EDUCATIONAL TECHNOLOGY ACCEPTANCE ACROSS CULTURES: A VALIDATION OF THE UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY IN THE CONTEXT OF TURKISH NATIONAL CULTURE

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ABSTRACT
The Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003, 2012) proposes a major model of educational technology acceptance (ETA) which has been yet validated only in few languages and cultures. Therefore, this study aims at extending the applicability of UTAUT to Turkish culture. Based on acceptance and cultural data from a large sample (N = 1723) of Turkish educational technology users of diverse profession, geographical location, age and gender, the UTAUT questionnaire displays good convergent and discriminant validity. Structural equations modeling confirms the model validity. Cross-cultural differences are explored within Turkey both between regions (Istanbul area vs. other regions) and between professional cultures (STEM, i.e. science, mathematics, engineering and mathematics, vs. non-STEM professions). The comparison uses measurement results from other European countries as a reference. Conclusions are drawn with respect to UTAUT applicability in educational practice, and to interconnections between ETA and culture.

INTRODUCTION

Significant efforts are sustained all over the world to enhance learning by the use of educational technology. However, a successful implementation primordially depends on the acceptance and diffusion of the used educational technology. This is why educational technology acceptance (ETA) is a topic of increasing importance in educational research and practice. After more than two decades of acceptance research (Šumak, Heričko & Pušnik, 2011; Venkatesh, Thong & Xu, 2012), Straub (2009) establishes that the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh, Morris, Davis & Davis, 2003; Venkatesh et al., 2012), a prominent acceptance theory synthesizing its major predecessors, is still insufficiently validated. In line with this statement, Nistor, Lerche, Weinberger, Ceobanu and Heymann (in press) find the shortcomings of acceptance research laying in the unilateral sample choice. Most of the previous acceptance studies were carried out in Western countries with strong technological infrastructure, and involved young participants with technology-related professions, hence with extensive corresponding knowledge and skills. In particular, the increasing internationalization of education calls for cross-cultural validation of ETA theories and models.

Against this background, due to special cultural, economical and political features, Turkey appears particularly interesting as a context for cross-cultural validation. In contrast to Western countries such as the United States of America or Germany, the Turkish national culture values more power distance, collectivism and uncertainty avoidance (Hofstede, 2001; also Barton, 2010; Parnell, Koseoglu & Dent, 2012). From economical and political point of view, Turkey is engaged in a powerful development that is likely to result in major changes of technological and educational infrastructure, and even in cultural changes. As a cultural context for ETA

research, all these local conditions extend the sample diversity and, potentially, the applicability of the examined ETA models. Therefore, the study at hand examines ETA on the basis of UTAUT (Venkatesh et al., 2003, 2012) in the context of Turkish national culture. The study is part of a larger ETA study carried out first in Germany and Romania, and extensively presented in Nistor et al. (in press). Preliminary follow-up results collected in Turkey were presented at the International Educational Technology Conference (IETC), Taiwan, 2012 (Göğüş & Nistor, in press). Further results are expected to allow wider comparisons between cultures. For educational practice, the study provides educational designers and developers of educational software with a description of acceptance profiles of e-learners, and with recommendations about more effective ways to support technology use in education.
After this introduction, the paper goes on with a literature review on ETA theories and models, and on national and professional culture. The empirical section starts with research questions and presents methodology and results. Finally, the findings are discussed and conclusions for educational research and practice are drawn.

THEORETICAL BACKGROUND

Educational Technology Acceptance

Technology acceptance models are based on the view of acceptance as an attitude towards technology. As stated by the theory of reasoned action and its expanded version, the theory of planned behavior (Ajzen & Fishbein, 2000), human action is guided by three categories of attitudes: beliefs about likely consideration of behavior (behavioral beliefs), beliefs about the normative expectation of others (normative beliefs), and beliefs about the presence of factors that may help or hinder the behavioral performance (control beliefs). In combination, behavioral, normative and control beliefs lead to a behavioral intention. The more favorable the beliefs, and the greater the perceived control, the stronger a person’s intention to perform the behavior in question should be.

In the context of technology adoption, the reasoned action and planned behavior approach resulted in several theories, of which the most frequently studied in educational settings is the Technology Acceptance Model (TAM; Davis, 1989), with two extended versions TAM2 (Venkatesh & Davis, 2000) and TAM3 (Venkatesh & Bala, 2008). Venkatesh and his colleagues (2003) formulate their Unified Theory of Acceptance and Use of Technology (UTAUT) as a synthesis of its predecessors and describe technology use under the influence of use intention, further determined by performance expectancy, effort expectancy, and social influence. Additionally, facilitating conditions directly determine technology usage. The influence of the predictors named above on behavioral intention and use behavior is moderated by users’ age, sex, experience, and by the voluntariness of use. On this ground, the UTAUT model explains up to 40% of the variance in the technology use behavior. By adding further acceptance predictors, from which habit seems to be the most important, an extended UTAUT version (Venkatesh et al., 2012) explains 52% of the same variance.

The studies cited so far are positioned in the domain of Information Systems. Only few efforts have been made to analyze technology acceptance from the perspective of technology-enhanced learning. Thus, Straub (2009) emphasizes that the UTAUT is still a relatively new model, with yet limited impact in educational research; further validation and replication of the UTAUT model appears to be essential. In a recent study, Nistor, Wagner, Istvánffy and Dragotă (2010) report findings that are consistent with Venkatesh and colleagues (2003), but increase the explanatory power of the UTAUT model by additionally considering the role of computer anxiety for ETA (cf. Beaudry & Pinsonneault, 2010; Conti-Ramsden, Durkin & Walker, 2010). However, the ecological validity of previous findings is limited by the low diversity of samples. The majority of the participants appear to be young technology users from Western countries, mostly with technological professions and displaying a high acceptance level. Some recent studies (see below) involve cultural diversity. In spite of limitations, UTAUT appears to provide a robust and reliable model that can be used to gain deeper understanding ETA. Additional validation is nevertheless necessary.

