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Comparing Four Competing Models in E-Learning System Acceptance

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ABSTRACT

E-Learning system is special in its capability for co-operative and collaborative learning activities through asynchronous and synchronous communications to enhance learning effectiveness. It is also about meeting instructor and peer learners in the virtual community, solving problems together, and expecting feedbacks and interactions. It is wondered which theoretical framework in technology acceptance would be the most appropriate for such technology. In a literature review of prior IS studies on technology acceptance, four competing models were found with extensive empirical support. This study aims at empirically testing these four competing models applying to an e-learning system. At last, their predicting and explanatory power is compared. Discussions, implications and limitations were given in the last section.

INTRODUCTION

According to IDC, the global e-learning corporate market would exceed US$23 billion by 2004, up from $1.7 billion in 1999 and would be rising at a startling compound rate of nearly seventy percent a year (Kelly, 2001). Organizations are working hard to strive for the full potential of E-learning systems, including tailor-made program for individual learners (e.g., Shichtman & Ting, 2004).

E-Learning System

To differentiate how e-Learning system differs from traditional classroom teaching, this study first started with a review of prior studies, including the implementation of virtual classroom (Hiltz, 1986); the theoretical analysis of how information technology assists teaching and learning (Leidner and Jarvenpaa, 1995); and the theoretical and empirical work on web-based virtual learning environments (Piccoli et al., 2001). In summary, e-learning system was distinguish from a typical technology in several aspects: (1) Communication tools provided in the system would not do anything good to the user if the user did not use them to find people to interact with; (2) Quality of learning material provided in the system varied significantly, ranged from discipline, instructor, and learners composition; (3) Therefore, e-learning system did not only directly related to expected benefits; but also involved people (the user, the instructor, the peers); process (collaborative learning; learners' virtual community); and the system technology (utilizing the integral computer and communication resources and tools). This study aimed at utilizing prior validated acceptance models to empirically test an e-learning system using in an institution and comparing the models for their explanatory and predictive power on e-learning system's acceptance.

LITERATURE REVIEW

There were several models and their derivatives which received considerable concerns and empirical support in the study of technology acceptance.

Theory of Reasoned Action (TRA) & Theory of Planned Behavior (TPB)

TRA, Theory of reasoned action (Fishbein & Ajzen, 1975), was among one of the earliest. Fishbein proposed that a person's intention to perform a given behavior was a function of two basic determinants, one attitudinal and the other normative. The attitudinal component referred to the person's attitude toward performing the behavior in question; the normative component (i.e., the subjective norm) was related to the person's beliefs that relevant referents thought he should or should not perform the behavior and his motivation to comply with the referents. Thus the formation of a given intention depended on the prior formation of a particular attitude (i.e., attitude toward the behavior in question) and of a particular belief (i.e., subjective norm) (p.332). TRA was well supported by empirical studies in itself as a whole (e.g., Davis et al., 1989). On the other hand, Ajzen proposed another theory, named the theory of planned behavior, TPB (e.g., Ajzen 1985). This was an extension of the theory of reasoned action. It included an additional construct, perceived behavioral control, to explain intention, in addition to the two original two constructs, attitude toward the behavior and subjective norm. Perceived behavioral control referred to the perceived ease or difficulty of performing the behavior and it was assumed to reflect past experience as well as anticipated impediments and obstacles. It was suggested to address the problem of incomplete volitional control in which the theory of reasoned action did not capture. In the ninety's, more empirical research supported the use of TPB as whole or as a part to explain acceptance (e.g., Chau & Hu 2001). However, perceived behavioral control was somewhat similar to those measured by perceived ease of use (Davis, 1989, p.323) or self-efficacy (Compeau et al., 1999, p.146), to be discussed in the following paragraphs.

