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STUDENTS' PERCEIVED EASE OF USE OF AN eLEARNING MANAGEMENT SYSTEM: AN EXOGENOUS OR ENDOGENOUS VARIABLE?

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ABSTRACT

Five factors affecting student use of an eLearning management system in two Web-enhanced hybrid undergraduate courses are investigated using the Technology Acceptance Model (TAM). This research represents a causal relationship existing between students' attitude toward WebCT and their actual use of the system. Students' perception of the WebCT use, Computer Self-Efficacy, and Subjective Norms are also taken into account. Multigroup structural modeling procedure, specifically PROC CALIS, is used to extract those factors from student use of WebCT and to determine their interrelatedness among one another. Results show that extended adaptations of the Technology Acceptance Model are not as suitable for Engineering students as they are for Psychology students. Of the two competing models in the psychology class, Perceived Ease of Use is deemed an exogenous variable. A multi-sample analysis suggests that covariance structure differences between psychology and engineering students were found obvious over Computer Self-Efficacy and Subjective Norms variables. Lessons and experience from a southeastern metropolitan university in the United States are addressed.

Studying the influence of the design features of learning technologies on end-users, specifically students, is of central importance in educational contexts.

Testing the viability of models that have found application in contexts outside of education may prove very beneficial, particularly when attempting to explain how educational institutions can support or even enhance the learning experiences of students through technology.

The primary focus of this study is to examine the viability of an empirically supported statistical model used in the corporate sector in context of education. The aim of this study is to evaluate one way of enhancing the educational experience of postsecondary students by identifying the factors underlying their affective response to the technology now widely used for the purpose of course management.

To meet diverse needs of the student body, Web-enhanced classes using WebCT are currently offered at the University of Central Florida (UCF). In the present study, WebCT is conceptualized as an information system project and it is also considered an eLearning management system. This study was contextualized in the inter-relationship among students' perception of WebCT design features, their attitude toward WebCT, and their WebCT use.

Fishbein and Ajzen's (1975) theory of reasoned action (TRA) specified a causal relationship between individual behavioral intention and actual behavior. With TRA, one can differentiate an individual's actual behavior from his or her behavioral intention. Behavioral intention is a latent factor that is measured by two other latent factors: attitude toward behavior and subjective norm.

Rooted in TRA, the Technology Acceptance Model (TAM) by Davis (1989) identifies two distinct constructs, Perceived Usefulness and Perceived Ease of Use. Those two constructs directly affect a person's attitude toward the target system use and indirectly affect actual system use (Davis, 1993), David (1993) defined Perceived Usefulness as "the degree to which an individual believes that using a particular system would enhance his or her job performance" and Perceived Ease of Use as "the degree to which an individual believes that using a particular system would be free of physical and mental effort" (p. 477). Furthermore, attitude toward use of a system is defined as "the degree to which an individual evaluates and associates the target system with his or her job" (p. 476). Actual system use is a behavioral response, measured by the individual's actions in real life. Davis (1993) states that "Frequency of use and amount of time spent using a target system are typical of the usage metrics" (p. 480).

The TAM is used by Management Information Systems (MIS) practitioners to predict the success or a failure of an information systems project. The TAM is based on the following assumptions:

1. When end users perceive the target system as one that is easy to use and nearly free of mental effort, they may have a favorable attitude toward using the system. Nevertheless, Sanders and McCormick (1993) argued that an individual must use some of or all of one's mental resources in order to perform a task.

2. When end users perceive the system as one that is helpful to their job, then they may have a positive attitude toward the system used.
3. When users have a favorable attitude toward the target system, they may use the system frequently and intensely, which means that the system developed is successful.
4. Above all, the TAM was adapted to predict the acceptance or rejection of WebCT by the participating classes when the courses go fully Web-based.

PURPOSE AND RELEVANCE OF THE STUDY

Pan (2003) conducted a correlational study to investigate the causal relationship existing among student perception of WebCT, student attitude toward the use of WebCT, their actual system use and two other external variables: Subjective Norms and Computer Self-Efficacy. In doing so, Pan successfully replicated the Technology Acceptance Model (TAM) and extended TAM in a higher education setting by verifying a belief-attitude-behavior relationship in the context of WebCT adoption.

Following the focus of this study aforementioned, the primary purpose is two-fold. First, we attempt to verify the role of students' perceived ease of WebCT's use in the presence of two external variables: Subjective Norms and Computer Self-Efficacy. Second, we identify differences of the factor covariance structures between the two student groups by conducting a multi-sample analysis using structural equation modeling. To be clear, the focus of this study is not on the WebCT courseware, per se, but instead the plausibility of the hypothetical TAM model in portraying their affective response to the technology used for the purpose of managing a course.

The relevance of this joint research effort presents to university professors insights in students' perception of the adopted courseware system and their personal traits. Both factors may possibly govern student acceptance or rejection of the technology. All of the findings from the present and past studies (e.g., Dziuban & Moskal, 2001; Moskal & Dziuban, 2001) in eLearning are able to serve instructors in analyzing the capability of the TAM in explaining the student affective response to an eLearning management system (in this case, WebCT) so that the impact of how students feel about this technology on how they learn can be better understood.

