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Measuring the Impact of a Web-Based Blended Learning Platform on Student Learning

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ABSTRACT

This study reports on how web-based learning platforms provide opportunities for students to leverage the capabilities of various information and communication technologies to engage in self-directed learning. Because the delivery of course content over such platforms may be a challenge for students, the impact of a blended simulation based learning environment should be studied. The purpose of this study is to measure the impact of a web-based blended learning platform on student learning.

KEYWORDS: Simulation based learning; Computer based training and assessment; Technology-mediated learning; End-user Satisfaction

INTRODUCTION

Various higher education institutions have deploying and implementing web-based learning platforms in blended online learning environments to help students develop positive learning experiences. In addition, since they are committed to improving student access to quality learning materials, more and more higher education institutions are making use of various blended online learning environments to directly support learning and teaching. Although there are numerous web-based options available for training and testing students, they all play an important role in enhancing students' learning experiences. One such tool is MyITLab from Pearson Education that trains and tests essential Microsoft Office skills.

Blended online learning platforms are often employed to enhance student learning experiences, and to provide them with interactive and more engaging learning experiences. However, such tools also allow instructors to create and organize online lessons, enhance classroom teaching, administer and deliver custom quizzes, tests and examinations. Further, they also provide instructors with a computer based assessment platform where they can automatically and quickly track student progress and analyze test results.

Web-based blended learning platforms provide opportunities for students to leverage the capabilities of various information and communication technologies to engage in self-directed learning. Nevertheless, in order for the blended online learning environments to be useful, such factors as user interface specifications, and technical and pedagogical factors should be analyzed. Because the delivery of course content over such platforms may be a challenge for students, the impact of a blended simulation based learning environment should be studied.

The purpose of the study is to develop an instrument to measure the impact of a web-based blended learning platform on student learning. In this study, we propose to customize the original instrument for end-user computing satisfaction by Doll and Torkzadeh (1988) to measure student learning. This study summarizes the key finding from a survey undertaken at a private university located in the Northeast USA.

LITERATURE REVIEW

Identifying the success factors behind the use of computer technologies in organizations has been an important objective of researchers. Some research frameworks such as the Information Systems Success Model (DeLone & McLean, 1992; 2003) focus on the relationship between user attitude, technology, information and net benefits to organization and individuals. Other frameworks such as the Technology Acceptance Model (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Doll & Torkzadeh, 1988) specifically focus on user acceptance and satisfaction .

With the increasing role of information technologies in the learning domain, researchers have tried to understand the effectiveness of such technologies in education context. Enhanced classroom, blended learning, and fully online learning are three major forms of e-learning (Garrison & Kanuka, 2004, p. 97). Technologies such as computers, computer networks, projectors, smart boards or handset systems are often employed to enhance classroom activities in enhanced classroom form of e-learning (Draper, Cargill, & Cutts, 2002). Fully online learning such as massive open online courses (MOOCs) does not have in class activities (Rodriguez, 2012). Blended learning represents a learning experience based on a combination of face-to-face learning and online learning. While this categorization of different types of e-learning is useful for distinguishing different uses of technology in education, fully online learning systems advocates have been trying to blend the advantages of in class learning experience with new system features (Byrne, 2014). Our research is based on a blended learning course setting.

Twigg (2003) defines four categories for blended learning: replacement, supplemental, emporium and buffet. In the replacement model, face-to-face class activities are replaced with online activities and class time is reduced. In the supplemental model, online resources are provided as a supplemental source without reducing the class time. Students heavily depend on the online lectures in the emporium model, but they can access a learning resource center to get help. In the buffet model, student can choose among face-to-face and online modules depending on their needs and preferences. Our research setting best fits the supplemental model among these categories. In our research setting, class time was not reduced and instructors used the online resource as a supplemental tool.

In addition to the traditional information systems success research, the education context brought new dimensions related to the dynamics of learning such as learning methods or models. For instance, in their Adaptive Structuration Theory, DeSanctis and Poole (1994) proposes a theoretical model for technology-mediated learning. Gupta and Bostrom (2009) identified learning methods as part of the structural impact. Piccoli et al. (2001) developed a framework for virtual learning environment effectiveness and included learning models as part of the design dimension. Design and human dimensions determine the effectiveness of the virtual learning environment in their study. Bitzer et al. (2012, p. 3) developed a conceptual productivity framework based on Information Success Model (Delone & McLean, 2003), the productivity concept (Grönroos & Ojasalo, 2004), and the learning success theory (Kirkpatrick & Kirkpatrick, 2005).

