The Impact of Student Attributes, Technology Beliefs& E-Networkingon Internet-based Learning Success

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Abstract

Online courses facilitated by Internet-based learning (IBL) systems have become integral to higher education; however, they have failed to provide the learning benefits that were originally anticipated. This study examines the role of student learning attributes, technology beliefs, and electronic networking in influencing IBL success.Experimental data was collected from students undergoing online business courses. Results indicate that the student attributes of learning style and self-regulation, technology beliefs of computer self-efficacy and enjoyment, and social learning through electronic networking impact IBL success. The findings emphasize the need for personalized online courses and the development of a denseelectronic learning network.

Introduction

Electronic learning (e-learning) broadly refers to knowledge transfer facilitated by information and communications technology infrastructure and related software applications. It can take a variety of forms including knowledge transfer over the Internet, local area networks, wide area networks, satellite broadcast, video, and CD-ROMs (Kaplan-Leiserson, 2007). CD-ROMs used to be the dominant e-learning delivery medium;however, the subsequent development of the global telecommunication infrastructure has led to the Internet supplantingit as the preferred e-learning delivery medium.

Internet-based learning (IBL) has now become an integral part of the educational and training portfolio of universitiesand businesses establishments.Course content and instruction are provided either fully online or as a combination of online and face-to-face meetings. In practice, a course is considered fully online if over 80% of the content is delivered online with few or no classroom sessions (Allen & Seaman, 2010). While universities use IBL to replace or supplement traditional classroom courses, business establishments use it for employee

training, skill updating, and certification (Allen & Seaman, 2010; American Society for Training & Development, 2010).Business schools in particular have proactively embraced IBL, offering online courses and complete degree programs at both undergraduate and graduate levels.

The recognition of online courses as a viable educational tool can in part be attributed to the increased sophistication of commercially available IBL systems such as Blackboard and its open- source alternatives such as Moodle. Apart from providing the instructor with the technology tools required to develop self-contained course material, they also permit the integration of publisher-supplied learning modules with instructor-developed material (Blackboard, 2010). Students have embraced online learning primarily due to its convenience, accessibility, and flexibility while universities have implemented it due to market demand, a potential global market, and reduced operational/overhead costs in comparison to classroom sessions. These factors have resulted in cost-effective education for students and increased profit margins for universities (Allen & Seaman, 2010). However, problems relating to inadequate instructor training, lack of student motivation and reluctance to adapt to the virtual learning environment, insufficient instructor presence leading to student perceptions of isolation, information overload, boredom with the self-paced nature of online learning, and the practice of offering identically structured courses to all students irrespective of their learning attributes and individual requirements have impacted IBL outcomes (Cooper, 2008; Rabe-Hemp, Woollen, & Humiston 2009; Rossett & Shafer, 2003; Sheridan& Kelly, 2010). To harness the full potential of IBL, researchers and practitioners agree that the design and development of online courses need to be further investigated (Burnsed, 2010; Fee, 2009; Muilenburg & Berge, 2005; Rosen, 2010).

This paper examines the role of student learning attributes such as learning style and self-regulation, technology beliefs such as computer self-efficacy, subjective norms, and enjoyment, and social learning through electronic networksin impacting IBL success. The rest of the paper is structured as follows. The literature is first reviewed and the research framework introduced. Testable hypotheses are presented, the experimental method outlined, and the research processes described. The results are reported and analyzed. The paper concludes with a discussion on implications, limitations, and avenues for further research.

Literature Review

Prior research has put forth learning style models that analyze individual learning preferences and prescribe strategies for maximizing learning outcomes. The Felder and Silverman learning model categorizes learners as being active or passive (Felder & Silverman, 1988). Active learners acquire and retain

knowledge through collaborative team-activities such as face-to-face discussions, explanations to other learners, question and answer sessions, and debates, while reflective learners learn best in solitude through methodical, repetitive review of text material (Felder & Silverman, 1988; Felder, 1993). Another widely used model, the Kolb experiential learning styles model, identifies four learning styles: converging, diverging, assimilating, and accommodating (Kolb, 1984). Converging and assimilating learners learn through abstract conceptualizations; however the former favor practical, active experimentation of conceptualizations while the latter focuses on theorizing. Both diverging and accommodating learners learn through new experiences; however the former prefer theorizing as opposed to the latter who favor active experimentation. Extending the Kolb learning model, the Honey and Mumford model categorizes learning styles into activist, reflector, theorist, and pragmatist (Honey & Mumford, 1982). However, as opposed to the Kolb model, these styles are viewed as being adaptable rather than fixed. Adopting a differing perspective, the neuro-linguistic VARK model categorizes learners into visual, auditory, read/write, and kinesthetic(Fleming, 2011). Visual learners learn best through seeing, auditory learners through listening, read/write learners through words, and kinesthetic learners through experience. Learning styles are important as a mismatch between the learning style and the learning environment can result in poor learning outcomes.

