Teaching and Learning with Technology: IT as a Value-Added Component of Academic Life

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Abstract:

Effective assessment of teaching and learning with technology requires a capacity to map learning outcomes. Student attitudes of the use of IT are measured in a structural equation model derived from an instrument based on the principles of undergraduate practice of Chickering and Ehrmann (1996). Institutional and background data are included. By employing path analysis derived from reliable measures, assessment can assist administrators and faculty in understanding the role of instructional/information technology (IT) as a value-added component of undergraduate education. IT Academic Use (R^2 = .158), Course Learning Management (R^2 = .584), Academic Performance (R^2 = .785), and IT as a Value-Added (R^2 = .195) component of teaching and learning are examined.

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Introduction:

A survey was developed to focus on the impact of information technology as a value-added component of teaching and learning inside and outside the classroom (Chickering and Ehrmann, 1996; Chickering and Gamson, 1999), the criterion dependent variable of this investigation. As a follow up to the reliability findings of the survey (Sandler, Fisher, and Zedeck, 2008), a path analytic procedure was conducted with survey data yielding a structural equation model as a means to map the experience of undergraduate learners using technology. The impact on Academic Performance, IT Academic Usage, Course Learning Management, and IT as a Value-Added component of learning is explored.

Literature Review:

Observers have affirmed that information technology has become a ubiquitous component of undergraduate education (Laird and Kuh, 2005; Green 1996). The use of computers and various forms of information technology (IT) on college campuses are commonplace among students and faculty, reflecting the societal embrace of personal and mobile computing in terms of its usefulness and acceptance over the past fifteen years or more (Dolence and Norris, 1995; Green, 1996; Oblinger and Hawkins, 2005a). Whether it is e-mail, the internet, office software, social-networking or mobile devices, information technology has found its place inside and outside the classroom for academic purposes thereby affecting the student experience, as reported in “Students and information Technology in Higher Education,” published by the EDUCAUSE Center for Applied Research (ECAR) (Smith, Salaway, and Caruso, 2009).

Survey reports from ECAR over the past six years have attested to the increase in the use and adoption of information technology, student ownership of laptops, IT skills, interactive communication tools, course or learning management systems, and the pervasive application of mobile computing and its presence in academic environments (Smith, Salaway, and Caruso, 2009). Whether students are having more frequent contact with faculty or participating in more active learning activities, Hu and Kuh (2001) noted a strong positive relationship of information technology and student engagement in wired university settings, while Kuh and Vesper (2001) asserted evidence attesting to the potential of technology which used in concert with powerful educational practices may produce an increase in student productivity.

This trend historically began with pivotal national and association reports in the mid-1980s (National Institute of Education (1984); Association of American Colleges and Universities, 1985) and the rubric of the seven principles of good practice (Chickering and Gamson, 1987), followed by development (Chickering, 1991; Pascarella and Terenzini, 1991, 2005; Cross, 1998), operational priming or putting the principles to work as operational definitions (Chickering and Gamson, 1999; Kuh, 2001a; Kuh 2001b), and adaptation of these principles that purported an active role for information technology as a lever for change and institutional development (Chickering and Ehrmann, 1996; Finkelstein and Scholz, 2000).

In the 1990s education practice, information technology, and learner engagement became intertwined, thereby reinvigorating many aspects of academic life (Chickering and Ehrmann, 1996; Laird and Kuh, 2005) related to the seven principles for good practice of Chickering and Gamson (1987). By positively influencing learning effectiveness, information technology became the means by which (Chickering and Ehrmann, 1996) the role of IT in academic life and the notions of academic productivity originating from student, faculty, and/or institutional perspectives were reinforced (Kuh and Vesper, 2001; Massey and Zemsky, 1996; Landry and Stewart, 2000; Finkelstein and Scholz, 2000). In fact, Oblinger and Hawkins (2005a) align their view of the developmental trajectory of information technology with the notion of engagement as both coexisted on a parallel path or timeline with the appearance of the National Survey of Student Engagement (NSSE) (Kuh 2001a; Kuh 2001b).

In this context, learning effectiveness, academic productivity, student engagement, outcomes assessment, and academic enterprise have emerged simultaneously in higher education as independent and interdependent forces to become conjoined, in part, in the landscape of the new economy at the turn of the millennium (Green and Gilbert, 1995a and 1995b; Massey and Zemsky, 1995; Landry 2000; Laird and Kuh, 2005). Whether addressing undergraduate education, distance education, *online education, course management systems, or learning in blended and hybrid environments*, it was clear that a convergence of these forces was emerging in academe while researchers affirmed the importance of student engagement (Kuh and Vesper, 1997; Kuh, Pace, and Vesper, 1997) and the entrepreneurial potential for information technology as an engine for enterprise and cost control in the new economy (Finkelstein and Scholz, 2000; Oblinger and Rush, 1997; Groccia and Miller, 1998; Twigg, 2003a and 2003b).

