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Factors Impacting Mobile Technology Acceptance In Higher Education Faculty

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Abstract

Integration of mobile technologies within the educational system presents significant opportunities for improving education efficiency and accessibility. Numerous studies have considered student mobile technology acceptance, however limited research considers teacher/faculty acceptance. In order to understand higher education faculty mobile technology acceptance, this paper aims to, in context of mobile technology, validate the Sánchez-Prieto, Olmos-Migueláñez, & García-Peñalvo technology acceptance model(TAM); an education-focused TAM specifically designed to target faculty acceptance. TAM of Sánchez-Prieto et al. (2016) was validated using questionnaire as an instrument to collect data from the respondents. A total of 300 responses from faculty members of 2 public and 2 private sector universities were gathered. There were 35 questions in total, 6 relating to capturing participant demographic factors, and 29 questions relating to Sánchez-Prieto et al. (2016) constructs. The research findings show that the intention of faculty to use mobile technologies, i.e. within the classroom for educational purposes, increases if they perceive the mobile device to be easy and convenient to use. In conflict to Sánchez-Prieto et al. (2016) model, anxiety, perceived enjoyment, and facilitating conditions were found not to significant influence mobile technology use. Subjective norms, although influencing behaviour did not impact perception of usefulness. Finally, teachers with a lower resistance to change are more likely to perceive mobile technologies as useful and/or more likely to use mobile technologies within the teaching environment. The aim of this paper is to validate the Sánchez-Prieto et al. extended m-learning TAM and highlight whether or not the following proposed hypotheses hold.

Keywords Mobile, Technology Acceptance, Behavioural intention, Usefulness, E-learning, Higher Education, IT diffusion, IT adoption, Resistance to change

Introduction

There is a significant desired shift towards, and dependence on, information technology (IT) use by education institutions. Resistance to use by faculty, however, still remains substantially high (Sánchez Prieto, García-Peñalvo, & Olmos-Migueláñez, 2016). Although traditional education methods are dominant, i.e. face to face delivery of lectures, mentoring, and tutorials, many universities are strategically investing heavily in learning technologies, with a view to improving their scope and quality of teaching (Concannon, et al., 2005).

Information Technology (IT) transforms the means by which students learn and access information in two ways. Firstly, by speeding up the process of accessing information, i.e. making information accessibility more flexible and efficient. Secondly, enabling students to partake in significantly different learning, e.g. enabling learning environments / experiences that goes beyond the confines of the physical classroom (Rocaa, et al., 2006).

Increased popularity and use of mobile devices, and the ubiquitous application of mobile technologies in day-to-day life, facilitates a shift to autonomous learning via use of mobile technologies; and drives a global trend towards ubiquitous mobile learning (m-learning) (Sánchez-Prieto, et al., 2016). Use of mobile devices, as part of formal education, can now be found across the educational sector, for example: the teaching of literature and language in primary education (Beschorner & Hutchison, 2013); the development of a personal learning environment (Conde, et al., 2013), use of augmented reality (AR) applications in secondary education (Navarro, et al., 2013). Although cases exist, due to guidance concerning integrate and align mLearning solutions with formal education structures (Prieto, et al., 2014), use of mobile technologies within the educational sector is still at a developmental stage.
The potential use of digital technologies, in formal and informal education processes, is increasingly prominent (Bates, 2005). Regardless of the technology, however, technology will not be used unless faculty members have the skills, knowledge, and positive attitude required to integrate and align new the technology as part of academic curriculum delivery (Baylor & Ritchie, 2002). Chen and Chen (2009) stated that technology acceptance by teachers is therefore key to the successful acceptance. Accordingly, teachers / faculty intention, i.e. concerning use of digital technologies, is extremely influential in their acceptance and/or resistance to using technology innovations (Windschitl & Sahl, 2002).

