Identifying Facets of Technology Satisfaction: Measure Development and Application

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ABSTRACT

As institutions of higher learning, universities must devote significant resources in developing intellectual capital in the use of educational technology to sustain their viability. To better understand satisfaction in technology used in classrooms, a psychometric instrument was developed to identify and measure the specific factors of satisfaction with the technology in a business school setting. Additionally, this instrument is employed on a sample of business students as a means of reporting satisfaction levels with educational technology. We show that students' satisfaction with educational technology is related to four main factors: Proficiency, assessment, performance, and preference toward Web-courses.

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INTRODUCTION

In the not so distant past, students would come to class on the first day of school and sometimes ask if the professor had a copy of syllabus to hand out. Technology seemed very simple in those days. Today, students come to class and sometimes ask if the syllabus and course material will be available on Blackboard, CourseSmart, WebCT, Homework Manager or any other Web-based course management system. They also want to know if you will be using Facebook, Twitter, and podcasts to disseminate course information. As technology has become much more complicated, it has also become a more accepted and expected form of course delivery in institutions of higher learning.

This proliferation of technology in all aspects of student life has affected institutions of higher learning in general, and business schools more specifically. Most students and faculty are getting very comfortable with various technological applications both inside and outside of the class-

room. As universities and faculty adopt more and more technological applications as tools for teaching course material, it is assumed that students' learning environment is enhanced. There are, however, some basic questions that should be answered in order for instructors to better understand the use of technology in supporting the teaching and learning functions. Some of those questions are:

- *What are students' preferences in the use of technology?*
- *How do students react to technology?*
- *How satisfied are students with the utilization of technology?*

Those questions led a group of professors at a small Midwestern university to investigate the use of educational technology in a business college setting.

There are various reasons why it is becoming more and more imperative to gain a greater understanding of the modern student experience in relation to technology. Technologies can enrich the experiences of students in an educational community. One of the missions of a viable university is preparing students for their future lives and careers (Blackburn and Lawrence, 1986). Universities' intellectual capital in the use of technology is critical to competing for students and in sustaining viability as institutions of higher learning.

The general trend at the university level is that technology is assumed to be a natural part of the environment for students (Oblinger, 2003). This has become the information-age generation of students. This comfort with technology often leads to the perception that the use of technology in classes, at an adequate level, enhances student satisfaction. But such perceptions may or may not be accurate. Colleges and universities are coming to understand that meeting student expectations as they relate to technology is essential to providing a satisfactory student experience.

Beyond higher education in general, understanding technology in the context of business schools is perhaps even more important. Business is an applied discipline that is also multidisciplinary, thereby requiring a certain level of technical expertise (Jaju, Kwah and Zinkhan, 2002). Quantitative and qualitative skills are needed in the discipline. Practical and experience-based skills are also emphasized. Various applications of technology are often employed in the teaching of such skills. It is therefore important that professors understand student satisfaction with the technology they are asked to use. In spite of the importance of understanding student experience with technology, there appears to be a relative lack of research on the nature of student satisfaction with such.

To examine the relationship between technology and student satisfaction, we first need a clear definition of technology. According to the Association for Educational Communications and Technology (AECT), educational technology is defined as "the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources" (www.aect.org/about/div_.asp?DivisionalD=18). Hence, in our study, we consider educational technology to encompass a variety of instructional tools such as computers, software titles, multimedia equipment, Internet applications, mobile devices and any other electronic instruments employed by an instructor to facilitate student learning.

The purpose of this study is to identify and establish the specific facets of technology satisfaction. In this study, a psychometric instrument to measure the perceived factors that comprise technology satisfaction in a business school setting is developed. Additionally, this instrument is employed on a sample of business students as a means of reporting satisfaction levels with technology.

LITERATURE REVIEW

Satisfaction as a construct has been used in the technology field. It is often associated with the acceptance or rejection of technology. A review of the technology studies quickly reveals that, when satisfaction is used, there appears to be no consistent definition of the construct in the context of technology. It is most often used as an outcome factor that seems to have some importance (Graham and Scarborough, 2001; Thurmond, Wambach, Connors, and Frey, 2002; Maki and Maki, 2003).

