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A Model for Adoption of ICT in Jordanian Higher Education Institutions: An Empirical Study

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Abstract

Information and Communication Technology (ICT) plays a major role in modern universities by facilitating and improving the educational system to be in line with the information technology age. The higher education sector in Jordan is considered as one of the most influential sectors that develop the country. In striving towards a competitive institution, a university must enhance teaching and learning process related to the advancement of ICT. However, this study attempts to focus on the adoption of ICT in Jordanian public universities among the academic staff, with the concern on the factors influencing their acceptance of ICT in the educational system. Moreover, the study attempts to build a conceptual model to the Jordanian case according to the results of factor analysis. A self-administrated survey was conducted on 500 teaching staff selected from public universities in Jordan. A total of 415 participants (83%) have responded, and series of data analyses of variables measurement for reliability and validity test of predictors were performed. The results of the analysis, however, contribute a new model which is considered as a novel model in such studies.

Keywords: Information and Communication Technology (ICT); adoption; Higher Education; Jordan.

Introduction

The new and rapidly growth of ICT has changed the face of the world. ICT has become the main influential determinant in economic, social, and human development (Dertouzos, 1997), and is being considered as the umbrella for the communication and networking devices and software with applications (Jain, 2006). The Hashemite Kingdom of Jordan (HKJ) is one of the highly developed Arab countries in the Middle East. The King and the Government have sponsored many initiatives to encourage the diffusion of technologies in the country that not only possessing the geographical advantage, but also often seeking to develop technological workforces to increase the standard of living and economic productivity (Al-Jaghoub and Westrup, 2003). Jordan focuses on the higher education sector and universities significantly in regards to the development of human resources in the country.

The adoption and diffusion of educational technologies that leverage ICT and the Internet has provided an unprecedented opportunity for improving higher education around the world (Davis and Wong, 2007). Therefore, educational technologies must become more popular among developing nations which seek economic improvement (Khasawneh et al., 2011). In fact, the educational technology is becoming more universal at an increasing rate as most firms recognize the needs to prepare the ICT professionals for the global environment (Margavio, 2005).

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In the matter of fact, the higher education sector in Jordan plays a critical role in the growth the national economy because the individuals have strong needs and interests in education to develop their knowledge and skills to become competitive and knowledge workers in the global markets. Unfortunately, until now there is a lack of ICT usage among the universities' academic staff in Jordanian higher educational institutions (Al-Mobaideen, 2009). Apart from that, the adoption and usage of ICT in universities in teaching and learning process are still limited among the academicians (Patnaik, 2001), in which they have lack knowledge, skills, motivation, and interests in using ICT in facilitating their works (Jawarneh et al., 2007; Qudais et al., 2010). From the perspective of ICT usage, this study makes an attempt in bridging the digital divide between developed and developing countries in the use of ICT in the education and learning process through Jordanian higher education institutions. The optimum using of ICT by academic staff in the universities will develop the quality of alumnus and improve the teaching and learning process in creating new generation capable and competitive in the global market.

Literature Review

Midgley and Dowling (1978) defined innovativeness as the time to which an individual is receptive to new ideas and product and makes adoption decisions independently of the communicated experience of others. In relation, the diffusion of innovation is a communication process they define innovativeness as a personality trait they call 'innate innovativeness' operating at the most abstract, global level of conceptualization to influence a variety of domain-specific behaviors, including the relative early purchase of new products (Midgley and Dowling, 1978).

Also, they proposed an intermediary level of product-category specific innovativeness which mediates the effects of innate innovativeness along with a variety of inter-individual difference variables and situational factors on actual innovation adoption (Midgley and Dowling, 1978). This definition opened up a new vista for studying innovative behavior as this view of innovativeness is postulated to all product classes. This led to propose a new model to study innovativeness as shown in Figure 1 below.