With the objective of exploring and identifying the factors that determine teachers' acceptance of mobile technologies, a faculty extended m-learning technology acceptance model was constructed by Sánchez-Prieto, Olmos-Migueláñez, & García-Peñalvo (2016) – see figure 1. The Sánchez-Prieto et al. model extends the major TAM concepts, i.e. 'perceived usefulness', 'perceived ease of use' and 'behavioral intention', however removes the 'attitude toward use' concept due to its limited mediating effect (Hu et al., 2003). Variables used in the Sánchez-Prieto et al. model were selected from a range of models including Motivational technology acceptance Model (MM), Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Unified Theory of Acceptance and Use of Technology (UTAUT), Technology Acceptance Model v. 2 (TAM2) and Technology Acceptance Model v. 3 (TAM3).

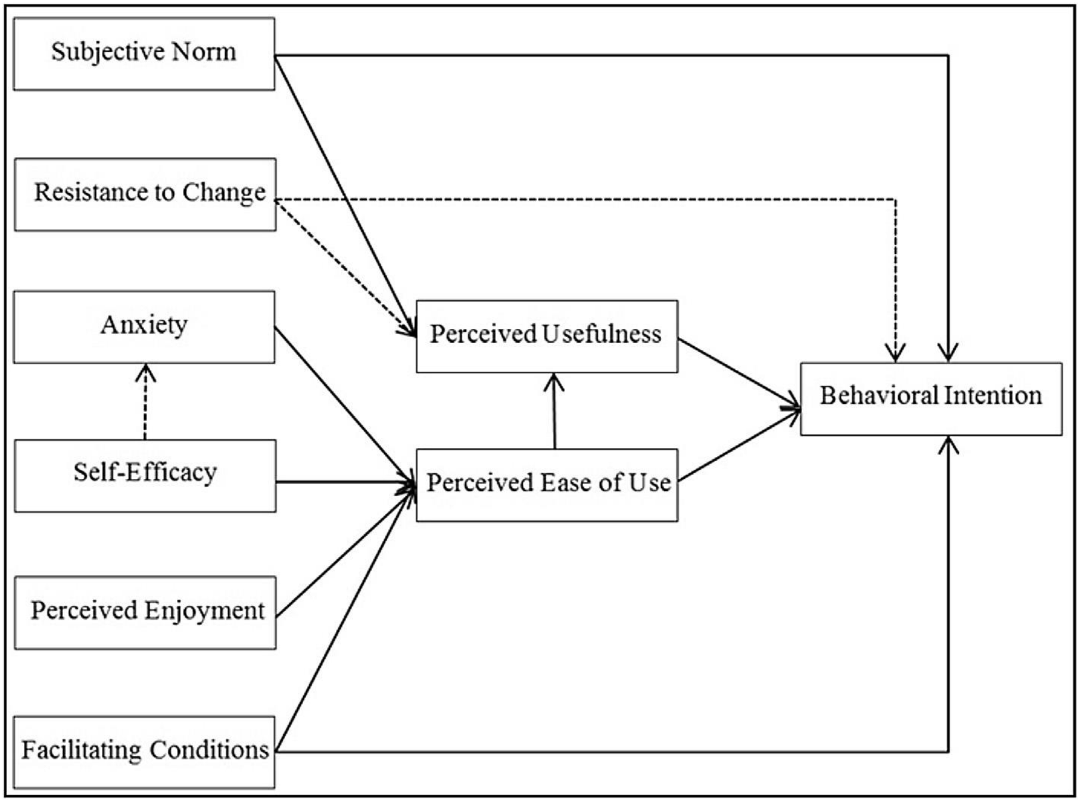

Fig.1. Faculty extended M-learning Technology Acceptance Model. (-- negative relationship).

Adapted from Sánchez-Prieto, Olmos-Migueláñez, & García-Peñalvo (2016).

Although Sánchez-Prieto, Olmos-Migueláñez, & García-Peñalvo defined the faculty extended m-learning technology acceptance model (see figure 1), limited validation of the model was undertaken. The aim of this paper is to validate the Sánchez-Prieto et al. model, and highlight whether or not the following proposed hypotheses hold.

Perceived Usefulness (PU), Perceived Ease of Use (PEU) and Behavioral Intention (BI) - The constructs of PU, PEU and BI were taken from the TAM model (Davis, 1989). In light of the literature, and in context of the Sánchez-Prieto et al. (2016) model (see figure 1), the following hypotheses were proposed:

H1. Perceived Usefulness has a positive relationship with University teachers' behavioral intention to use mobile devices.