The Cultural Context of Educational Technology Acceptance

There are numerous definitions of culture, in general (Triandis, 1972), as well as of organizational culture (Schein, 2004) and technological culture (Leidner & Kayworth, 2006). Hofstede (2001) defines culture as patterns of thinking, feeling and potential acting, which have been learned throughout a lifetime, and which are likely to be used repeatedly and unlikely (or difficult) to be changed by the individual. Cultural patterns are shared within a social environment such as nation, ethnicity or profession. In available cross-cultural ETA research literature (e.g., Barnett & Sung, 2006; Leidner & Kayworth, 2006; Li, Chau & Van Slyke, 2010; Li & Kirkup, 2007; Nistor et al., 2010; Teo, Luan & Sing, 2008; Veltri & Elgarah, 2009; Venkatesh & Zhang, 2010; Zakour, 2007), different cultures are compared using samples from different countries, thus tacitly equating culture with national culture, i.e. geographical location. This is a rough approximation, since timely stable patterns of thinking, feeling and potential acting may strongly vary within national borders. However, for the purpose of this research, we speak of *national cultures* defined by geographic location. Additionally, we examine *professional cultures*, defined by individual education and professional practice in a given domain.

Hofstede describes culture using five dimensions that were initially identified in a study among IBM staff in 72 countries (Hofstede, 2001; Hofstede & McCrae, 2004):

- PDI: Power distance index represents the extent to which the less powerful members of a culture accept the unequal distribution of power within the same culture.
- UAI: Uncertainty avoidance deals with the intolerance for unstructured, i.e. novel, unknown, surprising or unusual situations that the members of a society show.
- IDV: Individualism (vs. collectivism) refers to the quality of ties between individuals, and to the degree of integration into cohesive groups within society.
- MAS: Masculinity (vs. femininity), is a preference for assertiveness, achievement and material success; contrasted with femininity, which emphasizes relationships, modesty and caring.
- LTO: Long-term orientation (vs. short-term orientation) comprises values such as thrift and perseverance, as opposed to respect for tradition, the fulfillment of social obligations and face-saving, which are representative of short-term orientation.

Culture and Educational Technology in Turkey

Turkey is a Eurasian country located in Western Asia (the Anatolian peninsula) and in Southeastern Europe. It has a population of 74.72 million people, from which 13.59 million (18,2%) live in Istanbul. Turkey has 81 cities, in which 77% of the population lives. Turkey is a democratic, secular, constitutional republic with an ancient cultural heritage. The Islamic religion, recent political developments and its history link Turkey to Asia, while its memberships in the Council of Europe, NATO, OECD, OSCE and the G-20 major economies link it to Europe. Turkey's move towards Europe has begun with the acceptance of Western civilization at the turn of the 19^{th} into the 20^{th} century. More intensive and specific efforts have been done in the past two decades, aimed at entering the European Union (Bonnett, 2002). Actually, this process is still going on, major economical and cultural changes have been reported in the past decade (Parnell et al., 2012). Strongest development is observed especially in and around the capital, where 18% of the total population of Turkey resides (Barton, 2010).

Hofstede (2001) describes Turkish culture as follows:

- PDI = 66, moderately high level of power-distance, with group interactions affected by status and economic power
- IDV = 37, still moving from closely collectivist to individualist culture
- MAS = 45, moving from being strictly masculine to more feminine characteristics, with less emphasis on gender in work roles
- UAI = 85, moderately strong level of uncertainty-avoidance related to occupations and benefits
- LTO not provided as a numeric index, however described as slowly moving away from short-term orientation characteristics such as respect for tradition, the fulfillment of social obligations and face-saving.

Historically, the use of educational technologies in Turkey is largely connected with distance learning, which is a response to challenging topographical and demographic aspects, resulting in a high number of Internet users (estimated to approx. 24 milions, i.e. more than a third of the population) and high e-readyness, ranked to place 43 in the world (Barton, 2010). Examining several case studies of adoption and use of educational technology in the context of distance learning, Barton (2010) characterizes Turkish users of educational technology "by a very forward-looking, progressive outlook that optimistically looks to the future" and "generally keen to continue with development" (p. 192). In line with these conclusions, Gök & Erdoğan (2010) study preservice teachers' attitudes towards technology, and reports three most frequent, hence representative views, according to which technology is both harmful and beneficial (15.6%); technology is continuously developing and improving performance (15.0%); technology is a generally needed help (13.8%). TAM-based acceptance research was conducted in Turkey by Ramayah (2010), however her results are based on a relatively small sample, hence little representative.

Aydin and McIsaac (2004) suggest that the future of information technology in Turkey depends on the extent to which the infrastructure is put in place, the access that people have to networked technologies, and the training opportunities that teachers in schools have to use the new technologies. Recently, the Turkish government has been promoting the use of educational technology for several years at all levels. In Turkish schools, Özdemir and Kılıc (2007) analyse a technology-based educational program in the early 2000s and observe successful integration of information and communication technologies (ICT) in the primary school system, however with several shortcomings caused, among other factors, by lacking necessary cultural changes, placing an emphasis on technology rather than on pedagogy, and limited knowledge and skills of the school personnel. Şerefoğlu Henkoğlu and Yıldırım (2012, p. 23) assert that "the most important of these problems are results of the elective status of computer education course and the limited time allocated for this course". From another perspective, Çağlar and Demirok (2010) demonstrate the positive effect of students using a computer at home on their computer skills, as opposed to using a computer at school, which proved less effective. In Turkish universities, Turan (2010) as well as Yurdakul (2011) find both positive attitudes toward technology use, and essential technology skills and knowledge to feel adequate in a technology-enhanced learning environment. Notably, this state-of-the-art was reported from less technological domains, such as social sciences and teacher education, which may be less expected to promptly adopt new technologies.

Professional Culture and Educational Technology

Professional cultures are usually regarded in educational research as a typical context for acquiring and applying knowledge and skills; hence they are omnipresent in research literature. However, professional cultures are less studied from the perspective of Hofstede's (2001) cultural dimensions. Nistor et al. (in press) find cultural differences between STEM and non-STEM professionals from Germany and Romania in the dimensions PDI, IDV and UAI. These differences are not as strong as those between national cultures; nevertheless they reach statistical significance.

