E-Learning: Investigating University Student's Acceptance of Technology

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Abstracts

English

Information Communication Technology (ICT) is reshaping form and mode of delivery of higher education world wide. Some of the main challenges in education are access issues, and costs. In order to overcome those challenges ICT can play an important role. The application of ICT in the education sector can be referred to as e-learning, and comprises the use of various web-based technological tools with the purpose of disseminating education. The purpose of this study is to investigate what determines university students' acceptance of e-learning by applying the technology acceptance model (TAM). The study was conducted at a Swedish University among business students. The results demonstrate that Perceived usefulness is the main determinant of a student's acceptance of e-learning.

Swedish

Informations- och kommunikationsteknik (IKT) innebär en ny form och leveransmetod för högre utbildning världen över. Några av de stora utmaningarna inom utbildning är tillgänglighet och kostnader. IKT kan spela en viktig roll för att övervinna dessa utmaningar. Tillämpandet av IKT inom utbildningssektorn kan benämnas e-learning, och innefattar användandet av diverse webbaserade teknologiska hjälpmedel med syfte att sprida utbildning. Syftet med denna studie är att undersöka vad som avgör universitetsstudenters acceptans av e-learning, genom att tillämpa Technology Acceptance Modellen (TAM). Studien har utförts vid ett svenskt universitet bland ekonomistudenter. Resultaten visar att den upplevda användbarheten är det som huvudsakligen avgör studentens acceptans av e-learning.

Keywords

English

E-learning, TAM, Higher education, ICT, University, Internet.

Swedish

E-learning, TAM, Högre utbildning, IKT, Universitet, Internet.

Introduction

In today's information society, knowledge and know-how are some of our most valuable assets, setting the education sector under pressure to deliver according to demand. Major challenges in education include access issues, i.e. being able to provide education to everyone who requests, costs (of providing education) and declining public revenues with most of education still being in responsibility of the public sector (Daniel 1997). Many believe that the application of advancing ICT to education might help overcoming those challenges (Daniel 1997; Shirley 2001). Advances in technology as well as the increasing competition among education providers are reshaping higher education worldwide, driving universities to apply ICT to their teaching and learning in order to meet their stakeholders' needs.

Applying ICT to education is also referred to as e-Learning (i.e. electronic learning). Nichols (2003) defines e-learning as constituting *"the use of various technological tools that are either web-based, web-distributed, or web-capable for the purposes of education"*. E-Learning in higher education may include anything ranging from support for teachers in their traditional classroom teaching to complete courses thought electronically over a geographical distance (Keller & Cernerud 2002). It provides new ways of designing and delivering education to students (Mallak 2001) and can change the ways in which things work, how students learn and teachers teach (Landry et al. 2006). Common functions and services of e-learning technology that can be offered to students for instance include news updates and announcements, downloading of class documents, taking assessments, and the opportunity to communicate with other students or teachers whenever needed (Landry et al. 2006).

The benefits e-learning can bring to both students as well as teachers are commonly recognized. Those benefits particularly stem from the facilitated information exchange and the more collaborative learning (Keller & Cernerud 2002). ICT have the potential to improve service quality, i.e. the quality of teaching and learning, improve access to education and training, while at the same time reducing costs and improving the overall cost-effectiveness of educational services (Bates 1997). Moreover, just as in many other areas to which ICT are applied, e-learning brings more power to its users, as those users (the students) can become more (inter)active rather than being passive listeners (Landry 2006).

Since the use of personal computers nowadays is part of our everyday life, ICT and Internet-based tools have become valid parts of many learning environments (Landry et al. 2006). However, there are still certain issues that can hinder e-learning unfolding its benefits to universities, students and teachers. According to Mallak (2001) such hinders include the adoption rate of e-learning systems, but also costs and infrastructure requirements of an e-learning system. If not well planed and designed universities can spend an awful lot of money on new technologies and applications that in the end turn out to be a waste of money and time. It is crucial for universities to know if the shift to ICT-based learning and the services coming out of that really is what their students (and teachers) want and appreciate (Mallak 2001).

