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Appraising the Smart Card Technology Adoption; Case of Application in University Environment

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Abstract

Recently, smart card technology is used in a large variety of applications in many industries. Because of its personal security features such as access control, ability to perform multiple functions and also the capability to upgrade, it could be used as a multi-function card in the university environment. It is important to note that students' acceptance and confidence are crucial for further development of smart card technology as a university application. This paper aims to investigate the students' adoption of the technology of university smart card in Iranian universities. In this regards, University Smart Card Technology Acceptance Model (USCTAM) is developed. And then, in order to gain this goal, an online survey was conducted among the students of six private universities in Iran and collected data were analyzed by SPSS software. The results suggest that usefulness, security, ease of use, awareness, support, visibility, image, trailibility, social norms and satisfaction are factors which have significant and positive influence on adopting of smart card technology.

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Keywords: Smart Card; Technology Acceptance; Adoption; University Card; Smart Card Application.

1. Introduction

A smart card is a plastic card with an embedded microprocessor chip capable of storing a significant amount of data and performing basic computing operations. Most smart cards resemble the size of a standard credit card [1, 2].

Today, smart cards are used all over the world as personal identification cards for corporate building security systems and personal computer equipment access control. Governments, financial services, transportation,

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telecommunications, healthcare, education, retail, and many other industries are planning to or already using smart cards as a means of providing better security and improved services to its customers and users [3, 4].

These days, the main trend is the use of multi-application cards. A multiple application card is a smart card that can support different types of applications on the card itself thereby reducing the number of cards in the wallet. The big scale use for this card is a national e-ID for the citizens [5] and a multi-purpose university card as well which is discussed in this study, but before applying any technology innovation, the people's intention to adopt or acceptance would be the most important thing, in order to be successful [6].

Generally, acceptance is defined as an antagonism to the term refusal and it means the positive decision to use an innovation [7, 8]. Several researches developed theories and models to describe and analyze user acceptance and each of these models determines different factors to explain user acceptance [9]. The question about user acceptance is related to all researchers who want to presage which technologies will prove appropriate for an organization [10]. Thus, understanding the students' perception towards acceptance of smart cards could help facilitate further growth of the implementation of smart cards in Iranian universities. This study uses an adoption model which is the modified framework based on the previous developed models to investigate the user acceptance of multi-application smart card in Iranian university environment.

2. Background of the Study

Smart card is a device which includes an embedded integrated circuit that can be either a secure microcontroller or equivalent intelligence with internal memory or a memory chip alone. The card interacts with a reader through direct physical contact or with a remote contactless radio frequency interface [11]. The range of smart card applications is growing for many reasons such as security, multiple application and portability [12-15]. College and university environments offer one of the best opportunities for the adoption of smart card technology [16, 17]. A substantial amount of smart card development has already taken place at universities for several years. Universities issue multipurpose campus cards where students have their library ticket, car-parking details and electronic purse on one card [18]. For instance, Washington University issued a smart card that serves as a stored value card for vending machines, laundry and other small-value applications and use as an identification card (ID card) for access to campus facilities and buildings [19]. In fact, smart card provides better security and access control with enabling students to have access to the university facilities for twenty four hours [18-20].

Furthermore, by means of storing student's records, grades, fees, sport and recreational clubs, smart card presents better convenience and serviceableness [2, 18]. Smart cards can be designed for universities to improve registration process, reducing card-issuing cost, creating greater speed and convenience, accurate recording of student attendance and progress and it could contain a photograph of the cardholder as well as his/her name, signature, date of birth, date of expiry, type of program and personal number [17, 21]. In other words, because of the encapsulated nature of student life on campus, university sector has led the way in exploring of multi-function smart cards. Students currently have to hold separate cards for functions such as, Photo ID, photocopying, storing meal vouchers, gaining access to security doors and bank accounts while one smart card could combine all these functions [22].

On the other point of view, user acceptance is very important to the successful implementation of smart card technology at university environment. Additionally, it is significant to note that an application's features play a vital role in determining whether individuals involved in an activity will use it or not [23]. The general research question that this research tries to answer is:

What is the attitude of Iranian students towards the adoption of smart card technology at university environment?