Technology Acceptance Model (TAM)

Davies (ibid, 1989) developed and empirically tested a technology acceptance model (TAM). Two specific beliefs, perceived usefulness and perceived ease of use, were hypothesized to be fundamental determinants of user acceptance. Perceived usefulness was defined as "the degree to which a person believes that using a particular system would enhance his or her job performance," (p.320). A system high in perceived usefulness, in turn, was one for which a user believed in the existence of a positive user-performance relationship. On the other hand, perceived ease of use referred to "the degree to which a person believes that using a particular system would be free of effort," (p.320). All else being equal, an application perceived to be easier to use than another was more likely

to be accepted by users. There were significantly vast number of empirical IS studies thereafter validated the model and expanded its applicability to a number of technologies, subject domains, and organizational contexts (e.g., Legris et al., 2003).

Social Cognitive Theory (SCT1) & Application of Social Cognitive Theory (SCT2)

However, while TAM "focus almost exclusively on beliefs about the technology and the outcome of using it", Social Cognitive Theory included other beliefs that might influence behavior, independent of perceived outcomes (Compeau et al., 1999, p.146). According to Social Cognitive Theory, SCT, watching others performing a behavior influences the observers' perceptions of their own ability to perform the behavior, or self-efficacy, and the expected outcomes that they perceive, as well as providing strategies for effective performance. The application of self-efficacy in the study of technology acceptance was found empirically supported (e.g., Taylor & Todd, 1995) to intentions and to use. On the other hand, to apply self-efficacy as a factor to specifically anchor on computer technology, a computer self-efficacy scale was developed (Compeau & Higgins, 1995). Computer self-efficacy (CSE) was defined as an individual's beliefs about his or her capabilities to use computers. The scale was then well received as an important determinant or antecedent to the use of computer and specific technology in a number of empirical studies (e.g., Hu et al., 2003). This application model of social cognitive theory (referred to as SCT2) developed by Compeau et. al. included computer self-efficacy, anxiety and affect which had direct effect on computer usage.

MOTIVATION

A review of the previous literature found that there were rarely studies on the acceptance of learning system technology. However, web-based learning system was getting popular and important to both the academic and the practitioners. It was wondered whether the same conclusion could be drawn from the results of the previous IS acceptance studies. It was also wondered which was the best appropriate model framework to the study of such technology. Therefore, this study tried to fill this gap in investigating the acceptance of the e-learning system technology through the comparison of a number of competing models available to date. A unified model was also suggested and was included in the comparison to see if there existed such a better composite model.

THEORY AND HYPOTHESES DEVELOPMENT

Unified Model on Technology Acceptance

From the above literature review and the findings of prior empirical studies, several constructs were found to be directly related to the intention to use of a system. A number of hypotheses to this unified model were suggested as below.

From the Theory of Reasoned Action, normative component of TRA dealt with the influence of the social environment on intentions and behavior (Ajzen & Fishbein, 1980, p.57). It referred to the person's subjective norm which was his perception that most people who were important to him thought he should or should not perform the behavior in question. Previous studies on acceptance found that subjective norm was both a significant predictor to intention and actual usage, directly and indirectly (e.g., Taylor & Todd, 1995). With reference to the usage of an e-learning system, Interactive Learning Network (ILN), significant others might be the institution, the department, the instructor, the peers, or even the family members or friends. According to such theory, the following hypothesis (H1) was proposed.

H1: `The more a student perceived that others who were important to him thought he should perform using ILN behavior, the more he would intend to do so; conversely, if they believed important others thought they should not perform using ILN behavior, they would intend not to do so.

From the Technology Acceptance Model (e.g., Davis, 1989), perceived usefulness of a system is positively related to the intention to use of the system. ILN, as also a technology advancement, would be expected to perform similarly as other systems that perceived usefulness would be the determinants to ILN's acceptance. Thus, we proposed another hypothesis (H2).

H2: Individual's beliefs in perceived usefulness of using ILN was directly related to his/her intention to use the ILN.

From Social Cognitive Theory (e.g., Hill et al., 1987), if an individual had a higher self-efficacy, he/she would have more confident in his/her behavior towards the object, and so did ILN (e.g., Compeau & Higgins, 1995). Therefore, we proposed the following hypothesis (H3).

H3: The higher the individual's computer self-efficacy, the higher his/her intention to use the e-learning system ILN.