Landry et al. (2006) state that as education through applying the "e" becomes more interactive it is extremely important for designers of such systems to know what students value and what they find useful. Keller & Cernerud (2002) and others call for research on students' perspectives of e-learning systems in higher education with a particular focus on determinants of such perceptions. Yet, much of the literature on e-learning is more of a description on what the teacher could do or has done online, while the students' experience of those activities goes largely undocumented (Shirley 2001; Keller & Cernerud 2002). Most of the literature found on e-learning is more of descriptive nature and very practice-based as well as the focus often is on the technology or system itself rather than on theoretical contributions and implications (Nichols 2003). Yet, this would help transfer the knowledge to other tools and contexts. This study aims at investigating the issue of technology acceptance of an e-learning system by students and its determinants. The purpose of this study is to investigate determinants of the acceptance of e-learning by university students.

The remainder of this paper is structured as follows. In the following section, technology acceptance theory is presented and discussed, which builds the theoretical framework for this investigation. After having established the theoretical ground this studies' research objective is presented and hypotheses are put forward. Thereafter, the methodology is outlined and discussed. Finally, the results are presented and discussed, conclusions drawn and implications, limitations as well as avenues for further research outlined.

Conceptual Background

Several models have been developed with the intention of explaining and predicting usage of information technology. Among them, the Technology Acceptance Model (TAM), developed by Fred Davis in 1989, has gathered considerable support. It has been widely examined, validated and replicated (Davis et al. 1989; Adams et al. 1992; Venkatesh & Davis 2000; Hu et al. 2002;) and has become a *"robust, powerful and parsimonious model for predicting user acceptance"* (Venkatesh & Davis 2000). TAM has its roots in the Theory of Reasoned Action (i.e TRA) which was brought forward by Fishbein and Ajzen in 1975. TRA is based on the premise that *intention* is the main determinant of a person's actions or *actual behaviour*. Two constructs influence a person's behavioural intention: a*ttitude* toward a behaviour and *subjective norm* or social pressure to carry out the behaviour or not. In TRA the *beliefs and evaluations* affecting *attitude* refer to what the individual thinks about the consequences that could arise from the behaviour as well as the personal evaluation of desirability of these consequences. *Normative beliefs and motivation to comply (*which affect *subjective norm)* would be understood as the opinion of the reference group versus the motivation of the individual to act in accordance with that opinion. The TRA was designed to explain human behaviour in general; it could be applied to a wide variety of contexts (Davis et al. 1989).

Davis (1989) used TRA as his paradigm to develop a model that could specifically explain and predict *"user acceptance of computer based information systems"* (Davis 1989). The Technology Acceptance Model (i.e. TAM) adapted TRA by replacing several of its measures with two key constructs: *perceived usefulness* (PU) and *perceived ease of use* (PEOU)**.** According to Davis(1989 p. 320) *perceived usefulness* is defined as *"the degree to which a person believes that using a particular system would enhance his or her job performance". Perceived usefulness* is expected to be influenced by perceived ease of use as *"the easier a technology is to use the, more useful it can be"* (Venkatesh & Davis 2000, p. 187). *Perceived ease of use* is defined as *"the degree to which a person believes that using a particular system would be free of effort"* (Davis 1989, p. 320). It is a process of expectancy while perceived usefulness is an outcome of expectancy (Venkatesh 1999).

TAM's dependent variable is actual usage. This model explains how the key constructs (PU and PEOU) mediate the external variables, affect a person's *attitude* and help determine the *intention* of an individual to adopt a specific technology and later use it. The model does not include subjective norm. Still, TAM does explain variance in intention better than TRA (Davis et al. 1989).

Many studies have tested the validity of TAM and many have extended the model in order to address different contexts and populations, include constructs like those related with social influence and overall, extend its explanatory and predictive power. (Davis et al. 1989; Adams et al. 1992; Venkatesh 1999; Venkatesh & Davis 2000; Hu et al. 2002; An 2005). According to Adams et al.(1992) TAM can be useful in different settings. It can be employed to obtain feedback on features or design approaches, to diagnose problems of acceptance or to select between software applications. In research, it can be used to identify factors influencing success of information systems, understand IT diffusion and determinants of adoption.