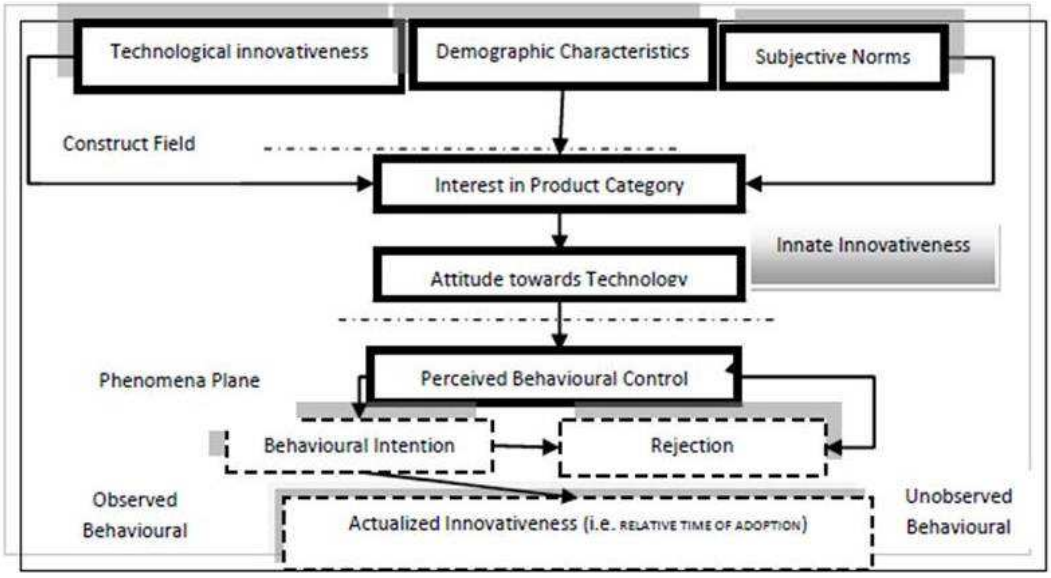

Fig 1. Research Model

The above model defines the innovativeness construct in a more comprehensible manner, suggests categories of variables that could be used to operationalize the model and provides examples of variables in each category. The model integrates the innovator (academician), the product (ICT), and the situation specificity as determinants of innovative behavior. As shown, the model is divided into three parts: (i) the construct field, (ii) phenomena plane, and (iii) (un)observed behavior. The construct field comprises into (a) demographic variables, (b) technological innovativeness, and (c) subjective norms. The phenomenon plane starts with an interest in the product category which is bolstered or dampened by intervening variables pertaining to product or technology characteristics. All these lead to the next phenomenon by intervening previewed behavior control factors that affected in the behavioral intention (BI).

This proposed model brings together many of the factors of greatest relevance identified in previous literature such as attitude towards technology (ATT), subjective norms (SN), and perceived behavioral control (PBC). The model shows the importance and recognition of external situational and environment factors commonly acknowledged in the literature as influencing ICT adoption, and which are missing from the general diffusion of innovation developed for innovations in general. The proposed model presents many factors which are considered impact upon the individual's adoption of ICT in addition to demographic variables.

The purpose of this study is to identify the factors that affect on the adoption of ICT at the institutional higher education in Jordan. The initial model is framed within the Diffusion of Innovation (DOI) (Rogers, 1995), and enhanced by others such as Theory of Planned Behavior (TPB) (Ajzen, 1991), and the Decomposed Theory of Planned Behavior (DTPB) (Taylor and Todd, 1995a). The model, and its corresponding hypotheses, incorporates the constructs that are considered to be most relevant to adoption in Jordan. These include the following factors:

- Demographic variables such as gender, age, higher education degree, place of obtaining higher education degree, major, and experience.
- ATT such as Rogers' attributes; relative advantage (RA), compatibility (Compt), complexity (Compx), trialability (Trial), and observability (Observ) (Rogers, 1995).
- SN such as word of mouth (WoM), and mass media channels (MMC) (Ajzen, 1991).
- PBC such as self efficacy (SE), technology facilitating conditions (TFC), resource facilitating condition (RFC), and government facilitating condition (GFC) (Taylor and Todd, 1995a, 1995b).