Despite these research frameworks, Bitzer et al. (2012) indicate that current technology-mediated learning research is not organized around a pivotal theoretical foundation. According to their literature review of 91 peer-reviewed research articles; 56 studies did not have a theoretical foundation and remaining 35 studies cited a theoretical foundation 51 times. Information Systems Success Model (Delone & McLean, 2003) or Technology Acceptance Model (Davis, 1989) were cited only eight times (Bitzer et al., 2012). In their study based on the Information Systems Success Model for e-learning systems, Freezer et al. (2010) report that system quality and information quality indirectly impact the system success, mainly through user satisfaction. In our study, we explore the effectiveness of the technology-mediated learning environment from a pure end-user satisfaction perspective (Doll & Torkzadeh, 1988, 1991). Major constructs of this perspective (content, accuracy, format, ease of use, and timeliness) are also explored.

Information systems (IS) scholars in business schools took the lead in exploring the technology-mediated business education in the early 1990s (Alavi, 1994; Alavi, Wheeler, & Valacich, 1995; Leidner & Jarvenpaa, 1993, 1995), developed frameworks linking technology applications to learning theories (Leidner & Jarvenpaa, 1995), and initially reported promising results (Arbaugh et al., 2009, p. 72). Arbaugh et al. (2009, p. 74) acknowledge the fact that IS scholars actively developed conceptual frameworks, but they were not as active in testing them.

Arbaugh et al. (2009) explored the state of research of online and blended in the business disciplines by examining 182 articles. There is a dramatic increase in volume and quality of research with uneven distribution across business disciplines and reached similar conclusions with Bitzer et al. (2012). They indicated *"the range of untested conceptual frameworks and the lack of discipline-specific theories"* as ample opportunities for scholars in the business field (Arbaugh et al., 2009, p. 71).

Exploring the role of online learning in business education, Rungtusanatham et al. (2004) define four types of online distance education based on content-related, delivery-related, and learning-related issues: Overview Model, Overview Model with Feedback, Technical-Skills Model, and Managerial Learning Model. In our research, students explored content-related, delivery-related and learning-related issues by evaluating factors such as quality of materials, technology ease of use and technology reliability. In terms of four models, Overview Model employs technology like a webcast with limited or not interaction. Overview Model with Feedback introduces feedback capability to the preceding model. Technical-Skills model focuses on the development of competency such as learning a spreadsheet tool as in our research with a feedback capability. Managerial Learning Model addresses more complex topics by focusing on open-ended situations. Our research setting best fits the Managerial Learning Model in terms of students' interaction with the technology to learn a skill, apply it, and test it. But the technology also offers course videos without a feedback capability as in the Overview Model along with the simulation capabilities.

Many introductory information systems courses feature spreadsheet and database applications and simulation based training assessment tools are frequently used in all modes of e-learning. Murphy et al. (2012) indicates that these tools are also effective tools for measuring assurance of learning standards for accredited business schools. Literature on the role of simulation based training and assessment tools in technology-mediated learning frequently referred several tools such as "Skills Assessment Manager" (SAM by Cengage Learning), SimNet (McGraw-Hill), and MyITLab (Pearson) (Hill, 2011). One of the common themes in the literature is the use of these tools in student skill assessment in such courses (Serwatka, 2003) to measure initial skill level of students and to determine exempt status of students for a given course (Tesch, Murphy, & Crable, 2006; Wallace & Clariana, 2005). Such initial assessment is important given the significant misperception of students on their spreadsheet skills at the beginning of such courses (Grant, Malloy, & Murphy, 2009). These tools have more capabilities. For instance, they can simulate a lecture with verbal guidance, provide interactive training with behavioral modeling, offer individual trials without help, and grade the submitted work (Hardin, Looney, & Fuller, 2014, p. 8).