TAM in E-Learning

Several authors have used TAM in an educational settings (Saadé & Galloway 2005; Liu et al. 2005; Roca et al. 2006; Landry et al. 2006). Landry et al.(2006) and Saade & Galloway (2005) made use of TAM to measure student's acceptance of web-based e-learning tools. In both studies TAM was found to perform well with the main hypotheses being supported and a total variance in usage intentions explained with a little less than 40% (Saade & Galloway 2005). Landry et al.(2006) found usage to be determined by the two TAM constructs perceived ease of use and perceived usefulness and could furthermore find support for the two dimensions suggested for perceived usefulness, namely perceived effectiveness and perceived importance. The relationship between university students' perceptions of *ease of use* and *usage* of Blackboard elements was fully supported but varied at different levels. As originally hypothesized by Davis(1989); Landry's et al.(2006) findings suggest that if students perceive Blackboard to be *easy to use*, they would also perceive Blackboard to be *useful*. This could be confirmed also by Saade & Galloway (2005). Usefulness turned out to be the strongest determinant of usage intentions (Landry et al.. 2006).

In order to predict a user's acceptance behaviour of e-learning Liu et al. (2005) developed a theoretical framework to explain students intentions to a e-learning system using TAM and flow theory. Additional variables that were investigated are different *presentation types* (Text audio, Audio-video. Text-Audio-video) and *concentration*. Liu et al.(2005) found the difference in *presentation types* as well as *concentration* to have a significant impact on usage intentions.

Roca et al.(2006) investigate student's intention to continue using an e-learning system. As the focus is on continued use, a satisfaction construct is proposed. Roca et al.(2006) suggest that the impact of the two TAM variables *perceived usefulness* and *perceived ease of use* on *continued use* is mediated by the *satisfaction*. By making use of TPB (including *behavioural control* and *subjective norm*) as well as expectation disconfirmation theory (EDT), Roca et al. (2006) break down the component perceived performance into *perceived quality* and *perceived usability* and further propose the constructs *information quality*, *confirmation*, *service quality*, *system quality* and *congitive absorption* as antecedents of satisfaction. Roca et al. (2006) found support for their proposed model, yet again, perceived usefulness turned out to be the strongest determinant.

Objective and Hypotheses

As indicated in the literature review, TAM has been identified as one of the most established models on technology acceptance, but has not been very widely applied to e-Learning. This, and the fact that acceptance and usage of technology are such crucial issues to those implementing it, gives reasonable motivation for the application of the TAM as theoretical framework for this investigation. The intention of this study is to investigate university student's acceptance of e-learning by applying the TAM with an herewith twofold objective. First, the aim of this paper is to investigate university student's acceptance of a particular e-learning system, which is done by using the three variables proposed by Davis(1989) in TAM that directly and indirectly determine an individual's intention to use a system. This would provide valuable insights for university executives and teachers in order to succeed with implementing and utilizing the e-learning system. Secondly, this paper aim's at applying the TAM to a new context, contributing to current TAM literature. In order to achieve this, the following hypotheses needed to be tested, having the four main constructs of the TAM and their relationships to each other as the base (the research model and hypotheses are visualized in Figure 1 below):

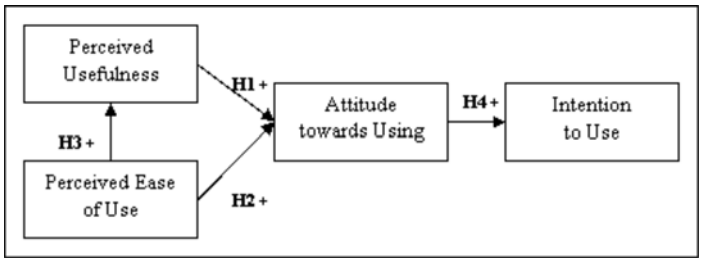

Figure 1. Research Model and Hypotheses based on TAM as suggested by Davis(1989)

An individual's perceived usefulness of an e-learning system is expected to have a significant impact on an his/her attitude toward using it. Thus, a first hypothesis is posed:

H1: *Perceived usefulness will have a positive effect on the university student's attitude towards using the e-learning system.*

Apart from the usefulness of an e-learning system, TAM furthermore suggests an individual's perception of its ease of use to be influencing the individual's attitude toward using system:

H2: *Perceived ease of Use will have a positive effect on the university student's attitude towards using the e-learning system.*

Another argument put forward by Davis(1989) is that an individual will only perceive a system to be useful as long as it is sufficiently easy to use. Hence, a third hypothesis is posed as:

H3: *Perceived ease of use will have a positive effect on perceived usefulness.*

Finally, one of the main assumptions of TRA which is held on to in TAM is that an individual's attitude toward a certain behaviour will influence the individual's intention to perform this behaviour. Thus, a final hypothesis is formulated as follows:

H4: *The university's students attitude towards using the e-learning system will have a positive effect on their intention to use the e-learning system.*

Method

Undergraduate business students at a Swedish University who have access to a particular virtual learning environment, called Fronter, built the sample for this investigation. Students where chosen based on the likelihood of their current or potential involvement with e-learning. Fronter, which was selected as the tool to assess, is a web based program for learning management in the European educational sector. It is a platform via which information can be exchanged between students and professors. In virtual classrooms students have notice boards, calendars, file managers, etc. and can share documents and communicate with each other through this website (Fronter.com).

Earlier measurement scales of *perceived usefulness*, *perceived ease of use*, *attitude*, and *intention to use* that are based on the originals put forward by Davis (1989) were obtained from prior studies (Keller & Cernerud 2002; Hu et al. 2002; Landry et al. 2006), using a seven-point Likert scale with anchors ranging from strongly agree to strongly disagree. The constructs and their factors used in the questionnaire can be found in Appendix A.

As most of the items were obtained directly from literature, the validity of the instrument was re-evaluated to ensure its applicability. Experts from the marketing faculty as well as three students evaluated the questionnaire to ensure face and content validity of the instrument. Furthermore, a small pilot study was conducted on 16 students with the aim of testing data collection procedures. The pre-testing and the pilot study led to some small modifications of the questionnaire. Students who took part in the pilot study were excluded from the subsequent formal study. For the formal study, 200 questionnaires were distributed to undergraduate business students attending different study programs within a business education.

Results and Analysis

Of those 200 questionnaires distributed, 120 were completed and returned, showing a 60 percent response rate. About 94.2 percent of respondents had used Fronter before; therefore, seven of the returned questionnaires were partially completed and they were excluded from the data analysis, resulting in an effective response rate of 56.5 percent. Most of the respondents are 20 to 24 years old; the male-to-female ratio is approximately 0.8 to 1 (fairly balanced); and 79.2 percent of respondents are Swedish.

Reliability was evaluated using Cronbach's alpha. As shown in Table 1 below, the values are either close to or above .70. Although the numbers are not as high as those obtained in some prior studies that had used the same items, they are in a range that is deemed acceptable, based on common threshold values recommended by the literature (e.g. Nunnally 1994).

Table 1. Descriptive statistics and Cronbach's Alphas

	Mean[a]	Standard Deviation	Cronbach's alpha	Skewness	
				Statistic	Std Error
Perceived usefulness (PU)			0.897		
PU1	4,22	1,557		-,279	,227
PU2	4,59	1,629		-,617	,227
PU3	4,44	1,493		-,361	,227
PU4	4,15	1,525		-,154	,227
PU5	4,14	1,608		-,054	,227
PU6	4,57	1,567		-,477	,227
Perceived ease of use (PEOU)			0.900		
PEOU1	5,25	1,584		-,788	,227
PEOU2	4,56	1,705		-,158	,227
PEOU3	4,94	1,611		-,626	,227
PEOU4	4,04	1,598		,115	,227
PEOU5	4,63	1,524		-,219	,227
PEOU6	4,58	1,683		-,301	,227
Attitude (ATT)			0.700*		
ATT1	5,62	1,472		-1,128	,227
ATT2	5,28	1,372		-,873	,227
ATT3	4,67	1,397		-,401	,227
Intention to use (ITU)			0.843		
ITU1	4,49	1,817		-,155	,227
ITU2	4,14	1,957		-,100	,227
ITU3	4,65	1,751		-,451	,227
ITU4	4,97	1,544		-,502	,227

