What affects students'

acceptance and use of technology?

A test of UTAUT in the context of a

higher-education institution in Qatar

Senior Honors Thesis

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Abstract

Students' acceptance and use of technologies introduced in their academic environments is an important factor in determining the success of these technologies. This research project used the Unified Theory of Acceptance and Use of Technology (UTAUT), a prominent technology acceptance and use model, as a theoretical basis to conduct empirical research testing the factors that influence students' acceptance and use of technology in their academic environment.

Although several studies applied UTAUT in various organizational and cultural contexts, very few implement the full model and examine all of its constructs. By focusing on students in higher-education and technology that is new to them, and by using the full UTAUT model with no changes or elimination of constructs, this study places itself in the area where there are no exhaustive studies. Also, this research addresses the question of whether UTAUT is applicable in an academic environment for educational technologies introduced to the students.

The study found a mixed support for UTAUT. Performance expectancy, effort expectancy, facilitating conditions and attitude towards using technology were significant determinants of technology acceptance. All moderating variables had a significant moderating influence except for experience, which was surprisingly not significant. The UTAUT model is found to be applicable to some extent in the educational setting, but might need a few modifications to fit the context.

The study provides recommendations to help prepare the appropriate environment and training before a new technology is introduced for students. It also provides recommendation for further research examining students' acceptance and use of technology.

Introduction

Technology is being increasingly integrated in classrooms to facilitate and enhance students' learning. From course management software to simulation and analysis systems, academic institutions are investing in technologies intended to provide an educational value to students. However, the success of new technology introductions cannot be achieved if the students do not accept and use the technology.

Technology acceptance is an active area of research where several models and theories have been proposed to understand the drivers of technology adoption. One of the most prominent models is the Unified Theory of Acceptance and Use of Technology.

Theoretical Background

Venkatesh, Morris, Davis, and Davis (2003) have synthesized eight user acceptance and motivation models to propose the Unified Theory of Acceptance and Use of Technology. The eight theories are the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Motivational Model (MM), the Theory of Planned Behaviour (TPB), a combined theory of Planned Behaviour/Technology Acceptance Model (C-TPB-TAM), the Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT).

Derived from the above, UTAUT suggests that four core constructs are direct determinants of technology acceptance (behavioral intention) and use (behavior): Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions. The theory also suggests that the effect of these four constructs is moderated by four other variables: age, gender, experience and voluntariness of use. The validation of UTAUT in the originating paper (Venkatesh et al., 2003) showed that

UTAUT explains 70% of the variation in usage intention (acceptance) of technology which is greater than each of the eight previous models and their extensions.

Since its publication in 2003, UTAUT has been cited by a large number of studies. However, among the studies citing UTAUT, very few implement the full model probing all of its constructs (Williams, Rana, Dwivedi, & Lal, 2011). Venkatesh, Thong, and Xu, (2012) also reported that "our review of this body of work revealed that most studies using UTAUT employed only a subset of the constructs" (p. 2), referring to the replications and applications of UTAUT. Therefore, further testing of the complete model is needed. Additionally, although it has been successfully used in a variety of contexts, continuing to examine it in new contexts will support its ecological validity. This study uses the complete UTAUT as a model to explore the factors that influence students' acceptance and use of technology in an institution of higher education.

Literature review

UTAUT has been tested in several cultures and organizational contexts. Research on cross-cultural validation of UTAUT includes a study on employees' acceptance and use of computers in Saudi (Al-Gahtani, Hubona, & Wang, 2007), Educational technology acceptance in Turkey (Göğüş, & Nistor, 2012), MP3 player and Internet banking in Korea (Im, Hong, & Kang, 2011), among others. Mixed support for the original UTAUT theory was found when UTAUT was applied in other cultural contexts which led some researchers to argue that UTAUT should be extended to include cultural constructs alongside the current constructs.

Besides being tested in several cultures, UTAUT has also been tested in several organizational contexts including healthcare organizations (e.g., Venkatesh, Sykes, & Zhang, 2011; Ifinedo, 2012), business organizations (e.g., Anderson & Schwager, 2004),

government organizations (e.g., Zhan, Wang, & Xia, 2011), and Educational institutions (e.g., Birsch & Irvine 2009). There has been some research suggesting adding context-specific constructs to UTAUT. For example, Vekatesh et al's (2012) paper on consumer acceptance and use of information technology suggests adding three constructs to UTAUT: hedonic motivation, price value, and habit, for the context of consumer technology use. Similarly, Sun, Bhattacherjee, and Ma (2009) suggested adding IT's perceived work compatibility to "fit the context of organizational work". However, there are still many contexts where the need for additional constructs in UTAUT has to be explored.