REVIEW OF LITERATURE

The Technology Acceptance Model

The Technology Acceptance Model (TAM) originated from the psychological environment and expanded into the business settings. Adapted from the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM) by Davis

(1989) identified two distinct constructs, Perceived Usefulness and Perceived Ease of Use, which directly affect the attitude toward target system use and indirectly affect actual system use (Davis, 1993). Each of the factors is defined as follows:

- Perceived Ease of Use: the degree to which the individual users perceive that their use of the target system would be mentally and physically effortless (Davis, 1993).
- Perceived Usefulness: the degree to which individual users perceive that their use of the target system would increase their work performance (Davis, 1993).
- Attitude toward use of target system: the degree to which individual users would assess and relate their use of the target system to their job performance (Davis, 1993).
- Actual system use: defined as a form of external psycho-motor response that is quantified by individual users' real course of action (Davis, 1989).

The causality of the four components of the Technology Acceptance Model addressed previously can be explained theoretically and empirically. Reversely speaking, management Information Systems (MIS) research bases the success of actual system use on the Frequency and Intensity of the target system use (Davis, 1993). Attitude measures the tendency toward actual system use (e.g., Davis, 1985; Harris, 1999; Lu, Yu, & Lu, 2001). According to Davis (1989), when the causal relationship between attitude and usage is established, then antecedents or determinants of end user attitude toward the target system are not as difficult to investigate. The antecedents mentioned referred to end-user perception about the easiness and usefulness of the IT system.

From a system design features' viewpoint (Davis, 1985), the TAM identified two vital determinants of end users' attitude toward the technology: Perceived Ease of Use and Perceived Usefulness. The causal relationship of Perceived Ease of Use to Perceived Usefulness is corroborated by Hubona and Blanton (1996). Hubona and Blanton measured the predictive capabilities of Perceived Ease of Use and Perceived Usefulness to three variables: task accuracy, task latency (i.e., response time), and user confidence in decision quality; their findings suggested that users' Perceived Ease of Use affects the three outcome variables much more significantly than users' Perceived Usefulness. This is supported by Igbaria, Zinatelli, Cragg, and Cavaye (1997), who demonstrated that administration/management support coupled with external expert support (e.g., vendors) can influence Perceived Ease of Use and Perceived Usefulness, which, in turn, contributes to system use.

The pattern of the TAM with respect to the models' predictive effect on end-user acceptance has been modestly detected in the past 20 years. Reviewing 22 pieces of TAM-related research, Legris, Ingham, and Collerette (2003) conducted a meta-analysis study on the effect and power of TAM and noted:

1. The TAM has been adopted and deployed in settings using three major types of information systems: office automation tools, software development tools, and business application tools.
2. The TAM has been compared and contrasted with other user acceptance models and theories. For instance, the theory of reasoned action (TRA) and the theory of planned behavior (TPB).
3. Some researchers have interchangeably used two variables: attitude toward the system use and behavioral intention to the system use; some have examined both respectively.
4. The TAM has been adapted and expanded in the literature, where differing causal paths and new external variables were investigated. Frequency and Intensity (or Duration) were treated as the two manifest variables or two sub-scales of Actual System Use, which is the outcome variable, in some relevant studies. Subjective Norms, a latent factor studied in the TRA, was commonly scrutinized in the expanded TAM studies. Computer Self-Efficacy is another popular variable in the literature.

Although these three Canadian researchers were not impressed by the performance of these external variables in their marginal increases on the explained variances of the outcome variable, they claimed that TAM is a useful user acceptance model when it comes to plotting user behavior in an information system.

External Variables

Drawing from Bandura's (1977) Self-Efficacy theory, Computer Self-Efficacy becomes a pivotal issue in technology acceptance. Venkatesh and Davis (1994) defined Computer Self-Efficacy as the degree to which an individual is confident in using the power of the computer for a particular purpose as a result of accumulated, successful prior experiences. In the context of the present study, the starkest difference between the scales used to assess Computer Self-Efficacy and perceived ease of WebCT use is the object upon which each scale is focused. In this study, the Computer Self-Efficacy focuses on computers; the Perceived Ease of Use scale, on WebCT. This readily apparent distinction is not the only one possible because a more subtle difference can be made between self-confidence and Perceived Ease of Use, per se. Self-Efficacy, unlike Perceived Ease of Use defined previously, assesses an individual's confidence in responding to external stimuli, based on previous successful experiences. in this context, Computer Self-Efficacy focuses specifically on an individual's confidence in responding to features central to work processing, e-mail, chat room, course content, and the Internet. Conversely, Perceived Ease of Use assesses confidence, but with the added attribute that previous experience is unnecessary. An individual can perceive a system to be easy to use with little or no prior experience, but instead simply based upon a gross initial impression.

Venkatesh and Davis (1994) reported that users' Perceived Ease of Use is strongly regressed on Computer Self-Efficacy in the early stage of technology acceptance. To their convenience, the authors used Computer Self-Efficacy in the present study to denote Self-Efficacy for online learning systems skills in Web-enhanced courses.

Subjective Norms include users' perception of the external forces and their motivation to comply with the forces (Robinson, 2001). Wolski and Jackson (1999) endorsed this proposition from the perspective of university faculty in the context of faculty development.

RESEARCH METHODOLOGY

This study is a research investigation using structural equation modeling. Derived from Davis' (1985) Technology Acceptance Model (TAM), two hypothetic models were designed to compete with each other in order to verify the role of students' perceived ease of WebCT's use in the presence of two external variables: Computer Self-Efficacy and Subjective Norms and to measure the factor covariance structure differences between the two classes of student participants: the psychology class and the engineering class. The purpose of this study was to answer the following questions:

1. Does student perceived ease of WebCT's use variable remain an exogenous variable in the presence of the two external variables?
2. To what extent does the psychology class differ from the engineering class with respect to factor covariance structures involved in the study.