From Technology Acceptance Model, perceived usefulness mediates perceived ease of use towards intention to use. Perceived ease of use because of its indirect effect is omitted from this unified model. On the other hand, instrumental belief in SCT (Hill et al., ibid) is conceptually equal to perceived usefulness in TAM. Therefore, in the unified model, subjective norm, computer self-efficacy and perceived usefulness were included for testing.

RESEARCH METHODOLOGY

Background

A local institute was just employed to use an e-learning system, named Interactive Learning Network (ILN) in the second term of the new academic year. The e-learning system included course management, communication, assessment functions available for both the instructors and the learners. The use of e-learning system was purely voluntary, and none of the subjects had any prior knowledge of the system.

Subjects

Diploma and undergraduate students of a local institution using the e-learning system ILN were selected for this study. There were 86 male respondents (35.8%) and 154 female respondents (64.2%). Their age ranged from below 19 to over 24, where the majority was between 19 to 21 years old (N=123, or 51.3%) and 22-24 years old (N=113, or 47.1%). Among them, 149 (62.1%) respondents were taking in the diploma program, 87 (36.3%) in bachelor program and 4 others. They came from various departments, including Accounting (59, or 24.6%), Business Administration (87, or 36.3%), Chinese Language & Literature (2, or 0.8%), Counseling & Psychology (46, or 19.2%), Economics (13, or 5.4%), Journalism & Communication (18, 7.5%), Social Work (8, or 3.3%), Sociology (6, or 2.5%) and others (1, or 0.4%). They had different levels of competence in computer applications.

Data Collection Method

The study employed a survey type data collection method. A questionnaire with a cover letter was uploaded onto the e-learning system ILN. Students were asked to complete the online questionnaire within two weeks time in the middle of the second semester of the academic year where ILN was launched in the second semester. In Part A, students were asked to identify their gender, age, course programs, affiliated departments, and their computer competence in various applications. In Part B, underlying model constructs items were listed, asking respondents to identify their own preference to the listed statements, referenced to a Likert's scale, ranging from 1 (strongly disagree) to 7 (strongly agree) (Survey instrument is available upon request). All the students using the ILN for their course gave a reply within two weeks time. There was no missing data, out of the 240 respondents.

FINDINGS

Reliability and Validity Check

Constructs were tested internal consistence with Cronbach's alpha. The alpha values of all constructs were above 0.86 and were significantly higher than the typically accepted threshold value of 0.7 (Nunnally & Bernsteain, 1974). Principal component analysis extraction method with Varimax rotation (Kaiser normalization) method were used to analyze the constructs. It was found that all the construct items exhibited significant high loadings within the same construct (all over 0.665) with no significant cross-loading among constructs. It shows that all the constructs exhibit discriminant validity and convergent validity (Netemeyer et al., 2003).

Model Testing Results

Confirmation of Prior Models

Confirmatory factor analysis confirmed all the indicators of each construct. Model fit were analyzed with Chi-square to degree of freedom ratio; root mean square residual; and three more goodness-of-fit indices. The results were summarized in Table 1.

Unified Model of Technology Acceptance

This model consisted of factors influenced intention to use, including perceived usefulness, subjective norm, and computer self-efficacy. The overall model-fit indices were acceptable. It was found that only perceived usefulness and computer self-efficacy had significant direct effect on intention to use the e-learning system. Subjective norm was found negative and non-significant on intention to use the e-learning system. The R-square of intention to use of the e-learning system is 0.58. Detailed path coefficients were summarized as below.

DISCUSSIONS

The first part of the analysis was a validation of prior models. The focus was on the confirmation of the models' applicability in the e-Learning system context, especially the validity of the models. To understand and reduce measurement error of the multi-item instrument measure used in this study, reliabilities of the constructs were evaluated, using Cronbach's alpha values. The reliability Cronbach's alphas ranged from 0.8625 to 0.9377. Suggested by Nunnally & Bernstein (1994, pp. 264-265), in the early stages of predictive or construct validation research, a reliability of .70 was acceptable. If significant correlations were found about the constructs, a reliability of .80 should be attained. On the other hand, increasing reliabilities much beyond .80 in basic research was often wasteful of time and money. As all the reliability alpha values attained were well above .80, the instrument was found reliable.