This research focuses on students' acceptance and use of technology in their academic institutions in an attempt to compare the results with the original UTAUT findings and explore whether context specific constructs should be added to UTAUT, specifically, constructs related to students and the academic environment. Literature on technology in education have studied the effect of faculty and peers encouragement (Martins & Kellermanns, 2004), availability of technology (Chung, 2002), TOE (technological, organizational and environmental) factors (Mills, 2008), educational compatibility (Chen, 2011), among others on the acceptance, diffusion, use, or effectiveness of technology in higher-education institutions. These educational context-specific constructs are not measured in the original UTAUT, which raises a question of whether UTAUT alone can be effectively used in a higher-education context to predict students' acceptance and use of technology.

Previous studies using UTAUT as a model to evaluate user acceptance and use of technology in an educational institution, specifically higher-education institutions, have several purpose and methodological differences leading to different conclusions about the applicability of UTAUT in higher-education institutions.

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Of the studies that survey students in higher-education institutions, some studies test technologies that are not related to the academic environment. For example, Al-Awadhi and Morris (2008) surveyed university students about e-government services and reported that the findings are "consistent to some extent" (p. 9) with other similar studies but indicating that using a sample of students might have caused some of the contradiction in results. Lin, Chan and Jin (2004) surveyed university students about instant messaging using a modified version of UTAUT. She reported that not all the results were consistent with the originating UTAUT study because the study was in a different environment. Although these studies use students as participants, they do not answer the question of whether the original UTAUT model is applicable in an educational setting. This research study is focused on technologies used by the students in courses *for academic purposes*.

The Second observation from the literature review related to the use of UTAUT in an educational environment is that some studies survey students on technologies that are not newly introduced to them. For example, a study on educational technology acceptance using UTAUT (Gogus & Nistor, 2012) studied "the computer as a learning tool, with specific references to office software, information search on the internet, communication and interaction between internet users" (p. 398) which also includes email, discussion forums and chat. Another study by Marchewka, liu and Kostiwa (2007) studied "students' perceptions of using Blackboard®" (p. 103) when the students were already familiar with that technology and had been using it prior to the study. The authors reported that "the study did not find strong support for the UTAUT model" (p. 103). Despite the interesting findings and questions these studies provide, they do not follow the same methodology as the original UTAUT study with regards to the timing of the survey.

Research that studies a technology familiar to the students, contrary to the original UTAUT study, are not longitudinal studies that evaluate user acceptance over time; rather, they capture the users' perception at one point only, well after the users' acceptance or rejection decision. The original UTAUT study focuses on user acceptance of technologies that are newly introduced to capture the user's first perception and how that perception changes with increased experience of using the technology. Consistent with the original UTAUT model, this study is examining new technologies that are introduced to the students and measures their first impression about it at the time of the training, and how their perception and adoption decision change over time.

Significance of the study

Course instructors in academic institutions use technology to enhance students learning and facilitate the flow of information between the instructor and the students, or among the students themselves. Providing the students with certain technologies is aimed at helping the students achieve a learning outcome. This study of students' acceptance and use of technology in an academic environment is significant because it helps predict students' reaction towards the technology introduced and explains how their perception changes with increased experience. Hence, the study can provide recommendations to prepare the right environment before introducing a new technology for students.

This research is an exploratory longitudinal study to examine students' acceptance and use of technologies that are introduced to them in their academic environment. By focusing on students in higher-education and technology that is new to them, and by using the full UTAUT model with no changes or elimination of constructs, this study places itself in the area where there are no exhaustive studies and where there is still a need for exploration. Also, this research adds to studies about the applicability of UTAUT in an educational environment by extending the diversity of the studied sample.

Research model

In their review of the eight prominent IT acceptance and motivation models, the authors of UTAUT found seven constructs to be significant direct determinants of acceptance and use of technology in one or more of the individual models. However, they found that three of these constructs (self-efficacy, anxiety, and attitude) do not have any direct effect on intention to use the technology, therefore, these constructs were dropped from UTAUT while the other four (performance expectancy, effort expectancy, social influence, and facilitating conditions)were kept. This study measures the seven original constructs to compare their influence on acceptance with the findings of UTAUT. Table 1 shows the definition of each of the aforementioned constructs as reported in the originating UTAUT study (Venkatesh et al., 2003).

Table 1: Definitions of the constructs

| Construct	Definition
Performance Expectancy (PE)	The degree to which an individual believes that using the system will help him or her to attain gains in job performance.
Effort Expectancy (EE)	The degree of ease associated with the use of the system.
Social Influence (SI)	The degree to which an individual perceives that important others believe he or she should use the new system.
Facilitating Conditions (FC)	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.
Computer self-efficacy (SE)	Judgment of one's ability to use a technology to accomplish a particular job or task. (adapted from the Social Cognitive Theory)
Computer anxiety (ANX)	Evoking anxious or emotional reactions when it comes to performing a behavior (i.e. using the technology) (Adapted from the Social Cognitive Theory)
Attitude towards using technology (ATUT)	An individual's overall affective reaction to using a system.