Clearly, as Oblinger (2005) asserted, “information technology has had a striking impact on learners and learning,” attesting to gains from the persistent “challenge of information technology in the academy” over the past fifteen years. Eight years earlier she affirmed at a nascent moment, that information technology had the capacity to contribute to a “learning revolution,” and produce fundamental changes in higher education contributing to “productivity, quality, access and competitiveness” (Oblinger and Rush, 1997).

Theoretical and Conceptual Framework:

From survey and institutional data twenty-four (24) variables, twelve (12) endogenous and twelve (12) exogenous background variables were incorporated in a hypothetical model. Among the principles considered are: 1) student-faculty contact, 2) cooperation among students, 3) active learning, 4) prompt feedback, 5) time on task, 6) high expectations, and 7) diverse talents and ways of knowing (Chickering and Ehrmann, 1996; Chickering and Gamson, 1999). For definitions of the seven principles of good practice please see Carboni, Mundy, and Black Duesterhaus (2002). Although all seven principles were employed in survey development, the names of the endogenous variables in this study are aligned with student experience, including elements of faculty and institutional delivery in the use of technology as a means to map teaching and learning. For ease of understanding the reader may interchange the meaning of IT to represent Information Technology or Instructional Technology.

With particular regard to this research study and the survey that was developed and deployed, technology and pedagogical perspectives can be integrated for delivery via course management systems like Blackboard (Bb) as part of a mobile computing program in traditional and blended environments and also in virtual/online classrooms (Newlin and Wang, 2002; Landry and Stewart, 2005; McVay, Snyder, and Graetz, 2005). Thus a survey titled “Information Technology and Your Learning” was developed by a team of faculty and administrators at a private institution in the northeast of the United States reflecting efforts to “ask the right questions" (Ehrmann 1995; Oblinger and Hawkins, 2005b) in order to explore IT as a value-added component of academic life by incorporating the seven principles of Chickering and Gamson (1987; 1999) and as subsequently addressed by Chickering and Ehrmann (1996); Newlin and Wang (2002); Carboni, Mundy, and Black Duesterhaus (2002).

Whether it is from the perspective of educators evoking a need for change in the academy drawing insight form the seven principles of good practice (Ehrmann 1995) or from the perspective of information technology professionals in higher education, both constituencies assert that when "asking students about academic technology," it may be better to ask them "to describe their ideal learning environment… We kept hearing *interaction*, as well as hands-on" and not necessarily advanced technologies, but "online access to syllabi, readings, and old exam… online submission of homework" and "a bit of PowerPoint can help" (Oblinger 2005).

In so doing the survey attempts to address the interactive and collaborative capacity of technology, so faculty and administrators can better understand the expectations that students and institutions have in using information technology. In turn, the survey explores the impact of IT on teaching and learning and possible gaps in perception between constituents at one institution. The survey drew some similarity in its aims from a question posed by Kuh and Vesper (1997); "Do Computers Enhance or Detract from Student Learning?" Evidence explored in this paper corroborates in large part with elements of the College Students Experiences Questionnaires' (CSEQ) data and discussion of the findings of Kuh and Vesper (1997). Evidence introduced here clearly attests to the notion of IT as a value-added component of academic life from the perspective of undergraduate students, as a result of structural equation modeling and a path analysis of survey data that ensued. A separate survey addressing the faculty perceptions of information technology was deployed in spring 2009 at the same institution, but the scope of this paper will be limited to the student survey that was conducted in spring 2008.

Methodology, Population, Sample, and Survey Administration:

The 2008 Teaching and Learning with Technology survey was comprised of forty-three (43) questions including a larger set of subsidiary items. By matching the total undergraduate student demographic profile of 4800 undergraduates at the institution, a sample was determined to be representative. In spring 2008, eleven hundred fifty-two (1152) undergraduates including freshman and juniors 18-21 years were administered an on-line survey at a University in the northeast United States. A $10 award for survey completion was disbursed to each respondent at the end of the semester, after a five week window was made available for survey completion.