[a] : number of respondents is 113, *: Outliers have been replaced with mean

The responses are widely spread throughout all items, with some student's indicating minimum levels on the scale while others indicated maximum scores on the same item. Looking at the mean however, we see that in all cases the mean lies between 4 and 5, which is more to the middle of the scale spectrum. Thus, we can infer that the data points lying in the extremities are few and are not likely to have any significant impact on the overall scores. This demonstrates an initial semblance of normality in the distribution. The standard deviation in each case is relatively low, ranging between 1.3 and 1.9. This also confirms a low deviation from norm, and signifies a normal distribution and consistency in the data sampling. Looking at the skewness statistic, we find all the values to fall within -1 and +1 except for one data point, signifying and further confirming a strong normal distribution. However, the variable ATT1, falls outside the normal curve with a value of -1.128. A recommended action is to measure the variable's approximate normality, and see whether it conforms. We do so by dividing the skewness value with the standard error estimation. Doing so, we find the value for ATT1 to be -4.969; this value falls below the recommended value of 2.5 for estimating skewness normality in case of abnormalities, and thus can be said to be approximately normal. Hence, the skewness of the variables can be regarded as following a normal distribution.

Correlation analysis and factor analysis evaluate the construct validity and discriminant validity of the instrument. Correlation is considerably higher among items intended for the same construct than among those designed to measure different constructs (see appendix B). This suggests sufficient convergent and discriminant validity of the measurements. As summarized in table 2, three principal component factor analyses are performed. As expected, two components could be extracted for independent variables, one is extracted for the dependent variable, and one for the mediator variable, Both, the observed reliability and discriminant validity suggested sufficiency of measurements used in the study.

Table 2. Principle Component Analysis

Independent Variables	Component

	1	2
PEOU3	,896	
PEOU1	,830	
PEOU5	,808	
PEOU6	,793	
PEOU2	,763	
PEOU4	,699	
PU4		,839
PU5		,834
PU1		,792
PU3		,745
PU6		,697
PU2		,632
Mediating Variable	**Component**	
	1	
ATT1	,890	
ATT3	,788	
ATT2	,765	
Dependent Variable	**Component**	
	1	
ITU3	,875	
ITU1	,855	
ITU2	,800	
ITU4	,731	

The objective of this research is to investigate what determines a university student's acceptance of an e-learning system, which after a consulting technology acceptance theory lead to four hypotheses based on TAM. In order to test these hypotheses multiple regression analysis is used as analytical technique. Although regression analysis is a rather robust technique it has several underlying assumptions that have to be met in order for this technique to be appropriate. These include linearity, constant variance of error terms, independence of error terms, and normality (Hair et al. 1998). An analysis of residuals through residual plots and statistical tests needs to be conducted to ensure that regression analysis is an appropriate analytical technique. With a Durbin-Watson of 2 the values demonstrate independence. Moreover, the results showed acceptable levels of linearity, constant variance and normality and gave no indication of a violation of the underlying assumptions. This lead us to consider multiple regression analysis as a suitable analysis technique for this investigation.

Another issue in regression analysis that has to be taken care of is (multi-)collinearity between the independent variables (Hair et al. 1998). As discussed earlier, the correlation coefficients of PU and PEOU showed acceptable collinearity below the threshold of .7 as suggested as a rule of thumb by Hair et al.(2003). Furthermore, variance inflation factors (VIFs) and tolerance levels for the two independent variables were calculated and demonstrated acceptable levels.

In order to statistically test whether there is a positive direct relationship between the two independent variables *perceived ease of use* and *perceived usefulness* and the dependent variable *attitude towards using*, corresponding to the two first hypotheses stated, a first regression analysis was conducted. This regression model explains 64.5% of the variance in attitude, demonstrating fairly good prediction power of the model and a better result than in previous studies. Yet, this at the same time means that 35% of the variation stems from other unexplored variables. The regression shows that the hypothesized relationships are statistically significant (F-ratio = 102,875, p-value = .000). This means that the chance that the results of the regression are by random instead of constituting a real relationship is .000 (Hair et al. 1998). As can be seen in Table 3 both, PEOU as well as PU, are significant predictors of attitude. Hence, hypotheses H1 as well as H2 are supported.