UTAUT Research Model:
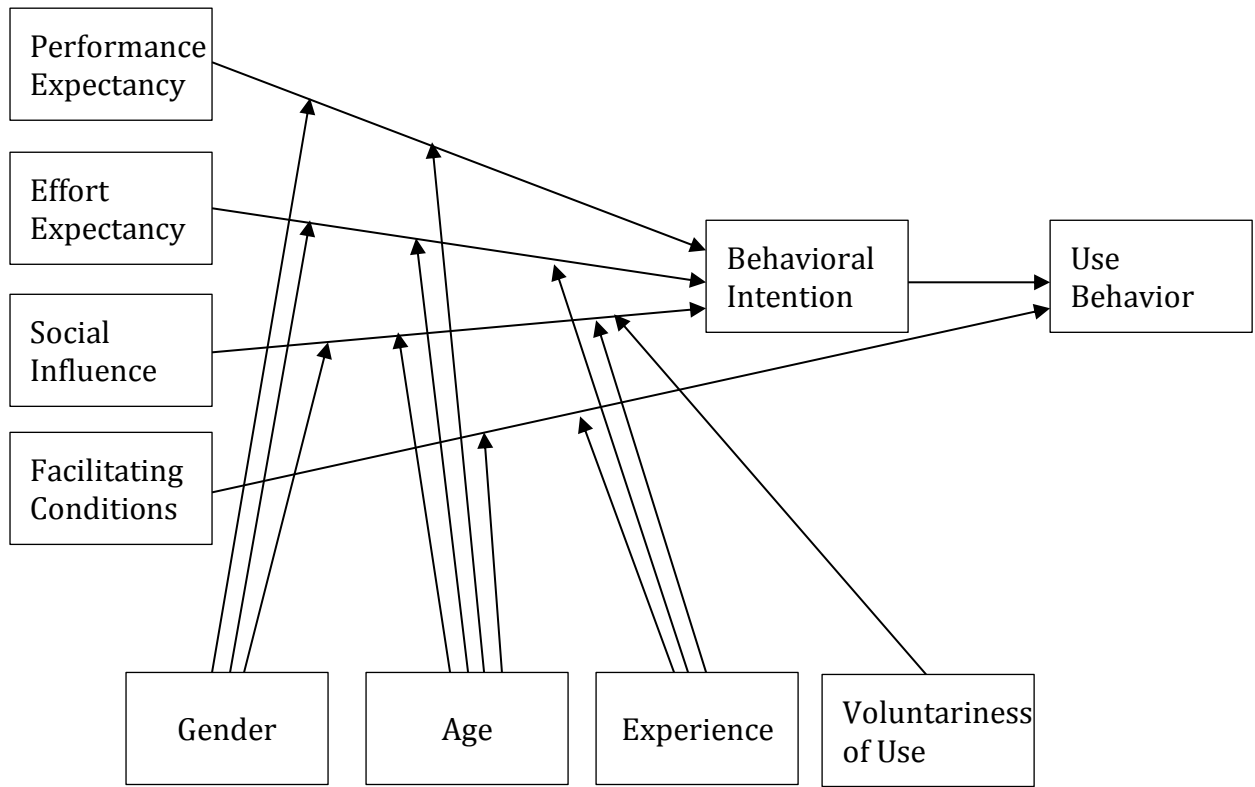
Figure 1: UTAUT Research Model

Hypotheses

Consistent with UTAUT, and as depicted in Figure 1, this research theorizes the following:

H1: The influence of performance expectancy on behavioral intention will be moderated by gender and age, such that the effect will be stronger for men and particularly for younger men.

H2: The influence of effort expectancy on behavioral intention will be moderated by gender, age, and experience, such that the effect will be stronger for women, particularly younger women, and particularly at early stages of experience.

H3: The influence of social influence on behavioral intention will be moderated by gender, age, voluntariness, and experience, such that the effect will be stronger for women, particularly older women, particularly in mandatory settings in the early stages of experience.

H4a: Facilitating conditions will not have a significant influence on behavioral intention.

H4b: The influence of facilitating conditions on usage will be moderated by age and experience, such that the effect will be stronger for older workers, particularly with increasing experience.

H5a: Computer self-efficacy will not have a significant influence on behavioral intention.

H5b: Computer anxiety will not have a significant influence on behavioral intention.

H5c: Attitude toward using technology will not have a significant influence on behavioral intention.

H6: Behavioral intention will have a significant positive influence on usage.

Method

The objective of this study is to examine the influence of the factors of UTAUT on technology acceptance and use by the students in a higher-education academic institution. UTAUT was tested by conducting a panel study collecting data from students over three times throughout the semester. The study was approved by Carnegie Mellon's institutional Review Board.

