SAIS 2012 Proceedings

Southern (SAIS)

2012

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Efosa C. Idemudia
Michael J. Coles College of Business, Kennesaw State University, eidemud1@kennesaw.edu

Solomon Negash
Michael J. Coles College of Business, Kennesaw State University, snegash@kennesaw.edu

AN EMPIRICAL INVESTIGATION OF FACTORS THAT INFLUENCE ANXIETY AND EVALUATION IN THE VIRTUAL LEARNING ENVIRONMENT

Efosa C. Idemudia
Michael J. Coles College of Business
Kennesaw State University
eidemud1@kennesaw.edu

Solomon Negash
Michael J. Coles College of Business
Kennesaw State University
snegash@kennesaw.edu

ABSTRACT

The growth of online education along with decisions by many prominent higher education institutions to offer virtually all their classes online has altered the strategic view of online education. Today, 66% of chief academic officers consider online education critical to their long-term strategy and 67% believe outcomes from online classes are equivalent to those in face-to-face classes. Hence, research to understand the factors that drive the effectiveness of the underlying technology, virtual learning environment (VLE), is important. This study evaluated the impact of student course interaction and technology comfort on VLE satisfaction. Two factors were used to operationalize satisfaction in this study: the virtual learning experience and anxiety in the VLE. We conducted an empirical study with 103 online learners. The results indicated positive relationship between course interaction and satisfaction and no support for the relationship between technology comfort and satisfaction.

Keywords

Virtual learning environment, virtual learning model, course interaction, anxiety, evaluation of virtual learning experience, and technology comfort

INTRODUCTION

A long range of key statistical indicators confirms the rise of online education: it has 6.1 million students registered in fully-online institutions, when counting students that take at least one online class the online student population is one third of all higher education student populations (Wisloski, 2011); from a survey of 2,500 institutions, 65% of higher education institutions consider online learning part of their long-term strategy (Allen and Seaman, 2011); 66% of chief academic officers, a 15% increase over the last 8-years, consider online education critical to their long-term strategy and 67% believe outcomes from online classes are equivalent to those in face-to-face classes (Wisloski, 2011); and online classes have experienced double digit growth (Allen and Seaman, 2010; Sun, Tsai, Finger, Chen and Yeh, 2008).

For-profit institutions are more likely to include online learning in their strategy (Allen and Seaman, 2011). However, even large public institutions are “feeling budget pressure and competition from the for-profit sector institutions” and are making online learning a main stay (Allen and Seaman, 2010). Online for-profit institutions have proven financial success; for example, the Apollo Group, parent company of University of Phoenix and its UK counterpart BPP, made $4.9 billion in 2010. The lion share of this came from the University of Phoenix with $4.5 billion net revenue and operating profit of $1.4 billion, which was larger than the total operating budget of most research universities (White, 2011).

These broad online education impacts along with MIT’s decision to offer virtually all its classes online have altered the strategic view of online education (Wu, Tsai, Chen and Wu, 2006). Hence, research to understand the factors that drive the effectiveness of the underlying technology, virtual learning environment (VLE), is important.

THEORY AND RESEARCH MODEL

Various definitions of the term VLE exist; Weller, Pegler and Mason (2005) used the Joint Information Systems Committee’s definition of VLE as the components in which learners and tutors participate in online interactions of various kinds; Chen (2008) defines VLE as a “true human-machine symbiosis, paired by human learning and system learning” (p.1); and Piccoli, Ahmad and Ives (2001) defined VLE as “computer-based environments that are relatively open systems which allow interactions and encounters with other participants and providing access to a wide range of resources”. Interaction, one of the key constructs in this study, is common among all definitions. For the purpose of this study, we adapted the Piccoli et al. (2001) definition.

The dependent variable in this study, satisfaction as operationalized by the virtual learning experience and by anxiety about the virtual learning environment, is confirmed by prior research as a dependent measure for VLE effectiveness (Piccolli et al., 2001). The theoretical support for the two independent variables in this study, content (course) interaction and technology comfort with the VLE, is provided as follows:

Course interaction: As our educational discourse gravitates to learner-centered environments researchers are using student interaction as a key predictor of VLE effectiveness (Beldarrain, 2006; Piccolli et al., 2001; Vrasidas and McIsaac, 1999). Strong relationship between students' perceived interaction and perceived learning is confirmed by many researchers but the relationship between actual interaction and actual learning is mixed (Picciano et al., 2002). This study furthers this discussion by assessing the impact of actual student course interaction on satisfaction.