Design and Sample of the Study

This is a correlational research study of students' use of WebCT in two WebCT-enhanced undergraduate courses in the University of Central Florida (UCF) in Orlando, Florida. This structural equation modeling study with quantitative measurements concentrated on the Web-enhanced hybrid courses, particularly the two large-sized undergraduate courses: PSY2012a General Psychology course and EGN1007a Engineering Concepts and Methods. In the psychology class, 230 out of 239 participants were randomly selected. In the engineering class, all of the 230 participants were included in the analysis.

The rationale for focusing on psychology and engineering students was based upon distinctions between the preparation and prior knowledge of both student groups. Previously, Pan, Sivo, and Brophy (2003) found that the TAM when fitted to psychology student data explained the relationships among factors germane to student acceptance of WebCT. One motivation for this study was to observe whether the constellation of relationships successfully specified to explain the affective response of psychology students to WebCT could be generalized to students in other majors. Indeed, if any alterations are to be made in course design to facilitate student acceptance of technology, the generality of this previous finding must be empirically validated. Psychology students were chosen as a benchmark group, having previously been studied. For a comparison group, engineering students were chosen for two primary reasons. First, in comparison to psychology students, who are in the social sciences, engineering students may serve to represent a field in the hard sciences. Second, the demand of the engineering major is that its students are required to have more technological familiarity and expertise than psychology. Generally, engineering students are expected to have more technological preparation including but not limited to computer technology. Hence, all the scales used to assess constructs pertinent to the TAM are arguably likely to be answered different across the two student groups. Among the number of other majors outside of psychology, engineering, as a very different major, was a choice that would challenge the generality of the TAM, given the tendency for student preparations and prior knowledge differences. In a recent study by Pan, Gunter, Sivo, and Cornell (2005) confirmed that there is indeed a dissimilar manner in which both psychology and engineering classes responded to Self-Efficacy and Subjective Norms scales. The second research question was intended to further explore the response pattern between the two participating groups on two time occasions.

In this article, the causality issue in the belief-attitude-behavior relationship was scrutinized from the students' perspective of WebCT use in the WebCT-enhanced hybrid courses across one semester with an emphasis on students' perceived ease of WebCT's use. Given this context and based on the previous findings, causal pathways among students' Perceived Ease of Use, Perceived Usefulness, Attitude toward Using WebCT, their personal Subjective Norms, Self-Efficacy with regard to WebCT, and Actual Use of WebCT were re-explored.

In this study, the model tested using structural equation modeling software implies certain causal relationships between variables. In many other kinds of correlational research, the idea of modeling causality can be swiftly challenged in that correlation does not necessarily imply causation. In the context of structural equation modeling, however, causality is capable of being assessed though the results are fundamentally based upon correlational data. This is particularly true for models with several variables where theoretical constraints can be placed upon the solution so that a path moving in one direction between two variables actually obtains a different estimated coefficient than a path between the same two variables, specified in the opposite direction. Here, the various constraints placed on the model affect the solution so that the success of one direction of a path can be discriminated from the other direction. The reader is directed to the following works for more on the interpretation of causality specified in structural models when analyzing correlational data: Pearl (1993, 1994, 1995) and Pearl and Verma (1991).

Data Collection and Analysis

Endorsed by the University of Central Florida Institutional Review Board, an online questionnaire with seven varied scales was administered to students in the two courses on two time occasions in the Spring Semester of 2003. The instruments included (1) a Usability Instrument (including Perceived Ease of Use and Perceived Usefulness scales by Davis, 1989); (2) an Attitude Instrument (Ajzen & Fishbein, 1980); (3) a Computer Self-Efficacy Instrument (Lee, 2002); (4) a Subjective Norms Instrument (Wolski & Jackson, 1999); (5) a WebCT Use Instrument (Davis, 1993); (6) a Student Demographic Instrument (Bayston, 2002; Lee, 2002). Sample questions in the instruments aforementioned are as follows:

1. Usability Instrument: "Learning to use WebCT would be easy for me," and "I would find WebCT useful in my course work."
2. Attitude Instrument: The instrument was introduced by a general statement, "All things considered, my using WebCT in my course work is . . ." Students were requested to respond to such scales as "Foolish vs. Wise" and "Negative vs. Positive."
3. Computer Self-Efficacy Instrument: "I feel confident conducting an Internet search using search engines," and "I feel confidence reading a message posted on discussion area."
4. Subjective Norms Instrument: "The instructor thinks that I should use WebCT for my course work," and "My peers think I should use WebCT for my course work."

For the scope of this study, all the variables from the first five instruments were analyzed, which yielded a total of 51 variables (including student achievement variable) for each class. To conduct a categorical analysis to determine the factor covariance structure differences between the two groups as suggested by Marcoulides and Hershberger (1997, p. 252), 102 variables were taken into account in this study. In acknowledging the linear dependency between variables found at the bottom level (Pan, Sivo, & Brophy, 2003; Sivo, Pan, & Brophy, 2004), the authors remained to conduct this study on a factor level. Please consult Appendices A and B for the validity and reliability of the instruments used in this inquiry. Appendices C, D, and E represent descriptive statistics of variables involved and correlation matrix on two different time occasions.

