The Impact of Perceived Security on Intention to use E-Learning Among Students

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***Abstract*—The use of online educational systems called E-learning has improved both teaching and learning. While researchers have examined several factors that affect the adoption and acceptance of E-learning among the students, the role of perceived security has not yet been examined. Using the Technology Acceptance Model (TAM) as the base, this paper investigates the impact of perceived security on E-learning acceptance among university students. Using a cross-sectional design, data were collected from 313 university students using an online survey. The analysis with SmartPLS v2.0 confirms that perceived security positively affects intention to use E-learning through the mediator (perceived usefulness). Further, a positive impact of perceived security was also found on perceived usefulness and perceived ease of use. In the end, we have given recommendations for the stakeholders - university, faculty, and students.** *(Abstract)*

Keywords-component; E-learning; security; TAM; perceived usefulness; adoption intention; SmartPLS

I. INTRODUCTION

E-Learning systems (ELS) provide the flexibility of usage - anytime-anywhere content delivery and support – to its users. These supporting features, and features such as interactivity, string search, immediacy, physical mobility, self-organised and self-directed learning, corporate training and knowledge gaining, have made ELS popular among both educators and learners [1, 2]. Realising the potential of E-Learning technologies, the higher educational institutions (HEIs) has invested significant resources towards ELS[3], [4] However, implementing ELS into HEIs does not guarantee the acceptance of such systems. For example, such systems remained underutilised after implementation in some instances [5–7]. Research shows that attitude towards acceptance of ELS plays an important role in the success of ELS [5]. Further, the literature shows that users' acceptance and adoption is influenced by individual, social, and organisational factors, along with demographics, perceived usefulness and ease of using ELS [5].

E-Learning itself has been treated differently by the researchers [8]. At one end it is described as an umbrella term for teaching and learning activities using ICT, on other, it depicts a learning environment that provides Internet-based access to resources and services for a quality learning [3, 9 & 10]. Despite the differences in the definitions, few things are common in the definition of E-learning. 1) the ELS, an application running on a server; 2) content of the learning system; 3) the network, through which learner will access the ELS, primarily the internet; 4) the user's system, which is either a computer or a mobile device such as a laptop or tablet or even the smartphone [4]. Since internet access is an essential component of the ELS, it is highly likely that the system can be exposed to information security and privacy threats. Although ELS adopted in HEIs do not involve the financial resources of the users, previous studies have shown that students have shown privacy concerns is using online learning environments [11, 12]. Nonetheless, students consider their academic information viz. course grades, assignments, etc. as essential assets in terms of information security [12].

Despite the users' concerns and the likelihood of information security and privacy threats, the institutions have often neglected the aspect of information security while implementing the ELS [13]. Furthermore, there is a scarcity of research examining the relationship of perceived security with E-Learning or ELS. Since perceived security and privacy impacts the adoption of other online systems, it is highly likely that role of perceived security will be salient in the acceptance of E-Learning as well.

In this paper, we study the relationship between perceived security and E-learning acceptance among university students. Considering HEIs are investing heavily in ELS and students are the ultimate users, we decided to conduct this exploratory study to understand students' perspective of perceived security in E-Learning acceptance. We used the Technology Acceptance Model (TAM) [14] as the framework.

Rest of the paper is organised as follow: Section II provides a background: theoretical model, and the importance of security in E-Learning. Section III describes the research model of the study and the hypotheses. Research Methodology is described in Section IV, followed

by results in Section V. Conclusion and recommendations are provided in Section VI.

II. Background

A. Technology Acceptance Model

Among the several adoption and acceptance models in the literature, TAM has been proven to be the most robust and parsimonious model for technology acceptance [15]. TAM suggests that perceived usefulness and perceived ease of use are the main drivers for acceptance of the technology. Both these beliefs influence users' attitude and intention to use the technology. Further, the possibility of adding external factors make TAM the most popular model for studying different technology adoptions [16], including E-Learning adoption and acceptance [8]. Thus, we used TAM as a theoretical model for our study.