Unlike the interconnections between ETA and national culture, there is scarce evidence of the relationship between ETA and professional culture. It seems to be unanimously accepted that professions in the domains of science, technology, engineering and mathematics (STEM) will promptly adopt top technologies, including educational applications, in a fashionable way (Wang, 2010). Presumably, the fast technology diffusion is due to the fact that STEM professionals will possess more extensive ICT knowledge and skills. Venkatesh and colleagues (2003, 2012), as well as numerous other authors, regard ICT knowledge and skills as a moderator variable of the technology acceptance model. Accordingly, ICT knowledge and skills reduce users' dependence of facilitating conditions, thus reducing the influence of facilitating conditions on use behavior. Also, with increasing ICT experience, technology use becomes routine, which is less dependent on individual use intention. Recently, Venkatesh et al. (2012) introduced the construct of habit in ICT use, which has a positive effect both on use intention and on actual usage of technology. ICT experience and habit are very likely to be associated with STEM professions, and thus display all the effects stated by UTAUT.

Nistor et al. (in press) find differences in acceptance profiles of STEM and non-STEM professionals that are consistent with Venkatesh et al. (2012). STEM professionals display higher performance expectancy, lower effort expectancy, stronger perceived social influence, better facilitating conditions, lower computer anxiety, higher use intention and higher use behavior. With respect to the UTAUT path coefficients, the use behavior of STEM professionals is somewhat weaker influenced by use intention, facilitating conditions and computer anxiety. As for the predictors of the use intention, there is a significant difference in the influence of the effort expectancy, which is stronger for non-STEM professionals.

Towards the Integration of Culture in ETA Models

Several researchers discuss cross-cultural aspects of acceptance models, usually by comparing samples from two different countries (e.g. Li & Kirkup, 2007; Li et al., 2010; Teo et al., 2008; Venkatesh & Zhang, 2010). However, these are isolated research results; an overall picture of the relationship of ETA and culture, which would integrate cultural dimensions and UTAUT, is still missing. Providing empirical evidence for this relationship is confronted with several methodological difficulties and limitations. The causal relationships between the culture dimensions and the UTAUT variables are still ambiguous (Leidner & Kayworth, 2006).

RESEARCH MODEL

To make a first step towards the integration of culture into the UTAUT model, we examine both the direct influence on the UTAUT variables and their moderating influence within the model (cf. Leidner & Kayworth, 2006). After checking *generic results* such as mean values of the model variables, path coefficients and moderating effects of sex, age and degree for the entire sample, we examine the following aspects of ETA in Turkey and compare them with available values from Germany and Romania.

The influence of national culture. To what extent do Turkish users of educational technology, as compared with Romanian and German users, differ with respect to (a) their cultural values sensu Hofstede, (b) their attitudes towards educational technology, and (c) the corresponding relationships between acceptance variables as described by UTAUT?

The influence of professional culture. To what extent do Turkish participants with professions in STEM vs. non-STEM fields differ with respect to (a) their cultural values sensu Hofstede, (b) their attitudes towards educational technology, and (c) the corresponding relationships between acceptance variables as described by UTAUT?

METHODOLOGY

A correlation study was conducted, recording transversal data in a one-shot survey, from Turkish learning technology users. In order to increase the probability that the participants are familiar with learning, in general, and specifically with learning technology, we chose academics (i.e. people with an academic degree, including faculty and teachers, from universities, schools and adult education centers) and university students. The sample was chosen randomly within a range aimed at overcoming the limits of the previous studies, i.e. sample size and sample diversity in terms of age, profession and acceptance level.

The collected sample consisted of N = 1723 participants. From these, n = 962 were from Istanbul area and n = 761 from other regions. Concerning participants' educational status, the survey participants had a highschool diploma (i.e. university students, n = 64), a university diploma (n = 1208) or a master or doctoral degree (n = 451). The participants had professions either in STEM fields (i.e. science, technology, engineering, and mathematics; n = 702) or in non-STEM fields (n = 1021). The sample provided further diversity in terms of sex (895 male and 828 female participants) and age (537 participants were under 30, 1005 between 30 and 50, and 182 over 50). An overview of the sample structure is provided in Table 1.

The independent variables performance expectancy, effort expectancy, social influence, facilitating conditions, computer anxiety and computer literacy were measured, as well as the dependent variables use intention and use behavior. Additionally, the demographic variables age, sex, geographic location and profession were registered. The research instrument consisted of a Turkish translation of the questionnaire proposed by Venkatesh et al. (2003, 2012) with variable values ranging from 1 = very low to 5 = very high acceptance (Appendix 1). Aimed at surveying general attitudes and intentions towards technology, the questions were framed about "the computer as a learning tool", with specific references to office software, information search on the Internet, communication and interactions between Internet users (e.g. e-mail, discussion forums, chat etc.), and e-learning. Computer literacy was self-assessed based on the statement "I know what the following are and how they work", related on the technologies mentioned above. The participants' cultural values were measured using the Values Survey Model VSM94 (Hofstede, 2012).

Table 1 Sample Description

	Geographic location		
	Istanbul area	other regions	Total
Sex			
female	478	350	828
male	484	411	895
Age			
under 30	313	224	537
30-50	544	461	1005
over 50	105	76	182
Profession			
STEM	374	328	702
non-STEM	588	433	1021
Educational status			
high school diploma	18	46	64
university diploma	675	533	1208
master & doctorate	219	182	451
Survey medium			
online	50	57	768
pen and paper	387	381	955
Total	575	380	1723

Data was collected calling for voluntary participation, partially online (n = 768) and partially using pen-and-paper forms (n = 955). Data analysis was performed using IBM SPSS Statistics version 19 and R version 2.11.1 (using Lavaan version 0.4-9 and SEM version 0.9-21). Since Hofstede's (2000) cultural dimensions are defined on group level, the usual statistical tests such as t-test or ANOVA, which are defined on individual level, may not be applied. In order to make more reliable statements on cultural dimensions, i.e. to be able to specify the statistical significance of the results, the Welch t-test was adapted based on Carmer's theorem and a correction factor depending on the sample size (Lerche & Kiel, under review).