Researchers compared the effectiveness of these tools in different learning forms. Comparing the traditional classroom form to the blended learning form; while some research reported lower attrition rates, lower failure rate, and higher student satisfaction in blended form than in traditional form (Cooper, 2011), other research reported no significant difference between traditional and blended learning forms, despite slightly higher performance (Kakish, Pollacia, & Heinz, 2011) or favorable student rating (Napier, Dekhane, & Smith, 2011) in blended classrooms. Comparing the fully online mode to the blended and traditional classroom modes; one study by Davies, Dean and Ball (2013) reports that blended and traditional form is more effective than the fully online form. Students are frustrated with the simulation's instruction and assessments and they are less likely to take another course in fully online form. Another study (Piccoli et al., 2001) reports some conflicting results that there is no significant difference between fully online and traditional classrooms in terms of performance, but students in the fully online form reported higher computer self-efficiency. Similar to the previous study, participants reported less satisfaction with the learning process in the fully online form.

METHODOLOGY

Research Method and Data Collection

This study was carried out at a private university located in the Northeast USA. The questionnaire was administrated to the entire student population who had enrolled in a required Business Information Systems (BIS) course. The course was required for every student in the College of Business regardless of their majors. The questionnaire was posted on each section's virtual classroom by the instructors at the end of the semester. The survey was administrated after the final grades had been turned in by the instructors so students' decision to participate in the study had no impact on their final grades. Students were informed that they had the right not to participate in the study.

The impact of the interactive learning environment on improving students' essential Microsoft Office skills was measured using a previously validated structured questionnaire adapted from Doll and Torkzadeh (1988), consisting of five subscales: content, accuracy, format, ease of use, and timeliness. Having analyzed the instrument, the authors decided to modify it to incorporate two more measures of overall reliability and satisfaction to capture students' overall satisfaction level with the tool. Once we added the two measures to the survey, we generated 24 items to measure the impact of the tool they used throughout the semester. A number of items in the questionnaire had to be reworded in reference to MyITLab. Overall, 24 items are used to measure and students' perceptions of the tool content, accuracy, format, ease of use, timeliness, reliability and satisfaction. A five-point Likert-type scale was used in the questionnaire where 1=strongly disagree and 5=strongly agree (Appendix A).

Students were informed by their instructors that their participation was voluntary and the confidentiality of their identity in the survey would be maintained. Students were asked to rate the extent to which they agree with each statement in the survey by circling a number from one to five

Sample Profile

The survey of this study was conducted on students who enrolled in a required BIS course. Although the total number of students enrolled in all sections of the same course was 231, responses were obtained from 144 students, for a 62% response rate. Students are first classified based on their gender. As seen in table 1, 70 percent of the students who enrolled in the course are males and the remaining 30 percent are females. Students are also categorized based on the year in which they took the course. 78 percent took the course in their freshmen year and 22 percent took it in their sophomore year. Because it is a required course for every student in the College of Business regardless of their majors, students were also tallied based on their majors. Students' major ranged from Accounting to Exploratory. Table 1 summarizes the data pertaining to students' major, gender, and year.

Table 1: Sample Characteristics

Item	Category	Frequency	Percent	Cumulative percent
Gender	Male	102	70.00	70.00
	Female	42	30.00	100.00
Year	Freshman	112	78.00	78.00
	Sophomore	32	22.00	100.00
Major	Accounting	20	14.00	14.00
	Finance	17	12.00	26.00
	General Business	10	7.00	33.00
	Management and Leadership	17	12.00	45.00
	Marketing /Marketing Comm.	9	6.00	51.00
	Sport Management	28	19.00	70.00
	Exploratory	35	24.00	94.00
	Other	8	6.00	100.00