The online learning approach is structured around the constructivist model which assumes that knowledge transfer is maximized when students control the pace of their learning, discover and experiment by themselves, and chart their own learning path (Leidner & Jarvenpaa, 1995). IBL systems mirror this approach by offering a high degree of self-instructional control to students with the expectation that they would self-orchestrate learning. However, knowledge transfer in the IBL environment requires the use of new learning strategies and students are often unaware of such strategies, and if aware, are not capable or sufficiently motivated to implement those strategies, leading to feelings of isolation and anxiety - being "lost" in the online environment (Bruckman, 2002; Rossett& Shafer, 2003). Prior research on classroom learning has identified self-regulation, the general ability of individuals to concentrate on a task, formulate task objectives, and implement strategies to meet those objectives as being predictive of learning success (Pintrich & DeGroot, 1990; Zimmerman, 2001; Zimmerman & Martinez-Pons, 1986). Self-regulatory skills assume added importance in the IBL environment as the onus is on the student to apply self-instructional control, strategize a learning path, and self-orchestrate learning.

User beliefs in technology can influence attitudes towards technology and its usage (Davis, 1989). Prior research has highlighted the role of computer self-efficacy beliefs, subjective norm perceptions, and user enjoyment in influencing attitudes towards technology (Heijden, 2003; Venkatesh, 2000; Venkatesh

&Davis, 2000; Venkatesh & Morris, 2000). Computer self-efficacy is the belief of users in their competence of performing a task with a computerized system while subjective norms is the tendency of users to use technology once they perceive important others believing that they should be using it. User enjoyment is the extent to which users are intrinsically curious about interacting with a system and finds it enjoyable over and above any benefits that may accrue from use of the system. All three have been found to be predictive of effective system use. In the IBL environment, it can be expected that the technology features of the IBL system that assist learning will be used more effectively by students harboring positive affect towards the system.

Instructor-initiated knowledge transfer forms the core of classroom learning, however, a supplementary knowledge source is social learning, wherein knowledge is acquired through informal face-to-face interaction with other students (Brown & Duguid, 1991; Lave & Wenger, 1991). Social learning assumes particular importance in business courses as it facilitatesthe transfer of non-codified experiential knowledge from students having real-world work experience to those who lack such experience. While such an informal face-to-face learning network may not be readily available in the IBL environment, most IBL systems facilitate the development of its electronic equivalent through technologies such as discussion boards, virtual classrooms, instant messaging, and e-mail. Students utilizing these technologies to develop electronic learning ties to other students will have access to student-initiated informal knowledge flows that can supplement the formal knowledge acquired thorough the course material.

Research Framework

Student Learning Attributes
Learning Style. Students with anactive learning style acquire knowledge though face-to-face collaborative activities such as discussions, debates, and brainstorming sessions; whereas students with a reflective learning style acquire knowledge through methodical, repetitive review of course material (Felder & Silverman, 1988; Felder, 1993). The classroom environment provides opportunities for both active and passive learners - hence neither group is disadvantaged. However, the IBL environment can negatively impact active learners as it is not amenable to face-to-face collaborative interactions comparable in quality to a classroom environment. Reflective learners are impacted to a lesser degree as they are not primarily dependent on face-to-face collaborative activities to acquire knowledge. Hence, it can be expected that reflective learners will perform better than active learners in the IBL environment. Thus,

H1a: *A reflective learning style will positively influence IBL system success.*

Self-Regulation. Self-regulation is the general ability of individuals to concentrate on a task, conceive and implement strategies to meet task objectives, and adapt strategies as required to successfully complete the task. Such "self-starters" possess superior time-management skills, can organize, rehearse, and encode complex information, and direct complex learning (Zimmerman, 2000). Self-regulatory skills have been shown to lead to improved classroom academic performance (Pintrich and DeGroot, 1990; Zimmerman, 2001; Zimmerman & Martinez-Pons, 1986). They assume added importance in the IBL environment where the responsibility is on the student to apply instructional control and self-orchestrate learning. Hence,

 H1b: *Self-regulatory skills will positively influence IBL system success.*

Technology Beliefs
Users whose beliefs result in positive attitudes towards technology tend to use it more effectively (Karahanna & Straub, 1999; Venkatesh & Davis, 2000; Venkatesh, 2000). Often, they are able to deploy technology features in innovative ways different from what they were originally intended to achieve (Jasperson, Carter, & Zmud, 2005; Orlikowski, 1996). In the IBL environment, students harboring positive attitudes towards the IBL system can be expected to effectively utilize the technical features of the system to further their learning.

