Evaluation of the Users' Continuous Intention to Use PACS Based on the Expectation Confirmation Model in Teaching Hospitals of Shiraz University of Medical Sciences

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ABSTRACT

Introduction: Users' behavioral intention to use the Picture Archiving and Communication System (PACS) is important in the systems' success and is an indicator of the users' satisfaction with commitment and dependence on information systems. The present study aimed to evaluate the users' continuous intention to use PACS based on the expectation confirmation model in educational hospitals of Shiraz University of Medical Sciences.

Method: This cross-sectional study was conducted in Nemazee and Shahid Faghihi hospitals, Shiraz, Iran in 2014. The subjects were 50 general practitioners, residents and specialists selected through stratified random sampling. The study data were collected using a researcher-made questionnaire. The content validity of the questionnaire items was confirmed by five experts in health information management. To evaluate the accuracy of relationships among the measurement models, reliability criteria, including Cronbach's alpha and composite reliability, convergent and divergent validity were used which showed acceptable reliability and validity. The data were entered into Smart PLS software, version 3.1.9 and analyzed through Structural Equation Modeling (SEM) by using Partial Least Squares (PLS) approach.

Results: The results showed appropriate fitness of reliability indices (Cronbach's alpha >0.7, composite reliability >0.7, loading >0.7), validity indices (AVE >0.5), structural model (redundancy =0.395, Q_{2CI}=0.364, f_{2H5}=0.524, R_{2CI}=0.687), and the total model (GoF=0.518). Moreover, all the research hypotheses, except H1 (the relationship between expectation confirmation and perceived usefulness) with T-value of <1.96, showed a significant relationship (T-value >1.96).

Conclusion: Expectation confirmation, perceived usefulness, and satisfaction were effective in continuous intention to use PACS. Thus, these factors should be considered by designers, developers, and managers while designing and implementing information systems to guarantee their success and improve the quality of health services.

Keywords: Information Systems, Expectation confirmation model, PACS, Satisfaction

Introduction

Picture Archiving and Communication System (PACS) refers to a set of technologies for digital imaging that uses various modalities such as cross-sectional tomography, Magnetic Resonance Imaging (MRI), ultrasound, radiography, and digital irradiation (1). The related images and data are sent to remote control locations through networks, which can be viewed on computerized stations (2). One of the advantages of these systems is data protection, and images can be changed (get lighter or darker with different contrasts) (3). Thus, immediate consultation with radiology specialists at far distances is possible. Besides, data are safe and can be stored on CDs or tapes and restored automatically if needed (4). In order to successfully implement PACS, recognition of the factors leading to its success or failure seems important (5). One of the barriers to acceptance of PACS in hospitals is the users' behavior, i.e. the individuals' resistance against change and physicians' resistance against information technologies (6). Frequent evaluations of the users' behaviors based on standard behavioral models in order to match the information systems with users' needs and expectations play a key role in such systems' success or failure.

Expectation confirmation model

Expectation Confirmation Model (ECM) is a theoretical model proposed by Bhattacherjee in 2001(7). According

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to this model, individuals' continuous intention to use the information technologies depends on three variables including the users' satisfaction with information technology, extent of confirmation of the users' expectations, and perceived expectations after acceptance of information technology, i.e. perceived usefulness (8).

Expectation is defined as a set of beliefs about the characteristics of a particular product or service(9). Satisfaction is a function of expectations and experiences. Perception of the relationship between previous expectations, its following evaluation, and the subsequent satisfaction (i.e. meeting the expectations) are important issues for researchers in various fields(10).

Perceived usefulness and trust are important in both initial and later stages in consumer acceptance of on-line health services. Consumers' actual usage experiences modify the perceptions of usefulness and influence the confirmation of their initial expectations. These results have implications for our understanding of the dynamic nature of trust and perceived usefulness, and their roles in long term success of e-services or E-services (11).