Internal Consistency, Convergent Validity, and Discriminant Validity

We first computed simple descriptive statistics summaries such as mean and standard deviation about the sample. As seen in Table 2, overall, while item S4 in the satisfaction category attained the lowest mean value, item T2 in the timelines category attained the highest mean value.
The instrument employed in this study was previously validated, however; since we added two more measures to the instrument, we decided to revalidate it. Thus, the instrument was examined to assess its reliability and validity. Because Cronbach's alpha coefficient is considered to provide an unbiased estimate of internal consistency, we first computed the internal consistency reliability values for the entire instrument as well as for each construct using Cronbach's alpha. Cronbach's alpha values in this study range from 0.85 (accuracy) to 0.95 (reliability) (Table 2). The entire instrument attained a Cronbach's alpha value of 0.97. Although the theoretical value of alpha varies from zero to 1, in this study all alpha values are greater than the recommended value of 0.70 (Nunnally and Bernstein, 1994).
The instrument was also assessed using factor analysis, which is often performed to assess variability among observed variables. In this study, we employed principal components as the means of extraction. In order to confirm that independent variables are represented by a particular factor, factor loadings should be greater than 0.70. Factor loadings range from 0.736 (item A1) to 0.976 (items R1 and R2). As reported in table 2, all factor loadings exceed the

recommended threshold value of 0.7 (Nunnally and Bernstein, 1994), which indicates that the instrument used in this study seems to possess good construct validity.

The convergent validity was also assessed. Fornell and Larcker (1981), and Bagozzi and Yi (1988) suggest the average variance extracted (AVE) and individual item reliabilities may be used to assess convergent validity of an instrument. The AVE values range from 0.70 (accuracy) to reliability (0.95). Similarly, item reliabilities range from 0.541 (A1) to 0.951 (R1 and R2). All AVE values are well above the recommended value of 0.5 (Fornell and Larcker 1981), and the item reliability for each item exceeds the commonly used benchmark of 0.5 (Fornell and Larcker 1981), indicating that the revised instrument employed in this study demonstrates a high degree of convergent validity.

Table 2: Factor loading, item reliability, corrected-item-to-total correlation, reliability, AVE

Construct	Item Code (Variable)	Factor Loading	Item Reliability	Item-to-total correlation	Mean	SD	Cronbach's α	AVE
Content	C1	0.855	0.731	0.769	3.71	0.96	0.92	0.76
	C2	0.911	0.830	0.850	3.67	0.95		
	C3	0.873	0.762	0.795	3.56	0.98		
	C4	0.840	0.706	0.753	3.60	1.02		
	C5	0.868	0.754	0.790	3.59	0.96		
Accuracy	A1	0.736	0.541	0.575	3.53	1.12	0.85	0.70
	A2	0.875	0.765	0.751	3.65	1.05		
	A3	0.876	0.768	0.755	3.35	1.16		
	A4	0.857	0.735	0.724	3.75	0.98		
Format	F1	0.890	0.792	0.797	3.76	0.87	0.91	0.80
	F2	0.848	0.719	0.739	3.69	0.98		
	F3	0.936	0.876	0.876	3.75	0.87		
	F4	0.905	0.819	0.822	3.76	0.92		
Ease of Use	E1	0.951	0.905	0.888	3.52	1.15	0.94	0.89
	E2	0.944	0.891	0.872	3.59	1.12		
	E3	0.930	0.865	0.846	3.57	1.13		
Timeliness	T1	0.949	0.901	0.712	3.85	0.91	0.89	0.90
	T2	0.949	0.901	0.671	3.97	0.86		
Reliability	R1	0.976	0.952	0.812	3.55	1.13	0.95	0.95
	R2	0.976	0.952	0.841	3.44	1.23		
Satisfaction	S1	0.911	0.829	0.840	3.45	1.19	0.94	0.85
	S2	0.948	0.899	0.902	3.03	1.22		
	S3	0.951	0.904	0.908	3.06	1.24		
	S4	0.886	0.785	0.804	2.75	1.27		

We also assessed discriminant validity of the instrument to see whether seven constructs are, in fact, unrelated and truly distinct from each other. Discriminant validity can be assessed using the AVE values and the correlations between the constructs. (Fornell and Larcker 1981) suggests that discriminant validity is achieved when the AVE value for a construct is greater than the corresponding squared correlation between two constructs.
To demonstrate discriminant validity we first computed the correlations between the variables. Table 3 summarizes the correlation matrix. As seen in table 3, correlations between constructs range from 0.582 (timeliness-accuracy) to 0.814 (reliability-ease of use).