Computer Self-Efficacy. Computer self-efficacy, the general belief of users in their competence of performing a task with a computerized system, has been repeatedly found to be a predictor of positive attitudes towards the system (Venkatesh & Davis, 2000; Venkatesh, 2000). In the IBL environment, to facilitate learning, students have to be confident of using the technical features of the IBL system; hence computer self-efficacy beliefs will impact IBL success. Thus,

H2a: *Self-efficacy beliefs will positively influence IBL system success.*

Subjective Norms. Users develop positive attitudes towards a system and use it more efficiently when they perceive important others as having positive attitudes towards the system. Such beliefs develop through statements made by peers and superiors regarding the capabilities and advantages associated with usage of the system. The influence may be particularly strong when the source is a person of authority (Igbaria & Chakrabarti, 1990; Sambamurthy & Chin, 1994). Students who perceive other students and instructors as harboring positive attitudes towards the IBL system can be expected to succeed in their use of the system. Hence,

H2b: *Subjective norm beliefs will positively influence IBL system success.*

Enjoyment. The intrinsic enjoyment and curiosity of using a system can generate positive attitudes and more effective use of the system (Heijden, 2003; Venkatesh, 2000). The focus here is on the actual physical interaction between the user and the system rather than any advantages accruing out of the interaction. Students who perceive their interaction with the IBL system to be enjoyable in its own right, apart from any learning benefits resulting from the interaction, can be expected to succeed in the IBL environment. Hence:

H2c: *Enjoyment will positively influence IBL system success.*

Social Learning through the Electronic Learning Network

The social learning approach posits that learning occurs through communication, interaction, and socialization among learners (Lave, 1988; Lave & Wenger, 1991). It is important in facilitating the transfer of implicit and non-codified knowledge (Brown & Duguid, 1991; Lave & Wenger, 1991). In a classroom environment, students acquire knowledge from other students through informal collaboration and socialization. This informal learning network is called the social learning network.
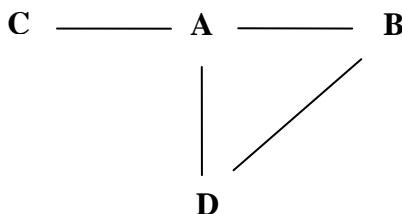
Business programs emphasize the importance of acquiring non-codified, experiential knowledge through the use of case-studies, co-op programs, and internships. Social learning can provide an avenue through which experiential knowledge may be acquired, particularly when the source of that knowledge are students with practical work experience. While a social learning network may not be readily available in the IBL environment, most IBL systems facilitate the development of its electronic equivalent through the use of discussion boards, virtual classrooms, group pages, video conferencing, and e-mail. This electronic parallel of the social learning network is called the electronic learning network (ELN).

The quality or "richness" of knowledge transferred depends on the extent to which the communication medium is amenable to social presence and cues, facilitates instantaneous feedback, and has recipient focus – all of which are characteristics of face-to-face communication (Daft & Lengel, 1984; Lengel& Daft, 1988). Hence, knowledge flowing through the classroom-based, informal, face-to-face social network would be superior to that of the ELN. In addition, creating and actively participating in theELN would require more timeand effort than what would be required in a face-to-face network. However, such participation would provide students with supplementary course-related knowledge that may not be available through the online course material.

In addition to course-related knowledge, the ELN can also channel system-related knowledge flows. Students who encounter and solve system-related problems or discover innovative uses for system features may share that knowledge with other students through the ELN. Access to such system-related knowledge flows will facilitate more effective use of the IBL system.

The ELN can be analyzed using Social Network Analysis (SNA) techniques (Brass, 1995; Hanneman& Riddle, 2005). SNA has been used to explain a range of phenomena in multiple areas such as urbanization (Fischer, 1982), international politics and economics (Snyder & Kick, 1979), human resource management (Brass, 1995), and innovation acceptance (Burkhardt& Brass, 1990; Burkhardt, 1994). Structurally, a social network consists of a set of actors and a set of ties, each tie representing a relationship between the actors. A simple social network is shown in Figure 1.