Table 3. Results of Regression Analysis: Dependent ATT, Independent PEOU and PU

	Beta	t	p-value

1	(Constant)		5,233	,000
	PEOU	,332	4,710	,000
	PU	,563	7,993	,000
N = 113, R^2 = 0.652 Adjusted R^2 = 0.645 F-statistic = 102,875 (p-value = 0.000)				

The regression analysis furthermore reveals that even though both variables are significantly related to attitude, it shows a stronger impact of perceived usefulness on attitude as compared to perceived ease of use. This corresponds to what has been found in previous research on TAM. A possible reason for why perceived ease of use to a lesser extent impacts on the attitude towards using a system as compared to perceived usefulness is that perceived ease of use might be a predictor of perceived usefulness impacting directly on that variable. This has been proposed in previous research and has thus been set formulated as H3 that was to test in this investigation. The results of the regression on the effect of PEOU on PU are presented in Table 4 below:

Table 4. Results of Regression Analysis: Dependent PU, Independent PEOU

		Beta	t	p-value
1	(Constant)		4,686	,000
	PEOU summated	,601	7,930	,000
N = 113 R^2 = 0.362 Adjusted R^2 = 0.356 F-statistic = 51.272 (p-value = 0.000)				

The results show fairly low predictive power of the regression of 35.6 %. Yet, the F value of 62.877 is rather high, giving reasonable indication for predictive power of PEOU on PU. With a Beta-value of 0.601 and a t-value of 7.930 and a significant *p* (= .000) we can accept H3 and state that PEOU has a positive impact on PU.

Finally, as suggested in TAM, the attitude towards using the e-learning system is hypothesized as having a direct positive effect on the student's intention to use the e-learning system (H4). For testing H4 another regression analysis was performed. The results are outlined in Table 5 below.

Table 5. Results of Regression Analysis: Dependent ITU, Independent ATT

		Beta	t	p-value
1	(Constant)		2,068	,041
	ATTsummated	,562	7,160	,000
N = 113 R^2 = 0.316 Adjusted R^2 = 0.310 F-statistic = 62.877 (p-value = 0.000)				

The overall predictive power of the regression with just over 31 % is acceptable, yet rather low. This means that approximately 69% of the variation in ITU is explained by other factors that have not been investigated. Still, the results demonstrate that ATT has a positive effect on ITU supported H4.

Conclusions, Limitations and Avenues for Future Research

This study investigates the issue of student's acceptance of an e-learning system. Its purpose, "to investigate determinants of the acceptance of e-learning by students", was accomplished by applying a *"robust, powerful and parsimonious model for predicting user acceptance"* (Venkatesh & Davis 2000), i.e. the Technology Acceptance Model (TAM) to a new context. A total of 120 completed questionnaires on university students' perceptions constituted the sample which revealed interesting results.

The results show that a student's *perceived ease of use* of the e-learning system as well as the student's *perceived usefulness* of that system are significant predictors of the student's *attitude* towards the e-learning system, as those two factors account for approximately 65 % of the variation in attitude. Yet, even though hypotheses one and two are thus supported, it at the same time means that 35% of the variation still is caused by other factors. These could include personal factors, such as age, background, sex, and computer experience etc., as well as a possible social influence or perceptions of risk. Those factors have been brought up in literature and have been tested in previous research in different context showing diverse results. Further research is needed for clarification. The results of this study furthermore confirm the hypothesized impact of a student's *perceived ease of use* of the system on his *perceived usefulness* of it (H3). This means that a student perceives a system as more useful if less difficulty in using it is experienced. Also the fourth relationship hypothesized (H4) could be supported, which asserted a positive and direct impact of a student's *attitude* towards using the system on his final *intention to using* it. Yet, the predictive power of *attitude* on the final *intention to using* was rather weak with only 31%. This means that even though a student might have a positive attitude towards the system he might still end up not using it. This could indicate that student's would like to use the system more but do not have the option, as the teacher might not fully utilize the system's potential in the course. The reverse case would be that a student

does not appreciate the system but will still use it. This might be explained by the student perceiving it as necessary to using the system or even be forced to using during the course. Yet, clearly, those issues need further investigation.

Altogether the results of this study suggest TAM to be a useful model and applicable in this e-learning context. Yet, in order to increase the predictive power of the research model of a student's intention to use the system, further research including further independent and control variables is necessary.