With a forty-four (44) percent online survey response rate, the final sample for analysis included (N=509). The demographic profile of non-respondents and respondents proved similar to the total sample population. After initial descriptive and transformational statistics were obtained using SPSS 16, eleven measures were determined reliable with Cronbach alpha reliability coefficients between .68 and .89 (Sandler, Fisher, and Zedeck, 2008; see Appendix A). As a means to reduce data, a principal components factor analysis yielded eleven (11) factors using varimax rotation. Each subscale yielded a single factor score with orthogonal composition. The endogenous variables in this study arose from eleven factors addressed. Cumulative GPA was added as the twelfth endogenous variable.

As a means to appropriately address the variable types, that included ordinal, continuous and dichotomous measures, and to examine the non-recursive effects among variables and bi-directional effects between variables, structural equation modeling was conducted using LISREL 8.80 with a WLS estimator after a pretreatment phase using PRELIS 2.5. Less than five (5) percent of the missing data in the sample was imputed using Full Information Maximum Likelihood (FIML) (N=509) yielding a representative sample of undergraduates. A path analysis using a weighted least squares (WLS) estimator was followed by means of structural equation modeling with LISREL 8.80.

Data Sources, Variables, Reliability, and Findings:

Twenty–four (24) variables, twelve (12) endogenous and twelve (12) exogenous variables denoting background were included to determine contributing effects.

Endogenous Variables – Twelve

IT Usage - Non-Academic - 2 item scale, .65 reliability*

IT Distracts, Impedes, Learning in Class - 4 item scale, .69 reliability*

IT Usage Academic - 2 item scale, .78 reliability*

Satisfaction with Laptop - 5 item scale, .85 reliability*

IT Skill Level - 4 item scale, .77 reliability*

Classroom Media Impact - 5 item scale, .86 reliability*

Satisfaction - Network Wireless - 4 item scale, .80 reliability*

Diverse Talents - 9 item scale, .89 reliability*

Course Management Bb Improves Learning - 7 item scale, .85 reliability*

IT Team Collaboration - 4 item scale, .68 reliability*

Cumulative GPA

Use of IT Value-Added for learning - 7 item scale, .88 reliability*

*Cronbach alpha reliability coefficient; See Appendix A for item statistics, item analysis, and reliability.

Exogenous Variables -Twelve

Gender

Race/Ethnicity, Minority/Majority White (dichotomous)

Parents' Educational Level

Household Income

Preferred Level of IT in courses

Verbal & Math SAT Score

Highest Academic Degree

Years to Degree

Cumulative Hours

Hours Studied

Hours Employed

Housing Status/Commuting Time

Upon fitting the model, an admissible structural equation model was determined from the data or measurement model using LISREL 8.80, producing a fine model fit. Three "Goodness of Fit Statistics" (Joreskog, and Sorbom, 1993) indicate an excellent fit: "Minimum Fit Function Chi-Square = 50.335 (p = 1.000), 193 degrees of freedom, Goodness of Fit Index (GFI) = 0.994, Adjusted Goodness of Fit Index (AGFI) = 0.992.

Central to this exploratory investigation, six (6) out of twelve (12) endogenous variables of the structural model had a notable level of variance explained, between sixteen (11) and seventy-nine (79) percent. Although six (6) remaining endogenous variables had lower levels, the nexus of relationships within the model could not be determined without these variables in consideration (Figure 1).

Ninety-eight (98) percent, fifty six (56) of fifty-seven (57) hypothetical paths were confirmed ($p < .05$; most paths $p < .001$). The largest total effect arose from students' Math and Verbal SAT Score Combined at .859 ($p < .001$) on Cumulative GPA. For every unit increase in Cumulative GPA there is a corresponding .859 increase in the students' SAT; the explained variance of Cumulative GPA was strong at seventy-nine (79) percent.

The total effect paths on three focal endogenous variables of the model are featured, IT Academic Use ($R^2 = .158$), Course Management Improves Learning, ($R^2 = .584$), and IT Value-Added ($R^2 = .195$), the criterion dependent variable in the investigation.

Results, Structural Equation Modeling, Path Analysis, and Discussion:

While the effect of the SAT was not among the primary purposes of this research inquiry, its presence in the structural model as a background or exogenous variable elicits some interesting considerations with respect to the current debate concerning admissions testing, particularly with regard to its contribution at a high level to the variance explained of Cumulative GPA (seventy-nine (79) percent) or academic achievement. Effects like these provide fuel for debate about the appropriate use of the SAT in admissions decisions that have embroiled academe for some time. While the debate is a most important one, the author refers readers to the literature and recent articles by Linn (2009) and Atkinson and Geiser (2009) so that the findings regarding the impact of information technology on learning can be more centrally explored. This tact regarding the discussion of the results in no way diminishes the value of controlling for the SAT and/or exploring the effects of the SAT accordingly, or for that matter, exploring the subject of the SAT in higher education.