Figure 1: A basic social network diagram

A central actor in a social network is one that has a large number of ties. The *degree centrality* of an actor is a measure of the number of direct ties that the actor has with other actors. Thus, actor A has a degree centrality of 3 and actor D has a degree centrality of 2. An actor having a larger number of ties has access to more knowledge flows and is considered powerful within the network (Brass, 1995; Hanneman& Riddle, 2005). In the case of the ELN, the actors would be the students, and the ties would be the electronic interactions facilitated by the IBL system.

The knowledge flows through the ELN may be course-related or system-related; the network capturing the former is termed the course-ELN (C-ELN) and the network capturing the latter is the system-ELN (S-ELN). The C-ELN channels informal course-related knowledge flows that supplement the formal knowledge acquired from the online course material while the S-ELN channels informal system-related knowledge flows that facilitate resourceful use of the IBL system.

In the C-ELN, students having higher degree centrality will have greater access to informal course-related knowledge flows, hence,

H3a: *Degree centrality in the C-ELN will positively influence IBL success.*

Likewise, in the S-ELN, students having higher degree centrality will have greater access to system-related knowledge flows, hence,

H3b: *Degree centrality in the S-ELN will positively influence IBL success.*

To test these hypotheses, an empirical study was conducted using data collected from business school students undergoing online courses delivered by a commercially available IBL system.

Research Methodology

Data Collection

Data was collected from undergraduate business students undergoing identical sections of an online course at a public university in the United States. The online course formed part of their four-year degree curriculum. The instructor had developed the course material and other instructional components based off a prescribed textbook. The course had no face-to-face classroom sessions and was delivered using Blackboard.

The syllabus indicated that e-mail would be the primary communication tool between students and between the student and the instructor. Each student had access to the names and e-mail addresses of all other students enrolled in the course, however, communication was optional and left to the discretion of individual students. There were no course related activities that required mandatory communication between students. Student performance was assessed through individual assignments, exams, and an individual project, all delivered through Blackboard. After completion of the course, students were requested to complete a questionnaire that collected data regarding their demographic background, learning attributes, technology beliefs, electronic communication patterns, and learning experience.

Measures

Drawing upon past research in classroom learning and technology acceptance, the student attributes of learning style and self-regulation, and the technology beliefs of computer self-efficacy, subjective norms, and enjoyment were measured using well-validated questionnaires adapted to reflect the research context (Felder &Soloman, 2011; Heijden, 2003; Venkatesh, 2000; Venkatesh & Davis, 2000) (see Appendix). The demographic variables included age, gender, and prior experience with online courses. The electronic learning networks were developed and analyzed using UCINET-6, a specialized social network analysis software (Borgatti, Everett, & Freeman, 2002; Hanneman&Riddle, 2005). Each

student was provided with a roster of all other students enrolled in the course and asked to indicate the presence or absence of course-related and system-related e-mail communication ties with other students and with the instructor. This facilitated the development of the C-ELN and the S-ELN. The questionnaire also provided students with the option of adding names of individuals with whom they had e-mail communication, outside of those enrolled in the course. Degree centralities were computed as the ratio of actual electronic communication ties to the maximum possible number of ties. Thus, a C-ELN degree centrality of 0.40 (i.e. 40%) indicated that the student had course-related e-mail communication with 40% of students.

From an information systems perspective, a system is deemed successful when usage leads to desired outcomes (Au, Ngai, & Cheng, 2008; DeLone& McLean, 1992, 2003; Petter, DeLone, & McLean, 2008). Hence, based on the Information Systems Success (ISS) model (DeLone& McLean, 1992, 2003), IBL system success was measured along two dimensions:information quality and system quality. The information quality dimension measured the learning impact of the IBL system including its relevance, completeness, and sufficiency, while the system quality dimension measured IBL system-specific attributes such as its clarity, understandability, and ease of use (DeLone& McLean, 1992, 2003) (see Appendix).

Data Analysis and Results

The number of study participants was one hundred and ten; after eliminating questionnaires that were improperly filled or incomplete, there were ninety-six usable responses.A confirmatory factor analysis on the questionnaire items using Principal Component Analysis resulted in the extraction of six factors that corresponded to the research measures. The items for each of these factors had loadings greater than 0.5, which was more than its loadings with any other factor.The Cronbach's alpha for each of the measures was greater than the critical threshold of 0.70 (see Appendix). The summary statistics are presented in Table 1A and Table 1B.