Factor Analysis

A wide series of factor analysis in the shape of Principle Component Analysis (PCA) is utilized to test for both the convergent and discriminate validity of the measurements. Factor analysis is an interdependent technique and the primary purpose of using it, is to define the underlying structure among the variables in the analysis (Zikmund, 2003; Hair et al., 2006). PCA and principal factors are the most commonly used (Tabachnick and Fidell, 2007). The aims that this study seeks to achieve from the factor analysis technique are discussed in the subsequent paragraphs.

The first aim is to analyze the scale items of each construct and verify their discriminate validity. Discriminate validity concerns with the ability of a measurement item to differentiate between the objects being measured (Davis, 1989). Malhotra (2004) puts it in another way, saying that discriminate validity aimed to identify new

uncorrelated variables to be used in subsequent multivariate analyses such as regression.

The second aim is to reduce the large number of interrelated variables to a small number of underlying factors that ensures the construct validity. It addresses the question of what construct or characteristic the scale is, in fact, measuring (Malhotra, 2004).
The third aim is to explain the interrelations between the constructs and the variables measuring them. It is concerned with whether constructs' items form distinct constructs (Davis, 1989). The fourth aim is to identify a smaller set of salient variables for use in subsequent multivariate analysis (Malhotra, 2004). Lastly, factor analysis may be utilized to meet the statistical assumptions of various models (Zikmund, 2003).

Factors Analysis for Criterion Variable BI

The four items of the BI construct assumed were subjected to PCA, Varimax with Kaiser Normalization as rotation method shown in Table 1, to determine how many dimensions those items which measure BI will converge along.

Table 1: PCA Result Component Matrix and Factor Loading: BI

Constructs	Items	Component,1 Loading
Behavioral Intention Eigenvalues: 2.626 The variance explained: 65.628% KMO: 0.801 Cronbach's Alpha: 0.83	BI_Q1: Given the chance, I predict that I would use ICT in the teaching system in the future	0.817
	BI_Q2: I will strongly recommended others to use ICT in the teaching system	0.746
	BI_Q3: My favorable intention would be to use technologies in the education system rather than traditional way in the teaching system	0.844
	BI_Q4: I plan to use ICT in the teaching and learning system	0.830

Consequently, the result of factor analysis in this construct revealed the following:

- The presence of one component with eigenvalues of 2.63 exceeding the recommended value of one.
- The factor analysis provided a solution in one component which explained 65.6% of the variance.
- An assessment of the Kaiser-Meyer-Olkin (KMO) value was of 0.801, which shows that the sampling adequacy for factor analysis was appropriate and the Barlett's Test of Sphericity reached statistical significance, supporting the factorability of the correlation matrix.

The interpretation of this component was consistent with previous research on the BI scale. In addition, the result of this analysis supports the use of selected items as a scale of BI as suggested by the scale (Mathieson, 1991; Venkatesh and Davis, 2000; Gardner and Amoroso, 2004; Shih and Fang, 2004).

Direct Psychosocial Determinants of BI

In this study, exploratory factor analysis (EFA) was employed to identify the factors underlying direct predictors (ATT, SN_WoM, MMC, and PBC). In this case, the factor extraction method of Principal-Axis Factoring Analysis (PFA) was selected because it is useful in determining the number of factors necessary to represent the data (Coakes and Steed, 2003).

Factor analysis revealed the presence of four components with eigenvalues exceeding one. In addition, the required 4 factors were retained on the measurement for the three direct factors conceptually and theoretically assumed to be the direct predictors of BI. The interpretation of the four components was consistent with the theory of TPB on the direct scale of BI (Fishbein and Ajzen, 1975; Ajzen, 1991;

Taylor and Todd, 1995a; Taylor and Todd, 1995b). In conjunction, Table 2 shows the items used to measure BI and their loading onto four different components as follows;