RESULTS

Instrument Validity

Although Venkatesh and colleagues (2003, 2012) have already published the validation of their acceptance questionnaire, due to the application of UTAUT in a new cultural context this study reassessed the reliability and validity of the instrument. A confirmatory factor analysis (Mulaik & Millsap, 2000) was performed. Six of the 33 items displayed factor loadings under .20 and were removed. The remaining items had satisfactory factor loadings and the average variance extracted was above 0.5 (Table 2), which demonstrates convergent validity of the instrument at item level. As shown in Table 3 by the principal component analysis with quartimax rotation, chosen because it best separated the variables, the square root of the average variance extracted was higher than any correlation with other constructs, which demonstrates the discriminant validity of the model. The comparative fit index (CFI) of the confirmatory factor analysis was .984, describing a good model fit.

Table 2 Principal Component Analysis with Varimax Rotation (Acceptable Threshold Values in Brackets)

	Factor loading	Cronbach α	Composite Reliability	Average variance extracted
Performance expectancy (PE)		0.86	0.91	0.62
PE 1	0.72			
PE 2	0.73			
PE 3	0.64			
Effort expectancy (EE)		0.81	0.96	0.63
EE 1	0.70			
EE 2	0.74			
EE 3	0.56			
Social influence (SI)		0.90	0.96	0.72
SI 1	0.70			
SI 2	0.71			
Facilitating conditions (FC)		0.75	0.90	0.48
FC 3	0.67			
FC 4	0.61			
Computer anxiety (CA)		0.91	0.96	0.78
CA 1	0.83			
CA 2	0.83			
CA 3	0.86			
CA 4	0.84			
Use intention (UI)		0.86	0.95	0.61
UI 1	0.84			
UI 2	0.77			
UI 3	0.84			
UI 4	0.76			
UI 5	0.65			
Use behavior (UB)		0.97	0.91	0.94
UB 1	0.94			
UB 2	0.95			
UB 3	0.95			
Computer literacy (CL)		0.89	0.97	0.70
CL1	0.84			
CL2	0.82			
CL3	0.85			
CL4	0.81			
CL5	0.69			

Table 3 Discriminant Validity for the Measurement Model (Bold Values: The Square Root of the Average Variance Extracted for Each Construct)

Construct	PE	EE	SI	FC	CA	BI	UB	CL
PE	**0.79**							
EE	0.56	**0.79**						
SI	0.22	0.43	**0.85**					
FC	0.08	0.14	0.25	**0.69**				
CA	0.37	0.23	0.05	0.09	**0.88**			
BI	0.22	0.25	0.28	0.12	0.05	**0.78**		
UB	0.64	0.45	0.14	0.10	0.41	0.19	**0.97**	
CL	0.59	0.39	0.09	0.05	0.41	0.14	0.76	**0.83**

Generic results

The mean values of the UTAUT variables are displayed in Table 4, along with comparative values measured by Nistor et al. (in press). The extended UTAUT model (i.e. containing the computer anxiety as additional variable compared to Venkatesh et al., 2003, 2012; cf. Nistor et al., in press) was tested for the entire sample. Due to the complexity of the verified model, the method of structural equations modeling with latent variables was chosen (Bentler & Weeks, 1980; Bollen, 1989). The resulting path coefficients are shown in Figure 1 and the fit indices of the research model in Table 5. The model's goodness of fit is good (Hu & Bentler, 1999).

Driven by the low path coefficients between use intention and its predictors, the influence of computer literacy on other model variables was closer examined. In a multiple regression model having use behavior as dependent variable and use intention, facilitating conditions, computer anxiety and computer literacy as independent variables, the influence of computer literacy was very strong ($\beta = 0.70$, $p < 0.000$), while all other predictors had very weak influence ($\beta < 0.12$). The model explained $R^2 = 0.61$ of the variance of use behavior, while in a simplified model version computer literacy alone explained $R^2 = 0.59$ of the same. Further, this influence was not affected by participants' geographical region or profession.

Hofstede□s profiles were calculated for the entire Turkish sample (Table 6). Turkish culture scored very low in power distance index, relatively high in individualism and feminity, moderately in uncertainty avoidance and long-term orientation. As a reference frame, the German culture was moderately power-distant, highly individualistic, feminine and uncertainty avoidant, and moderately long-time oriented. The Romanian culture was characterized by lower power distance and individualism, higher masculinity, less uncertainty avoidant, and similarly moderate long-time oriented.

Table 4 Values of the UTAUT variables for the entire sample and for the cultural subgroups, compared with Germany and Romania

	Turkey	Comparative values	
	(N = 1723)	Germany	Romania
	M (SD)	M (SD)	M (SD)
Performance expectancy	4.44 (0.69)	3.94 (.85)	4.31 (.66)
Effort expectancy	4.13 (0.74)	2.10 (.84)	1.80 (.62)
Social influence	3.44 (1.05)	3.23 (.89)	3.92 (.71)
Facilitating conditions	3.17 (0.89)	3.88 (.74)	3.78 (.61)
Computer anxiety	2.07 (0.98)	1.80 (.88)	2.21 (.96)
Use intention	3.56 (1.23)	3.60 (1.21)	4.09 (.90)
Use behavior	4.38 (0.68)	4.34 (.46)	4.07 (.84)
Computer literacy	4.52 (0.66)	4.61 (0.54)	3.38 (1.53)

Table 5 Fit Indices of the Extended UTAUT Model

Fit index	Level of acceptable fit	Fit of the extended UTAUT model
χ^2	$p < .05$	541.846; $p < .000$
CFI	> .900	.984
RMSEA	< .060	.039
SRMR	< .050	.028

CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean residual

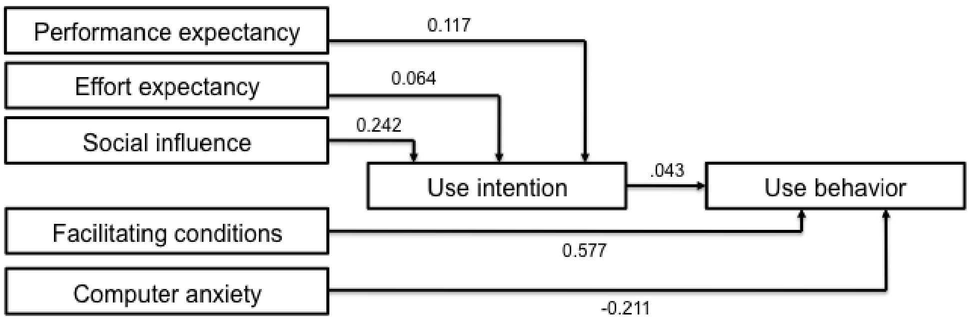

Figure 1 Verification of the Extended UTAUT Model with Path Coefficients for the Entire Sample

Table 6 Hofstede's Cultural Dimensions Scores in Turkey, Compared with Germany and Romania

	Turkey (N = 1723)	Comparative values Germany	Romania
Power distance index (PDI)	9.6	36.1	20.1
Collectivism vs. individualism (IDV)	76.5	92.5	67.4
Masculinity vs. femininity (MAS)	3.4	-29.9	38.5
Uncertainty avoidance (UAI)	43.7	76.9	65.2
Long-term orientation (LTO)	42.5	45.6	53.7

The Influence of Regional Culture

Regarding attitudes towards educational technology, participants from Istanbul area had significantly higher performance expectations, lower computer anxiety, they used educational technology more intensively, and they evaluated the own computer literacy higher than participants from other regions (Table 7). With respect to Hofstede's cultural dimension scores, no significant differences were found (Table 8). Further details concerning participants' acceptance were extracted by repeating the structural equations procedure described above and testing the extended UTAUT model separately for participants from Istanbul area and from other regions.

Table 7 Values of the UTAUT Variables with Regional Differences

	Istanbul area (n = 962) M (SD)	Other regions (n = 761) M (SD)	Differences (Oneway ANOVA) F	df	p
Performance expectancy	4.49 (0.69)	4.38 (0.69)	10.27	1722	0.001
Effort expectancy	4.13 (0.75)	4.12 (0.72)	0.05	1722	0.820
Social influence	3.44 (1.07)	3.43 (1.03)	0.04	1722	0.844
Facilitating conditions	3.20 (0.88)	3.13 (0.89)	2.71	1722	0.100
Computer anxiety	2.01 (0.96)	2.15 (0.99)	9.75	1722	0.002
Use intention	3.57 (1.24)	3.56 (1.20)	0.00	1722	0.975
Use behavior	4.45 (0.67)	4.29 (0.68)	26.45	1722	0.000
Computer literacy	4.59 (0.66)	4.44 (0.66)	20.35	1722	0.000

Table 8 Hofstede's Cultural Dimensions Scores with Regional Differences

	Istanbul area (n = 962)	Other regions (n = 761)	Welch-Lerche two sample t-test t	df	p
Power distance index (PDI)	11.8	6.9	-2.08	1466.13	0.981
Collectivism vs. individualism (IDV)	79.0	73.3	-2.87	1492.18	0.998
Masculinity vs. femininity (MAS)	3.92	2.76	-0.29	1488.80	0.613
Uncertainty avoidance (UAI)	46.0	40.9	-1.75	1487.76	0.960
Long-time orientation (LTO)	42.1	42.9	0.84	1529.47	0.202

As shown in Figure 2, the use behavior of participants from Istanbul area was stronger influenced by facilitating conditions, and their use intention was stronger influenced by effort expectancy, wheres the use behavior of participants from other areas was stronger influenced by computer anxiety, and their use intention more subjected to social influence.

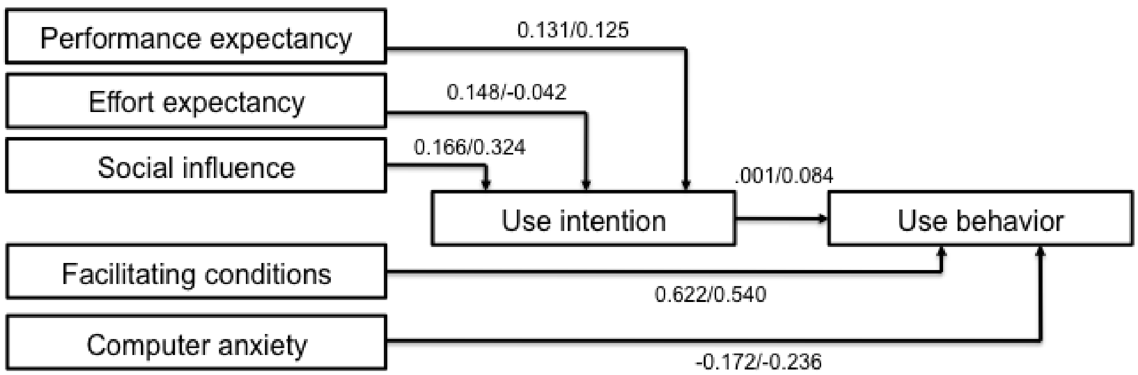

Figure 2 The Extended UTAUT Model with Regional Differences (Istanbul area/other Regions)

The Influence of Professional Culture

Observing participants' attitudes towards educational technology, those with STEM professions showed significantly higher performance and effort expectancy, at the same time lower computer anxiety, they used educational technology more intensively, and evaluated the own computer literacy as higher than participants with non-STEM professions (Table 9). As for the differences between professional groups related to Hofstede's cultural dimensions, the participants with STEM professions were less power distant, exhibited lower values on masculinity, and were less uncertainty avoidant than the participants with non-STEM professions. However, according to the Welch-Lerche test only the difference in PDI proved to be significant (Table 10). With respect to the path coefficients of the extended UTAUT model (Figure 3), the use behavior of the participants with STEM professions was less influenced by facilitating conditions and computer anxiety as compared to non-STEM professions. Their use intention was also somewhat weaker influenced by effort expectancy.