Studies on satisfaction in technology rely mostly on self-report surveys by students. Varmosi, Pierce, and Slotkin (2004) surveyed students to determine satisfaction with different learning delivery modes. Among other things, students were asked to report on their effectiveness in using technology as well as their level of comfort in using technology. In his study on students' satisfaction with Internet-based MPA courses, Arbaugh (2000) used a survey instrument that required students to report on their perceived level of satisfaction in usage of the Internet as a delivery mode.

There appears to be some research on the nature of student satisfaction with technology in limited situations. There is, however, a plethora of work on satisfaction as a construct in other business contexts. Various studies have indicated that employees and students share similarities (Cotton, Dollard, and deJonge, 2002; Tofi, Fleet and Timutimu-Thorpe, 1996). For this reason, work on job satisfaction is used as a foundation for exploring the facets of student satisfaction with technology.

Satisfaction as a construct has a long history in business. It is considered to be an attitude and is usually expressed as a continuum from high satisfaction (positive attitude) to low satisfaction (negative attitude); (Hitt, Miller, and Colella, 2006). The type of satisfaction most studied in a business context is job satisfaction. Job satisfaction in its most simple form reflects the extent to which a person likes their job. Job satisfaction involves an effective response toward the various aspect or facets of the job (Kreitner and Kinicki, 2007). This indicates that job satisfaction is not a single concept but rather a construct comprised of multiple factors.

Researchers at Cornell University found that job satisfaction contains the dimensions of work, pay, promotions, co-workers and supervision (Smith, Kendall, and Hulin, 1969). Other researchers have concluded that there are twenty different dimensions underlying job satisfaction (Weiss, Dawis, England, and Lofquist, 1967). Job satisfaction has been one of the most researched attitudes with more than 12,000 studies published by the 1990's (Kinicki, McKee-Ryan, Schriesheim, and Carson, 2002).

There are two initial questions concerning satisfaction as it relates to technology that need to be addressed. First, what are the facets or aspects that make up technology satisfaction? And second, what levels of technology satisfaction do business students possess? Valid support for these fundamental questions appears to be sparse. Existing research on students focuses on student satisfaction with the university (Astin 1993) or academic performance and college characteristics (Astin, 1993; Kuh and Hu, 1999, 2001; Hu and Kuh, 2003). Because of the noted similarities between students and employees, it follows that student satisfaction evaluations for their university or college would be similar in many respects to employee satisfaction evaluations for their employers. Furthermore, like job satisfaction, technology satisfaction seems to have several facets that are reflected in student evaluations of the use of technology in the university experience.

So, what are the facets of technology satisfaction that should be pursued? Most of the recent research has focused on distance learning as representing the use of technology in teaching. These studies point to many features that may predict student satisfaction with distance learning classes. These predictor variables include such things as:

- Student-teacher interaction (Bates, 1984; Feldman, 1989)
- Student-materials interactions (Perraton, 1991)
- Access to technology (Bates, 1995; Cybela, 1996)
- Perceived quality (Perraton, 1991; Bates, 1984)
- Prior experience (Gabrielle, 2001)
- Technological levels (Gehlauf, Shatz and Frye, 1991).

Most research that explores the construct of satisfaction in the context of technology is somewhat narrow in context, focusing on student satisfaction in Web-based instruction. In this context, satisfaction is generally treated as a simple construct assessed by as few as one scale item and as many as 21 scale items. For example, Vasmosi, Pierce, and Slotkin (2004) measure sat-

isfaction for Internet courses with a single-item scale. Eom, Wen, and Ashill (2006) combine three items measuring the quality of the online course relative to face-to-face courses, intent to recommend, and intent to take online courses in the future into one satisfaction measure. Arbaugh (2000b) measured student satisfaction with Internet-based MBA courses via a 12-item scale designed around satisfaction with the Internet course, perception of quality, and likelihood of taking future Internet courses. (See Table 1 for a summary of satisfaction measures from various articles.)