Table 1A: Intercorrelations

	Var.	1	2	3	4	5	6	7	8	9	10	11	12
1	Age	1											
2	Gender	.17	1										
3	Exp.	.00	-.01	1									
4	Lear. Style	.06	-.02	.20	1								
5	Self-Regn.	-.09	-.08	.34**	.42**	1							
6	Self Eff.	.03	.03	.28**	.38**	.73**	1						
7	Sub. Norm	-.03	.07	-.14	.06	.08	-.02	1					
8	Enjoy-ment	-.18	.12	.02	.08	.15	.12	-.063	1				
9	C-ELN	-.17	.02	.14	.33**	.36**	.38**	-.085	.09	1			
10	S-ELN	.03	-.05	.00	.15	.23**	.37**	.000	.19	.18	1		
11	Info. Qual.	-.05	-.10	.35**	.55**	.69**	.66**	-.017	.23*	.49**	.33**	1	
12	Sys. Qual.	-.05	-.01	.17	.64**	.65**	.65**	.012	.27**	.47**	.39**	.71**	1

Table 1B: Means and Standard Deviations

	Var.	Mean	SD
1	Age	18.5	1.1
2	Gender	1.4	0.3
3	Exp.	1.2	0.9
4	Lear. Style	6.1	3.2
5	Self-Regn.	4.0	2.3
6	Self-Eff.	3.8	1.9
7	Sub. Norm	4.1	1.8
8	Enjoyment	4.3	1.7
9	C-ELN	.37	.15
10	S-ELN	.38	.16
11	Info. Qual.	4.1	1.9
12	Sys. Qual.	3.8	1.8

Preliminary analysis using the multivariate Wilk's Lambda test indicated a significant relationship for learning style, self-regulation, self-efficacy, enjoyment, and C-ELN degree centrality on the joint distribution of the dependent variables (see Table 2). The individual distributions indicated a

significant positive relationship for learning style, self-regulation, computer self-efficacy, and C-ELN degree centrality with information quality; and for learning style, self-regulation, computer self-efficacy, enjoyment, and C-ELN degree centrality with system quality (see Table 2).

Hierarchical regression analyses were conducted to elucidate the differential impact of learning attributes, technology beliefs, and electronic network positioning (i.e. degree centrality) on the dependent variables (see Table 3 for Information Quality and Table 4 for System Quality).

Table 2: Tests of Between-Subjects Effects

Source	Multivariate Test (Wilk's Lambda)		Dependent Variable	F-value	Sig.
	Value	Sig.			
Model	-	-	Information Quality[a]	16.966	.000
			System Quality[b]	19.173	.000
Age	.998	.929	Information Quality	.044	.835
			System Quality	.076	.783
Gender	.971	.295	Information Quality	2.320	.131
			System Quality	.012	.912
Experience	.939	.070	Information Quality	3.141	.080
			System Quality	1.336	.251
Learning Style	.691	.000	Information Quality	12.078	.001
			System Quality	32.545	.000
Self-Regulation	.892	.008	Information Quality	6.214	.015
			System Quality	6.228	.015
Self-Efficacy	.897	.010	Information Quality	5.920	.017
			System Quality	5.831	.018
Subjective Norm	.999	.962	Information Quality	.003	.954
			System Quality	.065	.799
Enjoyment	.927	.041	Information Quality	3.803	.055
			System Quality	4.273	.042
C-ELN Degree	.906	.016	Information Quality	6.593	.012
			System Quality	3.992	.049
S-ELN Degree	.957	.157	Information Quality	.970	.327
			System Quality	3.451	.067

[a]$R^2 = .666$ [b]$R^2 = .693$

Model 1 (in Tables 3 and 4) utilized the demographic variables of age, gender, and prior experience with online courses and was able to explain 14% of the variation in information quality (R^2=.135) and 3% of the variation in system quality (R^2=.032). Model 2 included the learning attributes of learning style and self-regulation and was able to explain an additional 44% of the variation in information quality (R^2-change = .438) and 57% in system quality (R^2-change = .565). Model 3 included the technology beliefs of computer self-efficacy, subjective norms, and enjoyment and was able to account for a further 6% of the variation in information quality (R^2-change = .062) and 7% in system quality (R^2-change = .067). Model 4, the full model, included the electronic network characteristics of C-ELN and S-ELN degree centralities and was able to explain an additional 3% of the variation in information quality (R^2-change = .031) and system quality (R^2-change = .029). All R^2-changes were significant at the .05 level and the full model (Model 4) was significant at the .01 level.