H2. Perceived Ease of Use has a positive relationship with University teachers' behavioral intention to use mobile devices.

H3. Perceived ease of use has a positive relation with University teachers' perceived usefulness.

Perceived enjoyment (PEN) - Perceived enjoyment was taken from the MM model (Davis et al., 1992). PEN refers the degree to which the process of using a technology is perceived as enjoyable. The construct, perceived enjoyment has previously been shown to provide good results, particularly with teachers (e.g. Teo and Noyes, 2011). Accordingly, the following hypothesis was proposed:
H4. Perceived enjoyment has a positive relation with University teachers' perceived ease of use.

Subjective norm (SN) - The construct, 'Subjective norm' has been formulated within the TRA, and it plays a significant role in the TPB (Ajzen, 1985); i.e. describing the social and organizational pressure on an individual's behavior. In the Sánchez-Prieto et al. (2016) model, SN represents the social pressure on teachers to use a given technology. Item constructs were taken from Venkatesh and Davis (2000). The following hypotheses were proposed:
H5. Subjective norm has a positive relation with university teachers' perceived usefulness.
H6. Subjective norm has a positive relation with university teachers' behavioral intention to use mobile devices.

Self-efficacy (SE) - The term 'self-efficacy' refers to an individual's assessment about their ability to correctly use a device. SE was proposed by Bandura (1978) and comes from the social cognitive theory. Self- efficacy has been considered in numerous studies (Chen & Tseng, 2012; Holden & Rada, 2011; Yuen & Ma, 2008; van Dinther, et al., 2013). The following hypotheses, based on the TAM3 model, are proposed:
H7. University teachers' self-efficacy has a positive relation with their perceived ease of use.
H8. University teachers' self-efficacy has a negative relation with their mobile device anxiety.

Anxiety - This construct is strongly linked to self-efficacy. It is an adaptation of the construct, 'computer anxiety' from the TAM3 model. Mobile Device Anxiety (**MDA**) refers to an individual's apprehension, or fear, when he/she faces the possibility of using mobile technologies (Sánchez-Prieto, et al., 2016). For this construct, the following hypothesis were proposed:
H9. University teachers' mobile device anxiety has a negative relation with their perceived ease of use.

Facilitating conditions (FC) - This construct measures the perception of an individual towards the resources available to support their behavior. It is a part of the UTAUT (Venkatesh, et al., 2003). Moreover, it has generated good results in previous studies relating to technology acceptance of teachers and students (Deshpande, et al., 2012). The following hypotheses were proposed:
H10. Facilitating conditions have a positive relation with University teachers' perceived ease of use.
H11. Facilitating conditions have a positive relation with University teachers' behavioral intention to use mobile devices.

Resistance to change (RC) - Resistance to change refers to the formation of emotional stress when facing change. It is not part of the main theories, however, it has been studied as part of TAM (Al-Somali, et al., 2009). The definition of resistance to change is closely linked to perceived compatibility (Escobar-Rodríguez & Bartual-Sopena, 2015), which comes from the Innovation and Defusion Theory (IDT); defined as the level to which an innovation is perceived to be consistent with the existing values/experience/needs of an individual (Rogers, 1995). RC is similar to the Compatibility with Preferred Work Style and Compatibility with Existing Practices constructs proposed by Karahanna, Agarwal and Angst (2006). RC constructs have been adapted from Bhattacherjee and Hikmet (2007). The following hypotheses were proposed:
H12. Resistance to change has a negative relation with university teachers' perceived usefulness.
H13. Resistance to change has a negative relation with university teachers' behavioral intention to use mobile devices

Methodology

To validate the Sánchez-Prieto et al. (2016) model, this study used questionnaire as an instrument to collect data from the respondents. There were 35 questions in total, 6 relating to capture of participant demographic factors, and 29 questions relating to Sánchez-Prieto et al. (2016) constructs, however a five point Likert scale was used instead of the proposed 7 point scale. Four universities were targeted – 2 public sector universities and 2 private sector universities. The population for this study consisted of 300 full time university faculty; teaching in Lahore, Pakistan. From the 300 responses collected, 48 responses were discarded due to normality and skewness issues, and/or missing values; i.e. 252 questionnaire responses were considered usable. Respondents taught mainly in the fields of Engineering and Business Studies. Table 1 provides a summary of demographic information for the 252 usable respondents.

