

A Path Analytic Study of the Determinants of College Students' Motivation to Use Online Learning Technologies

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The objective of the present study was to model and test the extent to which previous success, online learning technology anxiety, and instructor-provided training influenced online learning technology efficacy beliefs, and subsequent motivation to use online learning technologies in the college classroom. The results, based on a sample of 280 students supported the hypothesized causal model. Implications and suggestions for future research are discussed.

Keywords: Online Learning Technology, Motivation, Self-Efficacy

Online learning technologies such as BlackBoard, Semester Book, or Web Board have become increasingly popular in a variety of instructional environments because they make available a range of components that are seen as capable of enhancing learning. These components can include authoring and assembly tools (e.g., multimedia, HTML, XML) that can be used to create learning content; storage and distribution components such as test and resource banks; synchronous and asynchronous interactive components (e.g., email, chat rooms, discussion boards) that allow learners and instructors to build 'real-time' collaborative learning environments; and learning management elements that can be used to direct and administer the learning process (Robson, 2002).

The incorporation of these technological elements into online learning systems is believed to provide a number of significant instructional advantages. For example, these systems are seen as having the ability to overcome the time and place constraints on instruction found in traditional classrooms (Harasim, 1989); make available to students a greater breadth of information about course topics; provide a means to more closely monitor and facilitate student progress; encourage more 'chair-time' and 'time-on-task'; encourage more active participation and interaction; and provide instructors with an increased range of instructional techniques and options.

The introduction of these technologies has also meant that the acquisition of skills using online learning technologies is becoming increasingly important to the success of college and university students. For example, nearly 30% of instructors in colleges and universities utilize some form of instructional technology for course delivery (Goggin, Finkenberg, & Morrow, 1997). Many campuses have computer literacy requirements for their students, and recruiting and retaining technology-competent students is often seen as a key for advancing the reputation of faculty, students, and institution as a whole (Chisholm, Carey, & Hernandez, 2002).

However, there are also questions about how students react to these technologies. For example, some suggest that as many as one-third of college students suffer from technophobia (DeLoughery, 1993), or a fear of computer and information technology. Such fear may be compounded by the instructional demands of online learning technology (OLT) that requires students to use a range of technologies such as e-mail, internet search engines, chat rooms, databases and so on (Kinzie & Delcourt, 1991). Multiple demands of this kind can leave students feeling shocked, confused, at a loss for personal control, angry and withdrawn (Sproull, Zubrow, & Keisler, 1986). These kinds of reaction can easily impair students' belief in their capacity to use and learn from the technology, and undermine their willingness to use them in the future.

Indeed, much of previous research related to computer-based instruction and information technology has tended to focus solely on user attitudes and anxiety and how these constructs are associated with individual difference variables (e.g., gender). However, many of these studies were criticized because they lacked adequate theoretical grounding that would allow for the development of more concrete insights into the causes of individual reactions (Henry & Stone, 1994). On the other hand, one promising area of research, grounded in social learning theory (Bandura, 1982), has focused on self-efficacy as an antecedent to students' motivation to use online learning systems. Using this theoretical foundation, the present study seeks to develop and test a path model describing a number of antecedent variables that influence the efficacy beliefs of college students about using OLT and their subsequent motivation to do so.

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Background

Bandura (1986) defined self-efficacy as a person's confidence in his or her abilities to use and execute personal skills for the purpose of reaching a goal or performing effectively in a given domain of activity. Efficacy beliefs are self-regulatory mechanisms that can influence the motivation (e.g., effort and persistence in using educational information technologies) (Bandura, 1991). Self-efficacy has been related to students' motivation to work harder (Linnenbrink & Pintrich, 2002), and is predictive of people's tendency and motivation to engage in a task (Bandura, 1986; Schunk, 1989).