B. E-learning Acceptance

Review of existing literature shows that acceptance, usage and adoption of E-Learning has been studied extensively (for detail consult reviews [16] & [32]). To maximise the utilisation of E-Learning, researchers have investigated factors, barriers, and drivers, towards acceptance, usage, and adoption of E-Learning among the learners. Apart from the constituent variables of TAM, researchers have studied several antecedents related to users' cognition, peer influence, system quality and content. Among these self-efficacy, satisfaction, confirmation, experience, anxiety, computer self-efficacy, enjoyment, playfulness and flow, social influence, compatibility, facilitating conditions, performance expectancy, system quality, management support, information quality, service quality, and usability are few to name [8]. Another study identified technological (infrastructure used), organisational (organisational compatibility and expected benefits (perceived usefulness) and environmental (pressure from peers) factors that may determine the E-Learning adoption in universities in Ghana [18].

C. E-learning and Security

For common E-learning situation, security and trust usually do not come up in the discussions, as students trust the university. In European Union (EU), the implementation of the General Data Protection Regulation (GDPR) forces schools and trainers to think through how one's data is collected, used, accessed, stored and deleted. The data collection and management issues have never been discussed in academic surroundings so extensively before [19], and it has its effects in the future, not only in the EU but in the world, as well.

Perceived credibility is a significant predictor of intention to use E-learning among engineers because of the belief of the system is free of privacy and security threats [20]. Trust and information security knowledge found to have a positive role in the acceptance of e-assessment system among lecturers of a public sector university in Malaysia [21]. E-learning services related to security concerns have been evident among the students as well (concerning integrity and availability of the system, trustworthiness of the online-assessment services) [21, 52]. Further, a study showed a significant impact of perceived system's security on attitude towards E-Learning [6].

III. Research Model and Hypotheses

This study uses TAM as a base model to examine the effect of perceived security on E-Learning of the students, by providing a relationship among four primary constructs, namely the perceived usefulness, perceived ease of use, attitude and intention to use E-Learning system. Previous studies on the application of TAM in E-Learning context (for example, [7, 23]) has removed attitude due to its weak role between perceived usefulness and attitude [24]. However, since our purpose was to examine the relationship of perceived security on E-Learning acceptance, we decided to test a model consisting of all original TAM constructs. Fig. 1 shows the proposed model that extends TAM by adding perceived security as an external construct.

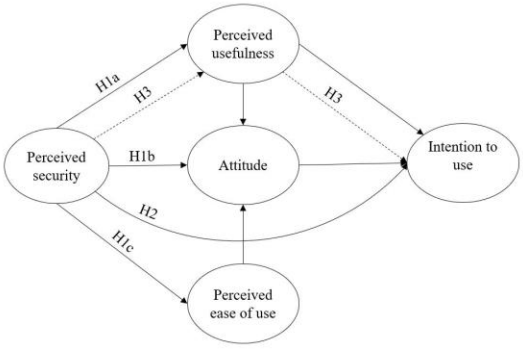

Figure 1: Research Model based on Technology Acceptance Model using Perceived Security as an external construct

Based on the discussion given in the background section, we also proposed the following hypotheses related to the study.

H_1: There is a positive effect of perceived security on (a) perceived usefulness, (b) attitude, and (c) perceived ease of use

H2: There is a positive effect of perceived security on the intention to use E-learning.

H3: The effect of perceived security on the intention to use E-learning is mediated by perceived usefulness.

IV. Research Methodology

A. Participants and Setting

We used online questionnaires in Google Forms to collect the data from the students. The link of the survey was sent to

enrolled students in different affiliated colleges of the university. The Najran university was established in 2006 and is located in the southwest region of Saudi Arabia. There are 14 constituent colleges, including Applied Medical Sciences, Pharmacy, Nursing, Medicine, Dentistry, Engineering, Computer Science and Information Systems, Education, Science and Arts, Administrative Sciences, Languages and Translation, Science and Arts, Fundamentals of Religion, and Community College. Blackboard is the ELS currently used at the University. At the time of the study, the Najran university had 12,177 undergraduate male and female students in total, of which 56% were males. The participants were regular students of the university and had experience using the ELS.