Based on the definition of technology that we provide, there is a need for a broader measure of satisfaction in order to assess students overall capabilities and comfort level with various types of technology applications. Additionally, the above-noted studies assess the satisfaction of students who self-selected into those courses thereby limiting the researcher's ability to generalize the findings to student satisfaction levels with technology in general. This indicates a gap in the research that identifies exactly what satisfies students about the use of technology in the classroom whether it is Web-based or traditional. The level of satisfaction then becomes critical as it has the potential to impact the effects that technology has on students. The use of technology in the classroom today is often expected as part of instruction. The research that has been conducted on technology as an instructional tool is headed in the right direction but needs to be developed in the area of student satisfaction with technology. This study responds to this gap in the extant research. The following section describes the development of a psychometric scale designed to measure multiple facets of student satisfaction with technology for Web-based courses as well as traditional courses.

METHODOLOGY

Because of the scarcity of research in the specific area of college student satisfaction toward technology, a metric is developed to accomplish the purposes of this research. After having established a theoretical basis for different facets of technology satisfaction, the following sections describe the process followed to empirically establish such facets as well as to develop instruments to measure such. Our methods are based

Table 1
Previous research establishing a relationship between technology and satisfaction

Past Studies	Technology Assessed	Satisfaction Measure
Annetta and Minogue (2004)	Interactive Television	Single-item scale
Arbaugh (2006)	Internet Course	Twelve-item scale
Beckert, Fauth, and Olsen (2009)	Clicker	Twenty one-item scale
Ebenezer, Lugo, Beirnacka and Puvirajah (2003)	Electronic Discussion Boards	Reflective dialogues
Eom, Wen and Ashill (2006)	Online Course	Three-item scale
Feldmann, Wess, and Moothart (2008)	Laptop Service	Single-item scale
Frederickson, Reed, and Clifford (2005)	Web Sessions	Five-item scale
Frey, Alman, Barron and Steffens (2004)	Online Program	Learner comments
Hazari, North, and More (2009)	Wiki	Twenty-item scale
Piccoli, Ahmad, and Ives (2001)	Virtual Learning Environments	Three-item scale
Shneiderman, Borkowski, Alavi and Norman (1998)	Electronic Classroom	Six-item scale
Vasmosi, Pierce, and Slotkin (2004)	Internet Course	Single-item scale
Warnock, Boykin, and Tung (2008)	Smart Board	Four-item scale

on traditional scale development procedures (Churchill, 1979; Gerbing and Anderson, 1988).

Phase 1: Scale Development

Item Generation. The exploratory stage of our research sought to generate a pool of items that would characterize the nature of satisfaction toward technology. This was accomplished through a review of relevant literature and by adapting such to the purposes of this research. From this qualitative process, an initial battery of survey statements was generated and distributed to 17 business school students as a pretest. Based on the results of that pretest, the initial list of statements was modified in order to minimize redundancy, ambiguity, and leading statements. These modifications resulted in a final list of 37 statements. This list was formatted into a questionnaire of five-point (strongly disagree to strongly agree) Likert scales, each with a "not applicable" option.

Exploratory Factor Analyses.

The initial questionnaire items were grouped into categories as a means of hypothesizing possible factors. These factors included general satisfaction (with the instructor, with the student's own performance, and with technology in general), general technological proficiency, technology preferences, general ability to learn, and interaction with students and professors.

Data were collected from undergraduate business school students at a Midwestern university who participated voluntarily (n = 568). One hundred and thirty seven responses were dropped during the factor analysis. In addition to the survey scale items, additional demographic information about each student was also collected, including race, age, gender, foreign/non-foreign student's status, home country, major, and number of online courses previously taken.

The sample consisted of all freshmen registered for the introductory Accounting class, all sophomores registered for Statistics I course, all juniors registered for the Corporate Finance course and seniors who were taking the business capstone course. All four courses are required for business majors. The survey participation rate is close to 100% due to the fact that it was administered during regular class time.