3. Methodology

In order to investigate the students' acceptance of university smart card, a survey was designed in three major parts. The first part is demographic section that contains questions about age, gender, education, computer experience, knowledge about smart card technology and the second part includes 31 Likert questions with the format of; strongly disagree to strongly agree to measure the effect of eleven constructs of the research model on the university smart card acceptance and finally, the third part is students' expectation and ideas about university smart

card. In this regards, an online survey was conducted among 358 students of six private universities in Iran and then the collected data were analyzed by SPSS software.

The method that is used in this study for testing the reliability is Cronbach's alpha which is the degree to which instrument items are homogeneous and reflect the same underlying constructs. It has the most utility for multi item scales at the interval level of measurement. If the amount is less than 0.7, it is not appropriate for the study.

4. Research Framework

In order to be able to answer the main question of this study, a model is needed to examine the user acceptance of smart card technology. Fig. 1 shows a schematic view of this model. The identification of adoption model and its factors are based on literature review. Table 1 shows the definitions of the factors which are included in the research model.

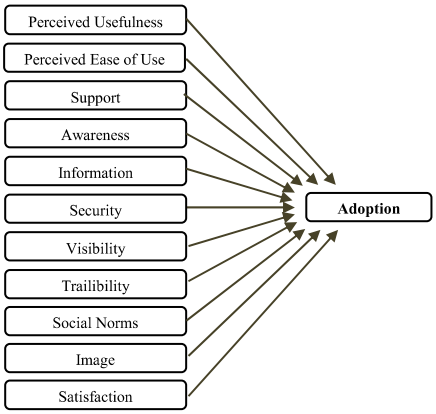

Fig. 1. University Smart Card Technology Acceptance Model (USCTAM)

Table 1. Acceptance Constructs' Definitions

Construct	Description
Perceived Usefulness (PU)	Perception of the innovation's utility in the individual's routine
Perceived Ease of Use (PE)	Perception of the ease with which the innovation can be made usable (or integrated) in daily tasks
Support (SU)	An individual believes that an organizational and technical infrastructure exists to support its use of the system
Awareness (AW)	An individual are aware about the technology
Information (IN)	Perception of the availability, quality and value of the information produced by the innovation
Security (SE)	Student feels that security is important to them and believes that using smart card is secure
Visibility (VI)	Visibility of the innovation, the people using it, and the results
Trailibility (TR)	Opportunity to try the innovation before adopting
Social Norms (SN)	Perception that it is important others believe he or she use the new system
Image (IM)	Perception of the prestige and value attributed to culture in relation to the use of the innovation
Satisfaction (SF)	The sum of one's feelings or attitudes towards a variety of factors affecting the situation

5. Analysis

Table 2 summarizes the demographic profile and descriptive statistics of the respondents. As it is shown, with a bit of luck, 75.7% of respondents are in the field of computer engineering and 8.1% are within electricity engineering that has more information and knowledge about the smart card technology. Among the students it is

unexpected that 13.7% of them have not used smart card before, further, 5% of students have not even heard about the smart card technology.

Table 2. Demographic Profile of the Respondents

Demographic Variable	Frequency (N)	Percentage (%)
Gender		
Female	191	53.4
Male	167	46.6
Age		
18-21	91	25.4
22-26	240	67.0
More than 26	27	7.6
Field of Study		
Computer	271	75.7
Management	38	10.6
Electricity	29	8.1
Accounting	20	5.6
How familiar are you with Smart Card		
Never heard about it	18	5.0
I have heard but have never used it	62	17.3
Use it only sometimes	198	55.3
Use it on a regular basis	80	22.3
How long have you been using Smart Card		
More than three years	98	27.4
1-3 year(s)	145	40.5
Less than a year	66	18.4
Never	49	13.7

Table 3 shows the percentage of respondents' response to the eleven factors' items and also the mean, standard deviation and variance of the each question. As shown in Table 3, almost all the participants (92.7%) agree or strongly agree that using smart card will enable them to accomplish their tasks more quickly and consequently save time. Furthermore, near nine out of ten (87.1%) of students mentioned that using smart card technology can improve services in term of speed, convenience and security. In brief, 84.3% of respondents agree or strongly agree that smart card technology is useful to perform the university daily tasks. On the other hand, almost nine out of ten the respondents (88%) agree or strongly agree that learning the operation of smart card is easy and approximately 80% of participants find smart cards easy to use.