Table 3: Pair-wise Construct Correlations

Variables	Content	Accuracy	Format	Ease of Use	Timeliness	Reliability	Satisfaction
Content	1.000						
Accuracy	0.687	1.000					
Format	0.695	0.645	1.000				
Ease of Use	0.695	0.744	0.660	1.000			
Timeliness	0.650	0.582	0.601	0.644	1.000		
Reliability	0.654	0.760	0.602	0.814	0.628	1.000	
Satisfaction	0.729	0.759	0.628	0.776	0.622	0.793	1.000

Table 4 summarizes squared correlations among seven factors/variables and the AVE value for each construct. In table 4, off-diagonal elements are the squared correlations between constructs, and diagonal elements are the AVE value for each variable. As seen, the AVE value for each construct is greater than the corresponding squared correlation between the constructs. These numbers demonstrate a high degree of discriminant validity for all seven factors used in this study.

Table 4: Squares of Correlations

Variables	Content	Accuracy	Format	Ease of Use	Timeliness	Reliability	Satisfaction
Content	**0.76**						
Accuracy	0.472	**0.70**					
Format	0.483	0.416	**0.80**				
Ease of Use	0.483	0.554	0.436	**0.89**			
Timeliness	0.423	0.339	0.361	0.415	**0.90**		
Reliability	0.428	0.578	0.362	0.663	0.394	**0.95**	
Satisfaction	0.531	0.576	0.394	0.602	0.387	0.629	**0.85**

ANALYSES AND RESULTS

Having assessed the instrument’s validity and reliability through a survey, the impact of a web-based blended learning platform on student learning was further analyzed using a number of factors such as students’ gender, major, and the year in which they took the course. All analyses performed in this section were carried out at a significance level of .05.

Since the course in which we employed a web-based learning platform is required for all students regardless of their major, we first assessed students’ perception based on the year in which they took the course. While 78 percent took it in their freshmen year, the remaining 22 percent had to take the course in their sophomore year. We ran a t-test to investigate if freshmen and sophomore had significantly different experiences with MyITLab used in this study. As seen in table 5, since the p-value, 0.590, is greater than the level of significance, 0.05, it cannot be concluded that freshmen and sophomore had significantly different satisfaction level and perception of the web-based learning platform employed in this study. Results indicate that the mean values for freshmen and sophomore are not significantly different, allowing us to conclude that the year in which student had to take the course is not an important factor.

Table 5: Freshmen vs. Sophomore: t-test results

	Freshmen	Sophomore	
Construct	Mean	Mean	P-value
Content	3.64	3.58	
Accuracy	3.60	3.48	
Format	3.77	3.63	
Ease of Use	3.57	3.51	0.590
Timeliness	3.90	3.92	
Reliability	3.52	3.41	
Satisfaction	3.09	3.02	
Grand Mean	3.58	3.51	

Students' satisfaction level and perceptions of the tool were also analyzed based on students' major. As seen in table 6, while those who major in Sport Management (MSP) reported the lowest satisfaction level, those who major in Exploratory Business (EXBUS) reported the highest satisfaction level with the web-based learning platform. We ran an ANOVA test to explore if the eight mean values across the various majors were significantly different. Since the F value, 2,46, is greater than the F-critical value, 2.20, we conclude that there is a significant difference among eight mean values, indicating that a student's major does affect his/her satisfaction level with the web-based learning platform (table 6).

Table 6: Students' major and ANOVA test results

	ACT	EXBUS	FIN	GBUS	MLE	MSP	MKT	OTHER			
Construct	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	F	P-value	F critical
Content	3.74	3.80	3.82	3.26	3.54	3.35	3.64	3.73			
Accuracy	3.56	3.79	3.78	3.48	3.43	3.41	3.25	3.53			
Format	4.00	3.84	3.65	3.70	3.51	3.71	3.61	3.59			
Ease of Use	3.85	3.77	3.57	3.43	3.49	3.27	3.22	3.58	2.46	0.03	2.20
Timeliness	4.08	4.04	3.85	3.75	4.03	3.63	3.56	4.31			
Reliability	3.78	3.77	3.53	3.55	3.26	2.98	3.56	3.69			
Satisfaction	3.14	3.41	3.35	2.80	2.93	2.63	3.00	3.06			
Grand Mean	3.73	3.78	3.65	3.42	3.46	3.28	3.41	3.64			

Multiple sections of the same course were offered by six different instructors in the same semester. Although the instructors were of the same gender, we postulated that students taking the same course with different instructors would report different satisfaction level with the tool.

