also have a more positive perception of the learning environment (Moore, 2002). Timely feedback and interaction with the instructor can help learners feel that they are valued as well as providing needed information more quickly. Timely interaction with peers can increase the information shared in the class which should also lead to a more positive view of the learning environment, as well as helping learners see greater value in the course. Therefore, we investigated the following hypothesis:

H3c. Individuals who interact more will be more satisfied than individuals who interact less.

3.4. Social presence

Social presence (SP) has been defined as "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships" (Short et al., 1976, p. 65). Some have viewed SP as a characteristic of the media's capabilities (Short et al., 1976), similar to the concept of media richness (Daft and Lengel, 1986), although others have viewed it as a socially construed perception based on multiple user interactions with the media (Carlson and Gordon, 1998; Burke and Chidambaram, 1999). Still others have focused on the psychological connections between learners (Tu, 2002). For the purposes of this study, we focus on social presence as a learner perception of the extent to which the technology enables them to create an environment in which they feel is warm, personal, sociable, and active and allows them to be connected in a shared learning space (Biocca et al., 2003). In this sense, social presence is a reflection of the shared learning space in which the social context necessary for learning emerges.

Social presence is also different from interaction because interaction focuses on the exchange of information whereas social presence focuses more broadly on an environment's ability to facilitate a shared learning environment. Although previous research has focused on peer interaction, limited research has examined the impact that the shared learning space has on e-learning outcomes. For example, it has been argued distributed learning initiatives that facilitate isolated learning are bound to fail (Davis, 2003), with only 3% of individuals preferring to learn alone (Linne and Plers, 2002).

Although the e-learning social environment may appear to be lacking, a shared learning space can be created in technology-mediated environments (Markus, 1994; Zack and McKinney, 1995) as students structure the learning environment through their technology-mediated interactions (Hillman et al., 1994). Therefore, an important aspect of e-learning effectiveness is the emergence of a shared learning space where students perceive they are part of a learning community. For example, individuals who perceive themselves to be in a shared context can exchange greater and more complex information (McGrath et al., 1993). This occurs because in a shared context individuals feel they can more effectively judge the quality of peer inputs. In turn individuals should place higher value on

peer messages and process these messages to a greater extent (Sahay, 2004) than when they are isolated.

Additionally, although computer-mediated interaction may allow for a large amount of interaction between individuals to occur (i.e. multiple postings and responses) this information may be less salient because individuals are not forced to cognitively process it in the same way they would in a FtF conversation. Similar arguments have been made by those studying group support systems (GSS) who found that groups using a GSS would exchange more information, but would not necessarily learn from the information (Dennis, 1996).

Social presence can help overcome these potential problems by increasing peer connections. When individuals are connected they are more likely to attend more deeply to messages and to see the value of the messages and the ideas and contributions of others (Mackie et al., 1990). Ultimately perceptions of presence add value though a facilitation of deeper connectedness and active engagement in the learning process. Through these stronger connections, individuals should be more likely to see the course as being valuable (i.e. its instrumentality) as well as learning more. Therefore the following hypotheses were investigated.

H4a. Individuals who perceive greater social presence will have higher perceptions of course instrumentality than individuals who perceive lesser social presence.

H4b. Individuals who perceive greater social presence will perform better than individuals who perceive lesser social presence.

Finally, social presence should also shape affective reactions to the course (e.g. course satisfaction). One of the major concerns about e-learning is that learners must interact in a new environment where they may be uncomfortable and engage in different behaviors than in a traditional learning environment (Maki et al., 2000; Piccoli et al., 2001). In addition, learners often complain about isolation and lack of peer connections. This can make participating in e-learning less satisfying. However, social presence can overcome these potential negative reactions by enabling stronger peer connections, reducing feelings of isolation and strengthening feelings of psychological connection and community. Improving social presence can enhance satisfaction with the learning environment (Gunawardena and Zittle, 1997; Arbaugh, 2001). Thus, the following hypothesis was investigated.