The outcome variables considered in this study were: frequency of WebCT use, intensity of WebCT use, and end of the semester grades. The Frequency and Intensity variables are standard variable considered in Davies' original TAM, and so are considered here. This study focused on grades as well because class objectives typically considered in a course may be sorted into affective as well as cognitive objectives. The heart of the TAM is focusing on the affective domain of the students to better model their reactions to the technology used to manage their class. It would be remiss, however, to not consider the possibility that student affective responses have some impact on student learning. This research has the potential benefit of helping instructors understand student acceptance of classroom technology and perhaps later intervene to facilitate better acceptance. A failure to model any connection between other factors in this model and student grades could potentially undermine the utility of this model in a distinctively educational context.

Data analysis of the present study was composed of two stages: testing the two competing models on both classes separately and examining the factor covariance structure differences between the two classes. After sampling the same number of participants in the two classes, a SEM procedure, PROC CALIS, was used to model all the variables and error terms at one time on a scale level. Then, taking Marcoulides and Hershberger's (1997) suggestion, the authors sought to "fool" the SAS program to undergo a factorial analysis of the two groups, using PROC CALIS, as opposed to EQS or LISREL. PROC PRINT was used to generate covariance matrices prior to the factorial analysis. The debate over use of PROC CALIS in the categorical analysis is beyond the scope of this SEM study.

The following fit indices were examined: Comparative Fit Index (CFI) and the Standardized Root Mean Square Residual Estimate (SRMR). These indices were chosen because of their relative merits. The CFI is an Incremental Fit Index that indicates how much the fit of a model improves upon the nested null model. This index is more sensitive to misspecification between latent and manifest variables relationship misspecifications. The SRMR is more sensitive to latent-latent variable relationship misspecifications.

An assessment of adequate fit in structural equation modeling is not without standard cutoff criteria. In part, the cutoff criteria chosen are the result of Hu and Bentler's (1999) monte carlo simulation findings. The CFI is expected to exceed .95 if the model is to be deemed as fitting well. The SRMR is expected to attain values no higher than .05.

RESULTS

The descriptive statistics calculated for the two groups presented in Table 1 reveal that both groups were overall similar in terms of the variable means and standard deviations.

Although the Engineering students scored a little higher than the Psychology students with respect to Self-Efficacy in terms of computer use, the difference is not pronounced enough to warrant attention, especially given the variability in the scores, as suggested by the standard deviations.

Table 1. Descriptive Statistics for Student Participants

Variable	Mean	Standard deviation
Psychology Class (*n* = 230)		
Perceived Usefulness of WebCT (PU_T1)	30.857	6.731
Perceived Ease of WebCT Use (PEU_T1)	33.522	6.801
Attitude regarding WebCT Use (AT_T1)	28.822	5.136
Self-Efficacy (SE_T1)	169.609	20.252
Subjective Norms (SN_T1)	21.604	3.553
Frequency of WebCT Use (AU21)	4.522	0.704
Intensity of WebCT Use (AU22)	2.061	0.889
Engineering Class (*n* = 230)		
Perceived Usefulness of WebCT (PU_T1)	29.613	6.594
Perceived Ease of WebCT Use (PEU_T1)	33.522	7.080
Attitude regarding WebCT Use (AT_T1)	27.504	5.102
Self-Efficacy (SE_T1)	172.730	23.149
Subjective Norms (SN_T1)	20.961	3.387
Frequency of WebCT Use (AU21)	3.330	1.273
Intensity of WebCT Use (AU22)	2.135	0.982

Research Question One

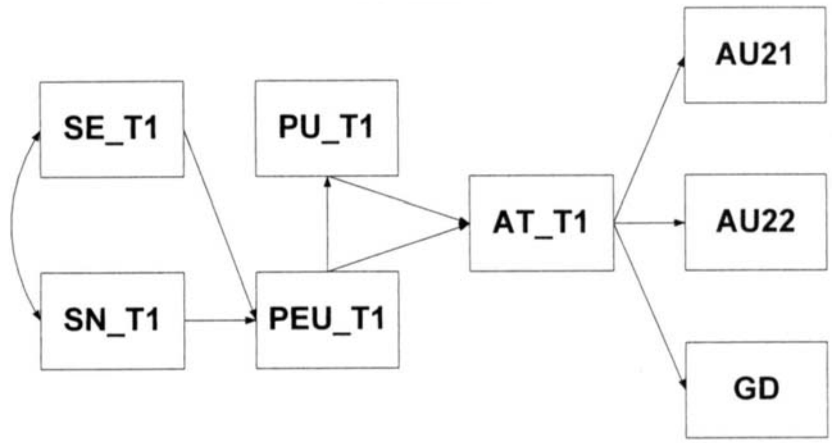
Does student perceived ease of WebCT use remain an exogenous variable in the presence of the two external variables?

To answer this question, two structural models, serving as rival hypotheses were fitted to the covariance data for psychology and engineering students separately (see Figures 1 and 2).

The two extended versions of the Technology Acceptance Model were pitted against one another: Model One specifying perceived ease of WebCT use as endogenous; Model Two, as exogenous.