Demographics		**Percentage (N)**
Gender	Male	70% (177)
	Female	30% (75)
Top Education Level	Bachelors	7% (18)
	Masters	48% (120)
	PhD	45% (114)
Designation	Lecturer (Teaching focus)	35% (86)
	Assistant Professor	33% (84)
	Associate Professor	20% (52)
	Professor (full)	12% (30)

Table 1: Respondent Demographics' Data

Data Analysis and Results

Reliability and Validity

Reliability is defined as an assessment of the degree of which consistency exists between multiple measurements of a variable (Hair, et al., 2010). Cronbach alpha was performed to measure the internal consistency (Cronbach, 1951). The Cronbach Alpha for all questionnaire items was 0.884. The extracted factors' Cronbach alpha values, i.e. for all the factors, are shown in Table 2. All alpha (α) values are greater than (>) 0.70, suggesting that the factors are highly correlated (Nunnally & Bernstein, 1994); supporting the constructs proposed by Sánchez-Prieto et al. (2016).

Factor Label	Number of Items	Cronbach's alpha (α)
Perceived usefulness	4	0.945
Perceived ease of use	4	0.876
Behavioral intention	3	0.935
Self-efficacy	3	0.916
Facilitating conditions	3	0.894
Subjective norms	3	0.876
Mobile device anxiety	3	0.807
Resistance to change	3	0.873
Perceived enjoyment	3	0.830

Table 2: Scale Reliability

Exploratory Factor Analysis (EFA)

The cumulative variance of the nine factors was 74.81%, and all extracted factors had eigenvalues above 1.0. All the communalities for each variable were significantly high; i.e. all were above 0.300, with most above 0.700. The Kaiser-Meyer-Olkin and Bartlett's test for sampling adequacy was significant, showing that the chosen variables were sufficiently correlated (Table 3).

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.736
Bartlett's Test of Sphericity	Approx. Chi-Square	5702.946
	Df	406
	Sig.	.000

Table 3: KMO and Bartlett's Test

To find out whether the observed variables meet reliability and validity criteria, EFA (using Principal Component Analysis) was conducted, with varimax rotation (see table 4). The nine factors that are extracted in the pattern matrix (Table 4) were used for further analysis.

Rotated Component Matrix									
	Component								
	1	2	3	4	5	6	7	8	9
PU_1	.927								
PU_2	.883								
PU_3	.970								
PU_4	.922								
PEU_1		.741							
PEU_2		.886							
PEU_3		.940							
PEU_4		.809							
BI_1				.883					
BI_2				.865					
BI_3				.833					
SE_1			.899						
SE_2			.881						
SE_3			.890						
FC_1					.887				
FC_2					.906				
FC_3					.930				
SN_1						.852			
SN_2						.850			
SN_3						.802			
MDA_1									.810
MDA_2									.881
MDA_3									.838
RC_1							.901		
RC_2							.662		
RC_3							.814		
PEN_1								.841	
PEN_2								.900	
PEN_3								.836	

Table 4: Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 6 iterations.

Confirmatory Factor Analysis (CFA)

Convergent validity and discriminant validity are ways to assess the construct validity of a measurement procedure (Campbell & Fiske, 1959). Convergent validity is measured from the composite readability. Terms measuring the same construct showed high construct loadings, which signifies sufficient convergent validity; i.e. all Average Variance Extracted (AVE) values are greater than 0.50 (Fornell & Larcker, 1981). Discriminant validity is measured through diagonal values, and relates to the ability to differentiate between groups (Wahlqvist, et al., 2002). All loaded values, as shown in table 5, are well above 0.50, confirming that the factors have sufficient discriminant validity; and no unexpected cross-loading exists (Table 5). Discriminant and convergent validity results show that the constructs for each variable belong to its specific variable, and that the nine variables are entirely different from one other.