Technology comfort: An empirical study of 700 graduate and professional students has found comfort with the VLE as a key determinant for satisfaction with the learning experience (Rodriguez, Ooms, Montanez and Yan, 2005). Lewis, Coursol and Khan (2001) and Piccolli et al. (2001) have also used technology comfort as independent variable.

Based on the above discussion, this study evaluates the impact of student course interaction and technology comfort on satisfaction; see Figure 1.

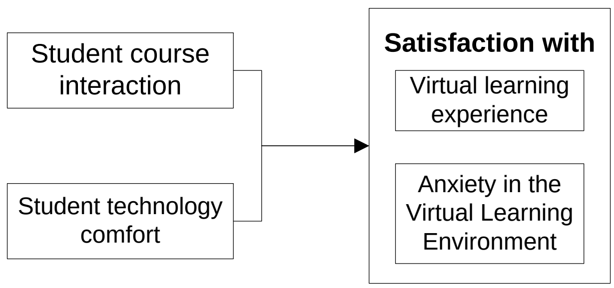

Figure 1. Research Model for Student Course Interaction and Technology Comfort in VLE

Student Course Interaction Hypotheses

Course flexibility and quality, key attributes of online courses, have a positive influence on VLE satisfaction (Liaw, Huang, and Chen, 2007; Piccoli et al., 2001; Sun et al., 2008). Swan (2002) also argued that course interaction helps to form support groups in an online community. Furthermore, research confirms that student course interaction enhances the learning experience (Lee, 2010; Leese, 2009; O'Reilly and Newton, 2002). We therefore hypothesize:

H1: Higher level of course interaction will increase positive evaluation of the virtual learning experience.

In order to reduce the negative effects of anxiety, researchers have suggested that computer-based interaction may be an ideal medium for communication and practice (Baralt and Gurzynski-Weiss, 2011; Kern, 1995). We therefore hypothesize:

H2: Increased level of interaction will reduce anxiety in the Virtual Learning Environment.

Student Technology Comfort Hypotheses

Lack of computer skills and fear of computer usage would hamper e-learning satisfaction (Piccoli et al., 2001; Sun et al., 2008) while software and hardware tools with user-friendly characteristics enhances e-Learning usage (Alavi and Leidner, 2001; Alavi, Marakasand and Yoo, 2002; Dagada and Jakovljevic, 2004; DeNeui and Dodge, 2006; Lee, 2010; Leese, 2009; Piccoli et al., 2001; Rodriguez et al., 2005; Seng & Al-Hawamdeh, 2001; Sun et al., 2008). Research has shown that participants who are comfortable with the technology evaluate virtual learning favorably: "I have done a vast amount more with technology this year than in my past 18 years." (Chiero, Sherry, Bohlin and Harris, 2003, p37). We therefore hypothesize:

H3: Higher technology comfort will lead to higher evaluation of the virtual learning experience.

Students who are less confident about their proficiency in the technology tend to have higher anxiety (Gross and Latham, 2007) while comfortable learning environments in which students can have a positive experience significantly reduces computer anxiety (Dupin-Bryant, 2002). Student perception of higher skills reduces anxiety (Brinkerhoff, 2006). We therefore hypothesize:

H4: Higher technology comfort will lead to lower anxiety in the Virtual Learning Environment.

The operational model for the impact of student course interaction and technology comfort on the two satisfaction factors is shown in Figure 2.

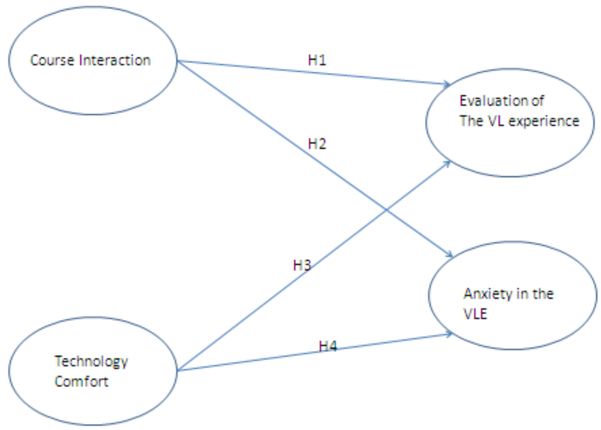

Figure 2. The Virtual Learning Environment Model

RESEARCH METHOD

We used survey methodology. The data for our study were collected from 103 students enrolled in a large U.S. public university (24,000 students). Undergraduate students that took online classes were asked to provide their feedback in a five-point Likert scale survey. Participant characteristics are shown in *Table 1*. To enhance external validity, we administered the questionnaires to college students who use the Internet in their regular activities and who are currently taking online or hybrid courses. As a result, the participants were online students familiar with online courses.

