

## Technology Acceptance Model and E-learning

Maslin Masrom

*Universiti Teknologi Malaysia City Campus*

[maslin@citycampus.utm.my](mailto:maslin@citycampus.utm.my)

### Abstract

The technology acceptance model (TAM) proposes that perceived ease of use and perceived usefulness predict applications usage. The study-in-progress investigated TAM for work-related tasks with the e-learning, and used TAM as a basis for hypothesizing the effects of such variables on the use of e-learning as the application. E-learning has become an increasingly popular learning approach in higher education institutions due to the rapid growth of Internet technologies in Malaysia. It has been integrated in many university programs, and is one of the new learning trends that challenge the banking concept of education (i.e. assumes that the instructor or teacher owns the knowledge and deposits it into the students who attend the class). E-learning is not intended to replace the traditional classroom setting, but to provide new opportunities for interaction and communication between students and instructor or teacher. This study focuses on the individual users' acceptance investigation for the e-learning in universities as an effective learning tool. It develops a technology usage model for the e-learning. The contributions of this study are three fold. First, this study may help identify whether learners or users would like to accept e-learning or vice versa. Second, this study will help to determine what are the factors that significant in explaining the intention towards e-learning. An attempt is made whether attitudinal belief such as perceived ease of use and perceived usefulness has relationship towards the e-learning adoption. Third, this study is among the first to use the technology acceptance model in the context of e-learning.

**Keywords:** Technology acceptance model, Perceived ease of use, Perceived usefulness, Attitude toward using, Behavioral intention to use

### 1. Introduction

The recent technology infusion has caused participation and communication methods in traditional university classrooms to change. In this context, the use of electronic learning or e-learning is increasingly prevalent in many higher educational institutions (HEIs) or universities in Malaysia. E-learning exists because of computer technology. There are many definitions about e-learning, but here e-learning is defined as learning facilitated and supported through the utilization of information and communication technologies (ICTs) (Jenkins & Hanson, 2003). Based on this definition, e-learning concept is the use of ICTs (e.g. Internet, computer, telephone, radio, video, and others) to support teaching and learning activities. A growing number of public and private universities throughout the nation are employing e-learning methodologies either to offer academic programs via distance or to support their full-time on-campus learners (OUM, 2004). E-learning is also known as online learning. The pedagogical thinking around e-learning is closely related to the computer-based training. The point is to deliver courses for students. E-learning system can be developed in various ways depend on the requirement of the HEIs. Some of HEIs only limited to course materials delivery through web, and the others have had integral framework for their e-learning system to be used for regular students and distance students. Hence, students can now use technology to receive class notes or information, take assessments, and communicate whenever and wherever the need arises.

University students are becoming more diverse and demand for e-learning based courses is increasing (Volery & Lord, 2000). Factors determining acceptance and use of the e-learning need to be uncovered in order to assist development of the system. Effective implementation of an e-learning initiative requires that a number of issues be taken into account, including technological, pedagogical, and individual factors. However, the lack of theoretical or conceptual frameworks in many past studies dealing with the effectiveness of e-learning system resulted in inconsistent results and left the question of what constitute the determining factors of effective delivery of e-learning unanswered.

The advent of e-learning technology has recently made training, teaching and learning feasible on the Internet. E-learning is essentially any form of education that is facilitated by the Internet and its technologies, and encompasses the use of the World Wide Web to support instruction and to deliver course content. Alavi and Leidner (2001) pointed out that e-learning represents one form of technology mediated learning, which is defined as “an environment in which the learner’s interactions with the e-learning materials...,peers, and/or instructors is mediated through advanced information technologies”. In order for e-learning to work, the technology must actually be used (Leidner & Jarvenpaa, 1993). And the effective use of ICTs in delivering e-learning based components of a course is of critical importance to the success and student acceptance of e-learning.