Setting and participants

The study was conducted at Carnegie Mellon University in Qatar (CMUQ). The home campus of Carnegie Mellon University is in Pittsburgh, Pennsylvania in the United States. The Qatar campus offers four undergraduate programs: Biological Sciences, Computer Science, Information Systems, and Business administration. The students of CMUQ come from 42 different nationalities, with 37% from Qatar. The total number of students is 373, of which 56% are females and 44% are males. The university supports using technology to enhance teaching and learning and provides several state-of-the-art technologies for students and faculty.

Eligibility, recruitment and procedure

The data collection and analysis was conducted over the course of the Spring semester in Carnegie Mellon University in Qatar. The instructors who are teaching courses in the Spring semester were contacted by email to ask if they are introducing any technology for the students in their courses. Of the responses received, eight courses where technology is introduced were eligible for the study. The courses were selected based on the type of technology introduced to ensure some level of consistency among them. The technology had to be new to the students (i.e. the students have not used it before) and used by the students themselves, whether mandatorily or

voluntarily, for the duration of the semester. Courses where the instructor was the one using the technology, or where the technology was used for a short period of time, were excluded from the study.

The design of the study is a panel study with three waves: beginning, middle, and end of the semester. For the first wave of the panel, participants were recruited by sending an email to the selected courses' instructors with a link to the online survey. The instructors were asked to forward the email to their students. Any student meeting the acceptance criteria of being 18 years of age or older, currently enrolled in the selected class, and new to the technology was eligible to participate.

The surveys had an online consent form on the first page. If the participants consented to participate, they were instructed to enter their emails in the form so that the principle investigator could contact them for the following surveys. Adhering to this procedure of recruiting participants ensured the participants' privacy because the instructors would not be able to identify who participated and the principal would only know the students who consented to participate, not all the students in class, so the students had autonomy over the flow of information.

For the second and third waves of the panel study, surveys were sent directly to the students who participated in the first survey and provided their email addresses. Email addresses were not directly linked to the responses, rather, the survey software used (LimeSurvey) allowed the researcher to create tokens containing the participant's email and other information to email them directly from the system to send them the survey and reminders. When the participant completed the survey, the software indicates that the token has taken the survey but it does not provide a link to the responses. In order to track the responses over time, the tokens (id) were emailed to the participants so they could input it in the survey. That way, responses could be

tracked over time without reference to the email address of the participant. The emails were deleted after the third survey was closed. Table 2 illustrates how the data was saved in two separate tables.

Table 2: Saving participant's information and their responses in two different tables

Email	Course name	Technology name	Survey exp date	Token		Token	Response to Q1	Q2	...

There was no compensation for participation; however, there was a raffle for an iPod shuffle at the end of the semester. The raffle was a random selection of an email address from the list of tokens for participants who had completed the three surveys. There were no costs for participation in the study.

Data collection schedule

Data was collected at three points during the semester: T1, T2, and T3. T1 was within one week from the introduction of the technology in the class and the training for the students, T2 was after four weeks of the technology introduction and training, and T3 was four weeks after T2 (Figure 2). Data collected at T1 measured the students' first reaction towards the technology as they had not used it before, while T2 and T3 measured the students' reaction after using the technology for some time and their self-reported actual use of the technology.
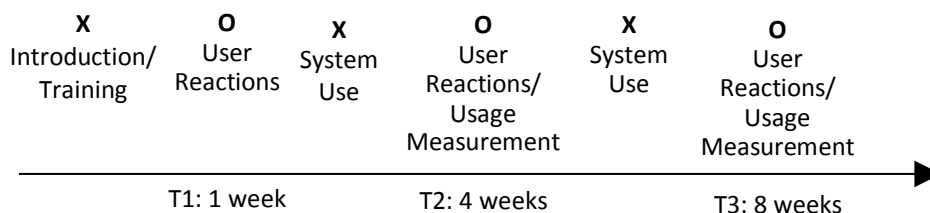

Figure 2. Data Collection Schedule (adapted from Venkatesh et al., 2003)

This data collection schedule was slightly different than the data collection schedule of the original UTAUT study (Venkatesh et al., 2003) to adapt for the context of an academic semester. The original UTAUT had a T1 one week after the introduction of the technology, a T2 a month after T1, and a T3 three months after T1. Actual usage was also measured six months after T3. While there was no time limit for using the technology in the organizations that the original UTAUT studied, in this study, the academic semester in which the technology was used is only four months long. Therefore, this design of the study allows answering the question of whether UTAUT can be applied in an academic context given the limitations of the context.

Survey instrument

The surveys were based on the original UTAUT model with minor changes to fit the academic context in which the study was conducted. The word "organization" was changed to "university", and "manager" to "instructor".

The survey was created as an online survey and sent to the students via email (as explained above). Pre-testing was conducted to ensure the clarity and understandability of the survey and the reliability of the server in handling the expected number of participants.