Our final sample consists of a total of 431 undergraduate students. Overall, 169 students (42.9%) had a single major while 144 students (36.5%) were double or joint majors. Joint majors are students whose total degree hours are taken in two emphasis areas rather than one. Unlike double majors who earn two separate degrees, joint majors earn a single degree in the two areas of emphasis. The sample also included 62 non-business majors (15.7%). Majority of students in the study were white/Caucasian (84.2%). In addition, there were more male students (214 or 53.0%) than female students (190 or 47.0%), and the sample comprised of thirty-seven (9.2%) international students. Our data also suggest that more than half of students (252 or 64.5%) have not had any online/Web courses in the past. (See Table 2.)

Exploratory factor analysis was used to suggest dimensions and construct a scale on the basis of the resulting factor loadings (Churchill, 1979). An analysis of the screen plots suggested four underlying dimensions. Further analysis using principal component factor analysis method confirmed the existence of the four factors. Items that loaded on more than one factor were eliminated as well as those with factor loadings below .60. This process reduced the scale to 18 items, with each of the four factors represented by four or five items, as depicted in Table 3.

Scale Description

The four factors represent the different manifestations of how students feel about technology and how satisfied they are with it. Our four factors are supported by the extant literature. Proficiency characterizes the general knowledge, experience, and comfort level that individuals have regarding personal technology use (Gabrielle, 2001; Arbaugh, 2000). Assessment is the individual's assessment of the availability, capability, and use of technology at their college or university, both inside and outside the classroom (Perraton, 1991; Bates, 1984; Bates, 1995; Cybela, 1996; Arbaugh, 2000). Performance encompasses the degree to which individuals feel that technology use improves their own performance and

Table 2
Descriptive Statistics

Major	No.	%
Accounting	19	4.8%
Actuarial Science	18	4.6%
Economics	3	0.8%
Finance	26	6.6%
General Business	28	7.1%
Information Systems	10	2.5%
International Business	13	3.3%
Management	21	5.3%
Marketing	31	7.9%
Joint/Double Majors	144	36.5%
Non-Business Majors	62	15.7%
Undeclared	19	4.8%
Total*	394	100.0%
Race	**No.**	**%**
African American	7	1.8%
Asian or Pacific Islander	20	5.0%
Hispanic/Latin American	4	1.0%
Indian Sub Continent	12	3.0%
Mexican American	4	1.0%
White/Caucasian	336	84.2%
Other	16	4.0%
Total*	399	100.0%
Gender	**No.**	**%**
Male	214	53.0%
Female	190	47.0%
Total*	404	100.0%
Domestic/International	**No.**	**%**
Domestic	365	90.8%
International	37	9.2%
Total*	402	100.0%
Web-Courses Taken	**No.**	**%**
0	252	64.5%
1	76	19.4%
2	33	8.4%
3	17	4.3%
4	1	0.3%
5 or more	12	3.1%
Total*	391	100.0%

*Demographic information survey items are optional and, consequently, do not add up to the total sample size of 431 due to a number of students opting out of answering several items.

learning in relation to courses (Arbaugh, 2000). Web-course deals with individual preferences for a Web-course versus a traditional classroom course (Beqiri, Chase, and Bishka, 2010).

Phase 2: Scale Confirmation

After establishing the four factors of technology satisfaction through factor analysis, the scales were distributed to more student respondents (n = 253) with the objective of confirming the factor structure. Through confirmatory factory analysis, the four-factor model identified in phase 1 was compared to a zero-factor or null model as well as to a single-factor model comprising all 18 items. The results (see Table 4) show that the four-factor model fits significantly better than the other two, as indicated by the improvement in the chi-square measure as well as other goodness of fit statistics (Jöreskog, 1993). In the four-factor model, the inter-factor correlations ranged from .08 to .47. Table 5 provides a descriptive statistics for the scale scores for each of the four factors.

SUMMARY AND CONCLUSION

The research presented in this article makes a significant contribution to the literature in that it represents a first effort to establish a psychometric scale to assess college students' level of satisfaction with technology as part of their college experience. This study establishes four factors that make up technology satisfaction in a business school. By use of factor analysis, it was revealed that students' satisfaction with educational technology is related to four main factors. These are proficiency, assessment, performance, and Web-course (i.e. whether a student prefers taking Web-courses). The four factors were subjected to confirmatory process using a new sample of students. Our analysis found that the four-factor model was a better fit leading to the conclusion that business students' satisfaction in technology is related to Proficiency, Assessment, Performance, and whether one prefers Web-courses or not (Web-course).