H4c. Individuals who perceive greater social presence will have more positive e-learning outcomes than individuals who perceive lesser social presence.

4. Method

4.1. Research setting and procedure

The research participants in this study were drawn from a single IS fundamentals course at a large university in the United States.[2] This course was a required course for all business majors and was taught exclusively online using WebCT.[3] The course was designed around the communication tools available in WebCT, which included threaded discussions, course email, and online chat. The course was a semester long course (in this case 12 weeks) divided into 6 modules. Each module focused on different IS topical areas such as the strategic use of information and technology, e-commerce, decision support systems, etc., and lasted approximately 2 weeks.

Student assessment occurred at the end of each module through the use of individual multiple-choice quizzes. In addition, the structure of the course required learners to read material from an introductory IS textbook and supplemental web-links and then to post answers to questions from an end of chapter case. Following this, the students were then required to discuss each other's answers using threaded discussion. Unlike a correspondence course or computer-based training (CBT) where an individual learns in isolation by consuming new material and then demonstrating that learning has taken place by passing some examination, this course leveraged the social context of communication between learners to enhance learning outcomes. To facilitate communication and to better manage the course, students were separated into groups of approximately 35. Although chat and email capabilities were available, their use was not required.

The course was managed by one instructor and three graduate assistants (GA). The instructor and two GAs communicated exclusively online (all were not physically on campus during the semester) and one GA held office hours both online and in person. Discussions with the last GA found that other than the 1st week assistance in setting up WebCT by a few students (<20), students chose to communicate via course email for assistance.

Data were collected from multiple sources. Perceptual data were collected using an online survey made available to participants for 1 week during the last course module. Interaction data was obtained from WebCT system logs, and quiz grades were obtained from the instructor. Participating students received nominal course credit for participating.

4.2. Research participants

A total of 371 individuals participated in the study (75% of the class). Out of those who participated in the study, usable data was obtained from 345. The sample consisted of 165 males and 180 females. The average age was 24.6 ($SD = 6.7$). All of those participating in the course

[2]None of the authors was involved in the administration of the course.

[3]WebCT is a course management software program for use in online environments that provides course designers with tools supporting course preparation, design, delivery, and management. The software allows for asynchronous and synchronous communication, a repository for course materials (e.g. syllabus and lecture notes/slides), supports the delivery of online quizzes and exams, and contains an online course grade book.

indicated that they had previous computer and Internet experience, with over 80% indicating that they had high levels of experience in both. Potential non-response bias was assessed by comparing course interaction and performance scores for those participating in the study with those who did not. Evidence from this analysis revealed no significant differences in course grade and amount of communication between the groups.

4.3. Measures

Application-specific computer self-efficacy: AS-CSE was measured with a 5-item scale developed for this study. The scale was developed consistent with the Bandura (2001) and Marakas et al. (1998) measurement development frameworks and used a response format of 0 (cannot do) to 100 (totally confident) in increments of 10. As part of its development, an earlier version of the scale was piloted to approximately 40 individuals, and only those items with high loadings ($>.60$) were retained for the main study.

Perceived usefulness: Perceived usefulness was measured with a 4-item Likert-type scale developed by Davis (1989). The scale used a 7-point strongly disagree to strongly agree response format.

Interaction: This variable was measured using four items: the number of discussion postings read, number of original discussion postings, number of follow-up discussion posts, and number of course emails sent.[4] A post was considered to be an original posting in a discussion repository if it was not posted as a reply to an instructor, GA, or other student's post. A follow-up discussion post was a posting made in response to another discussion post. Course email was made available in WebCT and the system aggregated the number of emails sent and received to all individuals. Postings read were assessed via system logs, which listed a posting read as any posting that was navigated to by a student. Summary statistics for each type of interaction are found in Table 1.