Total Effects of the Endogenous and Exogenous Variables on IT Use – Academic

Eight total effects on IT- Use Academic, from the trimmed model (effects < .10 are trimmed), determine sixteen (16) percent of the explained variance (see Table 1). Since the total effects are standardized, with every unit increase in IT – Academic Use there is a corresponding decrease of .436 ($p < .001$) units of student IT Skill level and so forth … for each of the variables listed. This suggests that students with lower IT skill levels are most apt to use their computer and IT (instructional/information technology) for academic purposes, which may seem counter intuitive at first glance, revealing the "complexity of the influences of inquiry-oriented activities on colleges students" (Hu, Kuh, and Li, 2008). As exciting news, the total effects of non-white/minority students were moderate (.391, $p < .001$) while male undergraduates were low (.123, $p < .02$) on IT Use-Academic, thereby commending the impact of the institution's mobile computing program on some critical students in the population. The moderate effect of IT Value–Added, low effect of Diverse Talents and low effect of Course Management (Bb) Improves Learning on IT Academic Usage affirms the notion of IT as an instrumental "lever" in higher education (Chickering and Ehrmann, 1996).

Insert Figure 1

Tabel 1: Total Effects of the Endogenous and Exogenous Variables on IT Use - Academic

	Variable	
1)	IT Skill Level	-.436***
2)	Race/Ethnicity – Minority	.391****
3)	IT Value-Added	.308****
4)	Diverse Talents	.165****
5)	Hours Employed	-.164**
6)	Course Mgmt. (Bb) Improves Lrng.	.162****
7)	Gender (Male)	.123**
8)	Cumulative Hours Passed	.108****

Reduced Form R^2 = .158;****p < .001, ***p < .01, **p < .02, *p < .05

Total Effects of the Endogenous and Exogenous Variables on Course Management Improves Learning

Fifty-eight (58) percent of the explained variance of Course Management (Bb) improves learning arose from five total effects in the trimmed model (see Table 2). Course Learning Management (Bb) has a moderate to strong impact on the course of undergraduate experience. For every unit increase in the use of Blackboard and the belief students express regarding its benefits, there is a moderate to strong increase (.665, $p < .001$) in the effect that course hours earned had on the impact of course management learning systems over time. Many of the survey items of this subscale, Course Management (Bb) Improves Learning, like interaction with faculty and collaboration or sharing materials with other students using Blackboard, have a direct reference to Chickering and Gamson (1987) and Chickering and Ehrmann (1996). Smith, Salaway, and Caruso (2009) also report on the increased prevalence of course learning management systems by institutions of higher learning thereby underscoring the significant impact of course management systems.

Likewise for very unit increase in student beliefs that Course Management improves learning, there is a low to moderate level (.261, $p < .001$) in the preferred level of instructional/information technology (IT) used by students and a low level (.212, $p < .001$) in the Diverse Talents and ways of knowing (Chickering and Gamson, 1987; Chickering and Ehrmann, 1996) that the use of a course learning management system engenders. Female students (.120, $p < .001$) and those students studying for longer hours (.119, $p < .05$) also believe Course Management produces learning benefits to a small degree.

Table 2: Total Effects of the Endogenous and Exogenous Variables on Course Management Improves Learning

Variable	
1) Cumulative Hours Passed	.665***
2) Preferred Level IT	.261****
3) Diverse Talents/Ways of Knowing	.212****
4) Gender (Female)	.120****
5) Hours Studied	.119*

Reduced Form R^2 = .584;****p < .001, ***p < .01, **p < .02, *p < .05

Total Effects of the Endogenous and Exogenous Variables on IT Value-Added

Twenty (20) percent of the explained variance on IT Value-Added arose from six total effects in a trimmed model (see Table 3). For every unit increase in IT Value-Added beliefs there is a .505 ($p < .001$) increase of students' Diverse Talents & Ways of Knowing (Chickering and Gamson, 1987; Chickering and Ehrmann (1996), and so forth … for each of the variables listed in the table. This suggests that students' perception of IT as a value-added component of their undergraduate education is in part due to the diverse talents students' integrate using IT, such as 1) constructively critiquing other students work using the computer and 2) spending time with other students on course related materials using instructional technology. Other effects suggest that Blackboard is considered to be a moderately strong component .497 ($p < .001$) of students' belief that instruction technology plays a value-added role with respect to teaching and learning. In other words, for every unit increase of IT Value-Added there is a .497 ($p < .001$) increase in students' belief that course management improves learning directly affirming the seven principles of good practice (Chickering and Gamson, 1987; Chickering and Ehrmann, 1996).