ICT adoption and diffusion has been studied in great detail lately by researchers in the information systems area. It can be studied at two levels: the first is at the organizational level and the other is at the individual level. If the unit analysis is an individual, the emphasis is on the acceptance of technology (Dasgupta, Granger & McGarry, 2002). In information systems research, the user’s attitude toward using and the actual usage of a technology are addressed in the technology acceptance model (TAM) (Davis, 1989; Davis, Bagozzi & Warshaw, 1989). TAM is an intention-based model developed specifically for explaining and/or predicting user acceptance of computer technology (Hu et al., 1999). It has been used as the theoretical basis for many empirical studies of user technology acceptance (Adams, 1992; Mathieson, 1991; Davis, Bagozzi & Warshaw, 1989 & Davis, 1989). Technology acceptance was defined as “an individual’s psychological state with regard to his or her voluntary or intended use of a particular technology” (Hendrick et al., 1984). Therefore, in this paper TAM is used to study the acceptance of the e-learning technology. The research presented here is motivated and guided by two main questions. First, do students (learners or users) would like to accept e-learning or vice versa? Second, what are the factors that significant in explaining the intention towards e-learning?, that is, do the attitudinal beliefs such as perceived ease of use and perceived usefulness has relationship towards the e-learning adoption? In other words, this study examined TAM in an academic setting, investigating the factors affecting students’ acceptance of e-learning technology.

The remainder of this paper is structured as follows. Section 2 describes the theoretical framework for this study of acceptance of e-learning in the classroom. Section 3 presents the research methodology. Section 4 presents the results and analysis. Section 5 discusses the results of the study. Section 6, conclusions and recommendations are provided.

## **2. Theoretical Framework**

The technology acceptance model (TAM) was first created by Davis (1989), based on the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975) in psychology research. The TRA posits that individual behavior is driven by behavioral intention where behavioral intention is a function of an individual’s attitude toward the behavior and subjective norms surrounding the performance of the behavior. In other words, it states that ones behavior and the intent to behave is a function of one’s

attitude toward the behavior and their perceptions about the behavior. Therefore, behavior is the function of both attitudes and beliefs. TRA is presented in Figure 1 below.

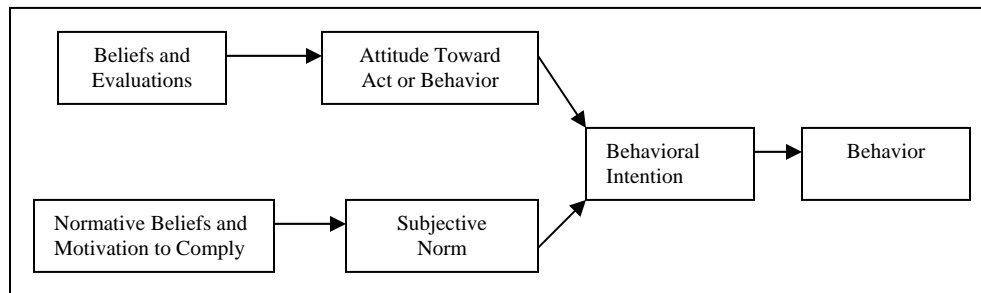


Figure 1. Theory of reasoned action

Meanwhile, TAM proposes that perceived ease of use and perceived usefulness of technology are predictors of user attitude towards using the technology, subsequent behavioral intentions and actual usage. Perceived ease of use was also considered to influence perceived usefulness of technology. Figure 2 presents original version of TAM (Davis, 1989).