Table 1
Summary statistics for interaction measures

Interaction type	*M*	SD
Postings read	269.28	260.77
Original posts	6.13	1.74
Follow-up posts	11.17	5.48
Course e-mails	16.28	12.14

Social presence: Social presence was measured with a 5-item scale developed by Short et al. (1976). For each question, respondents evaluated the characteristics of the class environment as delivered through WebCT. The scale used a 7-point, Likert-type scale with anchors such as "unsociable–sociable" and "impersonal–personal."

e-learning Effectiveness: e-learning effectiveness was assessed in three ways. Course instrumentality was measured using Alavi's (1994) 6 item scale, which was designed to assess the extent to which trainees believed that the course provided them with skills. This scale used a 7-point, Likert-type scale anchored by strongly disagree and strongly agree, and the wording was updated to reflect the current context. Course satisfaction was measured with a 7-item Likert-type scale developed by Biner (1993). The scale used a 7-point strongly disagree to strongly agree response format. Finally, course performance (learning) was assessed using the total score obtained on six end-of module multiple choice quizzes. A total of 125 points were possible across all modules.[5]

A full listing of all scales used in this study is found in Appendix A.

4.4. Analysis

Analysis was conducted using partial least squares (PLSGraph 3.0). PLS was chosen over AMOS or LISREL because it does not require as large of a sample and PLS does not make the same distributional assumptions about the data. Tests of univariate normality (Kolmogorov–Smirnov test) showed that many of the scales utilized in this study were not normally distributed ($p<.05$–$.001$). In the analysis, the majority of the scales were measured as reflective, with two exceptions. Learning performance and course communication were modeled as formative.

5. Results

5.1. Measurement model

The measurement model was tested with respect to individual item reliability, internal consistency, and discriminant validity. A common rule of thumb is that item loadings should exceed .707 and the average variance extracted for each construct should exceed .50. For all scales, the items explained more than half of the variance in the construct (i.e. AVE $<.50$) and with the exception of one item for social presence and one item for satisfaction all items exhibited strong items loadings (Table 2). Of the two poor loadings, both were above .60. The decision was made to retain these because (1) the internal consistency reliabilities were all greater than .707, (2) the scales in question have all been successfully used in multiple contexts and retaining items allows for better comparisons across studies, and (3) well-established scales sometimes have items with poor loadings when used in different research contexts (Barclay et al., 1995). Additionally, none of the items loaded more highly on another construct than they did on the construct they were designed to measure.

[4]Analysis of the chat logs and discussions with the GAs and instructor revealed that chat was rarely used.

[5]Students were able to drop their lowest quiz score, so total points reflected the top five scores.

Finally, for the interaction construct, the weights for two items were significant (original postings and follow-up postings) and two were non-significant (email and postings read). Although non-significant paths can be candidates for elimination (Bollen and Lennox, 1991), "from a theoretical perspective, elimination of indicators carries the risk of changing the construct itself…and should always be approached with caution" (Diamantopoulos and Winklhoffer, 2001). We believe that eliminating either form of communication (e.g. email or postings read) would materially affect the meaning of the construct, so we chose to retain both items as part of the construct.

In assessing discriminant validity, the square root of the average variance extracted for the construct should exceed the correlations with the other constructs. As can be seen in Table 3, all scales exhibited discriminant validity, with the square root of the variance extracted exceeding the correlations for all scales. A brief analysis of the descriptive statistics finds that individuals were fairly confident in their use of the technology, found the technology to be useful and to support the creation of social presence, and had strong course outcomes.

Table 2
Reflective and formative scales: item loadings

Reflective scales				Formative scales		
Item	Loading	Item	Loading	Item	Weight	t
PU1	.890	INST1	.869	Read	.126	.88
PU2	.912	INST2	.844	Posted	.630	4.53***
PU3	.933	INST3	.886	Follow-up	.390	2.44*
PU4	.859	INST4	.881	Email	.171	1.21
AS-CSE1	.762	INST5	.761			
AS-CSE2	.737	INST6	.854			
AS-CSE3	.842	SAT1	.733			
AS-CSE4	.789	SAT2	.767			
AS-CSE5	.804	SAT3	.797			
SP1	.735	SAT4	.853			
SP2	.834	SAT5	.758			
SP3	.750	SAT6	.824			
SP4	.808	SAT7	.632			
SP5	.630					

Note: PU—perceived usefulness, AS-CSE—application-specific computer self-efficacy, SP—social presence, INST—course instrumentality, SAT—course satisfaction. *$p \leqslant .05$; ***$p \leqslant .001$.