According to the nurses' views and continuance intention, the results of structural equation modeling analysis showed that firstly confirmed expectations have significant effects on perceived usefulness and satisfaction; and perceived usefulness had a significant effect on satisfaction. Then, the effects of perceived usefulness and satisfaction were significant on continuance intention (12).

In a study entitled "Website Quality, Expectation, Confirmation, and End User Satisfaction: The Knowledge-Intensive Website of the Korean National Cancer Information Center" by Koo et al. (2011), it was shown that knowledge confirmation has a greater effect on satisfaction than both knowledge expectation and perceived usefulness (13).

The results of a study by Lee (2010) demonstrated that satisfaction had the most significant effect on the users' continuance intention, followed by perceived usefulness, attitude, concentration, subjective norm, and perceived behavior control as significant but weaker predictors (14).

Previous investigations and related studies on the users' continuous intention to use information systems have only focused on expectation confirmation model(12, 15) while other studies have investigated the impact of various factors such as behavioral factors, systemic factors, quality of information, etc. on continuous intention in using the information systems by combining behavioral models as well as involvement of the factors except behavioral factors such as the quality of the system and system features (6, 16-20).

The present study aimed to evaluate the users' continuous intention to use PACS based on expectation confirmation model in educational hospitals of Shiraz University of Medical Sciences.

Method

This cross-sectional study was conducted on 50 general practitioners, residents, and specialists selected through stratified random sampling in Nemazee and Shahid Faghihi hospitals, Shiraz, Iran. The data were entered into Smart-PLS software, version 3.1.9 and analyzed by SEM approach and Confirmatory Factor Analysis (CFA) by using PLS method. The study data were collected by a researcher-made questionnaire composed of Bhattacherjee's standard continuous intention to use questionnaire (2001) (7), and the standard scale used by Palm et al. (2010) (16). The used questionnaire included 16 five-option items (items 1-3: expectation confirmation, 4-8: perceived usefulness, 9-11: satisfaction, and 12-16: continuous intention to use). These items were closed questions and could be answered through a 5-point Likert scale ranging from "completely agree" to "completely disagree." The content validity of the questionnaire was approved by five experts in the field of health information management. However, Cronbach's alpha, CR, convergent validity, and divergent validity were used to ensure the accuracy of the relationships in the measurement models. The study data were collected by referring to the clinical wards of Nemazee and Shahid Faghihi hospitals as well as by sending electronic questionnaires to the physicians' E-mails.

Criteria for evaluation of structural fitness

1) T-values: T-value is the primary criterion for assessment of relationships between the constructs of a model (structural component). T-values >1.96 represent the accuracy of the relationships between the constructs, confirming research hypotheses at 95% confidence (21).

2) R2 criterion: Higher R2 values of endogenous constructs of a model represent better fitness of the model. According to Chin (1998), 0.19, 0.33, and 0.67 are weak, moderate, and strong R2 values, respectively(22) .

3) Effect size criterion (f2): This criterion, which was proposed by Cohen (1988), determines the intensity of the relationship between a model's constructs. f2 values of 0.02, 15.0, and 35.0 represent small, average, and large effect sizes, respectively(23) .

$$f^2(X \to Y) = \frac{R^2_{Y(X\ included)} - R^2_{Y(X\ excuded)}}{1 - R^2_{Y(X\ included)}}$$

4) Stone-Geisser criterion (Q2): This criterion, which was introduced by Stone and Geisser (1975), shows a model's predictive power. They believed that the models with appropriate structural fitness have the capability to predict the indices related to the model's endogenicA constructs. Based on Henseler et al. (2009), Q2 values of 02.0, 15.0, and 35.0 indicate weak, moderate, and strong predictive power, respectively (24).