For every unit increase in IT Value-Added there is a twenty-three percent increase in the preferred level of IT that students express using in their courses and a seventeen percent increase in IT Use for academic purposes. With some caution, since the explained variance of the Variable IT Distracts or Impedes Learning was present at a negligible level at .001 and the effect of the same variable on IT Value Added was at a low level -.108 ($p < .001$), it may be concluded that IT proved not to be a distraction for undergraduates at this institution, largely in agreement with the findings of Kuh and Vesper (2001). As a caveat, since the variance of IT Distracts or Impedes Learning remains unexplained some caution should be made with regard to this conclusion reflecting the complexity of "inquiry-oriented activities" like "distraction" on college students (Hu, Kuh, and Li, 2008) suggesting the possibility of alternate conceptual considerations and structural paths that may shape new models as longitudinal inquiry is planned.

Table 3; Total Effects of the Endogenous and Exogenous Variables on IT Value-Added

	Variable	
1)	Diverse Talents/Ways of Knowing	.505****
2)	Course Mgmt. Improves Lrng.	.497****
3)	Cumulative Hours Passed	.331****
4)	Preferred Level IT	.228****
5)	IT Use - Academic	.173****
6)	IT Distracts/Impedes Lrng.	-.108****

Reduced Form $R^2 = .195$, ****$p < .001$, ***$p < .01$, **$p < .02$, *$p < .05$

Limitations:

The limitations of this study relate to the sample. Nevertheless, conclusions and inferences drawn regarding the impact of technology at the institution of inquiry remain robust as revealed by the Critical N (CN) = 2394.376 of the structural findings (Joreskog and Sorbom, 1993) accounting for half all students in the undergraduate body or all freshman and juniors in the population. Despite indications of reliability of the survey instrument and subscales, re-testing at the same institution, or at other institutions, remains essential. The conceptual framework used in model building proved to be exploratory and may require modification with longitudinal inquiry in the future to better account for "inquiry-oriented activities" like "distraction" and other purported variable relationships on college students (Hu, Kuh, and Li, 2008).

Conclusion:

Structural Equation Modeling enables assessment professionals, institutional researchers, instructional designers, and faculty to explore survey data through a powerful lens close to the respondents' experience, thereby explaining the impact of technology on teaching and learning with greater clarity. The "ah-ha" moment that many professionals experience in teaching with technology can be supported by using this tool and by harnessing the power of quantitative inference drawn from reliable measures.

It is clear that technology is indeed a "lever" for teaching and learning, regarding the seven principles of good practice of Chickering and Ehrmann (1996), as evidence attests to the impact that Diverse Talents and Ways of Knowing, Course Learning Management, IT Use – Academic and other variables have on the notion of IT as a Value-Added component of undergraduate education. By mapping effects within structural models, path analysis empowers the institutional researcher and assessment professional with options to better address calls for accountability made by accrediting bodies in employing reliable measures and evidence based on principles of good undergraduate practice to determine for instance, how strongly practices involving the information technology may be affecting the student body longitudinally at different points in time.

In exploring the seven principles of good practice, Cross (1998) urged academic researchers to reassess their direction of inquiry. Cross asserted that the "assumptions of most researchers is that further refinement of research methods, new statistical controls, more rigorous standards will lead to greater knowledge" may be misdirected inquiry, but asserted that data mining about "how college affects students" (Pascarella and Terenzini, 1995) is nonetheless a useful enterprise (Cross 1998). For Cross (1998) the underlying "epistemological question is do learners discover knowledge that exists 'out there' in reality or do they construct it for themselves through a process of language, thought and social interaction" much in the way the seven principles of good practice affirm in a pragmatic sense the notion of "active learning" (Braxton, Jones, Hirschy and Hartley, 2008).

Contrary to Cross' (1998) line of criticism, Braxton, Jones, Hirschy and Hartley (2008) speak of "active learning," its origins and impact. Intertwined with information technology, active learning provides each student an epistemological confirmation of what their learning is about, as it is fundamentally based on the principles of good practice. In so doing each student socially constructs their learning, using information technology, while simultaneously influencing their goals, academic and career futures, thereby affecting their ongoing studies to persist in college (Kuh and Hu, 2001; Sandler, 2000).