The results of this research can be used in order to design better targeted strategies to enhance e-learning in educational institutions and to help develop new marketing strategies for the educational sector. As this and other previous studies have demonstrated, educators need to carefully consider the course elements they use and take steps to understand what student reactions and perceptions may be towards the use of those elements. Above all, a student's intention to use a system is determined by how usefulness he perceives it to be. If students do not perceive the tools to be useful, the efforts might not show the results expected. Thus, teachers need to communicate benefits of using the system to their students. Furthermore, training and support need to be offered to students in order for them to learn how to utilize it.

The measurement for attitude which was taken directly from previous research exhibited relatively a low reliability value. This reinforces the importance of instrument re-evaluation.

This study is not exempt from limitations. First of all, a sample size of 120 students is fairly small as well as the study is restricted to a particular virtual learning environment (Fronter); others should be studied as well to confirm the results thrown in this investigation. The fact that 79% of the students are Swedish could also be stated as a limitation and open the door for a future study that integrates different cultural backgrounds. The study could be extended to Swedish students from other universities in other geographical areas. Yet, most important is the need to explore which other variables impact on a student's intention to using a particular system in the context of e-learning. This could be done by testing, using or integrating other well-established models like the Theory of planned behaviour (TPB) or work flow theory as well as by conducting an exploratory study of qualitative nature. The effect on use of e-learning, as the dependent variable in TAM, was not investigated in the research model, mainly due to the issue of not being able to examine causal relationships on cross-sectional data. Future research incorporating use of e-learning, preferably actual use rather than self-reported use, into the research model would enable an increasingly complete examination of the applicability of TAM.

References

[1] Adams D. A, Nelson R.R. & Todd P.A. (1992) Perceived Usefulness, Ease of Use, and Usage of Information Technology: A Replication. *MIS Quarterly* 16(2), 227-247.

[2] An, J.-Y. (2005) *Correlates and predictors of consumers' health information and services usage behaviour on the Internet: A structural equation modelling approach*, New York University. Doctoral Dissertation.

[3] Bates A. W. (1997) Restructuring the university for technological change *The Carnegie Foundation for the Advancement of Teaching, London*, June. available at: http://bates.cstudies.ubc.ca/carnegie /carnegie.html (last accessed 14 September 2007).

[4] Daniel J. S. (1997) Why universities need technology strategies *Change* 29(4) 11-17.

[5] Davis F. D. (1989) Perceived usefulness, Perceived Ease of Use and User Acceptance of Information Technology *MIS Quarterly* 13(3), 318-340.

[6] Davis F. D., Bagozzi R. & Warshaw P. (1989) User Acceptance of Computer Technology: A Comparison of Two Theoretical Models *Management Science* 35(8), 982-1003.

[7] Fishbein M. & Ajzen I.(1975) *Belief, Attitude, Intention, and Behaviour: An Introduction to Theory and Research* Addison-Wesley Reading.

[8] Hair J. F., Anderson R. E., Tatham R. L. & Black W. C. (1998) *Multivariate Data Analysis, fifth edition* Prentice-Hall International, Inc.

[9] Hair J. F., Babin B., Money A.H. & Samoul P. (2003) *Essentials of Business Research Methods* Leyh Publishing, LLC.

[10] Hu P. J. -H., Chau P. Y. K., & Sheng O. R. L. (2002) Adoption of Telemedicine Technology by Health Care Organizations: An Exploratory Study. *Journal of Organizational Computing and Electronic Commerce* 12(3), 197-221.

[11] Keller C. & Cernerud L. (2002) Student's Perceptions of e-Learning in University Education *Journal of Educational Media* 27(1-2), 55-67.

[12] Landry B. J. L., Rodger G. & Hartman S. (2006) Measuring Student Perceptions of Blackboard Using the Technology Acceptance Mode *Decision Sciences Journal of Innovative Education* 4(1), 87-99.

[13] Liu S. H., Liao H. L. & Peng C. J. (2005) Applying the technology acceptance model and flow theory to online e-learning user's acceptance behaviour *Issues in information systems* 6(2), 175-181.

[14] Mallak L.A. (2001) Challenges in Implementing e-Learning *International Conference on Management of Engineering and Technology, Portland*1, 298-299.

[15] Nichols M. (2003) A theory for e-Learning *Educational Technology and Society* 6(2), 1-10.

[16] Nunnally J. C. (1994) *Psychometric theory, third edition* McGraw-Hill, New York.