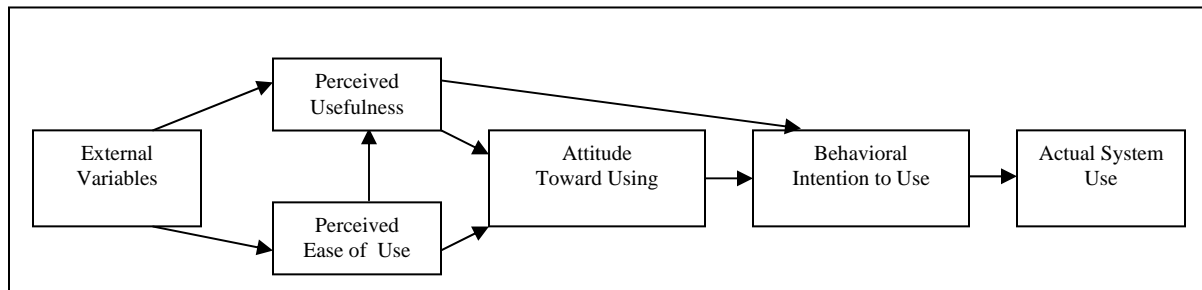
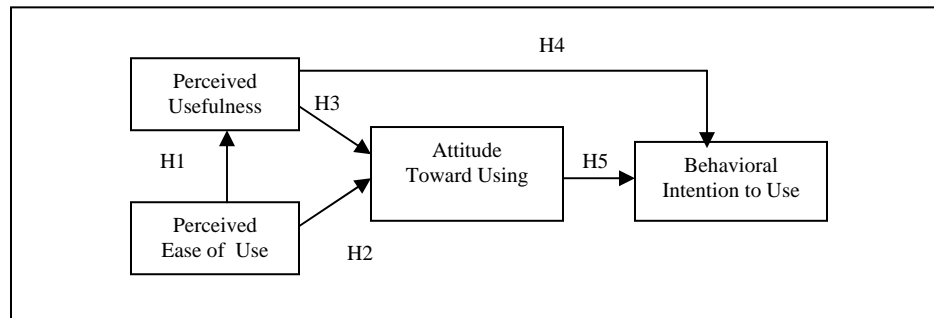


Figure 2. Original technology acceptance model

TAM has been applied in numerous studies testing user acceptance of information technology, for example, word processors (Davis et al., 1989), spreadsheet applications (Mathieson, 1991), e-mail (Szajna, 1996), web browser (Morris & Dillon, 1997), telemedicine (Hu et al., 1999), websites (Koufaris, 2002), e-collaboration (Dasgupta, Granger & McGarry, 2002), and blackboard (Landry, Griffeth & Hartman, 2006). In this study, the e-learning was considered a system that makes use of Internet and web technology in accomplishing its mission of delivering information to and interacting with the students through a computer interface.

In TAM, *perceived usefulness* refers to the degree to which the user believes that using the technology will improve his or her work performance, while *perceived ease of use* refers to how effortless he or she perceives using the technology will be. Both are considered distinct factors influencing the user's attitude towards using the technology, though perceived ease of use is also hypothesized to influence perceived usefulness and attitude towards using the technology. Finally, such attitude towards using the technology determines the behavioral intention to use that technology. Figure 3 depicts the research model employed in the study. It is a reduced TAM model, excluding actual system use. The external variables constructs are also not included in the research model as there is no immediate intention to examine antecedents to perceived usefulness and perceived ease of use.



**Figure 3. The research model (A technology usage model for e-learning)**

Therefore, the research hypotheses based on the diagram of the TAM model in the context of the e-learning system are:

- H1: Perceived ease of use has a significant effect on the perceived usefulness of the system.*
- H2: Perceived ease of use has a significant effect on attitude towards using.*
- H3: Perceived usefulness has a significant effect on attitude towards using.*
- H4: Perceived usefulness has a significant effect on intention to use.*
- H5: Attitude towards using has a significant effect on intention to use.*

### 3. Research Methodology

#### 3.1 Sample

A survey was conducted on students of the Science Department at College of Science and Technology, University Technology of Malaysia (UTM) *City Campus* to evaluate the application of TAM to the e-learning system. UTM had started implementing the use of e-learning since 1997. The major aim is to assist faculty in the delivery of courses. Using this system, instructors (or lecturers) are able to post course outlines, schedules, and lecture notes on the system for students. Course access is restricted to students enrolled in that course, which is similar to an intranet network. Students enrolled in database course were the test subjects for this study. The subjects were drawn from among diploma students (N=198) who were using the e-learning in their courses. Each participant was asked to fill out a single-page questionnaire indicating his or her agreement or disagreement with each statement on a 7-point Likert-type scale with the end points being “strongly disagree” and “strongly agree”. Scale items appearing on the survey were adapted from scales measuring variables in Davis et al. (1989). The measurement items used in this study are shown in *Appendix*.