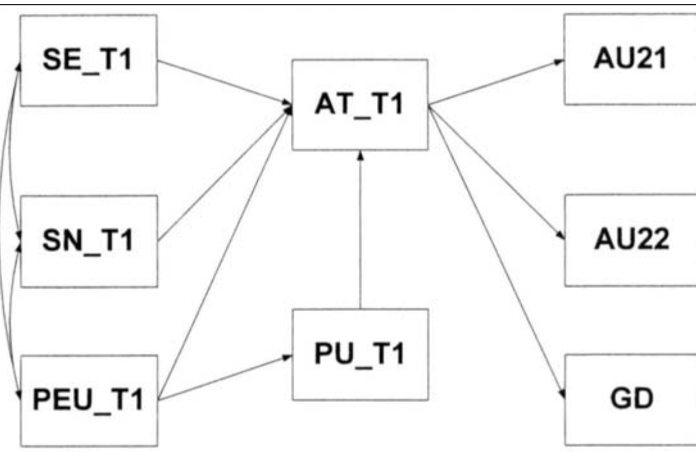
The maximum likelihood procedure was able to successfully converge upon a proper solution for all models fitted to the psychology and engineering covariance data. A review of the fit statistics revealed that the rival models fitted the psychology student covariance data well, but did not do the same with the engineering student covariance data. These findings suggest that both models explain the pattern of responses collected from the psychology students well, but do not explain responses given by engineering students (see Table 2).

Because neither Model One nor Two fit the Engineering student data, further attention will be confined to the Psychology student data. When comparing the fit of Model One and Two to the psychology student data, the difference in fit



Note: SE_T1 = Computer Self-Efficacy at Time 1; SN_T1 = Subjective Norms at Time 1; PEU_T1 = Perceived Ease of Use at Time 1; PU_T1 =Perceived Usefulness at Time 1; AT_T1 = Attitude toward WebCT at Time 1; AU21 = Frequency at Time 2; AU22 = Intensity at Time 2; GD = Grades.

Figure 1. Model One with Perceived Ease of Use as an endogenous variable.



Note: SE_T1 = Computer Self-Efficacy at Time 1; SN_T1 = Subjective Norms at Time 1; PEU_T1 = Perceived Ease of Use at Time 1; PU_T1 =Perceived Usefulness at Time 1; AT_T1 = Attitude toward WebCT at Time 1; AU21 = Frequency at Time 2; AU22 = Intensity at Time 2; GD = Grades.

Figure 2. Model Two with Perceived Ease of Use as an exogenous variable.

Table 2. Fit Results for Rival Models by Student Group[a]

Fit index	Model One: Peceived Ease of Use as Endogenous	Model Two: Ease of Use as Exogenous
Psychology Class		
Bentler's Comparative Fit Index (CFI)	0.9675	0.9797
Standardized Root Mean Square Residual (SRMR)	0.0587	0.0490
Chi-Square	29.9268	23.8224
Chi-Square DF	19	17
Pr > Chi-Square	0.0527	0.1243
Engineering Class		
Bentler's Comparative Fit Index (CFI)	0.8239	0.8709
Standardized Root Mean Square Residual (SRMR)	0.0969	0.8000
Chi-Square	86.2445	66.2865
Chi-Square DF	19	17
Pr > Chi-Square	<.0001	<.0001

[a]Covariance Structure Analysis: Maximum Likelihood Estimation

results is slight, although if Hu and Bentler's (1999) standards for these data were rigidly applied Model Two would be preferred as the SRMR for Model One exceeds the criterion of .05 (at .0587). Moreover, the chi-square statistic for Model One has an associated probability of .0587, although not statistically significant at the .05 level. Beyond these considerations, the coefficients of the paths should be evaluated, with particular attention given to Perceived Ease of Use. Figure 3 presents the coefficients associated with Model One.

The results reveal that neither Frequency of Use nor Intensity of Use are predicted very well by Attitude toward WebCT use, although student final grades were predicted to a statistically significant degree, though a very small degree. Table 3 indicates that only 2.3% of the variation in student grades was explained by Model One.

On the other hand, the variation in scores for Perceived Usefulness of WebCT, Attitude toward WebCT, and Perceived Ease of Use was explained very well, considering the reported R^2's in Table 3. Of the variation in scores for Perceived Ease of Use, approximately 24% can be explained by Subjective Norms and the psychology students' Self-Efficacy ratings. A correlation of .38 was found between the two exogenous variables: Subjective Norms and Self-Efficacy.

The results for Model Two in Figure 4 are comparable to those attained for Model One.