Individual efficacy appraisals occur most often when people encounter novel, unpredictable or demanding tasks (Bandura, 1982). Thus, students encountering OLT for the first time or applying these technologies to new learning tasks will likely generate and process efficacy information relative to these systems. The resulting efficacy beliefs act as regulatory mechanisms that can influence their "choices about what technologies to adopt, how much to use them, and how much to persist in the face of obstacles to successful use of such technologies" (Compeau & Higgins, 1999, p. 155). In general, research examining self-efficacy's role in individual perceptions and use of computer technology confirms these expectations and has shown that individuals continually make decisions about accepting and using computer technology, and that efficacy beliefs play an important role in these decisions (Venkatesh & Davis, 1996).

A good deal of research over the past two decades has demonstrated that efficacy beliefs influence behavior and performance through effects on direction, intensity, and persistence of effort, three core elements of motivation (Pajares, 1997). Because motivation is primarily concerned with how behavior is activated and maintained, the motivation to use online learning and other information technologies is clearly essential to student learning and success in technology supported courses (Geiger & Cooper, 1996; Graham & Weiner, 1996; Linnenbrink & Pintrich, 2002; Liaw, 2002; Pintrich & Schunk, 2002). From a self efficacy perspective, this suggests that the optimally effective use of OLT will occur in classrooms in which students come with or build positive beliefs about what they are able to do with that technology, set goals for themselves, and plan courses of action for using the technology. In short, they must approach online learning technology as their "problem solving tool of choice" for carrying out course-related learning activities (Holzinger, 1992).

The information on which efficacy beliefs are built can come from a variety of sources. One of the most important is that related to prior mastery experiences (Agarwal & Stair, 2000; Bandura, 1982; Compeau & Higgins, 1995a). Social cognitive theory suggests that previous performance successes, particularly in novel, challenging or difficult situations, help build and reinforce positive efficacy beliefs. Ineffective performance or failures, on the other hand, tend to create doubt and undermine self-beliefs of capabilities (Wood & Bandura, 1989). Thus it is reasonable to expect that college students approach course-related online learning situations with various prior experiences related to the technology being used. Their earlier success in those experiences will be attended to and closely evaluated. The resulting information will be used make judgments about present capabilities, judgments that will likely affect their motivation to use the technology.

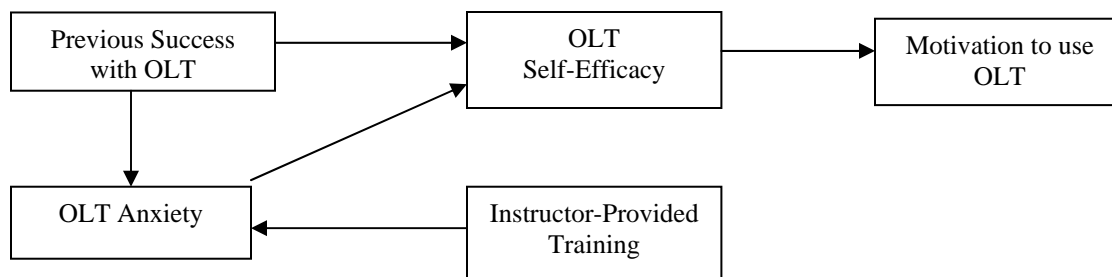
Along these same lines, the successful use of OLT often requires that students understand and apply highly sequenced strategies to complete assignments and meet learning demands. Training can help students learn these strategies and provide opportunities for early successes. Both of these outcomes can lead to the development of positive efficacy beliefs (Torkzadeh & Dwyer, 1994). It is therefore likely that students who receive early on in a course some type of training from their instructor about how to use relevant dimensions of OLT may develop and report more positive efficacy beliefs than students who do not receive such training.

Individual psychological states represent another potentially important source of efficacy information. Strong emotional reactions to a task such as that associated with computer use are believed to provide cues about the level of success or failure that can be anticipated in completing that task (Pajares, 1997). For example, Rohner and Simonson (1981) have defined computer anxiety as the "mixture of fear, apprehension, and hope that people feel when planning to interact or when actually interacting with a computer" (p. 551). Thus when task demands associated with OLT use produce such reactions, students may interpret these to indicate they do not have adequate skills or capabilities to complete the required learning tasks successfully. On the other hand, when anxiety reactions are no longer present (e.g., after the student develops some expertise) the recognition that he or she is no longer reacting negatively could lead to heightened efficacy beliefs.