In order to measure the level of support's effectiveness on smart card acceptance, two items were examined and more than 87% of respondents agree or strongly agree that they really willing to use smart card system if its service provider offered enough support. Another factor which can influence on user acceptance of university smart card technology is awareness so to measure the user awareness of smart card technology and its effect on user adoption; three items were designed in the survey. About 84% of respondents either agree or strongly agree that they would welcome university smart card system if they were more aware about it. Additionally, 89.4% registered that being aware about the university smart card system and services is important in order to use it while almost 70% of them agree or strongly agree that they have enough knowledge about the new technology. Alternatively, over 84% of participants agree that using university smart card would increase the accessibility of students' information.

In the research model, a further adoption factor is security. Hence, to measure the level of its importance for students' acceptance of university smart card, two items were addressed in the survey. Once, respondents were asked whether they trust on the smart card security or not, more than 74% of them cited their agreement while only 7% disagree or strongly disagree with it. Again, more than three quarters (77.1%) of respondents stated that using university smart card would increase the security of university environment. Moreover, over three out of four (78%) of students believe that university smart card includes the advantages to facilitate their expectation. Besides, as it is shown in Table 3 more than nine out of ten either agree or strongly agree that they would like to properly try university smart card out to see what it could do, before deciding to use it. Furthermore, almost the same percentage (88%) stated their agreement that they are really willing to use university smart card if they were able to use it on a trial.

The next research assumption addressed the social influence. Table 3 illustrates that respondents were more agree (53.7%) than disagree (15.3%) with the statement of "People who are important to me would think that I should use university smart card". Additionally, more than half (53.6%) of the students either agree or strongly agree that people whose opinion is valuable prefer them to use university smart card. The survey included another two items which are related to the image. A large amount of the respondents (74.3%) stated their agreement that having university smart card will be a status symbol and 61.4% of participants either agree or strongly agree that a student who uses university smart card have more prestige than those who do not use. At last not the least, the questionnaire included two items to investigate the effectiveness of satisfaction on the student acceptance of university smart card. Over four out of five (86.6%) of students believe that they would be satisfied of using university smart card because of its advantages, characteristics and functions. In addition, 84.6% of respondents would suggest other students to use university smart card.

Table 3. Descriptive Statistics of Factors' Items

Item	Strongly Disagree (%)	Disagree (%)	Neither Agree Nor Disagree (%)	Agree (%)	Strongly Agree (%)	Mean	Std. Deviation	Variance
Usefulness 01	0.6	0	6.7	31.8	60.9	4.53	.672	.452
Usefulness 02	0	2.8	10.1	34.6	52.5	4.37	.777	.603
Usefulness 03	0.6	5.0	14.8	37.2	42,5	4.16	.895	.801
Usefulness 04	2.8	6.1	32.7	29.1	29.3	3.76	1.031	1.063
Usefulness 05	1.1	4.7	12.0	39.4	42.7	4.18	.899	.808
Usefulness 06	3.4	5.6	23.2	35.8	32.1	3.88	1.033	1.066
Usefulness 07	1.7	2.2	11.7	34.6	49.7	4.28	.881	.776
Ease of Use 01	0	2.8	9.2	33.8	54.2	4.39	.770	.592
Ease of Use 02	0	2.8	15.3	30.2	51.7	4.31	.830	.690
Support 01	0.6	0.6	21.5	40.5	36.9	4.13	.802	.642
Support 02	0	4.7	7.5	32.4	55.3	4.38	.821	.674
Awareness 01	1.1	2.8	14.0	34.9	47.2	4.24	.876	.767
Awareness 02	1.1	7.3	20.9	36.9	33.8	3.95	.969	.939
Awareness 03	0	3.4	7.3	42.5	46.9	4.33	.754	.569
Information 01	0.6	4.5	10.3	39.9	44.7	4.24	.851	.725
Information 02	0.6	1.1	12.8	40.5	45.0	4.28	.772	.595
Security 01	1.4	4.7	16.8	37.4	39.7	4.09	.935	.874
Security 02	1.1	5.9	18.7	37.4	36.9	4.03	.945	.893
Visibility 01	0.6	3.1	14.2	43.9	38.3	4.16	.821	.674
Visibility 02	1.1	2.8	18.2	43.6	34.4	4.07	.857	.734
Trailibility 01	1.1	2.8	5.6	32.7	57.8	4.43	.813	.661