Consistent with the original UTAUT survey items, future tense was used in the survey items for T1 to capture students' perception (e.g. It *will* be easy for me...). In T2 and T3, present tense was used (e.g. It *is* easy for me...). The full survey items can be found in appendix 1.

Measurement

All the aforementioned independent and dependent variables of the model were measured using a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Voluntariness was measured by students' rating of voluntariness of using the system on a scale from 1 (completely mandatory) to 7 (completely voluntary). While the original study found a bi-modal distribution in the data which allowed them to separate the data into mandatory and voluntary settings, this study did not find such a bi-modal distribution and therefore voluntariness was measured on a 7 point scale as reported by the students. Actual usage behavior was measured through self-reported usage on a seven-point scale, which is different than the original UTAUT study where it was measured through system logs.

Consistent with the original UTAUT study, gender was recorded as a binary variable (0 for male and 1 for female), age of the participants was recorded as a continuous variable, and experience took the values 0,1, or 2 for T1 (no experience), T2 (some experience) and T3 (more experience), respectively.

Technologies studied and number of participants

A number of newly introduced technologies were studied. Technologies for which the number of participants in T1 was less than five were excluded.

Table 3: Technologies studied and the number of participants

Course	technology	Description	Class size	Number of valid responses		
				T1	T2	T3
1	Git	Version control software	28	14	5	5
2	iClicker	Student response system	21	6	3	3
3	Piazza	Q&A platform and	24	10	5	4
4	Piazza	learning	74	19	7	7
5	Piazza	management system	42	3	2	2
6	Capstone	Business simulation software	41	21	14	14
TOTAL			230	73	36	35

Only those 35 participants who filled the three surveys were included in the analysis. To check that those 35 do not constitute a biased sample, an analysis of all 73 participants was done and compared to the 35 participants' analysis. There were no significant variations between the 73 sample and the 35 sample.

Major characteristics of participants

As shown in Figure 3, 22 participants were females and 13 were males. The age range of the participants was 18-24 (M = 20.3, SD = 1.37).

Percentage of sample approached that completed the three surveys is 15%.
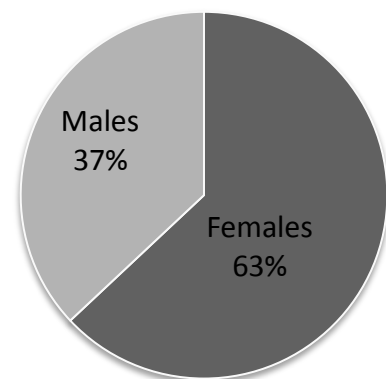
Figure 3: Participants' gender distribution

Results

Although the UTAUT model's survey was already validated by its authors, this study reexamines the validity of the instrument to ensure its reliability in the specific context of this study. Therefore, the internal consistency reliability (ICR) was calculated using Cronbach's Alpha for each construct in each time period (T1, T2, and T3) as shown in Table 3. All constructs had an ICR higher than 0.7 except Facilitating Conditions (FC) in all time periods and Self Efficacy in T2. High ICR indicates that the items used to measure that construct are adequately representing the construct and generate similar scores. Despite the low ICR for FC, it was not dropped from the model because of its importance in the original model. Additionally, a correlation matrix (Table 5) showed that inter-construct correlations were generally low.

Table 4: ICR measured by Cronbach's Alpha

	Cronbach's Alpha		
	T1	T2	T3
PE	0.7773	0.817	0.8339
EE	0.9053	0.8704	0.871
ATUT	0.9042	0.938	0.9338
SI	0.8413	0.7034	0.7612
FC	0.3037	0.07239	0.1641
SE	0.7554	0.4465	0.7031
ANX	0.7411	0.7271	0.7166
BI	0.9159	0.9298	0.9491
USE		0.9088	0.9348

Table 5: Inter-construct correlation

	PE	*EE*	*ATUT*	*SI*	*FC*	*SE*	*ANX*	*BI*
PE	1							
EE	0.678271	1						
ATUT	0.768424	0.795151	1					
SI	0.782268	0.590587	0.598772	1				
FC	0.469318	0.63969	0.4612	0.467177	1			
SE	0.451702	0.432973	0.37847	0.354321	0.334577	1		
ANX	0.190516	-0.11091	0.053666	0.29753	-0.17933	0.024091	1	
BI	0.404396	0.429575	0.417503	0.414691	0.494669	0.150246	0.01235	1

Technology acceptance was measured by the Behavioral Intention (BI) of using the technology. Consistent with the original UTAUT, this study measured the effect of the direct predictor variables on intention with the hypothesized moderating influence, for each time period (T1, T2, and T3), and for the pooled data across time periods (n = 35 x 3 = 105). The results of the analysis are summarized in Table 4 and 5.

Voluntariness in the original UTAUT study was coded as a dummy variable to create two sets of data, unlike this study where it takes values from 1 to 7 because there was no clear bi-modal distribution as there was in the original UTAUT study.