5.2. Structural model

The results of the tests of the structural model and associated path coefficients are found in Fig. 2. Consistent with previous research and recommendations (Chin, 1998), bootstrapping (100 subsamples) was performed to determine the statistical significance of each path coefficient using t-tests. Results indicated that all variables were related to e-learning effectiveness. Specifically, AS-CSE was related to course instrumentality ($\beta = .189$, $p < .001$), course performance ($\beta = .160$, $p < .05$), and course satisfaction ($\beta = .146$, $p < .01$). This provided full support for H1. In support of H2, perceived usefulness was related to course instrumentality ($\beta = .303$, $p < .001$), course performance ($\beta = .100$, $p < .05$), and course satisfaction ($\beta = .222$, $p < .001$). H3 was partially supported; interaction was related to course performance ($\beta = .287$, $p < .001$) and course satisfaction ($\beta = .100$, $p < .05$), but not course instrumentality. Finally H4 was partially supported; social presence was related to course instrumentality ($\beta = .167$, $p < .01$) and course satisfaction ($\beta = .405$, $p < .001$), but not course performance. Together the independent variables explained 26% of the variance in course instrumentality, 18% of course performance, and 41% of course satisfaction.

6. Discussion

The current study contributes to our knowledge of e-learning in several ways. First it delves more deeply into the framework originally developed by Piccoli et al. (2001) to include a reflection of the shared learning space enabled by the technology. Second, the study expands on previous work in this area by specifically concentrating on the factors associated with how individuals leverage the technology to improve performance and to create a shared learning environment. Specifically the results of this study show that AS-CSE and perceived usefulness were related to course performance, course satisfaction, and course instrumentality. Further, peer interaction was related to

Table 3
Means, standard deviations, reliability, correlations, and discriminant validity coefficients

Construct		Scale range	M	SD	ICR	AVE	1.	2.	3.	4.	5.	6.	7.
1.	Perceived usefulness	1–7	5.2	1.42	.94	.81	.90						
2.	AS-CSE	0–100	89	11.5	.89	.62	.28	.79					
3.	Interaction		–	–	–	–	.19	.25	–				
4.	Social presence	1–7	4.2	1.11	.87	.56	.54	.20	.16	.75			
5.	Satisfaction	1–7	4.9	1.22	.91	.59	.50	.31	.23	.56	.77		
6.	Performance	0–125	117.1	7.89	1.00	1.00	.23	.27	.36	.18	.19	1.00	
7.	Course instrumentality	1–7	5.3	1.10	.94	.72	.45	.31	.14	.37	.54	.22	.85

ICR = internal consistency reliability.
Shaded elements along the diagonal represent the square root of the variance shared between the constructs and their measures. Off diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