Table 9 Values of the UTAUT Variables for the Entire Sample and for the Participants with STEM vs. non-STEM Professions

	STEM professions (n = 702) M (SD)	Non-STEM professions (n = 1021) M (SD)	Differences (Oneway ANOVA) F	df	p
Performance expectancy	4.48 (0.64)	4.41 (0.72)	5.018	1722	0.025
Effort expectancy	4.18 (0.70)	4.09 (0.76)	6.621	1722	0.010
Social influence	3.49 (1.01)	3.40 (1.07)	3.650	1722	0.056
Facilitating conditions	3.19 (0.91)	3.15 (0.87)	0.715	1722	0.398
Computer anxiety	2.00 (0.97)	2.12 (0.98)	5.536	1722	0.019
Use intention	3.53 (1.24)	3.59 (1.22)	1.067	1722	0.302
Use behavior	4.44 (0.66)	4.34 (0.68)	8.208	1722	0.004
Computer literacy	4.59 (0.66)	4.48 (0.66)	12.09	1722	0.001

Table 10 Hofstede's cultural dimensions scores of STEM and non-STEM professionals

	STEM professions (n = 702)	Non-STEM professions (n = 1021)	Welch-Lerche two sample t-test		
			t	df	p
Power distance index (PDI)	6.08	12.01	2.55	1354.61	0.006
Collectivism vs. individualism (IDV)	77.0	76.1	-0.44	1296.95	0.669
Masculinity vs. femininity (MAS)	-0.26	5.93	1.52	1320.63	0.064
Uncertainty avoidance (UAI)	41.23	45.44	1.43	1289.87	0.077
Long-time orientation (LTO)	42.91	42.17	-0.71	1287.87	0.762

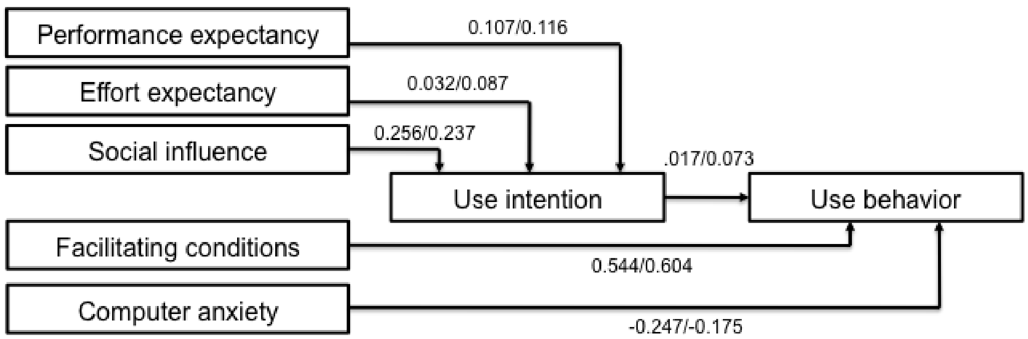

Figure 3 The Extended UTAUT Model with Path Coefficients for Participants with STEM vs. non-STEM Professions

Summary of Results and Discussion

Generic results. This study validated UTAUT and the corresponding measurement instrument for Turkish language and culture, proving thus evidence of the applicability of educational technology acceptance as conceptualized by Venkatesh and colleagues (2003, 2012). Thus, the applicability of UTAUT was extended to a new cultural context. Also, UTAUT was extended from the Information Systems domain, where it was initially developed to Educational Sciences.

Applying this to the Turkish sample of educational technology users reveals a collective acceptance profile that differs from similar findings in other European countries (Nistor et al., in press). Turkish users of educational technology displayed substantially higher scores in both performance and effort expectancy, and lower scores in perceived facilitating conditions. While they evaluated the own computer literacy at similar levels as German and Romanian users, their computer literacy was the main determinant of the use behavior. This profile suggests a very strong correlation between technology use, computer literacy and expectations, in the sense that an intensive use of educational technologies is associated with higher computer literacy (probably based on experiential and self-directed learning), and with (probably knowledge-based) higher expectations of increasing performance and reducing effort (Çağlar & Demirok, 2010). Further, this suggests a clear separation between intensive and occasional technology users. Another pervasive finding is the very weak or hardly significant effect of use intention on use behavior. At first sight, this contradicts the theory of reasoned action/planned behavior (Ajzen & Fishbein, 2000). At a closer look, however, this can be explained by the high degree of technology diffusion, which leaves little degrees of freedom in participants' choice of educational technology vs. previous learning forms, and practically leads in many cases to forced use of technology (Liu, 2012).

From the cultural point of view (Hofstede, 2001), the study at hand reveals Turkish culture as associated with very low power distance, high individualism, very low masculinity, moderate uncertainty avoidance and long-term orientation. These findings display large differences to Hofstede's measurements and estimations, suggesting cultural changes occurred in recent years. Also, unexpectedly low values of cultural masculinity in this study, corroborated with negative values reported by Nistor et al. (in press) suggest a possible reconceptualisation of cultural masculinity.

Influence of regional culture. In this case, Hofstede's (2001) model of cultural values in connection with the newly developed Welch-Lerche test revealed non-significant cultural differences between Istanbul area and other regions of Turkey. Comparing this result with significant cultural differences reported by Nistor et al. (in press) between Southern and Eastern Germany in the dimensions PDI, UAI and LTO support the interpretation of a culturally homogeneous sample, which contradicts the hypothesis of east-west differences within Turkey. However, there were significant differences in the regional acceptance profiles, i.e. higher scores of performance expectancy and educational technology usage, and lower scores of computer anxiety. The differences in regional acceptance profiles may be then interpreted as caused by differences in technological and educational infrastructure, in the sense that these are better available in the capital than in other regions.