Since this study tests the complete UTAUT model with no alterations, only the variables and interactions measured in the original UTAUT study were measured. Linear regression was used to regress Behavioral Intention on the predicting variables, the moderating variables, and their interactions.

To measure the effect of intention on actual use (usage behavior) as theorized by UTAUT, usage behavior (BI) was regressed over FC and the moderating variables as

shown in Table 5. Intention from T1 was used to predict actual use measured in T2, and intention from T2 to measure actual use as measured in T3. Therefore, T1 has no results for Use Behavior because at that point students have not used the technology, so only their intention was measured, not their actual use.

Table 6: descriptive statistics

	T1		T2		T3		Pooled	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
PE	4.914286	1.166226	5.192857	1.172738	5.164286	1.217131	5.090476	1.180839
EE	5.028571	1.255534	5.557143	1.023772	5.571429	1.083926	5.385714	1.143033
ATUT	4.914286	1.350303	5.221429	1.308585	5.207143	1.341484	5.114286	1.328329
SI	4.892857	1.302269	5.192857	1.055597	5.057143	1.032711	5.047619	1.132504
FC	5.035714	0.838291	5.157143	0.722754	5.021429	0.736075	5.071429	0.762488
SE	4.821429	1.120615	4.692857	0.931645	4.971429	1.132364	4.828571	1.061405
ANX	3.621429	1.293893	3.492857	1.302551	3.557143	1.20368	3.557143	1.256357
BI	5.485714	1.346365	5.866667	1.158092	4.438095	1.890415	5.263492	1.602412
USE			5.157143	1.630461	5.1	1.696883	5.128571	1.652152

Table 7: UTAUT test results

(a) Dependent Variable: Intention

	T1 (n=35)			T2 (n=35)			T3 (n=35)			Pooled (n=105)		
	Estimate	Std Error		Estimate	Std Error		Estimate	Std Error		Estimate	Std Error	
PE	0.88	53.45		20.34	10.10	.	78.63	294.85		22.35	8.92	
EE	15.69	13.25		-36.73	10.12	**	-211.4	410.83		-9.00	14.62	
FC	0.35	0.25		0.26	0.25		3.03	0.67	**	0.81	0.24	*
SI	-25.89	62.08		24.75	8.22	*	149.98	85.76		8.72	21.23	
SE	0.49	0.21	*	-0.18	0.14		0.35	0.41		-0.19	0.15	
ATUT	0.10	0.30		0.39	0.24		0.81	0.54		0.63	0.23	*
ANX	-0.19	0.28		-0.25	0.14		-0.05	0.36		-0.20	0.14	
gender	-109.4	204.84		-30.23	36.77		-262.1	789.60		99.74	94.96	
age	-4.29	10.64		0.34	2.10		-12.10	43.70		5.14	4.77	
voluntariness	-25.70	44.24		63.22	13.73	**	64.67	94.19		16.69	21.88	
Experience	NA	NA		NA	NA		NA	NA		21.25	49.25	
PE:gender	12.98	53.07		-17.43	10.37		-89.29	294.40		-17.99	10.32	
PE:age	0.05	2.73		-1.05	0.51	.	-4.34	15.82		-1.09	0.45	
gender:age	4.31	10.57		2.00	2.17		15.96	44.69		-5.38	5.03	
EE:gender	-28.57	15.13		29.03	11.28	*	220.15	412.18		2.69	16.05	
EE:age	-0.79	0.67		1.92	0.53	**	10.93	21.72		0.42	0.75	
EE:Experience	NA	NA		NA	NA		NA	NA		1.08	10.15	
gender:Experience	NA	NA		NA	NA		NA	NA		-22.20	59.97	
age:Experience	NA	NA		NA	NA		NA	NA		-1.21	2.63	
SI:gender	23.88	62.95		-11.25	8.60		-127.0	88.99		-8.43	22.53	
SI:age	1.05	3.05		-1.18	0.45	*	-7.03	4.00		-0.46	1.10	
SI:voluntariness	2.62	9.14		-12.60	2.78	**	-17.57	20.16		-3.74	4.24	
SI:Experience	NA	NA		NA	NA		NA	NA		-1.90	15.61	
gender:voluntariness	27.63	44.93		-47.50	15.10	*	-51.39	98.19		-14.61	23.57	
age:voluntariness	1.13	2.29		-3.12	0.70	**	-2.91	5.30		-0.85	1.17	
voluntariness:Experience	NA	NA		NA	NA		NA	NA		-2.61	15.67	
PE:gender:age	-0.72	2.71		0.95	0.52		4.92	15.81		0.88	0.51	
EE:gender:age	1.42	0.77		-1.55	0.59	*	-11.33	21.79		-0.12	0.82	
EE:gender:Experience	NA	NA		NA	NA		NA	NA		1.79	11.77	
EE:age:Experience	NA	NA		NA	NA		NA	NA		-0.06	0.52	
gender:age:Experience	NA	NA		NA	NA		NA	NA		1.36	3.13	
SI:gender:age	-0.91	3.10		0.47	0.45		5.66	4.19		0.49	1.16	
SI:gender:voluntariness	-2.64	9.27		10.04	3.04	*	13.05	21.02		3.56	4.51	
SI:gender:Experience	NA	NA		NA	NA		NA	NA		1.76	17.45	
SI:age:voluntariness	-0.10	0.47		0.62	0.14	**	0.80	1.12		0.19	0.22	
SI:age:Experience	NA	NA		NA	NA		NA	NA		0.13	0.78	
SI:voluntariness:Experience	NA	NA		NA	NA		NA	NA		-0.26	3.35	
gender:age:voluntariness	-1.20	2.32		2.30	0.76	*	2.18	5.49		0.76	1.24	
gender:voluntariness:Experience	NA	NA		NA	NA		NA	NA		-0.52	17.69	
age:voluntariness:Experience	NA	NA		NA	NA		NA	NA		0.15	0.81	