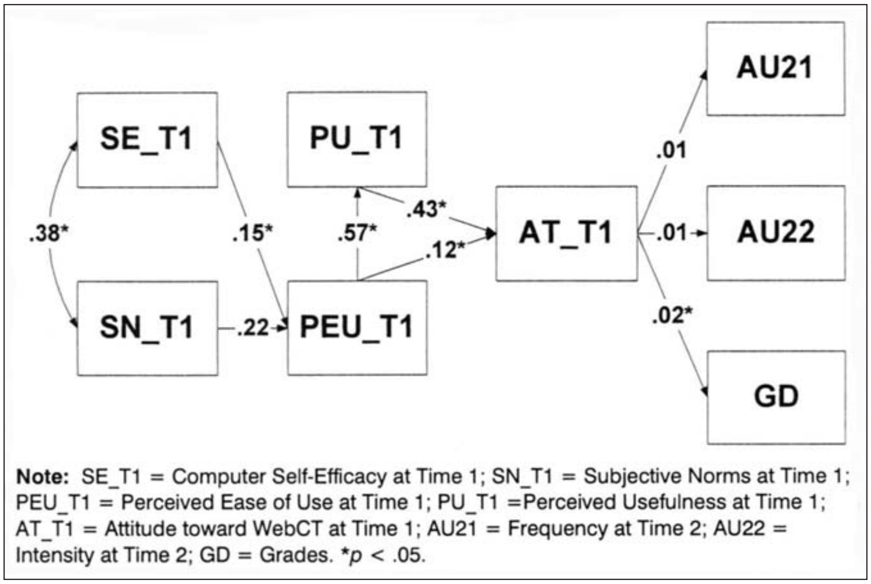
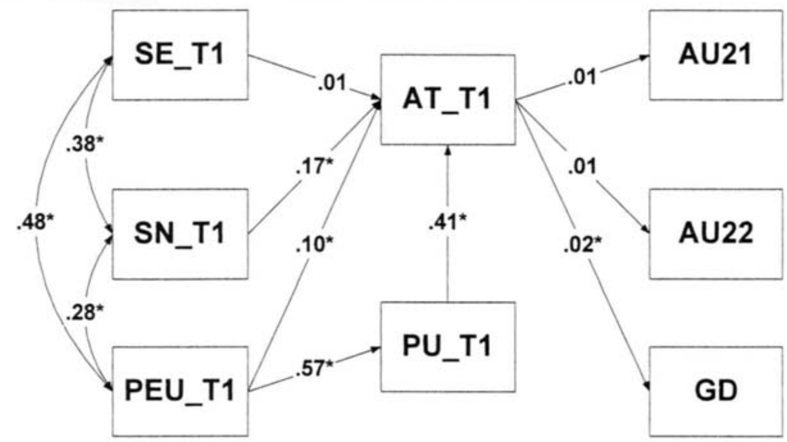


Figure 3. Causal paths associated with Model One fitted to Psychology Student Data.

Table 3. Squared Multiple Correlations for Model One Fitted to Psychology Student Data[a]

Variable	Error variance	Total variance	*R*-Square
PAU21	0.49425	0.49500	0.00152
PAU22	0.78709	0.79100	0.00494
PGD	0.33118	0.33900	0.0231
PAT_T1	14.50291	26.37400	0.4501
PPU_T1	30.38769	45.31100	0.3294
PPEU_T1	35.19718	46.25100	0.2390

[a]PPU_T1 = Perceived Usefulness; PPEU_T1 = Perceived Ease of Use; PAT_T1 = Attitude; PGD = Grades; PSE_T1 = Self-Efficacy; PSN_T1 = Subjective Norms; PAU21 = Frequency of Use; PAU22 = Intensity of Use.



Note: SE_T1 = Computer Self-Efficacy at Time 1; SN_T1 = Subjective Norms at Time 1; PEU_T1 = Perceived Ease of Use at Time 1; PU_T1 =Perceived Usefulness at Time 1; AT_T1 = Attitude toward WebCT at Time 1; AU21 = Frequency at Time 2; AU22 = Intensity at Time 2; GD = Grades. $^*p < .05$.

Figure 4. Causal paths associated with Model Two fitted to Psychology Student Data.

Again, Attitude toward WebCT use predicts neither Frequency of Use nor Intensity of Use, and WebCT Attitude predict student final grades to the same degree. Perceived Ease of Use, along with Subjective Norms and Self-Efficacy, explained a noteworthy proportion of the variation in scores for Perceived Usefulness of WebCT and Attitude toward WebCT, as reported in Table 4.

Moreover, the correlations between Perceived Ease of Use and the other two exogenous variables were not negligible, with Perceived Ease of Use correlating higher with Self-Efficacy ($r = .48$) than Subjective Norms ($r = .28$). In the end, the evidence tilts in favor of Model Two over Model One, if stringent fit criteria are used. The coefficients associated with Perceived Ease of Use are as viable in Model One as they are in the Model Two. Please note that correlations between Perceived Ease of Use and Self-Efficacy, Perceived Ease of Use and Subjective Norms, and Self-Efficacy and Subjective Norms are .48, .28, and .38 respectively.

Research Question Two

To what extent does the psychology class differ from the engineering class with respect to the factor covariance structures involved in the study?

Table 4. Squared Multiple Correlations for Model Two Fitted to Psychology Student Data[a]

Variable	Error variance	Total variance	R-Square
PAU21	0.49425	0.49498	0.00149
PAU22	0.78709	0.79090	0.00482
PGD	0.33118	0.33881	0.0225
PAT_T1	14.12142	25.72644	0.4511
PPU_T1	30.38769	45.31100	0.3294

[a]PPU_T1 = Perceived Usefulness; PAT_T1 = Attitude; PGD = Grades; PSE_T1 = Self-Efficacy; PSN_T1 = Subjective Norms; PAU21 = Frequency of Use; PAU22 = Intensity of Use.

To answer this question, a multi-sample analysis of the covariance structure differences between psychology and engineering students was undertaken on a variable level, with attention given to each scale considered previously in this study: Perceived Usefulness, Perceived Ease of Use, Attitude toward WebCT, Subjective Norms, and Self-Efficacy. When a Multi-sample model fits the data well, the implication is that the groups under comparison have very similar covariance structures underlying the patterns in their responses because such models require path coefficients for one group to be equal to path coefficients for the other group. In other words, each multi-sample model constrains the path coefficients for one group to be equal to path coefficients for the other group.