Trailibility 02	2.0	1.7	8.4	31.6	56.4	4.39	.862	.742
Social Norm 01	5.0	10.3	31.0	31.6	22.1	3.55	1.096	1.200
Social Norm 02	2.8	10.6	33.0	31.8	21.8	3.59	1.030	1.060
Image 01	3.9	7.8	14.0	34.4	39.9	3.99	1.099	1.207
Image 02	9.8	8.4	20.4	30.7	30.7	3.64	1.266	1.603
Satisfaction 01	0	1.7	13.7	37.7	46.9	4.30	.765	.585
Satisfaction 02	1.1	2.8	9.5	36.6	50.0	4.32	.842	.710
Adoption 01	0	1.2	6.1	35.8	57.0	4.47	.720	.519
Adoption 02	2.2	0.6	5.6	27.7	64.0	4.51	.816	.665
Adoption 03	1.7	3.4	13.7	33.5	47.8	4.22	.923	.852

Table 4 contains the means of each factors included in the research model. It is clear from the Table 4 that the means in most of the factors are more than four except image and social norms. The average for smart card usefulness is 4.16 and for smart card ease of use is 4.35 out of 5 which probe that users distinguish smart card is useful and easy to use. Moreover, the importance of security, trailibility, visibility, support and awareness in order to accept student smart card, are recorded by orderly means of 4.06, 4.41, 4.11, 4.25 and 4.17 that explain, from the users view, these factors are important that can persuade to use of university smart card system. Besides, the mean for user satisfaction is 4.31 out of five which demonstrates that users' are satisfied by using university smart card.

Table 4. Factors' means

Factor	PU	PE	SU	AW	IN	SE	VI	TR	SN	IM	SA	AP
Mean	4.16	4.35	4.25	4.17	4.26	4.06	4.11	4.41	3.57	3.81	4.31	4.40

Table 5 shows significant correlation between all the constructs represented by students' responses. Therefore, it could be concluded that the correlation of all factors is statistically significant and positive. Perceived usefulness and perceived ease of use have the highest correlation.

Table 5. Correlation between All Constructs from the Survey Results

	PE	SU	AW	IN	SE	VI	TR	SN	IM	SF
PU	.498**	.480**	.325**	.408**	.351**	.323**	.290**	.148**	.238**	.315**
PE		.487**	.385**	.451**	.284**	.284**	.412**	.206**	.252**	.351**
SU			.447**	.362**	.437**	.339**	.342**	.182**	.247**	.459**
AW				.317**	.236**	.307**	.414**	.166**	.216**	.234**
IN					.395**	.297**	.292**	.222**	.300**	.437**
SE						.283**	.227**	.278**	.244**	.310**
VI							.390**	.271**	.229**	.346**
TR								.183**	.261**	.381**
SN									.430**	.270**
IM										.495**

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Fig. 2 illustrates that perceived usefulness, perceived ease of use, support, awareness, security, visibility, trailibility, social norms, image and satisfaction are positively correlated with the university smart card adoption. Among them perceived ease of use has the strongest correlation (r = 0.494) with adoption. This suggests that being user-friendly and ease of use are the main factors to achieve the students' acceptance so to achieve this goal the training and educating of the students is a key element which is needed to obtain successful implementation of

university smart card. Nevertheless, other factors such as perceived usefulness, support, awareness, security, visibility, trailibility, social norms, image and satisfaction are also relatively important in facilitating the adoption process.