Sample demographic information with respect to age and gender was also taken for potential control purposes in data analysis. Responses were received from 122 subjects, giving a response rate of around 62% (N=122). Descriptive statistics collected from the survey showed the majority of the subjects were computer-savvy, and most spent over 10 hours a week on the Internet. Slightly over half of the respondents (55%) were female, and the respondents' age varied from 18 to 23 years (Mean = 20.4 years, SD = 0.90), reflecting the population from which sample was drawn.

### 3.2 Measures

Measurement validity in terms of reliability and construct validity was evaluated. The reliability analysis was conducted in order to ensure the internal validity and consistency of the items used for each variables. Hair et al. (1998) recommended that Cronbach alpha values from 0.6 to 0.7 were deemed the lower limit of acceptability. An alpha of more than 0.7 would indicate that the items are homogeneous and measuring the same constant. Table 1 shows the reliability of the measurement scales. Cronbach's alpha reliability scores were all over 0.8, which is considered very good (Nunnally, 1978). Hence, the results demonstrate that the questionnaire is a reliable measurement instrument.

Scale	Cronbach's alpha
Perceived ease of use	0.89
Perceived usefulness	0.89
Attitude towards using	0.85
Intention to use	0.85

**Table 1. Cronbach's alpha (Reliability)**

To examine construct validity of measures adopted in this study, a factor analysis was performed. Principal factor analysis with varimax rotation was conducted to assess the underlying structure for the fifth teen items of the TAM questionnaire. Four factors were requested, based on the fact that the items were designed to index four constructs: perceived ease of use, perceived usefulness, attitude toward using and intention to use. After rotation, the first factor accounted for 21.46% of the variance, the second factor accounted for 18.40%, the third factor accounted for 14.97%, and the fourth factor accounted for 11.05%. Table 2 displays the items and factor loadings for the rotated factors, with loadings less than 0.60 omitted to improve clarity.

Scale Item	Factor Loading			
	1	2	3	4
USE3	0.77			
USE4	0.70			
USE1	0.70			
USE2	0.60			
EASE1		0.75		
EASE2		0.74		
EASE4		0.70		
EASE3		0.61		
INT3			0.78	
INT1			0.71	
INT2			0.61	
ATT1				0.91
ATT4				0.79
% of variance explained	21.46	18.40	14.97	11.05
Cumulative percentages	21.46	39.86	54.83	65.88

Principal axis factoring was used with varimax rotation and Kaiser normalization, N = 122

Rotation converged in six iterations.

Factor 1 = Perceived usefulness; Factor 2 = Perceived ease of use; Factor 3 = Intention to use;

Factor 4 = Attitude toward using

**Table 2. Factor loadings for the rotated factors**

All factor loadings were 0.6 or above, showing good convergent validity (Chesney, 2006). The constructs are therefore unidimensional and factorially distinct, and all items used to operationalize a constructs load onto a single factor.

#### 4. Results and Analysis

The research model shown in Figure 3 was tested using Statistical Analysis System (SAS) software. No significant correlation was found between participants' age and gender and the two dependent variables namely, attitude and intention to use. These demographic variables were dropped from further analysis.

Separate linear regression analyses were conducted based on 122 completed surveys collected from the study. In testing Hypothesis 1 (H1), a regression analysis was performed, with perceived ease of use as an independent variable and perceived usefulness as the dependent variable. Table 3 presents the regression results used to test H1.