The Model

The objective of the present study was to model and test the extent to which previous success, OLT anxiety, and instructor-provided training influenced online learning technology efficacy beliefs, and subsequent motivation to use OLT in the college classroom. The research model hypothesized a positive link from previous success to self-efficacy and a positive link from training to self-efficacy. Anxiety is hypothesized to be a function of two constructs: previous success with OLT and instructor-provided training, both of which will presumably reduce anxiety reactions. Anxiety is likely to be negatively associated with online learning efficacy beliefs. Figure 1 presents the hypothesized relationships.

Figure 1. A model of College Students' Motivation to use Online Learning Technology



Methodology

Design

To assess the adequacy of the model and fit to the data, path analysis using LISREL 8.51 (Joreskog & Sorbom, 1993) was used in this study. The application of path analysis provides a way to a) model and estimate multiple and interrelated causal relationships, b) represent unobserved variables or concepts in these relationships and account for measurement error in the estimation process; and c) test a set of relationships concurrently (as a unit) instead of only focusing on bivariate relationships (Hair, Anderson, Tatham, & Black, 1998). One advantage of LISREL is that it provides tests of relationships between constructs that are not attenuated by measurement error (Loehlin, 1987). In addition, statistics representing the goodness of fit between the model and the data can, given supporting theory, provide guidance to model modification and improvement.

Subjects

Subjects in this study were 288 students enrolled in a variety of courses at a large public university in the Southern US. In terms of student status, the sample was diverse, composed of approximately 9% freshman, 8% sophomores, 16% juniors, 33% seniors, 30% Masters students, 3% Ph. D. students, and 2% non-matriculating students. Twenty-seven percent of the students were under 21 years of age, 57% were 21 to 29, and 16% were 30 or older. Eighty-two percent were full-time students. The sample was largely female (72%).

Procedure

Data reported here were collected from students during the last two weeks of the 2001 spring semester. Data were collected from 19 courses that were using a popular educational information technology (Blackboard) as a part of instruction. The graduate and undergraduate courses represented various fields of study including English, Speech and Communications, Business Administration, Social Work, Library Science, and Human Resource Development. Permission to include a particular class in the study was first obtained from the course instructor who was contacted in person or by telephone. Once permission was obtained, one of the authors visited the class, explained the nature and goal of the study, and asked for volunteers to participate in the study. Surveys were distributed and collected in the class at that time.

Instrumentation

A 29-item survey was used in this study. The instrument was developed from several sources. The first part of the instrument, the OLT self-efficacy measure, was adapted from a computer self-efficacy measure developed and tested by Compeau and Higgins (1995; Compeau, Higgins, & Huff, 1999). The Compeau and Higgins scale was modified in the present study to more specifically reflect efficacy beliefs related to the use of online learning technologies. These modifications were important in our effort to infer causal relationships because self-efficacy judgements have the greatest explanatory power when matched to specific tasks and situations. Items in this measure consisted of a stem ("I could complete the online learning requirements of a college course using online

learning technology . . .”) and a series of eight phrases that completed the stem (e.g., “. . . if I had never used technology like it before”). Respondents were asked to rate each completing phrase along a ten-point scale that used three anchors (1 = not at all confident; 5 = moderately confident; 10 = totally confident).

The authors developed the other scales used in the study with the assistance of several content judges who had expertise in the use of educational information technology. Scale items were drafted by the authors and submitted to the content judges for review. Based on their feedback, items were added, dropped or reworded where necessary. A preliminary questionnaire was pilot tested with a group of 38 students and instructors. Feedback from this pilot test led to minor modifications in the wording of several items.