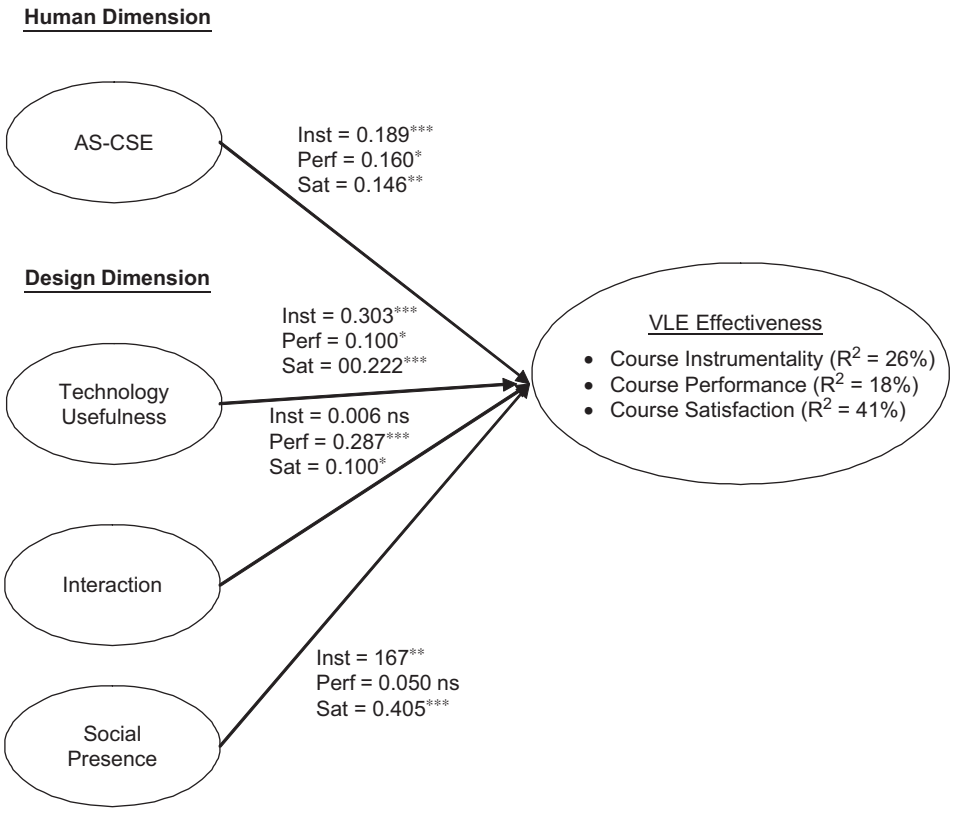

Fig. 2. PLS results.

course performance and satisfaction. In addition, social presence was related to course satisfaction and course instrumentality.

Thus, the evidence suggests that creating and maintaining a shared learning space within an e-learning environment is important for enhancing learning, value, and satisfaction for participants. In addition, simply exchanging information may not create the shared social context necessary; instead the evidence suggests that social presence is also important. Finally, with evidence from training research suggesting that training transfer is more likely to occur when individuals perceive value in the course (Alliger et al., 1997), a third contribution from this study is the integration of perceptions of course instrumentality into our models of e-learning effectiveness.

Contrary to the theorized relationships, peer interaction was not related to course instrumentality and social presence was not related to course performance. It may be that in e-learning environments, it is not simply the exchange of information which affects perceptions of instrumentality, but instead perceptions of instrumentality emerge as students feel connected in a shared learning environment. With respect to the relationship between social presence and course performance, the non-significant finding may be due to the nature of the quizzes given. It may be that the declarative knowledge-oriented course quizzes did not require as rich of a shared learning environment as more complex learning tasks would require.

6.1. Implications for research

This study has several implications for e-learning research. First, it indicates that our models assessing e-learning effectiveness should take into account social presence. Our study suggests that the perceived presence of others in the learning environment creates the social fabric necessary to facilitate learning through the creation of deeper relationships and increased opportunities for information sharing and transfer. The evidence also suggests that simply sending and receiving emails, postings, etc. does not alone create an effective learning environment, but instead it is the connections gained through viewing, cognitively processing, and responding to the postings that improves the effectiveness of the environment.

In an e-learning environment, social presence becomes even more important because it affects course satisfaction. Previous research has found that individuals who are less

satisfied with their experiences or view the system negatively are less likely to participate in future e-learning initiatives (Lim, 2001; Carswell and Venkatesh, 2002). Therefore a key future research question is how to design e-learning courses to maximize affective reactions to the learning, and intentions to participate in future e-learning initiatives.