	$\beta$	Standard Error of $\beta$	t	p	R <sup>2</sup>
<i>Perceived ease of use</i>	.749	.062	12.392	<.001	.558

**Table 3. Regression results for H1**

As indicated in Table 3, perceived ease of use had a significant influence on perceived usefulness ( $\beta = .749$ ;  $p < 0.001$ ). Thus, Hypothesis 1 (H1) was supported.

Hypothesis 2 (H2) and Hypothesis 3 (H3) were tested by regressing both perceived ease of use and perceived usefulness on attitude towards using the e-learning. Table 4 provided results from the regression analysis for both H2 and H3.

	$\beta$	Standard Error of $\beta$	t	p	R <sup>2</sup>
<i>Perceived ease of use</i>	-.322	.114	-2.635	< .05	.140
<i>Perceived usefulness</i>	.557	.125	4.562	<.001	

**Table 4. Regression results for H2 and H3**

As shown in Table 4, both perceived ease of use and perceived usefulness have a significant influence on attitude toward using. Accordingly, H2 and H3 are both supported.

Hypothesis 4 (H4) and Hypothesis 5 (H5) were tested through a third regression model, with perceived usefulness and attitude regressing upon intention to use. To control for the indirect influence of perceived usefulness on intention to use through attitude, a stepwise regression was performed in which perceived usefulness was entered in step one and attitude toward using was entered in step two. Results for H4 and H5 are presented in Table 5.

	$\beta$	Standard Error of $\beta$	t	p	$R^2$
<i>Perceived usefulness</i>	.637	.075	8.875	<.001	.399
<i>Attitude toward using</i>	.009	.051	.121	>.05	

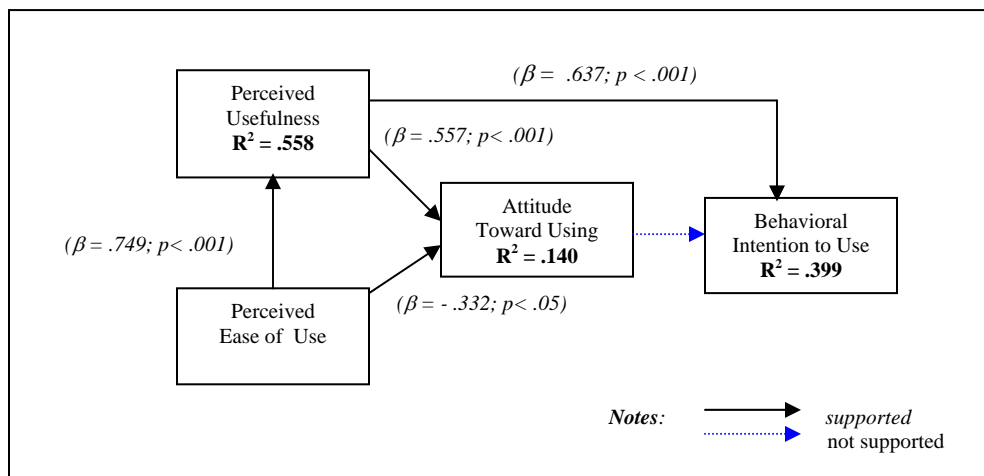
**Table 5. Regression results for H4 and H5**

Consistent with prior research (Davis, 1989 & Hu et al., 1999), perceived usefulness had a significant effect on intention to use, with  $p < 0.001$ . The effect of perceived usefulness and attitude toward using explains 39.9% of the variance of usage intentions by students. While perceived usefulness had a significant effect on intention to use, attitude toward using did not. Thus, Hypothesis 4 (H4) was supported, but Hypothesis 5 (H5) was not supported.

Table 6 summarizes the results of the hypotheses testing, and Figure 4 shows these results.