Exploratory factor analysis was conducted to provide some evidence of construct validity for the measures. Factor analysis has been recognized as a “powerful and indispensable method of construct validation” (Kerlinger, 198, p. 247) that “is at the heart of the measurement of psychological constructs” (Nunally & Bernstein, 1994, p. 111). Factor analysis is a data reduction technique that examines the intercorrelations among variables to identify underlying (latent) variables, or factors, that explain the pattern of correlations within a set of observed variables. In short, it is used to identify a small number of factors that explain most of the variance observed in a much larger number of variables. A central question when using factor analysis for construct validation concerns which method to use, exploratory factor analysis (EFA) (also called common factor analysis and principle axis factoring) or confirmatory factor analysis (CFA). Although there are no generally accepted decision rules, most researchers agree that the use of CFA requires the presence of a strong theoretical framework underlying the hypothesized latent variables and indicators. EFA, on the other hand, has no such requirement even though the latent variables may be drawn from a theoretical framework, as were the variables examined in this study. In addition, EFA makes no assumptions about the number of factors (hence its exploratory nature), but can be used in a confirmatory manner when testing for a loosely constructed model believed to underlie data. Some researchers believe the two methods should be used as progressively more rigorous tests suggesting that the measurement models tested in CFA should be based on prior EFA (Bentler and Chou 1987). In the present study, exploratory common factor analysis was used to identify the underlying latent structure of the data. Statistically, EFA is considered more appropriate for scale development in general (Hurley *et al.* 1997) and, in particular, more useful in early stages of scale development because it shows the extent to which items cross-load across different factors, and it represents only the common variance of each item (i.e., it excludes error variance). CFA, on the other hand, does not show cross-loadings and does not exclude error variance (Kelloway 1995).

The results of the factor analysis closely paralleled the hypothesized variables and the following scales and items emerged: OLT self-efficacy (8 items), motivation to use OLT (4 items), previous success with OLT (8 items), OLT anxiety (5 items), and instructor-led training (4 items). All of these scales used a five-point Likert-type scale with values ranging from 1 (strongly disagree) to 5 (strongly agree). Estimates of reliability using Cronbach’s alpha were acceptable for all scales (see Table 1).

Data Analysis

The Pearson product moment correlation coefficient was the statistical measure used to determine the strength of the associations among the hypothesized variables (Table 1). An alpha level of .05 was used to determine the significance of relationships. The maximum likelihood method was used to estimate parameters in the path model. To assess the overall fit of the hypothesized model to the data, six fit indices were examined. These fit indices provided insight into the degree to which the overall path model predicted the observed covariance matrix accurately while minimizing error. Perhaps the most essential measure of overall fit is the chi-square statistic (Joreskog & Sorbom, 1984). Because the chi-square fit indicator index is sensitive to sample size and violations of the assumption of multivariate normality alternative fit indexes were used to complement the chi-square index (Tabachnick & Fidell, 1996). These indexes were the goodness of fit index (GFI) (Bentler, 1980), the adjusted goodness of fit index (AGFI) (Bentler, 1983), the comparative fit index (CFI) (Bentler, 1990), the nonnormed fit index (Byrne, 1998), and the root mean square error of approximation (RMSEA) (Byrne, 1998).

In general, obtaining a non-significant chi-square value suggests model adequacy and fitness to the data. Large chi-square values indicate a poor fit while small chi-square values indicate a good fit. A value of .90 or above for the GFI and AGFI is usually recommended for an acceptable level of fit (Hair *et al.*, 1998). Finally, RMSEA values below .05 indicate very good fit while an RMSEA values between .05 and .08 indicate a moderate fit. Any values above .08 indicate poor fit (Joreskog & Sorbom, 1993). The last two fit indices (CFI and NNFI) are considered incremental fit indices because they measure the proportionate improvement in fit of the proposed model relative to a baseline represented by the null model. These measures have the advantage of being less influenced by sample size when compared to other indices such as GFI. Generally values above .90 are considered sufficient (Byrne, 1998).

Results

Correlations

The correlation matrix shown in table 1 indicated that previous success was associated with OLT self-efficacy ($r = .54, p < .01$); anxiety was negatively associated with training ($r = -.52, p < .01$), previous success ($r = -.62, p < .01$), and OLT self-efficacy ($r = -.57, p < .01$); and OLT self-efficacy was positively associated with motivation to use OLT ($r = .36, p < .01$). Training and self-efficacy showed no meaningful correlation.