Research in this area can be informed by longitudinally studying the ongoing reciprocal relationship between peer interactions, social presence, and how individuals use the technology to create a shared learning environment. For example, previous research has suggested that through ongoing communication and interaction, social presence and a sense of community emerge. In turn social presence encourages further communication and information sharing, creating an ongoing reciprocal relationship between communication and social presence (Walther, 1992; Gunawardena and Zittle, 1997). Another interesting avenue for future research is investigating how the content of communication affects social presence and e-learning outcomes. For example, research on team communication suggests that multiple types of communication (task focused, team maintenance, and member support) are necessary for the development and effectiveness of teams (McGrath, 1991). Could the same communication patterns necessary for team success be important in e-learning, and under what conditions?

This research also suggests that e-learning success is not simply a matter of providing a rich set of technological opportunities, but instead technology must be seen as contributing to the learning success. Future research should investigate how and where technology can create value in e-learning initiatives, whether through increased opportunities for learning, or through the facilitation of a shared learning environment. This suggests that individually oriented CBTs programs, which are central to most corporate training initiatives and are receiving increasing focus in the training literature (cf. Brown, 2001; Schmidt and Ford, 2003), have a distinct shortcoming. They do not allow for or support socially connected learning. A potentially fruitful and interesting research area is how technology can be utilized to enhance traditional, non-interactive, CBTs with training approaches that provide perceptions of others, perhaps via the use of avatars or other types of digital presences.

Although social presence captures the salience of the interactive experience, this experience only emerges as it is created and refined by the learners. Designers of e-learning initiatives need to be aware of the emergent structures that are created by learners as they interact with each other, the content, the instructor and the system that mediates the communication. Consistent with the arguments of DeSanctis and Poole (1994), creating an effective e-learning environment is not simply a matter of providing technology to learners; we must also begin to better understand the process through which these individuals appropriate the structures available to them. This is also of importance because many individuals coming to e-learning courses have no shared background or communication patterns. Before successful learning can occur, a shared learning environment needs to emerge. Future research should seek to understand the process through which this occurs.

Finally, this research also confirms the importance of AS-CSE in e-learning. Not everyone entering e-learning course has the same confidence and skills in leveraging technology. Thus, some individuals may be at a distinct disadvantage in e-learning courses, even if they have similar course skills, knowledge, and motivation. Thus, learner comfort with the technology should be an overriding concern in understanding e-learning effectiveness. Future research should investigate whether interventions can be developed to assist those with lower levels of efficacy to gain confidence and comfort with the technology.

6.2. Implications for practice

This study also has multiple implications for practice. First, those designing and implementing e-learning initiatives should design the environment and use technology to facilitate the creation of social presence. Consistent with previous research and recommendations (e.g. Webster and Hackley, 1997; Piccoli et al., 2001; Davis, 2003; Salas et al., 2005), this research supports the need to create a learning environment that encourages peer to peer and peer to instructor interaction. An excellent way to do this is through projects and activities that require individuals to participate ideas and content. Additionally for large-scale training initiatives, using smaller peer groups could improve learning outcomes.

Although creating an environment that encourages information sharing though interaction (e.g. reading, posting, or replying to discussions, chatting, emailing, etc.) is an important way to improve e-learning outcomes, this alone may not reveal enough about the types and strength of the connections that are occurring in the course. Instead, instructors may wish to encourage richer communication through the development of small project groups that must work together to solve course-related projects. Another idea is to include interactive game simulations that can be used to not only facilitate the learning process, but also to improve the connections between learners (Salas et al., 2005).

A third approach argued to facilitate a shared community is the use of multiple course facilitators, each of whom focus on a different aspect of the learning and each of which interact with the learners (Davis, 2003). This can allow for broader communication by providing learners flexibility with whom they will interact. Whatever approach is taken, for students to have the greatest potential for success, the course must facilitate experiences that create a sense of shared connectedness within the virtual classroom.