5) Redundancy criterion: Redundancy is computed by the constructs' communality values multiplied by their R2 values. This criterion indicates the changeability of the indices of an endogenic construct which is affected by one or some exogenous constructs. The mean redundancy value of endogenic constructs of a model is a suitable criterion for assessment of structural fitness of SEMs; higher means represent better structural fitness of a model (21).

Criteria for evaluation of fitness of the total model
Goodness of fit criterion
Goodness of Fit (GoF) is related to the total component of SEMs and is computed by using the following formula:
GoF= SQRT Average Communality * Average R^2
According to Wetzels et al. (2009), values of 01.0, 25.0, and 36.0 represent weak, moderate, and strong GoF, respectively(25).

Results

Among the 49 respondents, 65.3% were male and 34.7% female. Besides, 80% of them were under 40 years old and most of them were residents (9.42%). Moreover, 2.61% of the participants had more than two years of working experience with PACS; 42.9% had taken part in PACS training courses before system implantation; and 61.2% did not approve the usefulness of the trainings.

Factor loadings and R2 indices are presented in Figure 1. Accordingly, all the items' factor loadings were above 0.4, indicating the acceptability of this criterion. R2 of the main endogenous construct of the research was 0.687, which shows the acceptable fitness of the structural model.

Considering Cronbach's alpha, CR, and AVE values (Table 1) and their permissible measures (7.0, 7.0, and 5.0, respectively), reliability and convergent validity of the present research were confirmed.
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According to Table 2, AVE squared values shown in the main diameter of the matrix are greater than their correlations presented in the cells below and at the left side of the main diameter. Therefore, the constructs are more correlated to their indices than to other constructs. In other words, the model enjoys an appropriate divergent validity.
As Table 3 shows, all research hypotheses, except H1, were confirmed at 95% confidence level. In addition, the largest effect size was related to the relationships between the model constructs in H5.

Figure 1. Factor loadings and R2 values of the constructs of expectation confirmation model
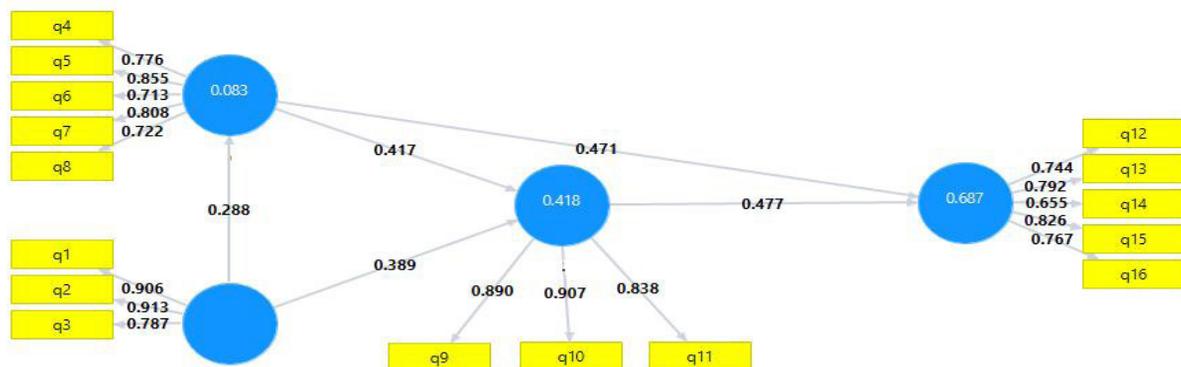
Table 1. Reliability and convergent validity of the research conceptual model

Construct	Reliability		Convergent validity
	Cronbach's alpha	**Composite reliability**	**AVE**
Expectation confirmation	0.840	0.904	0.759
Perceived usefulness	0.835	0.883	0.603
Satisfaction	0.852	0.910	0.772
Continuous intention to use	0.815	0.871	0.576

Table 2. Divergent validity of the research conceptual model

Divergent validity	Fornell-Larcker criterion	Constructs	Expectation confirmation	Satisfaction	Perceived usefulness	Continuous intention to use
		Expectation confirmation	0.871			
		Satisfaction	0.509	0.879		
		Perceived usefulness	0.288	0.529	0.777	
		Continuous intention to use	0.522	0.726	0.723	0.759

"Continuous intention to use" was the main endogenous variable of the current study and its Q^2 value indicated the model's high predictive power regarding this construct. However, its mean redundancy was 0.26, which confirmed the fitness of the research model's structure.