Age	<19	3
	19-23	39
	24-29	25
	30-35	14
	36-40	10
	41-45	6
	46-50	4
	> 50	2
Gender	Female =	79
	Male =	24
Graduate or Undergraduate	**Academics**	
	Freshman	8
	Sophomore	14
	Junior	22
	Senior	30
	Graduate	28
	Unknown	1
Course Format	Hybrid Course =	81
	Online Course =	22

Table 1. Participants' Characteristics (N=103)

To administer the questionnaire we emailed all 25 instructors teaching online or hybrid courses during the semester we collected the survey. Half of the instructors agreed to encourage their students by sending email notification. The survey was posted on the university website and student response was collected anonymously. The time spent by most subjects to complete the questionnaire online was between 10-15 minutes.

The Operationalization of Constructs and Measurement Scales

The construct and measurement scales were adapted from prior studies using a five point likert scale. Evaluation of the learning experience of online courses was measured using questionnaire items developed and validated by Arbaugh (2000) and Sun et al. (2008). Anxiety of the online learning experience was adapted from Arbaugh (2000) and Sun et al. (2008). Course interaction was adapted from Arbuagh (2000), Sun et al. (2008), and Swan (2002). Technology comfort was adapted from Brown, Fuller and Vician (2004) and Howard and Smith (1986).

DATA ANALYSIS

For data analysis, construct validity, model fit, and hypotheses testing we followed the two-step approach (measurement model and structural model) suggested and recommended by Anderson and Garbing (1988). In the first step approach, the measurement model, we used confirmatory factor analysis (CFA) to assess convergent validity, item reliability, construct validity, and composite reliability. In the second step approach, structural model, we fit our theoretical model to show the causal relationship between the latent variables. It should be noted that we chose CFA in our data analysis because Bagozzi and Phillip (1982) argue that CFA is more appropriate for pre-validated measurement scales and adopting prior theory compared to exploratory factor analysis. We chose this two-step data analysis approach instead of the one-step approach because the two-step approach provides a more comprehensive test for construct validity and hypotheses testing (Anderson and Garbing 1988).

Scale Validation and Measurement Model

In our study, we used CFA to assess convergent and discriminant validity. The three conditions we used to assess convergent validity are all reported in Tables 2 and 3. The three conditions are: the CFA loadings indicate that all scale items exceed 0.70 and are significant; each constructs composite reliability exceeds 0.80; and each construct average variance extracted estimate (AVE) exceeds 0.50. Our results indicate that all conditions for convergent validity recommended by Fornell and Larcker (1981) are met.

Construct and Indicators	Loading	Indicator Reliability	Error Variance	Reliability	Variance Extracted Estimate (AVE)
Evaluation of the Learning Experience (FA1)				0.9468 ^{C}	0.8172
S1	0.9250	0.8556	0.1444	0.8556	
S2	0.8028	0.6445	0.3555	0.6445	
S3	0.9087	0.8257	0.1743	0.8257	
S4	0.9710	0.9428	0.0572	0.9428	
Anxiety (FA2)				0.8855 ^{C}	0.7224
AN1	0.8807	0.7756	0.2244	0.7756	
AN2	0.9270	0.8593	0.1407	0.8593	
AN3	0.7296	0.5323	0.4677	0.5323	
Course Interaction (FA3)				0.8692 ^{C}	0.6270
I1	0.8994	0.8089	0.1911	0.8089	
I2	0.8181	0.6693	0.3307	0.6693	
I3	0.7644	0.5843	0.4157	0.5843	
I4	0.6674	0.4454	0.5546	0.4454	
Technology Comfort (FA4)				0.8882 ^{C}	0.8004
T1	0.9795	0.9594	0.0406	0.9594	
T2	0.8009	0.6414	0.3586	0.6414	

Note: ^{C} Denote composite reliability. All loading in Table.2 are significant at p<0.0001.

Table 2. Construct, Indicators, Reliability, Error Variance, & Variance Extracted

Construct	Composite Reliability	AVE
Evaluation of Learning Experience (ELE)	0.9468	0.8172
Anxiety (ANX)	0.8855	0.7224
Course Interaction (CI)	0.8692	0.6270
Technology Comfort (TC)	0.8882	0.8004

Table 3. Construct Reliability and AVE

Construct	ELE	ANX	CI	BP
ELE	***0.90***	-0.84	0.76	0.35
ANX		***0.85***	-0.89	-0.33
CI			***0.79***	0.39
TC				***0.89***

Note: The diagonal values (in bold and italic) represent the square root of the average variance extracted (AVE) of the specific construct. The square root of AVE for that construct exceeds the correlation of that construct and any other constructs. This is an indication of discriminant validity.
The acronyms used are ELE=Evaluation of the Learning Experience; ANX=Anxiety; CI=Course Interaction; TC=Technology Comfort.