Influence of professional culture. The comparative examination of cultural and acceptance profiles of STEM vs. non-STEM professionals revealed clear differences that support the view of STEM and non-STEM as two different cultures. From cultural perspective, STEM participants appear as more democratic (lower PDI scores), more oriented to feminine cultural values (such as more caring and making less difference between gender roles, which is reflected in lower MAS scores), and tendentially less uncertainty avoidant (lower UAI scores, however the Welch-Lerche test with $p < 0.077$ was tightly above the statistical significance threshold). The differences in PDI and UAI are consistent with those reported by Nistor et al. (in press). However, lower MAS for STEM professionals differs from the same findings. From ETA perspective, STEM professionals score higher in performance expectancy and use behavior, somewhat higher, however not statistically significant, in effort expectancy, and lower in computer anxiety. These findings are consistent with the differences in requirements between professions, and with the findings of Venkatesh and colleagues (2003, 2012). However, according to Venkatesh and Zhang (2010), since STEM culture appears to be more feminine than the non-STEM culture, performance expectancy should be higher for non-STEM, and lower for STEM, which could not be reproduced in this study. As for the UTAUT path coefficients, effort expectancy has a somewhat stronger influence for non-STEM professions, which is similar to Nistor et al. (in press). As a further concordance, facilitating conditions have a stronger influence for non-STEM professions. Finally, the generally weak influence of use intention on behavior is somewhat stronger for non-STEM, which can be interpreted by educational technology diffusion being stronger in STEM than in non-STEM domains, which leves more degrees of freedom for non-STEM professionals in adopting or refusing technology according to their use intention.

CONCLUSIONS

Conclusions on ETA. This study confirms the wide applicability of the ETA concept, as conceptualized by Venkatesh and colleagues (2003, 2012) in UTAUT. The corresponding empirical findings appear robust and reproductible across cultures (Nistor et al., in press; Venkatesh & Zhang, 2010). Given the relative high complexity of UTAUT, a more in-depth discussion of the model would have to consider three different zones of the model: firstly the intention-behavior correlation; secondly the predictors of technology use intention, and thirdly the influence of facilitating conditions and anxiety on use behavior.

With respect to the first zone, Bagozzi (2007, p. 245) describes the intention-behavior correlation as "probably the most uncritically accepted assumption in social science research in general and IS research in particular". Nistor (under review) emphasizes that the majority of previous studies that include this correlation use the same data collection method for both variables, which is prone to statistical arterfacts likely to inflationate the strength of the correlation (Podsakoff, MacKenzie & Podsakoff, 2012). In this study, in spite of common methods, the correlation is extremely low, which calls for alternative explanations to Ajzen and Fishbein's reasoned action and planned behavior, such as restrained degrees of freedom in media choice or participants' insufficient information on performance and effort in technology use. Future research should clarify these open issues.

The predictors of technology use intention are designated in previous research (e.g., Nistor et al., in press; Pynoo, Tondeur, Braak, Duyck, Sijnave & Duyck, 2012; Schaupp, Carter & McBride, 2010; Venkatesh et al., 2012) as the strongest predictors in the entire acceptance model. The study at hand shows a simple alternative in which computer literacy, previously considered to be merely a moderator variable of the UTAUT model, can gain weight, become the strongest predictor and throw the other predictors at the lower limit of significance.

Finally, facilitating conditions embody a main acceptance predictor in this study as well as in previous studies. Venkatesh et al. (2003, 2012) understand this variable as including also computer anxiety. On the other hand, many authors (Beaudry & Pinsonneault, 2010; Conti-Ramsden et al., 2010; Nistor et al., in press) emphasize the meaning of computer anxiety for the adoption of educational technology. In order to enhance the explicative power of UTAUT, the authors of this study sustain the explicit representation of computer anxiety as a separate predictor. Its impact on educational technology usage is then expressed both in absolute values of the UTAUT variables and in the path coefficient leading from computer anxiety to use behavior.

Conclusions on the integration of cultural dimensions in UTAUT. This study shows once again that different definitions of culture apply in the context of ETA, and have different impacts on acceptance. Besides national culture, professional culture such as STEM vs. non-STEM can impact acceptance profiles. Several publications (Li et al., 2010; Li & Kirkup, 2007; Nistor et al., in press; Teo et al., 2008; Veltri & Elgarah, 2009; Venkatesh & Zhang, 2010; Zakour, 2007) are available suggesting how cultural dimensions can be integrated in acceptance models such as UTAUT. However, the present findings are still insufficient for proposing an acceptable model. Comparing acceptance profiles across national and professional cultures, as the study at hand does, may result in the progress of this research line.

In this study, progress in integrating culture in ETA models was done with respect to the cultural dimension of uncertainty avoidance. Both in this study and in Nistor et al. (in press), STEM professionals appear less uncertainty avoidant; in the Turkish, as opposite to the measurements in Germany and Romania, STEM professions are associated with significant higher computer anxiety and with a stronger influence of computer anxiety on use behavior. This reinforces the assumption of a correlation between UAI and computer anxiety, but also suggests that additional variables may be involved here in a more complex relationship that should be further explored.

An additional variable that may be highly relevant for acceptance models together with culture may be the availability of the technological infrastructure. The particularly strong correlation between technology use, computer literacy, computer anxiety and performance/effort expectancy, on the one hand, and the non-significant cultural differences between regions of Turkey, on the other, suggest regional differences in the technological and educational infrastructure availability. Hence, future acceptance research should also consider infrastructure availability along with cultural differences.

Conclusions for educational practice. As a general conclusion, which is not new at all, this study evidentiates the importance of computer literacy, which is tightly intertwined with the acceptance and use of educational technology. This may be directly supported by computer skills training, and indirectly by supporting self-directed experiential learning (Çağlar & Demirok, 2010).