Table 2: PFA Result: Factors Underlying Direct Attributes of BI

Item coding	Factors			
	ATT	SN_WoM	MMC	PBC
ATT_Q2: If I were to use ICT in the teaching system, the quality of my work would improve	0.569			
ATT_Q3: If I were to use ICT in the teaching system, it would enhance my effectiveness on my job	0.507			
ATT_Q4: If I were to use ICT in the teaching system, it would make my job easier	0.294			
ATT_Q1: If I were to use ICT in the teaching system, it would enable me to accomplish my tasks more quickly	0.276			
WoM_Q2: My referents (peers, colleagues, friends, and family) would think that I should try out ICT in the educational system.		0.961		
SN_Q3: Most people who are important to me would think that I should try out the technologies in the educational system.		0.928		
WoM_Q3: Generally speaking, I want to do what my referent thinks I should do		0.924		
WoM_Q1: My referents (peers, colleagues, friends, family) would think that I should use ICT in the educational system		0.908		
SN_Q2: The people who influence my decisions would think that I should use ICT in the educational system		0.903		
WoM_Q6: Generally speaking, I want to do what my opinion leaders think I should do		0.881		
SN_Q4: The people who influence my decisions would think that I should try out the technologies in the educational system		0.877		
SN_Q1: Most people who are important to me would think that I should use ICT in the educational system		0.863		
WoM_Q4: My opinion leaders would think that I should use ICT in the educational system		0.840		
WoM_Q5: My opinion leaders would think that I should try out ICT in the educational system		0.839		
MMC_Q4: I read/saw news report that using ICT in the educational system was a good way to manage the teaching and learning process			0.701	
MMC_Q5: I want to do what the media think I should do			0.694	
MMC_Q2: The media and advertising consistently recommend using ICT in the educational system			0.541	
MMC_Q1: The media are full of report, articles, and news suggesting that using ICT in the educational system is a good idea			0.492	
PBC_Q2: I have the resources necessary to make use of ICT in the teaching system				-0.882
PBC_Q3: I have the knowledge necessary to make use of ICT in the education system				-0.860
PBC_Q4: I have the ability to make use of ICT in the education system				-0.844
PBC_Q1: I would be able to use ICT in the educational system				-0.748
PBC_Q5: Using ICT in the teaching system would be entirely within my control				-0.704
Eigenvalue	12.343	2.087	1.623	1.203
Variance explained	50.395	7.115	5.213	3.185
Cronbach's Alpha	0.73	0.98	0.75	0.91

[a] Total Variance Extracted by three factors 65.909%; KMO 0.947; Barlett's Test<.001

The set of 23 items comprising four constructs (ATT, SN_WoM, MMC, and PBC) were subjected to factor analysis and the solution was rotated using rotational method with the Oblimin with Kaiser Normalization approach. The result of the analysis indicates that:

- Respondents involved in the study sample are able to distinguish the variation among the four of BI functions (direct determinants) or predictors of BI whereby this findings in agreement with the DOI, TPB, and the DTPB of the direct predictors.

- The assessment of direct determinants of BI construct, according to respondents, seemed to be through four predictors; (ATT, SN_WoM, MMC, and PBC).

- An assessment of the KMO value was of 0.947 which shows that the sampling adequacy for factor analysis was appropriate and the Barlett's Test of Sphericity reached statistical significance, supporting the factorability of the correlation matrix.

Factor Analysis of Salient Variables

The adoption's model that combines the three independent variables (ATT, SN, and PBC) to explain the intention to use innovation performs well by exceeding the 40% in the explaining the intention that was achieved by several other theoretical models in the fields of information systems. Evidence of efficacy was drawn from meta-analytic review of 185 independent studies, in which they demonstrated that TPB has accounted for 27% to 39% of the variance in BI (Armitage and Conner, 2001).

This study uses three adoption theories in proposing a new model related to the area of the study. The theories are DOI (Rogers, 1995), TPB (Ajzen, 1991), and DTPB (Taylor and Todd, 1995a, 1995b).

Contrast with expectations, the results of SN predictor showed difference with TPB (Ajzen, 1991). The findings of PFA shown in Table 3 reveal that only two factors out of three predetermined variables related to the SN of TPB were statistically extracted by the study. Results of the PFA demonstrated that there are two normative beliefs components were found related to the BI which are subjective norms with the personal channels (SN_WoM) and the MMC.