Table 4. Correlations among Latent Constructs

The criterion we used to assess discriminant validity is the one recommended by Fornell and Larcker (1981), which states that the square root of AVE for each construct should surpass the correlation of that construct and any other constructs. From Table 4, the highest correlation between a particular construct and any other construct is 0.76; hence, this value is lower than the 0.79 lowest square root of AVE of all the constructs. The Normed Fit Index (NFI) is 0.86, which indicates our model's overall goodness of fit.

Hypotheses Testing and Structural Model

In our study, we used CFA analysis to examine the R-square score of each endogenous variable and the explanatory power of each path in our model, see Figure 3. For the data analysis, we used structural equation modeling (SEM) to analyze all paths in a model as one analysis (Chin, 1998).

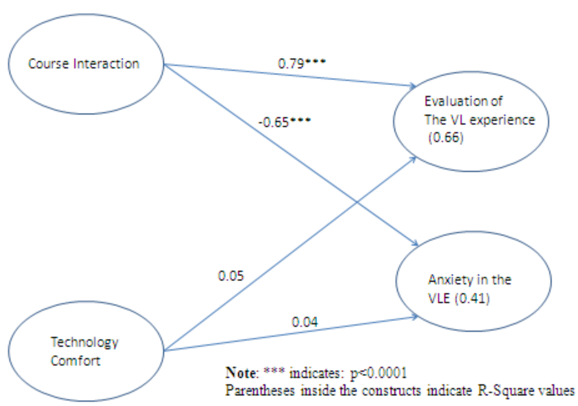

Figure 3. SEM Analysis with Path Coefficient and R-square

DISCUSSION OF KEY FINDINGS

SEM analysis as shown in Figure 2 indicates that together course interaction and technology comfort explain 66% of the evaluation of the virtual learning experience and 41% of anxiety in the virtual learning environment.

Course interaction (H1) has a positive and significant effect on the evaluation of the virtual learning experience. This hypothesis suggests that online students with increased course interaction tend to rate the VLE experience favorably. Also, course interaction (H2) has a negative and significant effect on anxiety of the virtual learning environment. This hypothesis (H2) indicates that online students with increased course interaction tend to experience lower level of anxiety about the virtual learning environment. Thus, this study found support for both H1 and H2 corroborating prior research (Lee, 2010; Liaw et al., 2007).

On the other hand, the hypothesized relationship between student technology comfort and evaluation of the virtual learning experience (H3) and the hypothesized relationship between student technology comfort and anxiety in the virtual learning environment (H4) were not supported. The rejection of H3 and H4 suggest that technology comfort when using VLE has no effect on anxiety and evaluation of the virtual learning experience. This contradicts prior research (Piccoli et al., 2001) and studies that advocate adding a technology literacy course to increase comfort level of participants (Leh, 2000) and require further investigation.

CONCLUSION

This study found strong empirical support indicating that increased student course interaction increases the virtual learning experience and reduces anxiety in the virtual learning environment. This corroborates prior research (Lee, 2010; Liaw et al., 2007) and has implications for policy makers and VLE designers. Hence, to increase the virtual learning experience and reduce online anxiety, instructors and policy makers should consider finding tools and methods to increase course interaction. Some have argued that VLE design as a component instead of as an integrated monolithic system impacts student experience (Weller et al., 2005). Goold, Augar, and Farmer (2006), on the other hand, studied what students liked and disliked in the VLE; their finding indicates that the best things students identified are flexibility of time and place for participation and communication. They also found the worst things students identified are communication difficulties with team members that delay participation and submission to the last minute (Goold, Augar and Farmer, 2006).

Contrary to prior research (Leh, 2000; Piccoli et al., 2001) the impact of technology comfort on the virtual learning experience and on anxiety in the VLE was not supported in this study. In essence our findings indicated that increased technology comfort did not make contribute to increase the virtual learning experience or to reduce anxiety. Further investigation is needed to understand the implication of this finding vis-à-vis studies that propose adding a technology literacy course to increase comfort level of participants (Leh, 2000) and argue that increased technology literacy positively impacts student learning outcome encouraging critical and reflective thinking (Vaiciuniene and Gedviliene, 2008).

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