Composite Reliability	**AVE**	**Constructs**	**RC**	**PU**	**PEU**	**BI**	**SE**	**FC**	**SN**	**MDA**	**PEN**
0.878	**0.708**	**Resistance to change**	**0.841**								
0.948	**0.821**	**Perceived usefulness**	-0.155	**0.906**							
0.883	**0.663**	**Perceived ease of use**	0.194	0.056	**0.814**						
0.938	**0.835**	**Behavioral intention**	0.565	-0.067	-0.001	**0.914**					
0.916	**0.785**	**Self-efficacy**	0.453	-0.080	0.164	0.357	**0.886**				
0.899	**0.748**	**Facilitating conditions**	0.027	0.013	-0.006	0.062	0.091	**0.865**			
0.876	**0.702**	**Subjective norms**	0.515	0.024	0.027	0.596	0.382	0.111	**0.838**		

0.809	**0.593**	**Mobile device anxiety**	-0.078	-0.026	0.061	-0.165	0.084	-0.003	-0.133	**0.770**	
0.838	**0.639**	**Perceived enjoyment**	0.119	-0.091	-0.013	0.196	0.016	-0.071	0.075	-0.066	**0.799**

Table 5: Discriminant and Convergent Validity.

Tests of Hypotheses

A regression model is used for testing the hypotheses. Table 6 summarizes the test results. Only seven of the thirteen hypothesis are supported, i.e. with a P-value < 0.05. Perceived usefulness had a positive significant effect on behavioral intention, i.e faculty using mobile technologies in educaiton (β=0.335; P-value=0.000); accordingly, H1 was validated as being true. Perceived ease of use had a significant positive impact on behavioral intention, thus supporting H2 (β=0.312; P-value=0.004). Moreover, perceived ease of use has a significant positive effect on faculty perception of mobile technology usefulness, supporting H3 (β=0.389; P-value=0.000). H4 was, however, rejected, as perceived enjoyment had no significant effect on perceived ease of use.

Hypothesis	Relationship	β	T	P -Value
H1	PU → BI	.335	4.607	.000*
H2	PEU → BI	.312	3.369	.004*
H3	PEU → PU	.389	5.252	.000*
H4	PE → PEU	.003	.046	.963
H5	SN → PU	.135	1.672	.096
H6	SN → BI	.378	6.486	.000*
H7	SE → PEU	.104	2.205	.028*
H8	SE → MDA	.007	.126	.900
H9	MDA → PEU	-.048	-.936	.350
H10	FC → PEU	.017	.312	.755
H11	FC → BI	.024	.399	.690
H12	RC → PU	-.297	-3.186	.002*
H13	RC → BI	-.445	-6.508	.000*

Table 6: Regression estimates with 95.0% Confidence Interval for β
***indicates p-value < 0.05 means that hypothesis is supported.**

Subjective norms did not significantly influence perceived usefulness, rejecting H5; yet did have a significant positive effect on behavioral intention (H6, β=0.378; P-value=0.000), supporting H6. Self-efficacy positively impacted perceived ease of use (H7, β=0.104; P-value=0.028) – supporting H7 - however did not impact mobile device anxiety (MDA) – rejecting H8.

H9, H10 and H11 were rejected due to no significant relationship between independent variables had on the dependent variables (see Table 6). H12 and H13 suggests significant negative relationships exist between resistance to change and, respectively, perceived ease of use (H12, β=-0.297; P-value=0.002) and behavioral intention (H13, β=-0.445; P-value=0.000).

Figure 2 shows a revised, validated, and simplified, model, which highlights Factors impacting Higher Education faculty mobile technology acceptance.