Table 3: Hierarchical Regression Summary (DV: Information Quality)

Model	Predictor Variables	R^2	Adjusted R^2	Change Statistics		Model Sig.
				R^2-change	Sig.	
1	Age, Gender, Experience	.135	.107	.135	.004	.004
2	Age, Gender, Experience, Learning Style, Self-Regulation	.573	.549	.438	.000	.000
3	Age, Gender, Experience, Learning Style, Self-Regulation, Self-Efficacy, Subjective Norms, Enjoyment	.635	.602	.062	.003	.000
4	Age, Gender, Experience, Learning Style, Self-Regulation, Self-Efficacy, Subjective Norms, Enjoyment, C-ELN Degree, S-ELN Degree	.666	.627	.031	.023	.000

Table 4: Hierarchical Regression Summary (DV: System Quality)

Model	Predictor Variables	R^2	Adjusted R^2	Change Statistics		Model Sig.
				R^2-change	Sig.	
1	Age, Gender, Experience	.032	.000	.032	.392	.392
2	Age, Gender, Experience, Learning Style, Self-Regulation	.597	.575	.565	.000	.000
3	Age, Gender, Experience, Learning Style, Self-Regulation, Self-Efficacy, Subjective Norms, Enjoyment	.664	.633	.067	.001	.000
4	Age, Gender, Experience, Learning Style, Self-Regulation, Self-Efficacy, Subjective Norms, Enjoyment, C-ELN Degree, S-ELN Degree	.693	.657	.029	.023	.000

The detailed statistics for the regression models are shown in Table 5 and a summary of the results in Table 6. From the full model (Model 4), learning style

has a significant positive relationship with both dependant variables at the .01 level; henceH1a [*A reflective learning style will positively influence IBL system success*]is strongly supported. Likewise, self-regulation has a significant positive relationship with both dependant variables at the .05 level; hence H1b [*Self-regulatory skills will positively influence IBL system success*] is supported. Of the technology beliefs, computer self-efficacy has a significant positive relationship with both dependent variables at the .05 level; hence H2a [*Computer self-efficacy beliefs will positively influence IBL system success*]is supported. Enjoyment has a marginally significant relationship with information quality (p = .055) and a significant relationship with system quality at the .05 level; hence H2c [*Enjoyment will positively influence IBL system success*] is partially supported. However, there is no significant relationship for subjective norms, hence, H2b is not supported.

Degree centrality in the C-ELN has a significant positive relationship with information quality at the .01 level and with system quality at the .05 level; thus, H3a [*Degree centrality in the C-ELN will positively influence IBL system success*] is supported. However, degree centrality in the S-ELN has no significant relationship with the dependent variables, hence H3b [*Degree centrality in the S-ELN will positively influence IBL system success*] is not supported. Synthesizing the above, the data broadly supports the contention that student learning attributes, technology beliefs, and electronic networkingimpact IBL system success.

Table 5: Hierarchical Regression Statistics

Model	Predictor Variables	DV: Information Quality		DV: System Quality	
		Beta Coefficient	Significance	Beta Coefficient	Significance
1	Age	-.041	.681	-.052	.618
	Gender	-.092	.351	.004	.967
	Experience	.351	.000	.171	.098
2	Age	-.019	.784	-.040	.556
	Gender	-.051	.466	.048	.477
	Experience	.117	.116	-.084	.241
	Learning Style	.321	.000	.454	.000
	Self-Regulation	.507	.000	.492	.000
3	Age	-.018	.797	-.037	.578
	Gender	-.094	.165	.004	.946
	Experience	.111	.116	-.091	.179
	Learning Style	.291	.000	.425	.000
	Self-Regulation	.271	.010	.257	.011
	Self-Efficacy	.309	.002	.307	.002
	Subjective	-.017	.803	-.031	.635

	Enjoyment	.138	.045	.150	.023
4	Age	.014	.835	-.018	.783
	Gender	-.100	.131	.007	.912
	Experience	.121	.080	-.076	.251
	Learning Style	.249	.001	.393	.000
	Self-Regulation	.251	.015	.241	.015
	Self-Efficacy	.242	.017	.231	.018
	Subjective	.004	.954	-.016	.799
	Enjoyment	.130	.055	.132	.042
	C-ELN Degree	.185	.012	.138	.049
	S-ELN Degree	.068	.327	.124	.067

Table 6: Summary of Results

No.	Hypothesis	Supported
1a	A reflective learning style will positively influence IBL system success.	Yes
1b	Self-regulatory skills will positively influence IBL system success.	Yes
2a	Self-efficacy beliefs will positively influence IBL system success.	Yes
2b	Subjective norm beliefs will positively influence IBL system success.	No
2c	Enjoyment will positively influence IBL system success.	Partial
3a	Degree centrality in the C-ELN will positively influence IBL success.	Yes
3b	Degree centrality in the S-ELN will positively influence IBL success.	No

Discussion

Prior research has highlighted the need for addressing individual student characteristics while designing online courses (Alavi & Leidner, 2001; Piccoli, Ahmad, & Ives, 2001). However, most universities and instructors adopt a "one size fits all" approach - the same online course offered to all students, regardless of their learning attributes and personal beliefs. Students with an active learning style learn best through face-to-face collaborative activities with other students whereas students with a reflective learning style learn best in solitude by methodical review of course material. The former group was disadvantaged in the IBL environment as its inherent seclusion conflicted with their learning style. Though IBL systems are moving towards providing technology-based interactivity using a range of video/audio tools, the lack of face-to-face interaction degraded the learning experience for active learners.