Table 3: PFA Result: Type of Interaction's Norms

Coding	SN_WoM	MMC	A
SN_Q3	0.943		
WoM_Q2	0.942		
WoM_Q3	0.928		
WoM_Q6	0.911		
SN_Q2	0.901		
SN_Q1	0.895		
WoM_Q5	0.886		
WoM_Q4	0.885		
SN_Q4	0.882		
WoM_Q1	0.874		
MMC_Q4		0.731	
MMC_Q2		0.670	
MMC_Q5		0.654	
MMC_Q1		0.568	
Eigenvalue	8.90	1.91	1.00
Variance Explained	58.23	9.39	2.50
Cronbach's Alpha	0.98	0.75	

(a)Total Variance Extracted by two factors 70.134%; KMO = 0.942; Barlett's Test <.001
(b) Extraction Method: Principal Axis Factoring;
(c) Rotation Method: Oblimin with Kaiser Normalization

Rogers' five attributes explain the educational technology characteristics which affect academic staffs' attitude toward the use of these technologies (Rogers, 1995). As study expects, the results of the PFA shown in Table 4 reveal that all the factors which are defined in DOI appear

as separated factors. The factors are RA, Comp, Compx, Trial), and Observ.

Table 4: PFA Result: ICT Attributes

Items	RA	Compt	Compx	Trial	Observ	6
RA_Q4: If I were to use ICT in the teaching system, it would make my job easier	0.773					
RA_Q3: If I were to use ICT in the teaching system, it would enhance my effectiveness on my job	0.650					
RA_Q5: Using ICT in the education system gives me greater control over my work	0.619					
RA_Q2: If I were to use ICT in the teaching system, the quality of my work would improve	0.514					
RA_Q1: If I were to use ICT in the teaching system, it would enable me to accomplish my tasks more quickly	0.358					
Compt_Q1: If I were to use ICT in the teaching system, it would be compatible with most aspect of my work		-0.917				
Compt_Q2: If I were to use ICT in the teaching system, it would fit my work style		-0.820				
Compt_Q3: If I were to use ICT in the teaching system, it would fit well with the way I like to work		-0.759				
Compx_Q1: Training and learning to using ICT in the teaching system would be easy for me			0.767			
Compx_Q3: It would be easy for me to become skilful at using ICT in the teaching system			0.681			
Compx_Q2: Overall, if I were to use ICT in the teaching system, it would be easy to use			0.617			
Compx_Q4: Using ICT in the education system requires a lot of mental effort			0.489			
Trial_Q3: I want to be permitted to use ICT in the teaching system, on a trial basis long enough to see what it can do				0.706		
Trial_Q1: Before deciding on whether or not to use ICT in the teaching system, I want to be able to use it on a trial basis				0.644		
Trail_Q2: Before deciding on whether or not to use ICT in the teaching system, I want to be able to properly try it out				0.643		
Observ_Q2: I will use ICT in the teaching system, when I have seen others using it					0.730	
Observ_Q5: I will wait until other academicians start use it					0.693	
Observ_Q6: I will use ICT in the teaching system, when other academicians have successful experience of using it					0.690	
Observ_Q4: I will use ICT in the education technology if it become popular					0.675	
Eigenvalue	6.92	1.98	1.90	1.52	1.15	1.09
Variance Explained	30.20	6.77	6.56	4.66	3.99	1.88
Cronbach's Alpha	0.74	0.92	0.69	0.71	0.91	

(a) Total Variance Extracted by the five factors 54.085%; KMO =0 .870 ; Barlett's Test <.001.
(b) Observ_1, Observ_Q3 and Observ_Q7 dropped in the second round of factor analysis.