Advanced "correlation" techniques like structural equation modeling and others are far from misdirected inquiries as Cross (1998) suggests in her interpretation of the seven principles of good practice as qualitatively apart or epistemologically distinct. In fact these practices assist the researcher and others in acquiring a better understanding of undergraduate learning in a pragmatic way. The seven principles are inextricably intertwined as an engaged learning process, as we come to know them today using information technology. Over the past forty years, researchers in higher education have used advanced statistical techniques like structural equation modeling to explore many important issues in the field (Joreskog 1970; Garcia and Pintrich, 1991; Pike 1991; Cabrera, Nora, and Castaneda, 1993; Sandler 2000) and in time the impact of information technology on teaching and learning is that much better understood using these techniques.

Future possibilities for research may mirror the notion of "scalets" introduced by Pike (2006). That is, dependable subscales derived from larger survey instruments may be better equipped to explore department and/or other units of inquiry as "scalets" for assessment purposes. In other words, the methods employed in this study can be used similarly to explore the value added component of information technology on the department level, with respect to Introductory Psychology, or for that matter with respect to freshman writing as a part of a general education initiative.

Since the notion of technology, as a "lever" may not have changed perceptions of engagement and good practice (Chickering and Gamson, 1999) as we come to know them, efforts in examining how teaching and learning with technology may differentially impact various institutional ecologies, departments, faculty and types of students would be a fruitful path for future investigation, beyond established inventories like NSSE which may pose limitations (LaNasa, Cabrera, and Trangsrud, 2009). Perhaps learning about engagement using 'scalets' in the disciplines (Pike 2006), or for that matter learning about the differential impact of information technology on the disciplines would be a productive approach for future research.

In closing, studies at institutions, across institutions and on the national level would be better if equipped with reliable measures and stronger empirical practices assessing the impact of teaching and learning with technology are employed, particularly with respect to hybrid and blended course curricula. Rich meta-analyses of research in the literature are born in part from path analyses, thereby moving beyond descriptive analyses that bear limited fruit for institutional exchange and meaningful dialogue. New inquiry has begun examining the relationship between technology and higher education, specifically regarding e-learning and student retention (Nora 2009; Nora and Snyder, 2008; McCracken 2008) that may bear constructive considerations for traditional, hybrid and blended curricular course delivery using course or learning management systems like Blackboard.

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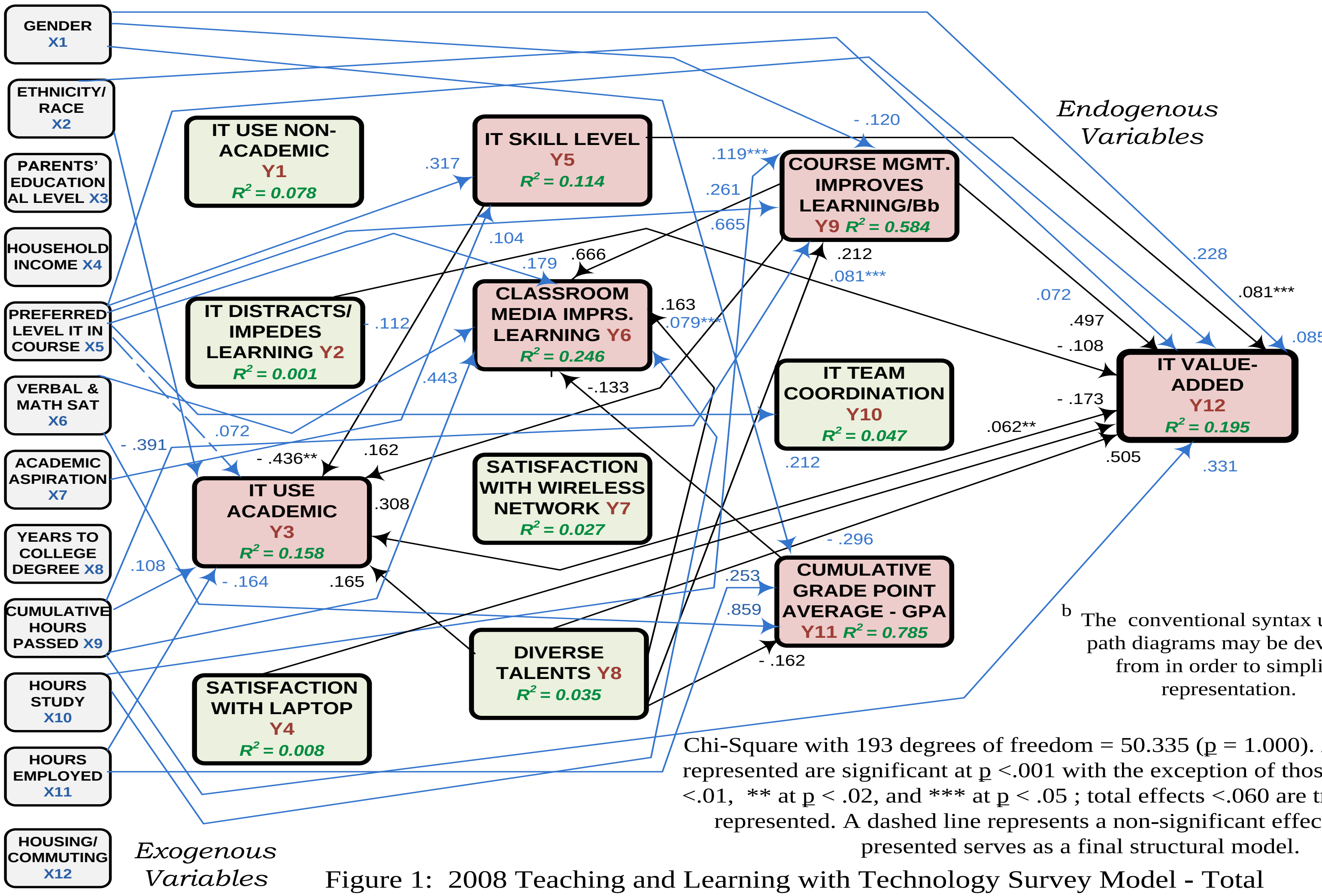