As mentioned previously, it is assumed that technology is a natural part of the environment for students (Oblinger, 2003). As universities invest large sums of money into technology, they should

Table 3
Technology Satisfaction Factor Loadings

Factor	Factor Loading			
	Proficiency	Assessment	Performance	Web-Course
Proficiency (coefficient alpha = .861)				
I have experience in using technology.	.786	.134	.078	-.045
I am comfortable using technology in my classes.	.836	.100	.100	-.023
I like using technology.	.844	.054	.159	.038
I am motivated to learn new technology.	.700	-.025	.252	.147
I expect my personal experience with technology to help me accomplish the outcomes required in my classes.	.673	.151	.307	.036
Assessment (coefficient alpha = .815)				
Overall, I am satisfied with the training I have received at [institution] to use technology in the classroom.	.049	.682	.162	-.109
Overall, I am satisfied with [institution]'s level of classroom technology capabilities.	-.123	.768	.066	-.103
Overall, I am satisfied with [institution]'s level of technology capabilities outside the classroom.	.025	.710	-.102	.105
Overall, I am satisfied with the availability of technology at [institution] outside the classroom.	.003	.721	-.130	.125
Overall, I am satisfied with the training I have received at [institution] to use technology outside the classroom.	.056	.700	-.041	.115
Performance (coefficient alpha = .812)				
The use of technology makes course material easier to learn.	.282	-.040	.690	.247
When my instructor uses technology, it helps me organize my course material.	.222	.045	.786	.070
When my instructor uses technology, it helps me organize my class notes.	.091	.053	.742	.048
When my instructor uses technology, it helps my performance in the class.	.205	.096	.749	.148
Web-Course (coefficient alpha = .735)				
I would rather take a course on the Web than in a traditional classroom.	.142	-.020	.188	.679
I prefer classes which allow face-to-face interaction with my instructor.	.084	-.033	.048	.740
I prefer classes which allow face-to-face interaction with my classmates.	.023	.050	-.039	.630
I have a better understanding of the material when the instructor lectures to the class.	.095	-.111	.049	.626

Table 4
Models and Goodness of Fit Indices for Confirmatory Factor Analysis (n = 253)

Model	Description	DF	Chi-square	Delta chi-square	CFI	NNFI	RMSEA	ECVI
A	Null model	153	3,015.24	--	--	--	--	--
B	One-factor model	135	1,392.18	1,623.06	.56	.50	.21	6.71
C	4-factor model	129	426.96	965.22	.90	.88	.10	2.15

consider to what extent their efforts are incorporated into a seamless experience for students. In other words, does technology enhance students' experience and even facilitate their learning process? For these reasons, it is imperative that the construct of technology with satisfaction be studied with respect to variables that are relevant to student experience and learning; variables like grades and learning outcomes. If the objective of spending resources on technology is to improve learning, this scale now provides a means to measure the extent to which that relationship is true.

Table 5
Descriptive Statistics for Factors

Factor	Mean	SD	Variance	Range
Proficiency	4.093	.669	.448	1.40 – 5.0
Assessment	3.479	.710	.504	1.00 – 5.0
Performance	3.667	.688	.473	1.25 – 5.0
Web-Course	3.801	.783	.612	1.50 – 5.0

These relationships can be considered in relation to student learning styles to determine if certain types of students have benefited more from the use of technology in education. Other considerations in the future study of the impact of technology satisfaction are the impact of the accessibility and availability of technology for students. Future research should also focus on how the four factors of the technology satisfaction scale are differentially related to actual student experience. Additional research should investigate which of four factors is more critical than the others.

Technology satisfaction should also be studied in the context of diverse populations. Universities adopt most technological products as universal efforts for all students. The extent to which satisfaction with technology differs with respect to gender, ethnicity, age, and socio-economic status should be studied to establish whether or not this is the case. Additionally, differences by major should also be investigated.

In short, we feel that the concept of satisfaction with technology is not only important, but is in its infancy. As such, we call for researchers to answer the call to address the unanswered questions with respect to this construct.

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