Table 1. Cronbach's Alpha, Means, Standard Deviations, and Correlation Coefficients for the Latent Variables

	∇	Mean	SD	1	2	3	4	5
1. OLT self-efficacy	.95	7.28	1.82	--				
2. Previous Success with OLT	.91	3.63	.78	.54**	--			
3. OLT Anxiety	.93	2.19	.97	-.57**	-.62**	--		
4. Motivation to use OLT	.88	3.33	.85	.36**	.68**	-.52**	--	
5. Instructor-led training	.71	3.11	.84	-.01	.18**	-.02	.18**	--

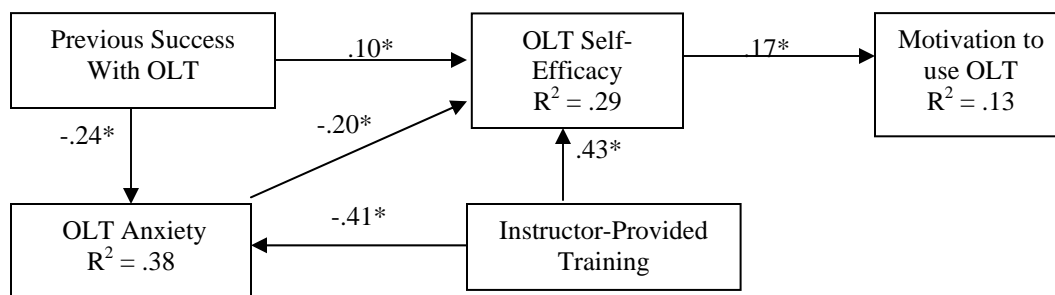
* $p < .05$ ** $p < .01$

Path Analysis

The initial model was moderately consistent with the data ($X^2(3) = 8.78, p = .03$). In this model, the chi-square value was significant. A significant chi-square value indicates that the proposed path model does not completely fit the observed covariances and correlations (Hair et al., 1998). However, the chi-square by itself should not be used as the sole indicator of model fit due to its sensitivity to sample size and violations of multivariate normality. Therefore consideration of other fit indices is considered essential. For example, the values for GFI (.99), AGFI (.94), CFI (.99), and NNFI (.97) indicated that the model fit the data sufficiently (Byrne, 1998). The RMSEA (.08) value indicated that there was a minimal amount of error associated with the tested path model (Byrne, 1998). The standard errors of all the estimates were small enough to say that the estimates are relatively precise. The t-values for the paths were above the absolute value of 1.96 indicating that paths were significant at the .05 level (Joreskog & Sorbom, 1989). Finally, the modification indices provided by LISREL did not suggest any significant changes to improve the model, implying that this model fits the data relatively well. The intercorrelations of the measures presented in Table 1 indicated none exceeded .80, a level commonly regarded as indicative of problems in these kinds of analyses (Hair et al., 1998).

Six separate paths were tested in this model. The results of the path analysis are summarized in Figure 2 which displays the standardized path coefficients (beta weights), as well as the explained variance (R^2) for the dependent variables. As can be seen, all six of the hypothesized paths were supported ($p < .05$).

Figure 2. A model of College Students' Motivation to use Online Learning Technology/Tested



$p < .05$ Note: The path from OLT anxiety to OLT self-efficacy had an R^2 value of .33.

The results of the path analysis are summarized in Figure 2 that displays the standardized path coefficients (beta weights), as well as the explained variance (R^2) for the dependent variables (OLT anxiety, OLT self-efficacy, and motivation to use OLT). The model shows that previous success was related to self-efficacy (beta = .10) and anxiety (beta = -.23). Training was related to anxiety (beta = -.41) and self-efficacy (beta = .43). Anxiety was related to self-efficacy (beta = -.20). Finally, self-efficacy was related to motivation (beta = .17) (see Figure 2). Overall, this model had an adequate predictive power as shown by the R^2 statistic. From this model, 13% of the variance in

motivation was explained by self-efficacy. Furthermore, 29% of the variance in self-efficacy was explained by previous success. Previous success explained 38% of the variance in anxiety, while 33% of the variance in self-efficacy was explained by anxiety.