With respect to culture, this study suggests that acceptance and Hofstede's culture dimensions are appropriate starting points when dealing with cultural discrepancies in the context of educational technology. The use of educational technology requires taking into consideration the individual differences in ETA, especially when members of different – national and professional – cultures are involved. Different learners may have different expectations with respect to the design and outcome of computer-enhanced learning environments, and need different support, e.g. in order to successfully deal with computer anxiety. In mixed, STEM and non-STEM learner groups, probably STEM professionals will initially expect more performance. However, the influence of performance expectations will be similar for both STEM and non-STEM. Educational technology designers should provide means of communicating these expectations, as well as possibilities to fulfill them.

In general, forced use of educational technology should be avoided (Liu, 2012), no matter what the profession of the learners is. Notably, technology use may implicitly become compulsory, if there is no alternative in using technology in order to reach an educational goal. Forced technology use contradicts personal attitudes and intentions, and may thus increase comptuer anxiety and impair learning motivation (Deci & Ryan, 2000). Therefore, learning environments should be provided along with technology-free alternatives, or at least include face-to-face components.

Individual learners' characteristics, from which acceptance profiles are most important, should be considered in association with design elements of learning environments. Relying on the paradigm of mass-customization (Nistor, Dehne & Drews, 2010), technology-enhanced learning environments may be designed for specific groups of users defined by national and professional culture.

Limitations of the study and open research questions. While this study, corroborated with former studies, provides robust evidence of UTAUT and its associated measure instrument's validity across cultures, the findings still have some limitations. One of them is due to the subjective character of the data, hence future research should also include objective data gained by methods such as observation or artifact analysis. As already mentioned, the comparative study of ETA across cultures should be continued in order to provide deeper insight in the complex relationship between ETA and culture.

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APPENDIX 1

Acceptance Questionnaire (Turkish translation, cf. Venkatesh et al., 2003, 2012)
Aşağıdaki durumlara ne kadar katılıyorsunuz?
kesinlikle katılıyorum-katılıyorum-tarafsızım-katılmıyorum-kesinlikle katılmıyorum

UTAUT-Subscale Computer knowledge (UTAUT-Altölçek Bilgisayar bilgisi)
Aşağıdakilerin ne olduğunu ve nasıl çalıştıklarını biliyorum:
1. bilgisayar
2. ofis yazılımları (Word, Excel vb.)
3. Internet'te bilgi araması yapmak
4. Internet kullanıcıları ile iletişim ve etkileşim içinde olmak
5. e-öğrenme (teknoloji destekli öğrenme)

UTAUT-Subscale Computer usage (UTAUT-Altölçek Bilgisayar kullanımı)
Aşağıdakileri düzenli olarak kullanıyorum:
1. bilgisayar
2. ofis yazılımları (Word, Excel vb.)
3. Internet'te arama yapmak
4. Internet kullanıcıları ile iletişim ve etkileşim içinde olmak
5. e-öğrenme (teknoloji destekli öğrenme)

UTAUT-Subscale Performance expectancy (UTAUT-Altölçek Performans beklentisi)
Bilgisayarı işimde faydalı olan bir öğrenme aracı olarak görüyorum.
Bilgisayarı işlerin üstesinden daha kolay gelmemi sağlayan bir öğrenim aracı olarak kullanıyorum.
Bilgisayarı üretkenliğimi arttıran bir öğrenim aracı olarak kullanıyorum.
Bilgisayarı öğrenme aracı olarak kullanırsam, maaşımda artış olma ihtimalini artırabilirim.

UTAUT-Subscale Effort expectancy (UTAUT-Altölçek Girişim beklentisi)
Bilgisayarla bir öğrenme aracı olarak etkileşimim daha açık ve anlaşılır olacaktır.
Bilgisayarı öğrenme aracı olarak kullanırsam kişisel yeteneklerimi geliştirmem kolay hale gelecektir.
Bilgisayarı öğrenme aracı olarak kullanmak zamanla daha kolay hale gelecektir.
Bilgisayarı öğrenme aracı olarak kullanmayı öğrenmek benim için kolaydır.

UTAUT-Subscale Social influence (UTAUT-Altölçek Sosyal etki)
Benim davranışlarımı etkileyen insanlar bilgisayarı öğrenme aracı olarak kullanmam gerektiğini düşünüyorlar.
Benim için önemli olan insanlar benim bilgisayarı öğrenme aracı olarak kullanmam gerektiğini düşünüyorlar.
Çalıştığım kurumun deneyimli yöneticisi, bilgisayarın öğrenme aracı olarak kullanılmasında yardımcı olmuştur.
Çalıştığım kurum genel olarak, bilgisayarın öğrenme aracı olarak kullanımını desteklemiştir.

UTAUT-Subscale Facilitating conditions (UTAUT-Altölçek Olanak sağlama koşulları)
Bilgisayarı öğrenme aracı olarak kullanmak için sunulan yeterli kaynağa sahibim.
Bilgisayarı öğrenme aracı olarak kullanmak için sunulan yeterli bilgiye sahibim.
Bir öğrenme aracı olarak bilgisayar, öğrenme aracı olarak kullandığım diğer araçlar ile uyumlu değildir.
Bilgisayarı öğrenme aracı kullanırken yaşadığım sorunları çözmeme yardım edecek özel biri ya da bir grup insan var.

UTAUT-Subscale Computer anxiety (UTAUT-Altölçek Bilgisayar korkusu)
Bilgisayarı bir öğrenme aracı olarak kullanırken kendimi endişeli hissediyorum.
Yanlış bir tuşa bastığım zaman bilgisayarımdaki birçok bilgiyi kaybedebilecek olmak beni korkutuyor.
Düzeltemeyeceğim bir hata yapacağım korkusuyla, bilgisayarı öğrenme aracı olarak kullanmaktan çekiniyorum.
Bilgisayarı öğrenme aracı olarak kullanmak biraz gözümü korkutuyor.

UTAUT-Subscale Behavioral intention (UTAUT-Altölçek Davranışsal niyeti)
Birkaç ay içinde bilgisayarı öğrenme aracı olarak kullanmak niyetindeyim.
Birkaç ay içinde bilgisayarı öğrenme aracı olarak kullanabileceğimi tahmin ediyorum.
Birkaç ay içinde bilgisayarı öğrenme aracı olarak kullanmayı planlıyorum.