Before relationship to have any meaning, each measure must validly measure what it is purports to measure (Nunnally & Bernstein, 1994, p.85). The construct validity of the instrument was evaluated with both convergent and discriminant validity. Convergent validity refers to the degree to which two measures designed to measure the same construct are related. Convergence is found if the two different measures of the same construct are highly correlated. On the other hand, discriminant validity assesses the degree to which two measures designed to measure similar, but conceptually different, constructs are related. A low to moderate correlation is often considered evidence of discriminant validity (Netemjeyer et al., 2003, p.13). Exploratory factor analysis was used as precursors to confirmatory factor analysis to evaluate both convergent and discriminant validity. Exploratory factor analysis shown a both convergent and discriminant validity of the constructs: there were no significant cross loading across constructs; while factor loadings of the corresponding items were all exceeding 0.6. Thereafter, the use of confirmatory factor analysis helped finalize the factor structure and confirmed the theoretical factor structure. The results were shown that all factor structures postulated in the theory development were confirmed. The relationships among the constructs were analyzed using structural equation modeling (SEM). All the models suggested by prior research were found valid and reliable. Goodness-of-fit indices of each individual model were found acceptable, as threshold values suggested by Hair et al. (1998).

All of the theoretical models were parsimonious in nature. There were two constructs for the three models and three constructs in the remaining model, in determining acceptance. Therefore, there would not be significantly more explanatory power to acceptance if they had the same R^2. However, as they resulted in different R^2 values, the higher the R^2, the higher would be the explanatory power to the observed variance, and hence, the higher would be the predictive power in acceptance. Results shown that social cognitive theory with instrumentality beliefs and self-efficacy gave the highest (R^2=0.58); social cognitive theory with self-efficacy, affect, and anxiety was the second (R^2=0.56); technology acceptance model with perceived usefulness and perceived ease of use the third (R^2=0.48); while theory of reasoned action with attitude and subjective norm was the last (R^2=0.45).

Table 1. Summary of Goodness-of-Fit Measures of Competing Models and Unified Models

Goodness-of-fit measure	Recommended value*	TRA	TAM	SCT1	SCT2	UTA
Chi-square / degree of freedom	≤3.0	3.0	3.2	3.3	3.6	3.0
Comparative fit index (CFI)	≥0.90	0.96	0.93	0.93	0.90	0.92
Non-normed fit index (NNFI)	≥0.90	0.95	0.92	0.92	0.88	0.91
Goodness-of-fit index (GFI)	≥0.90	0.90	0.83	0.82	0.79	0.82
Root mean square approx (RMSR)	<0.08	0.042	0.048	0.045	0.081	0.047
R^2		0.45	0.48	0.58	0.56	0.58
Adjusted R^2		-	0.34	-	0.29	-

**Recommended values were adapted after Hair et al. (1998).*

CONCLUSION

E-learning systems are unique and distinct. It is not just to provide a technology for a user to use alone to enhance his or her performance, but also a system provided for users to access at any time and at any place to both learning material and other users in the learning community. Users can get the corresponding learning material, however, more importantly; users can get the guidance from the interaction with the instructor and also with the peer learners as well. Therefore, the usefulness of the system does not just depend on the technology, but also the participation of other users. We argue that the traditional technology model, which aims at identifying the technology component, does not explain the whole picture in explaining the acceptance of the system. In this study, we firstly validated four competing models in explaining technology acceptance. It was found that all four competing models were valid and reliable. The explanatory and predictive power was comparable with each other. Then, we further analyzed the data with a unified model. We found that the unified model was valid and reliable. Model fit indices shown that the model was a good fit to the data. Although there was no additional predictive power resulted as there was no significant increase in R-square (the variance explained). However, the unified model provided a better explanatory power through the better picture revealed from the relevant constructs including in the model. It also widened the scope of the implications to implementation strategies on e-Learning systems to both practitioners and academics.

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