B. Questionnaire Design and Measurements

An introduction was added to the questionnaire, explaining the purpose of the study and confirmation of participants' anonymisation. Several single and multi-items constructs were used in the questionnaire.

There were 17 multi-item constructs, including the intention to use, perceived ease of use, and perceived usefulness (adapted from [23]), perceived security and attitude (self-developed). All these constructs were measured on a 5-point Likert scale (1: strongly disagree to 5: Strongly agree). (For item description, consult Table I)

Single item measures included demographics such as gender and educational background (level and discipline. Age was measured on a continuous scale, whereas, experience with computers, internet, and ELS was measured in years using five groups (1-3, 3-5, 5-7, 7-10, >10).

C. Data Analysis

Among the usable sample (N=313), most of the respondents in the study were female students (80%). The age of participants ranged from 18 to 48 years, with a mean age of 21.5 (SD = 2.90). 37% were students of information technology, computer science, and information systems subjects, 39% were students of business and economics, and rest were studying other disciplines such as natural sciences, education, medicine, and law. The percentage of students who have been using computers, the internet, and ELS for more than five years was 63%, 67%, and 30% respectively.

For hypothesis testing, we used partial least squares structural equation modelling (PLS-SEM). PLS-SEM is a second-generation statistical technique with a widespread application in recent years [25]. We used Smart PLS 2.0 to compute the path model. As suggested by [26], the path weighting scheme was used for parameter estimation. For data analysis and interpretation, we followed the guidelines given in [25]. Consequently, we assessed the measurement model before the structural model.

In PLS, constructs are assessed for reliability (indicator reliability and consistency reliability) and validity (convergent validity and discriminant validly). The results of reliability and validity analyses are shown in Table I. Cronbach alpha values of all the constructs are above the threshold value of 0.70. The composite reliability of the constructs ranges from 0.89 to 0.94, which exceeds the recommended limit of 0.70 [27]. Finally, all the indicator loadings are above the cutoff value of 0.60, which further establishes the reliability of the constructs used in the study [28]. The results, as shown in Table I, support the convergent validity as AVE values of all constructs is above the recommended value of 0.50 [25].

TABLE I
MEASUREMENT STATISTICS OF CONSTRUCT SCALES BASED ON REFLECTIVE INDICATORS

Construct/ Indicators [Reference]	**IL**	**CR**	**α**	**AVE**
Perceived Security (PS) (M=3.67, SD=0.95) [Self-developed]		0.89	0.83	0.66
PS1 – The information submitted to ELS cannot be misused	0.80			
PS2 – There is an effective mechanism to address any violation of information I provide in ELS	0.81			
PS3 – I believe an unauthorized party will not manipulate the information I provide in ELS	0.81			
PS4 – I am confident that the information I provide to ELS will be secure	0.84			
Perceived Usefulness (PU) (M=3.55, SD=0.98) [23]		0.93	0.89	0.82
PU1 – E-learning improves my learning outcomes	0.89			
PU2 – E-learning is very useful to me	0.93			
PU3 – E-learning helps me accomplish my learning effectively	0.89			
Perceived Ease of Use (PEoU) (M=3.58, SD=1.05) [23]		0.92	0.83	0.85
PEoU1 – E-learning study methods are easy to understand	0.93			
PEoU2 – E-learning is easy to use	0.92			
Attitude (ATT) (M=3.70, SD=0.97) [Self-developed]		0.94	0.91	0.82
ATT1 – Using E-learning is a good idea	0.84			
ATT2 – Using E-learning is wise	0.92			
ATT3 – Using E-learning is beneficial for me	0.93			
ATT4 – It is interesting to use E-learning	0.88			
Intention to Use (IU) (M=3.41, SD=1.04)) [23]		0.93	0.90	0.76
IU1 – I prefer E-learning to traditional learning	0.84			
IU2 – I am willing to participate in other E-learning courses	0.91			
IU3 – I think E-learning should be implemented in other classes	0.85			
IU4 – I will recommend E-learning classes to other students	0.88			

For the assessment of discriminant validity, we used the Fornell-Larcker criterion [29]; average variance extracted from each construct was compared with the correlation among constructs [30]. Table II provides the correlation coefficients in the off-diagonal elements of the matrix and the square roots of each construct's AVE along the diagonal. The bold values along the diagonal are higher than all respective rows and columns, which fulfils the Fornell-Larcker criterion.