The last predictor of the proposed model is control belief, in which the results of this factor are consistent with the DTPB (Taylor and Todd, 1995a, 1995b), decomposed into two dimensions; SE and facilitating conditions (FC). The FC construct was broken down into three other dimensions, which include TFC, RFC, and GFC. As expectation, the results of the PFA shown in

Table 5 reveal all the factors that defined in DTPB appear as separated factors.

Table 5: PFA Result: Control Belief

Items	SE	TFC	RFC	GFC	PBC	6
SE_Q4: For me, being able to use the applications for teaching system form university website on my own is important	0.732					
SE_Q6: For me, being able to use the applications for teaching system even if there is no one around to show me how to use it is important	0.695					
SE_Q3: If I wanted to, I could easily operate applications for using it in the teaching system from the university website on my own is important	0.673					
SE_Q2: For me, feeling comfortable using ICT in the education system on my own is important	0.634					
SE_Q1: I would feel comfortable using ICT in the education system on my own	0.616					
SE_Q5: I would be able to use the applications for the educational system even if there was no one around to show me how to use it	0.541					
TFC_Q1: I have the computers, Internet access and applications which I need to use it in using ICT in the educational system		0.643				
TFC_Q2: For me, availability of the computers, internet access and applications to use ICT in the educational system is important		0.639				
TFC_Q7: A reliable internet connection is available when I want to use ICT in the educational system		0.612				
TFC_Q6: For me, advances in Internet security, which provide a safer of using ICT in the educational system are important		0.609				
TFC_Q8: For me, reliability of internet connection services is very important to use ICT in the educational system		0.494				
RFC_Q2: For me, having computers and ICT tools is important			0.678			
RFC_Q6: For me, the training courses is very important to use ICT in the educational system			0.642			
RFC_Q4: For me, the good is infrastructure which facilitate to use ICT in the educational system very important			0.623			
RFC_Q5: There will be lack of the training courses to using ICT in the educational system			0.616			
RFC_Q3: There will be no good infrastructure and network to use ICT in the educational system			0.569			
GFC_Q6: For me, the government promotes of using ICT in the educational system is important				0.582		
GFC_Q5: The government promotes the use of ICT in the educational system				0.565		
GFC_Q3: The Jordanian government endorses using ICT in the educational system				0.349		
PBC_Q2					0.888	
PBC_Q3					0.831	
PBC_Q4					0.793	
PBC_Q1					0.628	
PBC_Q5					0.550	
Eigenvalue	15.00	2.22	1.22	1.18	1.13	1.09
Variance Explained	47.49	6.15	2.82	2.23	1.83	1.65
Cronbach's Alpha	0.90	0.96	0.94	0.71	0.91	

(a)Total of variance explained = 62.198

This study is motivated by the need to inform researchers and practitioners about what are the factors that affect academic staff to adopt or reject ICT in Jordanian institutional and encourage faster and more efficient adoption. This is a theory building investigation to explore the factors that are likely to influence the use of ICT among staff in the Jordanian higher education institutions. However, there is no known study that has empirically investigated such factors. Little attention has been paid in the literature to the adoption of ICT in the context of developing countries in general. As the objective of the present study is to consider academic staffs' behavior pertaining to the adoption of ICT, we carefully chose the variables that the literature has shown to be important in explaining the adoption of ICT, which are amenable to statistical analysis.

Conclusion

The study is considered novel in the developing countries, Jordan and the Arab world in particular, which share the same culture, language and religion. It makes a significant contribution to theory and academic understanding of the adoption in areas of IS, and specifically ICT usage in higher education institutions, Jordanian context. As a summary, understanding the behavioral aspect of adoption is important to both researchers and industry players. The findings of the current research contribute to theoretical modelling by modifying the IS adoption theories in relation to a new application area that may give new insights into the theory. It is also proposed that this study improves a successful adoption of the particular services (ICT) that are supported by new technologies by deepening the knowledge about factors which inhibit or facilitate the adoption among the developing nation and the Arab countries in particular, as these countries share similar culture, religion, and speak the same language. Eventually, the proposed research model will be the authority for all universities to encourage the adoption and utilization of ICT in the educational and learning process in Jordan and all Arab countries.

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