	Estimate	Std Error		Estimate	Std Error		Estimate	Std Error		Estimate	Std Error	
EE:gender:age:Experience	NA	NA		NA	NA		NA	NA		-0.07	0.60	
SI:gender:age:voluntariness	0.10	0.48		-0.48	0.15	*	-0.57	1.16		-0.18	0.24	
gender:age:voluntariness:Experience	NA	NA		NA	NA		NA	NA		-0.01	0.90	
SI:gender:age:Experience	NA	NA		NA	NA		NA	NA		-0.16	0.87	
SI:gender:voluntariness:Experience	NA	NA		NA	NA		NA	NA		0.41	3.73	
SI:age:voluntariness:Experience	NA	NA		NA	NA		NA	NA		0.01	0.17	
SI:gender:age:voluntariness:Experience	NA	NA		NA	NA		NA	NA		-0.01	0.19	
Residual standard error	0.7001			0.31			1.113			1.129		
Multiple R-squared	0.9443			0.9852			0.9286			0.7278		
Adjusted R-squared	0.7296			0.9284			0.6531			0.5034		
F-statistic	4.397			17.32			3.37			3.243		
p-value	0.02482			0.000355			0.05081			1.503e-05		

(b) Dependent Variable: Usage

	T1 (n=35)			T2 (n=35)			T3 (n=35)		Pooled (n=105)		
	Esti-mate	Std Error		Esti-mate	Std Error		Esti-mate	Std Error	Esti-mate	Std Error	
BI	0.67	0.27	*	0.85	0.28	**	NA	NA	0.75	0.19	**
FC	12.42	7.45		-0.53	7.32		NA	NA	13.32	7.01	
age	3.43	1.92	.	0.10	1.85		NA	NA	3.67	1.80	
Experience	NA	NA		NA	NA		NA	NA	66.46	53.64	
FC:age	-0.64	0.38	.	0.01	0.35		NA	NA	-0.69	0.35	
FC:Experience	NA	NA		NA	NA		NA	NA	-13.19	10.36	
age:Experience	NA	NA		NA	NA		NA	NA	-3.42	2.64	
FC:age:Experience	NA	NA		NA	NA		NA	NA	0.68	0.51	
Residual standard error	NA			1.548			1.495		1.512		
Multiple R-squared	NA			0.2047			0.3147		0.2595		
Adjusted R-squared	NA			0.09863			0.2233		0.1624		
F-statistic	NA			1.93			3.444		2.672		
p-value	NA			0.1312			0.01975		0.01385		

Note: Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Discussion

Mixed support for UTAUT was found. Most hypotheses were supported, or partially supported, while some were not.

As UTAUT suggests, performance expectancy had a significant influence on technology acceptance. The effect of performance expectancy was moderated by gender and age (as represented by the interaction terms) such that it was more salient for men and particularly for younger men, thus supporting **H1**.

H2 was partially supported as effort expectancy had a significant influence on behavioral intention and was moderated by only gender and age, and only in T2. Surprisingly, experience had no significant moderating effect on the relationship between effort expectancy and technology acceptance.

Social influence was moderated by gender age and voluntariness only such that the effect is more salient to younger students in mandatory settings. Experience had no significant moderating effect. The effect of social influence was significant in T2 only, thus partially supporting **H3**.

H4a was not supported as Facilitating conditions had a significant influence on behavioral intention. The influence was notably higher in T3 and was significant to a lesser extent in the pooled data. In addition, facilitating conditions had a significant influence on actual usage as expected. Age had a significant moderating influence on the relationship between facilitating conditions and usage while experience had no significant influence. Thus, **H4b** was partially supported. This might be attributed to the fact that usage behavior was not measured beyond T3, or that students stop using the system after the semester is over.