[b] The conventional syntax used in path diagrams may be deviated from in order to simplify representation.

Chi-Square with 193 degrees of freedom = 50.335 (p = 1.000). All total effects represented are significant at p <.001 with the exception of those marked * at p <.01, ** at p < .02, and *** at p < .05 ; total effects <.060 are trimmed and not represented. A dashed line represents a non-significant effect. The figure presented serves as a final structural model.

Figure 1: 2008 Teaching and Learning with Technology Survey Model - Total Effects on Six Principal Endogenous Variables [b]

24_var_T&LwT_2008LIS_9a_cent_EM_Centered_3_BEST.LS8

Appendix A

Teaching and Learning with Technology Spring 2008 Survey

Reliability Statistics

Reliability Statistics Summary

Subscale – Endogenous Variables	*# of items*	*Cronbach Reliability*
1) Satisfaction w - Laptops	5	.85
2) Satisfaction w - Wireless Network	4	.80
3) IT Usage – Academic	2	.78
4) IT Usage – Non-Academic	2	.65
5) IT Skill Level	4	.77
6) Impact of Classroom Media	5	.86
7) Course Management Imp. Learning	7	.85
8) Collaborative Learning on Teams	4	.68
9) IT Distracts/Impedes Learning	4	.69
10) Diverse Talents & Ways of Knowing	9	.89
11) Information Tech Value Added	5	.88

Reliability Statistics Details

Subscale – Endogenous Variable	*# of items*	*Cronbach Reliability*
1) Satisfaction w - Laptops	**5**	**.85**

Item Statistics

	Mean	Std. Deviation	N
Q22a - Overall satisfaction with your laptop	3.76	1.034	489
Q22b -Satisfaction - Training	3.52	.977	489
Q22d - Satisfaction - Laptop hardware	3.48	1.114	489
Q22e - Satisfaction - Preloaded software on your laptop	3.71	.964	489
Q22f - Satisfaction - Size/weight of your laptop	3.59	1.068	489

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.846	.846	5

2) Satisfaction w - Wireless Network	**4**	**.81**

Item Statistics

	Mean	Std. Deviation	N
Q24a - Often - wireless reliability on campus	3.73	.964	504
Q24c - Often - Wireless connection in classrooms	3.79	.865	504
Q24d- Often - Wireless connection in public areas	3.66	1.019	504

Item Statistics

	Mean	Std. Deviation	N
Q24a - Often - wireless reliability on campus	3.73	.964	504
Q24c - Often - Wireless connection in classrooms	3.79	.865	504
Q24d- Often - Wireless connection in public areas	3.66	1.019	504
Q24e - Satisfaction - Blackboard availability/reliability	3.76	.893	504