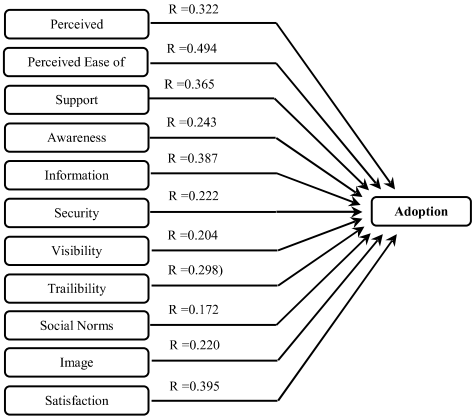

Fig. 2. University Smart Card Technology Acceptance Model Measures

In the third section of the survey, students were asked about their opinion towards the university smart card. The first part of this section was about the exterior design of the card. Table 6 lists the ranking of students' opinions about the features that should be included on their university smart card. It shows that from the students' point of view, it is more important to have their family name and student number, printed on their university smart card than their expiry date, given name and date of birth.

Table 6. Students' Ideas about the Features on the University Smart Card

Feature	Students' responses (%)
Family name of card holder	83%
Student Number (unique number)	80%
Student Status	72%
Image of the card holder	66%
Expiry Date	66%
Given name of card holder	61%
Date of Birth	29%

The second part of the third section in the survey included questions about the possible applications and services that students would like to be contained in the university smart card. As it is demonstrated from Table 7, the most favorable services are transportation, banking services (ATMs, payment transactions) and access to the buildings, whereas applications such as access to the results and financial records and campus parking have the least importance for students. It is obvious from Table 7 that most of the respondents either agree or strongly agree in each of the items that university smart card includes offered application and service.

Table. 7. Possible Applications and Services of University Smart Card

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree	Mean	Std. Deviation	Variance
Cafeterias	0.6	5.3	14.0	28.8	51.4			
Payphone	2.2	3.9	11.2	38.3	44.4	4.19	0.93	0.88

Campus parking	2.8	5.9	19.8	31.8	39.7	4.00	1.04	1.08
Grocery Stores	1.7	3.9	8.4	32.4	53.6	4.32	0.90	0.82
Transportation	1.4	1.1	6.7	27.9	62.8	4.50	0.78	0.62
Health Services	2.8	1.7	14.0	34.1	47.5	4.22	0.95	0.90
Photocopy	2.5	3.1	13.1	25.4	55.9	4.29	0.98	0.97
Library	2.8	1.1	16.5	34.6	45.0	4.18	0.94	0.88
Bank Services	0.6	1.7	10.6	29.3	57.8	4.42	0.88	0.62
Access to Building	2.5	2.2	9.8	27.9	57.5	4.36	0.93	0.86
Access to Computer	2.8	2.2	7.5	27.9	59.5	4.39	0.93	0.86
Access to Internet	2.5	3.9	25.7	31.3	36.6	3.96	1.00	1.00
Identification Card	2.8	2.8	7.0	38.8	48.6	4.28	0.92	0.84
Vendor Machine Card	2.0	2.2	8.4	25.4	62.0	4.43	0.88	0.78
Access to Personal Information	1.4	3.4	12.8	24.9	57.5	4.34	0.92	0.85
Access to Results	10.3	1.7	16.5	28.8	42.7	3.92	1.26	1.58
Access to Financial Records	2.0	0	17.9	40.2	39.9	4.16	0.85	0.73
Cash Card	1.7	2.8	16.8	43.0	35.8	4.08	0.88	0.78

6. Conclusion

However, smart card technology is expected to be used as an university application in Iran, but before implementing the smart card in university environment, it is needed to investigate the adoption of smart card technology in Iranian university, furthermore it should be addressed that what applications a smart card has to offer to Iranian university students. This paper has provided a modified model for measuring the adoption of university smart card in Iran based on the results from six private universities in Iran. Moreover, the findings of this research give a better understanding of the basic constructs and their relative importance in forming the smart card acceptance in Iranian universities.

The results suggest that usefulness, security, ease of use, awareness, support, visibility, image, trailibility, social norms and satisfaction are factors which have significant and positive influence on adopting of smart card technology. Also, the results from the explored model demonstrate that the score for university smart card adoption in Iran was 4.40 out of five. Additionally, 92.8% of students either agree or strongly agree that implementing smart card technology in university environment as a student smart card is valuable and more than nine out of ten (91.7) of respondents think that there is a need for smart card in Iranian university.

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