Students having self-regulatory skills are "self-starters" - with minimal instructor support or supervision, they are able to strategize and chart a coherent learning path encompassing the cyclical processes of planning, strategizing, executing, reflecting, reviewing, and adapting.

Their innate ability to apply self-instructional control and self-orchestrate learning led to their performing in the IBL environment. However, those lacking self-regulatory skills were unable to develop an effective learning strategy. Such students would need a "lifeline" in the form of sustained support from the instructor in strategizing a learning path for mastering the course material.

The role of computer self-efficacy beliefs and user enjoyment in influencing technology attitudes has been established in the information systems literature (Heijden, 2003; Venkatesh& Davis, 2000; Venkatesh, 2000). The results of this study indicate that these findings can be extended to the IBL environment. Students who had positive beliefs in their capabilities of using a computerized learning system performed better than those who were diffident in their approach. Also, students who possessed an intrinsic curiosity in the features offered by the IBL system and derived pleasure in interacting with the system performed better than those who were emotionally detached. The former group enjoyed technology for the sake of technology over and above any benefits that may have accrued from the interaction. However, subjective norms did not have an impact on IBL success; this could be because the courses undergone by the students were offered only through the IBL system and had no corresponding classroom version. Hence, they could be perceived as being mandatory; students had to undergo the course irrespective of the views of other students and important others.

A high degree centrality in the C-ELN positioned students to acquire supplemental course-related knowledge over and above what was available through the course material. Informal networks tend to provide experiential, implicit, non-codified knowledge that typically is not available through formal course material. Such knowledge is particularly important in the context of business courses and it gave students additional perspectives on the course material and a more holistic learning experience that translated into improved performance. However, degree centrality positions in the S-ELN did not have a similar impact; this could be because of the availability of extensive "Help" options offered by the technology help-desk of the university and integrated into the IBL system. The knowledge acquired through the S-ELN may not have offered anything over and above what could be obtained from the system-integrated "Help" feature.

Individual student attributes, technology beliefs, and participation in the ELN contributed to IBL success; however, it is important to view these as an integrated whole and not in isolation. While learning styles are important, it should be noted that their impact could be offset by other complementary learning attributes, technology beliefs, and electronic networking characteristics. For example, active learners might be disadvantaged in the e-learning context; however, possession of self-regulatory skills, computer self-efficacy beliefs, and

being deeply embedded in the ELN may to a certain extent serve to mitigate the negative impact of the absence of face-to-face collaborative ties. Likewise, while passive learners might be expected to outperform active learners, inadequate self-regulatory skills, low self-efficacy beliefs, and isolation in the ELN may nullify their inherent learning style advantages. Hence, it is important to assess the learner holistically using multiple perspectives and address the interplay between these perspectives to better appreciate their impact on IBL success.

Implications

Student learning attributes need to be taken into account while designing courses for the IBL environment. For those with an active learning style, the disadvantages posed by the IBL environment could be mitigated by mandatory classroom sessions and through the use of video-rich technologies such as virtual classrooms and video-conferencing sessions. The presence of a dense C-ELN, particularly one facilitated by video-rich technologies may also provide the collaborative support required by active learners. To this end, the instructor can mandate student participation in discussion forums, online question and answer sessions, and team activities. In addition to ensuring that active learners have the collaborative support that they require for learning, this would also provide all students with access to the non-codified, experiential knowledge that is implicitly present in the classroom learning experience.

Those students with lower self-regulatory skills could benefit from a structured learning path that would guide them through the learning process. Motivational scripts could provide detailed instructions on the activities to be performed and strategies to be implemented to improve learning and successfully complete the course. Such scripts could also be used to enhance self-efficacy beliefs. Care should be taken to ensure that the design of the IBL system interface is such that it invokes interest in the student and the act of interaction becomes an enjoyable experience in its own right.