Discussion

This study represents one of the few efforts to more precisely evaluate the antecedents and causal role of self-efficacy in college students' motivation to use OLT to complete course-related learning activities. According to social cognitive theory, antecedent variables such as students' previous success with OLT, instructor feedback, anxiety, and pre-course training are important because they provide cues used in making self-efficacy judgements that, in turn, can influence student motivation levels. The results are consistent with the conceptualization of self-efficacy as a mediator between previous success with OLT, OLT anxiety, and instructor provided training and motivation to use OLT. Specifically, previous success with OLT was associated with higher levels of self-efficacy and lower levels of OLT anxiety; instructor provided training contributed positively to efficacy beliefs and negatively to OLT anxiety; and OLT anxiety was negatively associated with efficacy beliefs. OLT self-efficacy, in turn, was positively associated with motivation to use OLT. These findings are congruent with a social learning perspective on the development and role of self-efficacy as contributor to the direction, intensity, and persistence of effort related to the use of OLT in the college classroom.

How this Research Contributes New Knowledge in HRD

A major criticism in the design and implementation of online learning systems is that such efforts are often done with little reference to theories of behavior or the principles of learning. For example, Salas and Cannon-Bowers (2001) have suggested that a science of e-learning has yet to evolve and that, until it does, many issues about how to best support and use these systems to enhance learning will remain unanswered. In short, we are only beginning to understand how these systems can best be designed and what factors influence the ability of learners to use these technologies as learning tools. This study represents a theory-based effort to evaluate several fundamental antecedents to the development of OLT self-efficacy beliefs among college students, to examine the role that those beliefs play in student motivation to use online learning systems. The results are consistent with the notion that one of the strongest sources of self-efficacy beliefs is an individual's direct experience with the same or a similar phenomenon. They suggest that, for both trainers in organizational classrooms as well as instructors in higher education settings, attention must be paid early on to setting conditions that enhance the development of positive efficacy beliefs. This includes both efforts to reduce OLT-related anxiety and the development of OLT-related expertise through positive prior experiences or training.

Unfortunately, it is tempting for instructors, when developing instruction with these technologies, to focus on the instructional 'bells and whistles' the technology provides and, as a consequence, to overlook the need to develop students' confidence and capacity to effectively use the technology for learning. This research suggests at least two ways in which this could represent a fatal flaw in the use of online learning technology. First, the value of facilitating student success with OLT is seen in the causal linkage from previous success with OLT to self-efficacy and subsequent motivation, and in the ability of previous success to minimize anxiety reactions to OLT. Secondly, pre-course training was examined in this study to more directly test the role of instructor support activities in fostering self-efficacy beliefs and subsequent motivation to use online learning systems. Pre-course training showed a significant relationship with online learning self-efficacy and a negative relationship with anxiety. Thus students who reported receiving some type of instructor-provided training in the application of OLT to learning activities at the beginning of their courses reported more positive efficacy beliefs about their capacity to use OLT to meet learning demands and significantly less anxiety about doing so than did students who did not receive such training. Although little research has addressed instructor support activities in online learning contexts, these findings suggest that even minimal activities aimed at preparing students to use OLT to meet course learning demands may pay substantial dividends in terms of reducing anxiety, a potential block to the development of positive efficacy beliefs. Thus, preparatory activities such as familiarizing students with the technology, discussing how it will be used to meet learning objectives, and providing opportunities to experience some early successes with the technology appear to be important strategies contributing to the formation of positive attitudes, building strong efficacy beliefs, and motivating students to use OLT.

The findings of this study extend previous research by demonstrating the importance of self-efficacy in enhancing learning-related motivation in environments characterized the use of online learning technologies.

Findings suggest that instructors and trainers should consider the importance of students' anxiety, confidence and motivation when designing classes employing some form of online technology in the teaching and learning process. Moreover, instructors and trainers should consider how to prepare students to use instruction-related technologies prior to class, and how preparatory activities can best be designed to enhance efficacy beliefs and reduce anxiety.

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