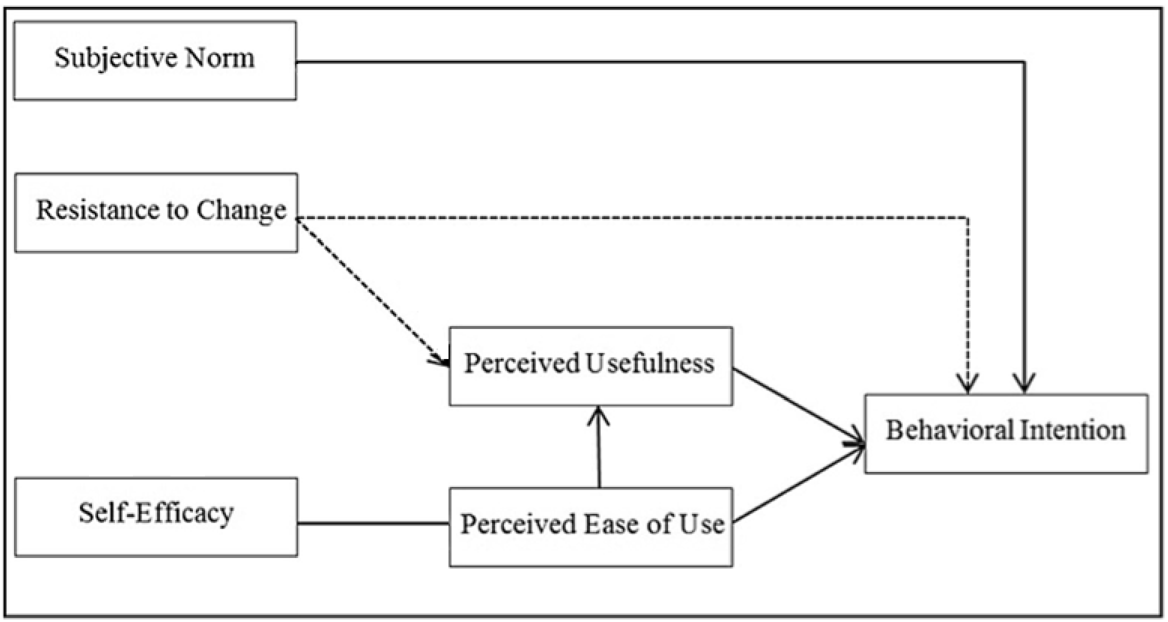

Fig.2. Validated m-learning technology acceptance model. (-- negative relationship) Adapted from Sánchez-Prieto et al. (2016)

Conclusion

It is unlikely that any learning tool/solution will be embraced by academic faculty unless there are clear pedagogical benefits to its use. This paper acknowledges, however, the significant push, by higher education institutions, towards acceptance and use of mobile information technology in education. Figure 2 shows that, assuming positive subjective norms, the intention of higher educational faculty, i.e. to use of mobile technologies within the classroom for educational purposes, increases if they perceive the mobile device to be easy and convenient to use.

The results of our study simplifies the Sánchez-Prieto, Olmos-Migueláñez, & García-Peñalvo (2016) faculty m-learning technology acceptance model, by showing that anxiety, perceived enjoyment, and facilitating conditions do not significantly influence mobile technology use intention. Subjective norms, influencing intention of use, also did not impact perception of usefulness. Finally, teachers with a lower resistance to change are more likely to perceive mobile technologies as being useful to education and/or are more likely to use mobile technologies within their teaching environment.

Although some faculty are still somewhat resistant to use of mobile technology (Sánchez Prieto, García-Peñalvo, & Olmos-Migueláñez, 2016), m-learning offers flexible access to course materials, and consistent and managed content delivery via a channel that is not restricted by spatial and/or temporal dimensions. Although traditional education methods are still dominant in higher education, many universities are strategically investing in m-learning online solutions (Concannon, et al., 2005), i.e. supporting the integration and alignment of m-learning solutions with traditional formal education structures. M-commerce, therefore, for many institutions, is seen as a viable solution for managing, and resourcing, student autonomous learning needs.

Our study shows, however, that in addition to investment in m-learning technology, higher education institutions, i.e. to maximise faculty adoption, need to positively manage social norms concerning use of technology, ensure staff are consistently and effectively trained use of mobile technologies, and/or encouraged to embrace m-learning solutions as part of their teaching solution.

Although data was captured from faculty in Pakistan, and although we believe that the Sánchez-et al. mobile technology acceptance model needs to be validated within different countries, and across different levels of education, our results show that consideration of both student and faculty is critical to understanding and supporting effective delivery of mobile technologies in the arena of learning.

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