Limitations and Future Research

The sample size was small and the study was conducted using business school students. The courses formed part of the undergraduate curriculum that the students had to undergo to complete their degree program. Hence, caution needs to be exercised in extending the results of this study to a business work environment where such online courses might be optional and aimed more at self-improvement than the attainment of a specific learning goal.

Online business courses often require student interaction in the context of team-based project activities. As the course studied did not have any team-based project activities, the possibility of social learning through such "mandated"

team-based networks could not be addressed. As the ELN was developed based on self-reporting by students, there could be inaccuracies in the communication patterns. Also, this study considered only the quanta of electronic communication ties between students and not the quality of knowledge flows through ties. It also assumes that informal knowledge transfer takes place exclusively through the ELN.While the ELN is important in facilitating knowledge transfer, it is possible that students had face-to-face communication regarding the online course in the context of other classroom-based courses. This physical face-to-face social network has not been considered in this study. It is also possible that students communicated directly with the technical help-desk of the university regarding technical issues they might have faced with the system and this has not been taken into consideration.

Future research could examine how active learners interact with different types of IBL systems. This study considered e-mail based communication ties. Would an ELN based on richer communication media such as video-conferencing technologies provide greater support for active learners? The impact of richer communication technologies on other learning styles such as visual/verbal/auditory could also be examined.

As stressed earlier, online business courses often have instructor-mandated team-based project activities. It would be interesting to study the social learning dynamics in such a context. Would there be a minimum threshold of sociallearning for every student in the context of their online team interactions?Would those who chose to communicate outside their team perform better than those who chose to confine their interactions to within their team?

Self-regulatory skills and computer self-efficacy beliefs impact IBL success. Future research could examine the impact of these variables on a spectrum of e-learning courses ranging from the purely self-paced to the completely structured. Researchers could also examine how self-regulatory skills and computer self-efficacy beliefs could be enhanced. The interaction between them should also be examined; for example, would highly interactive technology have a greater impact on learners with lower self-regulatory skills?

Prior research in social networking has indicated that ties with others who themselves are not connected provide non-redundant knowledge that can provide creative solutions to complicated problems (Hansen, 1999). Future research could examine whether these findings could be extended to the IBL environment. The quality and direction of knowledge flows as well as the structure of the ELN could also be examined in greater detail.

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Appendix: Study Measures

Measure (1-7 Likert Scale)	Items	Factor Loadings	Cronbach's Alpha
Self-Regulation	I am able to finish assignments by deadlines.	0.82	0.88
	I am able to study even when there are other interesting things to do.	0.84	
	I am able to plan my schoolwork.	0.86	
	I am able to organize my schoolwork.	0.87	
	I am able to motivate myself to do schoolwork.	0.86	
Computer-Learning Self-Efficacy	I could successfully use computer-based learning software.	0.83	0.90
	I feel confident using a computer to learn about and apply new concepts.	0.85	
	Using computer-based learning software is an efficient way for me to learn new things.	0.86	
	I could apply new concepts that I learned from computer-based learning software.	0.84	
	I would be comfortable using computer-based learning software.	0.86	
Enjoyment	I find using the e-learning system to be enjoyable.	0.82	0.92
	The actual process of using the e-learning system is pleasant.	0.84	
	I have fun using the e-learning system.	0.80	
Subjective Norms	People who are important to me think that I should use the e-learning system.	0.84	0.90
	People who influence my behavior think I should use the e-learning system.	0.86	
	My friends think I should use the e-learning system.	0.84	
System Quality	My interaction with the e-learning system has been clear and understandable.	0.84	0.92
	Overall, the e-learning system is easy to use.	0.86	
	Learning to use the e-learning system was easy for me.	0.87	
	I rarely become confused when I use the e-learning system.	0.84	
	I am rarely frustrated when using the e-learning system.	0.82	
Information Quality	The e-learning system provides information:		0.90
	that is exactly what I need.	0.86	
	that is relevant to my learning.	0.84	
	that is easy to understand.	0.88	
	that is sufficient for my learning.	0.85	
	that is up-to-date.	0.82	

Notes:
- *The term e-learning was used in the questionnaire as it was the commonly used term to refer to the IBL system.*
- *Age was measured in years, Gender was coded as Male -1, Female -2*

- *The learning style questionnaire was obtained from: http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/ILS-certification.html. The active/reflective dimension had 11 forced choice items (a or b corresponding to active or reflective). For statistical analysis, the recommended practice of counting 'a' responses was adopted (Felder &Spurlin, 2005). This would result in a score ranging from 0 to 11 with 0 representing the active end and 11 representing the reflective end. For the purpose of this study, these scores were reversed to give 0 as the reflective end and 11 as the active end.*

Biography

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