Table 7: ANOVA test results for student satisfaction level and instructors.

	1	2	3	4	5	6			
Construct	Mean	Mean	Mean	Mean	Mean	Mean	F	P-value	F critical
Content	3.79	3.26	3.77	3.72	3.69	3.59			
Accuracy	3.83	3.46	3.75	3.48	3.29	3.52			
Format	3.73	3.63	3.94	3.75	3.65	3.67			
Ease of Use	3.89	2.99	3.69	3.77	3.41	3.66	4.827	0.001	2.477
Timeliness	4.07	3.58	4.15	3.92	3.65	3.92			
Reliability	3.97	3.04	3.64	3.65	3.24	3.53			
Satisfaction	3.62	2.53	3.19	3.25	3.10	3.01			
Grand Mean	3.84	3.21	3.73	3.65	3.43	3.56			

To make a comparison among the students in terms of their satisfaction level, we carried out an ANOVA test. As seen in table 7, while students who took the course with instructor 1 reported the highest satisfaction level, students who took the same course with instructor 2 reported the lowest satisfaction level. Since the p-value, 0.001, is smaller than the level of significance, 0.05, the ANOVA test we carried out suggests that the six mean values are significantly different from one another. Similarly, since the F value, 4.827, is greater than the F critical value, 2.477, it can be concluded that students taking the same course with different instructors experienced significantly different satisfaction level. Hence, instructor is an important factor in determining students' satisfaction level with the tool.

An assumption we made was that students who struggled a lot in the course would report the lowest satisfaction level with the web-based learning tool. However, as seen in table 8, they seem to be the most satisfied student group (mean=3.99). Student who attained a "D" as their final grade reported the lowest satisfaction level. To investigate if the five mean values, as summarized in table 8, are statistically and significantly different, we ran an ANOVA test.

Table 8: Final grade and student satisfaction level.

	A	B	C	D	F			
Construct	Mean	Mean	Mean	Mean	Mean	F	P-value	F critical
Content	3.73	3.58	3.56	3.28	3.60			
Accuracy	3.59	3.55	3.43	3.80	4.13			
Format	3.82	3.71	3.63	3.45	4.00			
Ease of Use	3.58	3.54	3.49	3.53	4.33	3.88	0.0116	2.69
Timeliness	4.02	3.81	3.84	3.80	4.25			
Reliability	3.49	3.47	3.51	3.70	4.00			
Satisfaction	3.01	3.08	3.21	2.85	3.63			
Grand Mean	3.61	3.53	3.52	3.49	3.99			

Since the p-value, 0.0116, is less than the level of significance, and the F value, 3.88, is greater than the F-critical value, we reject our initial assumption and conclude that there is a significant difference among the students in terms of their final grades they attained.

We hypothesized that males would report a higher satisfaction level compared to their female counterparts as computers are perceived as being a male domain. As seen in table 9, it was not the case as both males and females reported the same satisfaction level. To further investigate the data we carried out a t-test. Since the p-value, 0.990 is way greater than the default level of significance, 0.05, it may be concluded that there is no difference between males and females in the course in terms of their satisfaction level (table 9).

Table 9: Gender and satisfaction level.

	Male	Female	
Construct	Mean	Mean	P-value
Content	3.65	3.55	
Accuracy	3.56	3.60	
Format	3.69	3.86	
Ease of Use	3.55	3.59	0.990
Timeliness	3.87	4.00	
Reliability	3.51	3.45	
Satisfaction	3.13	2.92	
Grand Mean	3.57	3.57	

DISCUSSIONS AND CONCLUSION

Although various higher education institutions have been deploying and making use of web-based learning tools to provide their students with better learning experiences, they should be more comprehensively and carefully assessed and analyzed to see whether such tools have negative or positive impact on students' learning and how they affect their learning experiences.

In this study, we made an attempt to redesign a previously designed instrument and validate it through a survey. However, to improve its validity and reliability, this study should be repeated with larger sample sizes. In addition, given that this study was conducted in just one institutions in one semester, there is a need for further research to test the generalizability of our findings.

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