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.803	.805	4

3) IT Usage – Academic 2 .78

Item Statistics

	Mean	Std. Deviation	N
Q1a - Hours per day e-mail academic	1.28	.766	509
Q1c - Hours per day Internet websites academic	1.48	.831	509

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.777	.778	2

4) IT Usage _ Non-Academic 2 .65

Item Statistics

	Mean	Std. Deviation	N
Q1b - Hours per day non-academic	1.11	.762	509
Q1d - Hours per day Internet websites non-academic	1.83	.986	509

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.633	.648	2

5) IT Skill Level 4 .77

Item Statistics

	Mean	Std. Deviation	N
Q3a - Skill SHU website	3.79	.786	509
Q3b - Skill spreadsheet programs	3.19	.900	509
Q3c - Skill presentation programs	3.66	.784	509
Q3d - Skill graphics software - Adobe Photoshop)	2.62	1.004	509
Q3f - Skill ssing the Internet to find information	4.10	.771	509

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.765	.776	5

6) Impact of Classroom Media 5 .86

Item Statistics

	Mean	Std. Deviation	N
Q4a - Impact - Audio	3.91	.850	396
Q4b - Impact - Digital Projector	4.17	.823	396
Q4c - Impact - Overhead Projector	3.95	.921	396
Q4d - Impact - Slide Projectors	3.82	.946	396
Q4e - Impact - Video (CD/DVD, VHS)	3.99	.871	396

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.861	.862	5

7) Course Management Imp. Learning 7 .85

Item Statistics

	Mean	Std. Deviation	N
Q13a - Bb Online Syllabus improves my learning	4.31	.780	399
Q13b - Bb Online Readings and links to course materials improve my learning	4.10	.836	399
Q13c - Bb Discussion board improve my learning	3.86	.948	399
Q13f - Bb Turning in assignment improves my learning	4.25	.761	399

Q13g - Bb Getting assignments back from your professor improves my learning	4.14	.822	399
Q13h - Bb Sharing materials with other students improves my learning	3.96	.833	399
Q13i - Bb Keeping track of grades (e.g. gradebook) improves my learning	4.22	.825	399

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.847	.851	7

8) Collaborative Learning on Teams 4 .68

Item Statistics

	Mean	Std. Deviation	N
Q12i - IT in my courses help me collaborate with classmates about content.	4.00	.812	491
Q18b - How often - spend time with other students on course related materials.	3.27	1.260	491
Q2d - Use IT working in teams during class	3.31	1.066	491
Q2e - Use IT working in teams outside of class on assignments	3.24	1.093	491

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.679	.675	4

9) IT Distracts/Impedes Learning 4 .69

Item Statistics

	Mean	Std. Deviation	N
Q19b - Instant messenger and net-surfing during class impede learning for students.	3.73	1.041	509
Q19c - Text messaging on cell or smart-phones activity distract others from learning.	3.45	1.182	509
Q19d - I am distracted by other students using IM or net-surfing during class.	2.66	1.286	509
Q8f - IT gets in the way of learning in the class	2.75	1.020	509

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.680	.672	4

10) Diverse Talents & Ways of Knowing 9 .89

Item Statistics

	Mean	Std. Deviation	N
Q18e - How often - explore course materials in a variety of ways.	3.73	1.028	509
Q18f - How often - demonstrate what I have learned in different ways.	3.53	1.111	509
Q18g - How often - communicate with people outside the university on course content.	2.42	1.450	509
Q18h - How often - learn technology related skills.	3.03	1.362	509
Q18b - How often - spend time with other students on course related materials.	3.25	1.269	509
Q18d - How often - edit and improve my projects and assignments over time.	3.32	1.283	509
Q18i - How often - observe and record my own progress.	3.26	1.328	509
Q18j - How often - constructively critique other students' work.	2.58	1.436	509
Q18k - How often - apply skills learned in this course outside of the classroom.	3.25	1.291	509

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.890	.892	9

11) Information Tech Value Added 5 .88

Item Statistics

	Mean	Std. Deviation	N
Q12a - improves my learning.	3.94	.791	509
Q12c - helps me focus on course content.	3.86	.826	509
Q12d - allows me to take greater control of my course activities.	4.04	.780	509
Q12f - IT in my courses help me learn at my own pace.	3.81	.884	509
Q12g - IT in my courses enables me to stay on task.	3.73	.879	509
Q12j - IT in my courses result in more prompt feedback from instructor.	4.02	.850	509
Q12k - IT in my courses result in increased value of feedback from instructor.	3.82	.899	509

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.883	.884	7