Hypothesis	Relationship tested	Results
H1	Perceived ease of use has a significant effect on the perceived usefulness of the system.	Supported ( $p < 0.001$ )
H2	Perceived ease of use has a significant effect on attitude towards using.	Supported ( $p < 0.05$ )
H3	Perceived usefulness has a significant effect on attitude towards using.	Supported ( $p < 0.001$ )
H4	Perceived usefulness has a significant effect on intention to use.	Supported ( $p < 0.001$ )
H5	Attitude towards using has a significant effect on intention to use.	Not supported ( $p > 0.05$ )

**Table 6. Summary of hypotheses testing**



**Figure 4. Results of regression analyses**

## 5. Discussion

This study examined TAM using student acceptance of e-learning technology. Overall, TAM was partially supported. Based on data collected from 122 students, the utility of TAM for explaining acceptance of e-learning technology by students was evaluated. Results showed that perceived usefulness is more important in determining intention to use than attitude toward using. In agreement with what TAM postulates, perceived usefulness was found to have a significant influence on students' intention to use the technology, that is, it is in accordance with Davis (1989) who found attitude toward using was at best a partial mediator of the effect of perceived usefulness on intention to use, and that it added little causal explanatory power. An explanation might be that students are willing to adopt beneficial applications of e-learning, and this may suggest that students tend to focus on the usefulness of the technology itself. In this context, providing proper user training is essential for directing and solidifying students' perception of the usefulness of the technology. Furthermore, perceived usefulness and perceived ease of use were also found to have a significant effect on attitude towards using the technology. Contrary to what TAM hypothesizes, attitude was found to have no effect on intention to use. These might reflect limitations of TAM's applicability with respect to technologies, user populations, or both. Compared with prior TAM studies, the model appeared to have relatively weaker utility for explaining students' attitude formation and intention development. TAM appears to lack adequate specificity to explain and enunciate attitude and intention of students. The results of this study show that TAM can be used to explain the students acceptance of e-learning technology.

## 6. Conclusions and Recommendations

This study represents research in examining the applicability of TAM to explaining students' acceptance of the e-learning technology within the academic setting. The model was evaluated using data collected 122 students studying at College of Science and Technology, UTM *City Campus*. Several implications can be drawn from the findings of the study. First, an important contribution is the use of a preeminent intention-based model in an educational context, which differs considerably from the business organizations ordinarily studied in previous research. From a managerial standpoint, the findings of this study reveal that, in order to foster individual intention to use a technology, positive perception of the technology's usefulness is crucial, whereas the students' attitude toward using the technology may not be equally important. Training and information sessions on e-learning need to focus primarily on how the technology can help improve the efficiency and effectiveness of students' learning process rather than on the procedures of actual use of the technology. In conclusion, TAM is not a descriptive model, that is, it does not provide diagnostic capability for specific flaws in technology, it can serve the purpose of evaluating and predicting technology acceptability

The author analysis indicates two recommendations. First, to expand the theoretical validity of the literature, reexamination of TAM with another student or user population and different information technology (IT) application will be important. Second, the study did not test a full TAM. Actual technology use was not included in the research model. Continued studies that incorporate actual technology use into the research model would enable an increasingly complete examination of the applicability of TAM in explaining or predicted IT acceptance by students. Second, future studies should also not be limited by the original TAM. Davis (1993) suggested additional factors to be included in the original TAM such as prior usage, user experiences, and user characteristics. Accordingly, future studies should investigate the role of adding such variables to those originally used in the model.



## Acknowledgements

I would like to thank the Diploma of Computer Science students at College of Science and Technology, University Technology Malaysia for their cooperation on this project.