H5a stating that computer self-efficacy will not have a significant influence on behavioral intention was supported in T2, T3, and the pooled analysis. SE had a significant positive effect only in T1. The reason behind this might be that students are less confident with the system when they are first introduced to it, but with increased experience this effect disappears.

Consistent with UTAUT, computer anxiety did not have a significant influence on behavioral intention at any point of measurement, supporting H5b. However, attitude toward using technology had a significant influence on behavioral intention unlike what UTAUT suggests. The data shows that the better attitude students have towards using technology, the more likely it is for them to accept it. Thus, **H5c** was not supported. The significance of the influence of attitude towards using technology might be attributed to contextual factors such as participants being university students of a relatively young age and perhaps a more salient attitude.

Finally, **H6** was supported as Behavioral intention had a significant positive influence on usage across all points of measurement and in the pooled analysis, as suggested by UTAUT.

Differences in the results of this study and the original UTAUT study could be attributed to the difference in the cultural or organizational context. Another possible reason is the noise in the data because of the small sample size and the inaccuracy of students' responses.

Comparing these results with similar work of others, an interesting finding is that age in this study had a significant moderating effect on performance expectancy, effort expectancy, and social influence, while in other studies applying UTAUT in an educational environment age was not a significant moderator (e.g. Marchewka et al, 2007) since the age range is small. However, the finding that attitude toward using

technology is a significant predictor of intention is consistent with other studies testing UTAUT for university students (El-Gayar & Moran, 2006). Unfortunately, the finding of experience not being a significant moderator could not be compared to other studies because there were very little or no studies tracking students' acceptance of technology over time.

Limitations

This study does not measure culture-related constructs. Studies such as Straub, Keil, and Brenner (1997) have shown (using Hofestedes cultural dimensions) that there are cultural dimensions that can affect technology acceptance. Also, the sample size poses a limitation especially with the large number of variables and interactions included in the model. Additionally, there might be other influencing factors related specifically to the technology or class that students completed the study for. The sample size per class and per technology is small and does not allow for running the analysis per class or technology to examine whether differences exist.

Implications for future research and practice

Future research should focus on examining further relationships between the full direct and moderating determinants of technology acceptance from UTAUT, including the excluded variables of attitude towards using technology, self-efficacy and anxiety. Future research in this area should be specifically focused on students in an educational environment where an educational technology is introduced to them. Since there is little or no research studying students' acceptance of technology over time with increasing experience, more longitudinal and panel studies should be conducted to address the influence of experience as a moderating variable. Lastly, the UTAUT model

can be extended beyond the use of technology to measure the success of the technology implementation from the students' and the institutions' perspective.

As for practice, course instructors should focus on providing the students with the appropriate environment and training before introducing a technology to them to ensure a successful technology adoption. Preparation should focus on providing the students with the knowledge and resources (facilitating conditions) needed to use the technology and emphasize the task-related outcomes (performance expectancy) of using the technology.

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Appendix

The authors of UTAUT used survey items from the previous eight models to estimate UTAUT. Each construct had three or four items. In this study, the survey items were adopted from the originating study of UTAUT with minor modifications to fit the context of an academic institution. The survey items were mixed and distributed among four pages of the online survey. Also, the tense of the verbs was changes based on the time period (future tense for T1, and present for T2 and T3). Below is the list of items for each construct.

Performance expectancy

I find the system useful for the course.

Using the system will enable me to accomplish tasks more quickly.

Using the system will increase my productivity.

If I use the system, I will increase my chances of getting a high grade.

Effort expectancy

My interaction with the system will be clear and understandable.

It will be easy for me to become skillful at using the system.

I find the system easy to use.

Learning to operate the system is easy for me.

Attitude toward using technology

Using the system is a good idea.

The system will make work more interesting.

Working with the system is fun.

I like working with the system.

Social influence

People who are important to me think that I should use the system.

People who influence my behavior think that I should use the system.

The instructor of this course has been helpful in the use of the system.

In general, the university has supported the use of the system.

Facilitating conditions

I have the resources necessary to use the system.

The system is not compatible with other systems I use.

I have the knowledge necessary to use the system.

A specific person (or group) is available for assistance with system difficulties.

Self-efficacy

I could complete a job or task using the system...

If there was no one around to tell me what to do as I go.

     If I could call someone for help if I got stuck.

     If I had a lot of time to complete the job for which the software was provided.

     If I had just the built-in help facility or assistance.

Anxiety

I hesitate to use the system for fear of making mistakes I cannot correct.

It scares me to think that I could lose a lot of information using the system by hitting the wrong key.

I feel apprehensive (anxious) about using the system.

The system is somewhat intimidating to me.

Behavioral intention to use the system

I plan to use the system in the next <n> months.

I predict I would use the system in the next <n> months.

I intend to use the system in the next <n> months.

Actual use

USE1   I have used the system a lot in the past 4 weeks.

USE2   I have been using the system regularly in the past 4 weeks