[17] Roca J.C. Chiu C.-M. & Martínez F. J. (2006) Understanding e-learning continuance intention: An extension of the Technology Acceptance Model *International Journal of human-computer studies* 64(8), 683-696.

[18] Saadé R. G. & Galloway I.(2005) Understanding Intention to Use Multimedia Information Systems for Learning *The Journal of Issues in Informing Science and Information Technology* 2, 287-296.

[19] Shirley A. (2001) E-Learning developments and experiences *Education + Training* 43(4/5), 240-248.

[20] Venkatesh V. (1999) Creation of Favourable User Perceptions: Exploring the Role of Intrinsic Motivation *MIS Quarterly* 23(2), 239-260.

[21] Venkatesh V. & Davis F. D. (2000) A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies *Management Science* 46(2), 186-204.

Appendix A: Annotated Items

Intention to Use (ITU)

ITU1. I use Fronter whenever appropriate for school work.

ITU2. I use Fronter frequently for school work.

ITU3. I use Fronter whenever possible for school work.

ITU4. I use Fronter a lot for school work.

Attitude (ATT)

ATT1. Using Fronter is a good idea.

ATT2. Using Fronter is unpleasant.

ATT3. Using Fronter is beneficial to my school work.

Perceived Ease of Use (PEOU)

PEOU1. Using Fronter is easy for me.

PEOU2. It was easy for me to become skilful at using Fronter

PEOU3. I find Fronter easy to use.

PEOU4. I find Fronter to be flexible to interact with.

PEOU5. I find it easy to get the information I want from Fronter.

PEOU6. My interaction with Fronter is clear and understandable.

Perceived Usefulness (PU)

PU1. Using Fronter improves my school work performance

PU2. Using Fronter enables me to accomplish my school work more quickly.

PU3. Using Fronter increases my productivity in doing school work.

PU4. Using Fronter enhances my effectiveness in doing school work.

PU5. I find Fronter useful in doing school work.

PU6. Using Fronter makes it easier to do school work.

Appendix B: Inter-measurement correlation

Table 6. Analysis of Inter-measurement Correlation

PU1	**1,000**																
PU2	**,360**	**1,000**															
PU3	**,424**	**,509**	**1,000**														
PU4	**,572**	**,606**	**,549**	**1,000**													
PU5	**,592**	**,662**	**,614**	**,854**	**1,000**												
PU6	**,508**	**,563**	**,627**	**,677**	**,692**	**1,000**											
PEOU1	,164	,521	,325	,394	,503	,551	**1,000**										
PEOU2	,030	,323	,150	,341	,350	,399	**,551**	**1,000**									
PEOU3	,162	,384	,331	,333	,458	,566	**,752**	**,622**	**1,000**								
PEOU4	,382	,471	,419	,477	,557	,597	**,598**	**,469**	**,696**	**1,000**							
PEOU5	,231	,481	,303	,443	,584	,551	**,770**	**,504**	**,721**	**,631**	**1,000**						
PEOU6	,296	,511	,379	,451	,552	,666	**,631**	**,553**	**,766**	**,724**	**,691**	**1,000**					
ATT1	,442	,552	,546	,511	,559	,579	,570	,303	,381	,557	,525	,470	**1,000**				
ATT2	,225	,323	,407	,259	,336	,419	,468	,082	,436	,478	,377	,404	**,525**	**1,000**			
ATT3	,558	,594	,646	,808	,802	,791	,529	,367	,517	,616	,542	,561	**,620**	**,324**	**1,000**		

ITU1	,431	,334	,302	,375	,434	,442	,348	,171	,384	,428	,466	,455	,437	,354	,423	**1,000**	
ITU2	,424	,525	,457	,568	,630	,659	,533	,293	,442	,522	,645	,608	,525	,387	,584	**,529**	**1,00**
ITU3	,422	,342	,208	,402	,451	,418	,348	,275	,332	,359	,480	,410	,362	,229	,422	**,819**	**,481**
ITU4	,197	,229	,207	,150	,229	,356	,343	,389	,350	,355	,408	,453	,307	,178	,310	**,362**	**,565**
	PU1	PU2	PU3	PU4	PU5	PU6	PEOU1	PEOU2	PEOU3	PEOU4	PEOU5	PEOU6	ATT1	ATT2	ATT3	ITU1	ITU