## References

- Adams, D. A., Nelson, R.R. and Todd, P.A. (1992). Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS Quarterly*, 16, 2, 227-247.
- Alavi, M. & Leidner, D.E. (2001). Research commentary: technology-mediated learning-a call for greater depth and breadth of research. *Information Systems Research*, 12,1-10.
- Chesney, T. (2006). An acceptance model for useful and fun information systems. *Human Technology*, 2(2), 225-235.
- Dasgupta, S., Granger, M. & McGarry, N. (2002). User acceptance of e-collaboration technology: an extension of the technology acceptance model, *Group Decision and Negotiation*, 11, 87-100.
- Davis, F.D. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-339.
- Davis, F.D., Bagozzi, R.P., & Warshaw, P.R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, 35(8), 982-1003.
- Davis, F.D., Bagozzi, R.P., & Warshaw, P.R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology*, 22, 1111-1131.
- Davis, F.D. (1993). User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies*, 38(3), 475-487.
- Fishbein, M. & Ajzen, I. (1975), *Belief, attitude, intention and behavior: an introduction to theory and research*. Reading, MA: Addison-Wesley.
- Hu, P.J., Chau, P.Y.K., Sheng, O.R.L., & Tam, K.Y. (1999). Examining the technology acceptance model using physical acceptance of telemedicine technology. *Journal of Management Information Systems*, 16(2), 91-112.
- Jenkins, M. & Hanson, J. (2003). *E-learning series: A guide for senior managers*, Learning and Teaching Support Network (LSTN) Generic Centre, United Kingdom.
- Koufaris, M. (2002). Applying the technology acceptance model and flow theory to online consumer behavior. *Information Systems Research*, 13 (2), 205-223.
- Landry, B.J.L., Griffith, R. , & Hartman, S. (2006). Measuring student perceptions of blackboard using the technology acceptance model. *Decision Sciences*, 4(1), 87-99.
- Leidner, D.E. & Jarvenpaa, S.L. (1993). The information age confronts education: case studies on electronic classrooms, *Information Systems Research*, 4, 24-55.
- Mathieson, K. (1991). Predicting user intentions:comparing the technology acceptance model with theory of planned behavior. *Information Systems Research*, 2(3), 173-191.
- Morris, M.G., & Dillon, A. (1997). The influence of user perceptions on software utilization: application and evaluation of a theoretical model of technology acceptance, *IEEE Software*, 14(4), 56-75.
- Neter, J., Kutner, M. H., Nachtsheim, C.J., & Wasserman, W. (1996). *Applied linear statistical models* (4<sup>th</sup> ed.). Burr Ridge, IL:Irwin.
- Nunnally, J.C. (1978). *Psychometric Theory*, (2<sup>nd</sup> ed.). New York: McGraw-Hill.
- OUM (2004). KTKM-OUM Research on E-Learning Readiness in Malaysia concept paper.
- Studenmund, A.H. (2001). *Using econometrics: A practical guide* (4<sup>th</sup> ed.). Reading, PA:Addison-Wesley.
- Szajna, B. (1996). Empirical evaluation of the revised technology acceptance model. *Management Science*, 42(1), 85-92.

Volery, T. & Lord, D. (2000). Critical success factors in online education. *The International Journal of Educational Management*, 14(5), 216-223.

## APPENDIX

### Measurement items used in the study

#### Perceived Ease of Use (PEOU)

---

EASE1: I found E-learning easy to use.  
 EASE2: Learning to use E-learning would be easy for me.  
 EASE3: My interaction with E-learning was clear and understandable.  
 EASE4: It would be easy for me to find information at E-learning.

#### Perceived Usefulness (PU)

---

USE1 : Using E-learning would enhance my effectiveness in learning.  
 USE2 : Using E-learning would improve my course performance.  
 USE3 : Using E-learning would increase my productivity in my course work.  
 USE4 : I found E-learning useful.

#### Attitude Toward Using (ATTITUDE)

---

ATT1: I dislike the idea of using E-learning. (R)  
 ATT2: I have a generally favorable attitude toward using E-learning.  
 ATT3: I believe it is (would be) a good idea to use this E-learning for my course work.  
 ATT4: Using E-learning is a foolish idea. (R)

*Note:* R = reversed item

#### Intention to Use (ITU)

---

INT1: I intend to use E-learning during the semester.  
 INT2: I will return to E-learning often.  
 INT3: I intent to visit E-learning frequently for my course work.