The findings also suggest the need for instructors to realize the importance of student comfort with the technology. As suggested by this study and by studies on

user acceptance of technology, AS-CSE and perceptions of usefulness have a strong influence on how individuals utilize computers. Thus, designers of e-learning initiatives and those teaching e-learning courses should develop initiatives to reduce technology discomfort, as well as illustrating the value of the course technology to the learning process. One way to do this is by providing opportunities for individuals to have early positive experiences with the technology though techniques such as simple games where individuals or teams solve a simple interactive online problem could help increase student comfort in the environment. Another suggestion is to train individuals in the use of e-learning technology and in the behaviors necessary for successful navigation of the e-learning environment before allowing course enrollment (Salas et al., 2005).

6.3. Limitations

Although the results of this study provide insight into effective e-learning initiatives, a number of limitations must be considered when interpreting the results. First, this study represents the first test of a theoretical model and should be subjected to further testing with different participants, contexts, and technological architectures. Second, the research participants were undergraduate students who were completing the course as part of a degree requirement, so the results may not generalize to other settings and contexts. Issues of motivation for research participation by undergraduates can also impact results. In the case of this research study, evidence from post-survey comments and feedback suggested that those participating were actively engaged; participants provided many comments and ideas about the strengths, weaknesses, and methods for improving the course and environment.

Third, due to the requirements of the course and the focus of the research questions, the research was unable to fully capture the richness of the reciprocal relationship between social presence and interaction. For a complete picture of the phenomena, a better understanding of the development of social presence and its ongoing reciprocal relationship with other variables in the model is important. We encourage future researchers to investigate this phenomenon in greater detail through a longitudinal approach, where variables of interest are assessed at multiple points during the course. Finally, since the variables of interest in this study were captured concurrently, it is not possible to show causal relationships in this study.

7. Conclusion

This research was motivated by the desire to gain a better understanding the role of social presence in IS models of e-learning. A secondary goal of this study was to investigate its importance in the context of three additional factors which should affect how individuals leverage the technology for learning: AS-CSE, interaction, and perceived usefulness. The results of the study suggest that social presence does indeed play an important role in e-learning effectiveness and should be included in future models of e-learning. In addition, the results suggest that researchers, educators, and trainers should focus efforts on developing mechanisms that encourage development of shared social learning environments to enhance e-learning effectiveness.

Appendix A. Scale items

A.1. Application-specific computer self-efficacy

1. I believe I have the ability to respond to comments posted in an online discussion.
2. I believe I have the ability to post comments in an online discussion.
3. I believe I have the ability to locate information on the class website.
4. I believe I have the ability to use all WebCT features.
5. I believe I have the ability to access and complete the end of module assessments (quizzes).

A.2. Perceived usefulness

1. Using WebCT improves my performance in this class.
2. Using WebCT in this class improves my productivity.
3. Using WebCT enhances my effectiveness in this class.
4. I find WebCT to be useful.

A.3. Social presence

For social presence, participants were asked to evaluate the characteristics of the class environment as delivered through WebCT. Each question used the stem, "The environment is:" Higher numbers represent more presence and lower numbers represent less presence. The anchors for each item were:

1. Impersonal…Personal
2. Unsociable…Sociable
3. Insensitive…Sensitive
4. Cold…Warm
5. Passive…Active

A.4. Satisfaction

1. I am satisfied with the clarity with which the class assignments were communicated.
2. I am satisfied with the degree to which the types of instructional techniques that were used to teach the class helped me gain a better understanding of the class material.
3. I am satisfied with the extent to which the instructor made the students feel that they were part of the class and "belonged".

4. I am satisfied with the instructor's communication skills.
5. I am satisfied with the accessibility of the instructor outside of class.
6. I am satisfied with the present means of material exchange between you and the course instructor.
7. I am satisfied with the accessibility of the graduate assistants.

A.5. Course instrumentality

1. I feel more confident in expressing ideas related to Information Technology.
2. I improved my ability to critically think about Information Technology.
3. I improved my ability to integrate facts and develop generalizations from the course material.
4. I increased my ability to critically analyze issues.
5. I learned to interrelate the important issues in the course material.
6. I learned to value other points of view.

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