Finally, the total model's fitness was approved by GoF criterion:

GoF= $\sqrt{0.6775 * 0.396} = 0.518$

Table 3. The results of assessment of research hypotheses

Research hypotheses	T-values	f2
Perceived usefulness < expectation confirmation H1	1.474	0.090
Satisfaction < expectation confirmation H2	3.463	0.238
Satisfaction < perceived usefulness H3	4.640	0.274
Continuous intention to use < perceived usefulness H4	4.839	0.511
Continuous intention to use < satisfaction H5	5.649	0.524

Table 4. Q2 and redundancy criteria of the endogenous constructs of the research conceptual model

Endogenous constructs	Q2	Redundancy
Perceived usefulness	0.036	0.050
Satisfaction	0.308	0.323
Continuous intention to use	0.364	0.395

Discussion

The results of the present study showed that according to the users' viewpoints, satisfaction followed by perceived usefulness and expectation confirmation had the largest effects on continuous intention to use PACS. Expectation confirmation and perceived usefulness were the key determinants of the users' satisfaction. Similarly, the results of the studies by Cheng (2013), Stone and Eveleth (2012), and Lee (2009) demonstrated that in comparison to perceived usefulness, the users' satisfaction had a stronger effect on continuous intention to use. This implies that perceived usefulness has a closer relationship with acceptance of information systems, and the users' satisfaction plays a more important role in continuous intention to use. Thus, in order to increase the users' acceptance and continuous intention to use, information system managers should employ interactive strategies, i.e. (1) making new system users aware of the potential advantages of information systems and the role of these advantages in improving their performance, skills, and efficiency; and (2) training old users regarding effective continuous use of such systems enhances their confirmation and satisfaction with information systems(12, 14, 15). In this respect, Wang (2008) introduced perceived usefulness as a cognitive index related to the users' beliefs and satisfaction as an emotional index related to their attitude, and disclosed cognitive assessments as a priority over emotional responses (20); this was consistent with the results of the current study.

Expectation confirmation is determined by PACS' ease of use, quality, and user-friendliness in accordance with the users' expectations. This variable had a considerable impact on the users' satisfaction, which is in agreement with the results of the studies by Koo et al. (2011) and Hsieh and Wang (2007). When users are obliged to use an information system, meeting their basic needs can result in their satisfaction (13, 26) and encourage them to continue using that system.

In the current study, expectation confirmation had no significant effects on perceived usefulness, which is in contrast with the Mou and Cohen's findings (2014). This can be justified by the significant impact of expectation confirmation on users' satisfaction. In acceptance and use stage, PACS users only focused on their objective understanding of the system's usefulness, and did not consider their previous expectations compared to their perception of the system's potential advantages, and also did not compare their expectations to their perceived usefulness of PACS. However, independently, expectation confirmation, like perceived usefulness, affects the users' satisfaction(11).

Conclusion

Regarding the effect of the expectation confirmation, perceived usefulness, and satisfaction- which are the cognitive and behavioral factors related to information systems' users- on continuous intention PACS, designers, developers, and managers of these systems should identify the strengthening and limiting factors of those variables. In this way, implementation of these systems, which requires great costs and resources, can be done successfully in health and treatment centers. In fact, the users' behavioral intention to use the information systems implies their applicability. Moreover, using these systems can improve the quality of healthcare services through reducing the users' workload, saving time and resources, and increasing the cost-effectiveness of the services.

Acknowledgements

Conflict of Interest

None declared.

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