The fit results suggest that covariance structure differences between Engineering and Psychology students are particularly notable with respect to how they responded to questions on the Self-Efficacy and Subjective Norms scales (represented by a SRMR of .0988 and .0670, respectively), as neither multi-sample model fit well. Both SRMR values exceeded the customary cut-off point of .05.

The manner in which Engineering and Psychology students responded to questions concerning Attitude toward WebCT are, on the other hand, very similar, as suggested by the CFI of .99 and a SRMR of .0255. Similar results were found for Perceived Usefulness and Perceived Ease of Use. This may explain why neither Model One nor Two fit the Engineering covariance data well. Perhaps the way in which the Engineering students responded to the Self-Efficacy and Subjective Norms scales was antithetical to the specification of Models One and Two.

CONCLUSIONS

Instructors are increasingly relying on eLearning management systems such as WebCT. With many student dollars allocated to the adoption of such eLearning management systems to facilitate learning, it is important to consider how best to understand student perceptions and attitudes regarding these systems. The authors' primary intention in conducting this piece of research is to provide instructors with insights in facilitating a learning experience and customizing their instructions for student clients, using an alternative learning technology, in a hope to accommodate the growing UCF student populations with a wide variety of backgrounds. Making a sound decision on the use of an eLearning management system has not always been easy for the university, particularly faculty. This situation can be exacerbated by the limited resources, e.g., manpower and budget. Given the importance of the scholarship of teaching, a prudent approach on the part of instructors would be to study student reactions to the technology used and how to improve them to positively affect their overall learning climate and, indeed, learning itself. The results presented in this current study suggest that extended adaptations of the Technology Acceptance Model are not as suitable for engineering students as they are for psychology students. New or modified TAM models are in demand. Moreover, although both competing models hypothesized are capable of explaining the attitudes of students taking a psychology course, neither ultimately does a very good job of explaining how frequently or how long students make use of WebCT while completing their coursework. Still more, neither model can predict very well the Final Grades that students earn. In the end, with respect to WebCT use, final grades were not associated with the Frequency of WebCT use ($r = -0.0647$, $p = .3290$), and very little with the Intensity of WebCT (i.e., duration of WebCT use per session; $r = .1690$, $p = .0102$). Indeed, the ever slight association existing between Intensity and student grades would suggest that students who used WebCT for longer periods, tended to do slightly less well. This may have been that psychology students were conscientious enough to log on and off WebCT as soon as they got the assignments done or what they needed. Another possible explanation may involve low playfulness or low enjoyment of the WebCT course.

Though we feel the results of this study address an important issue, and the findings illuminate that distinctions may exist between student groups, it is imperative to identify limitations associated with this study. First, this research only applies to one university setting. Its results can only be applicable to similar settings. Because the sample was selected purposively, the study findings may be skewed to some extent. Second, because a simple random sample of either student group was not obtained, the generalizability of these results may be questioned. Although this is true, to this end, we do find that the results obtained for the psychology students in the class studied replicate previous findings for psychology students in a similar class previously examined by Pan, Sivo, and Brophy (2003), Pan, Gunter, Sivo, and Cornell (2005), and Sivo and Pan (in press). These replicated results do suggest that the previous findings are generalizable at the very least to other psychology students at UCF taking a similar class, though further replication is always preferable.

The findings of this study suggest that none of the outcome variables considered were particularly well-explained by student attitudes toward WebCT, but this does not rule out the consideration of student attitude toward WebCT as an end itself inasmuch as a caring instructor would like to know the factors that are at play in student reactions to an eLearning management system. The TAM succeeded in predicting student attitudes suggesting a positive relationship between Attitude and Perceived Usefulness ($\beta = .41$, $t = 9.02$), Perceived Ease of Use ($\beta = .10$, $t = 2.02$), and Subjective Norms ($\beta = .17$, $t = 2.24$), with Perceived Usefulness being most highly predictive of student attitudes toward the eLearning management system. These results suggest that to an instructor who wants to single out one issue to address in order to improve student attitudes toward an eLearning management system, focusing on improving student perceptions of the usefulness of the system would be most beneficial. An instructor concerned about improving the overall climate of the classroom by improving student attitudes toward the required technology in the classroom, in this case WebCT, might make the habit of emphasizing the usefulness of the system throughout the course. Clearly, the instructor, in doing so, will also serve to affect attitudes inasmuch as Subjective Norms influences student attitudes as well. Subjective Norms, as it should be recalled, is grounded, in part, in students' perceptions of instructor expectations. As with significant causal relations of Perceived Ease of Use with Perceived Usefulness and Attitude toward WebCT considered, an eLearning management system, which is made to afford clear and favorable interaction between the instructor/content/system and the learner and between learners may be adopted and used to advantage. With that in mind, instructors are advised to selectively use available features of an eLearning management system that best facilitate effective course activities and promote instructional objectives.

APPENDIX A
Exploratory Factor Analysis

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
PU11	8	69*	11	7	–6	–9
PU12	4	83*	–4	–8	–1	14
PU13	–4	88*	0	–1	3	5
PU14	–6	86*	2	2	3	3
PU15	17	65*	12	8	–4	–4
PU16	7	72*	14	3	–3	–10
PEU11	80*	7	–12	14	–7	–14
PEU12	91*	–7	5	1	–2	–3
PEU13	87*	6	2	–2	1	–4
PEU14	76*	3	17	–10	10	–2
PEU15	86*	3	–3	7	3	0
PEU16	89*	2	2	–1	1	–5
AT11	5	2	81*	10	1	5
AT12	–4	6	79*	–2	6	1
AT13	4	8	82*	–5	3	6
AT14	–1	7	83*	–7	1	–5
AT15	7	6	85*	–9	4	6
SN11	–9	0	9	35	53*	–12
SN12	3	12	8	–6	70*	23
SN13	–1	–11	5	16	69*	–18
SN14	11	0	–14	–9	67*	52
AU11	–3	–10	50	22	–19	33
AU12	–21	5	11	7	4	65*
SE01_T1	–6	–4	18	59*	13	–23
SE02_T1	–1	5	–5	86*	9	–13
SE03_T1	–3	8	–10	90*	11	–2
SE04_T1	12	–1	–2	84*	–6	24
SE05_T1	12	–6	1	79*	–9	32

Printed values are multiplied by 100 and rounded to the nearest integer. *Values greater than 0.52; PU1: Item 1; PU12: Item 2; PU13: Item 3; PU14: Item 4; PU15: Item 5; PU16: Item 6; PEU11: Item 7; PEU12: Item 8; PEU13; Item 9; PEU14; Item 10; PEU15; Item 11; PEU16: Item 12; AT11: Item 13; AT12: Item 14; AT13: Item 15; AT14: Item 16; AT15: Item 17; SN11: Item 45; SN12: Item 46; SN13: Item 47; SN14: Item 48; AU11: Item 49; AU12; Item 50; SE01_T1: Sum of Items 18 to 20; SE02_T1: Sum of Items 21 to 28; SE03_T1: Sum of Items 29 to 36; SE04_T1: Sum of Items 37 to 40; SE05_T1: Sum of Items 41 to 44; Time 1 data of respondents in the two courses used.

APPENDIX B
Reliability Testing

	Cronbach alpha for instruments	
	Time 1	Time 2
Perceived Ease of Use	.942	.954
Perceived Usefulness	.910	.946
Attitude toward WebCT	.926	.944
Computer Self-Efficacy	.969	.982
Subjective Norms	.625	.679

APPENDIX C
Descriptive Statistics of Variables (N = 469)

Variable	Mean	*SD*[a]	Sum	Minimum	Maximum
Time 1					
Attitude toward WebCT	28.22	5.15	13233	11.00	35.00
Perceived Ease of Use	33.56	6.91	15738	6.00	42.00
Perceived Usefulness	30.27	6.68	14197	6.00	42.00
Subjective Norms	17.13	2.62	8033	8.00	21.00
Computer Self-Efficacy	171.13	21.85	80260	30.00	189.00
Frequency	4.08	1.02	1915	1.00	5.00
Intensity	2.15	0.85	1008	1.00	5.00
Time 2					
Attitude toward WebCT	28.64	5.63	13432	5.00	35.00
Perceived Ease of Use	34.60	7.39	16226	6.00	42.00
Perceived Usefulness	30.78	7.64	14434	6.00	42.00
Subjective Norms	16.97	3.22	7960	3.00	21.00
Computer Self-Efficacy	171.39	26.25	80384	27.00	189.00
Frequency	3.94	1.18	1848	1.00	5.00
Intensity	2.09	0.93	982.00	1.00	5.00
End-of-Course Grades	4.78	0.62	2243	1.00	5.00

[a]*SD* = standard deviation.

APPENDIX D
Correlation Matrix on Time One

	AT_T1	PEU_T1	PUS_T1	SN_T1	SE_T1	AU11	AU12	GD
AT_T1	—							
PEU_T1	.47	—						
PUS_T1	.66	.58	—					
SN_T1	.45	.31	.40	—				
SE_T1	.24	.43	.23	.33	—			
AU11	.29	.18	.22	.15	.19	—		
AU12	.05	–.06	.05	.05	–.02	.11	—	
GD	.16	.09	.12	.08	.05	.05	–.09	—

AT_T1 = Attitude toward WebCT on Time 1; PEU_T1 = Perceived Ease of Use on Time 1; PUS_T1: Perceived Usefulness on Time 1; SN_T1 = Subjective Norms on Time 1; SE_T1 = Computer Self-Efficacy on Time 1; AU11 = Frequency on Time 1; AU12 = Intensity on Time 1; GD = End-of-Course Grades.

APPENDIX E
Correlation Matrix on Time Two

	AT_T2	PEU_T2	PUS_T2	SN_T2	SE_T2	AU21	AU22	GD
AT_T2	—							
PEU_T2	.33	—						
PUS_T2	.62	.58	—					
SN_T2	.44	.52	.55	—				
SE_T2	.14	.66	.40	.53	—			
AU21	.33	.14	.31	.20	.03	—		
AU22	.04	.01	.14	.06	–.09	–.06	—	
GD	.17	.06	.08	.04	.02	.06	–.12	—

AT_T2 = Attitude toward WebCT on Time 2; PEU_T2 = Perceived Ease of Use on Time 2; PUS_T2: Perceived Usefulness on Time 2; SN_T2 = Subjective Norms on Time 2; SE_T2 = Computer Self-Efficacy on Time 2; AU21 = Frequency on Time 2; AU22 = Intensity on Time 2; GD = End-of-Course Grades.

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