TABLE II
CONSTRUCT RELIABILITY AND VALIDITY COEFFICIENTS

Construct	1	2	3	4	5
Attitude	**0.89**				
Intention to Use	0.69	**0.87**			
Perceived Security	0.32	0.28	**0.81**		
Perceived Usefulness	0.67	0.70	0.38	**0.91**	
Perceived Ease of Use	0.60	0.70	0.50	0.70	**0.92**

V. RESULTS

First, we verified the relationship of TAM constructs, and then we examine the relationship of perceived security with constructs of TAM. The results are shown in Table III. As expected, all predictors in the original TAM model are significant in explaining the relationships.

TABLE III
STRUCTURAL MODEL ASSESSMENT

Relation	Model 1	Model 2 (Mediation)		
	β (R2)	β (R2)	Indirect Effect	Total Effect
PS→PU	0.35* (0.13)	0.35*(0.13)		
PS→ATT	0.03			
PS→PEoU	0.51* (0.26)			
PS→IU		0.71*(0.50)		
PS→IU	0.26* (0.07)	0.00	0.25*	0.51

*Note: * = significance at p<0.05, PS = Perceived security, PU = Perceived usefulness, PEoU = Perceived ease of use, ATT = Attitude, IU = Intention to use]*

Perceived usefulness has a positive impact on perceived attitude ($\beta = 0.54$, $p < 0.01$) and intention to use e-learning ($\beta = 0.43$, $p < 0.01$). Similarly, attitude has a significant positive effect on intention to use e-learning ($\beta = 0.42$, $p < 0.01$). Finally, perceived ease of use has significant positive relationship with attitude ($\beta = 0.22$, $p < 0.01$). Overall, all the relationships in TAM are confirmed.

To understand the role of perceived security in acceptance of e-learning, we examined the impact of perceived security on perceived usefulness (H1a), attitude towards e-learning (H1b), perceived ease of use (H1c) and intention to use e-learning (H2). Results (Table III, model 1) show that perceived security has positive effect on perceived usefulness ($\beta = 0.35$, $p < 0.01$), perceived ease of use ($\beta = 0.51$, $p < 0.01$) and intention to use learning system ($\beta = 0.26$, $p < 0.01$). Consequently, hypotheses H1a, H1c and H2 are confirmed. However, we did not find any support for hypothesis H1b as perceived security did not have any significant relationship with attitude ($\beta = 0.0.03$, $p > 0.05$).

To test whether perceived usefulness mediates the relationship between perceived security and intention to use e-learning (H3), we performed mediation analysis. We already know that perceived security has a positive impact on both perceived usefulness and intention to use e-learning. The mediation will be established if the presence of the mediator that is perceived usefulness reduces the strength of the relationship between perceived security and intention to use e-learning. As shown in Table III (model 2), when we include the perceived usefulness into the relationship between perceived security and intention to use E-learning, the impact of perceived security on the intention to use e-learning becomes insignificant. Moreover, the indirect effect of perceived security on the intention to use e-learning via perceived usefulness is statically significant (0.25, $p < 0.01$). It shows that perceived usefulness fully mediates the relationship between perceived security and intention to use the E-learning, which confirms hypothesis H3.

VI. CONCLUSION

This study investigates the role of perceived security in acceptance of E-Learning among the university students (N=313). We ran structural equation modelling (SEM) to examine the relationship between perceived security and E-Learning acceptance. Our study shows that like any other information system (E-commerce, E-banking) and services (E-tax filing), perceived security has a role in the acceptance of E-learning among the users. We proposed five hypotheses to ascertain the effect of perceived security on perceived usefulness, perceived ease of use, attitude towards E-learning and intention to use E-learning, and that the impact of perceived security on the intention to use E-learning is mediated by perceived usefulness. The analysis showed that all four hypotheses related to direct relationships of perceived security with constituent constructs of TAM were supported. The results indicate that, indeed, perceived security not only positively affects intention to use E-Learning, but also improves perceived usefulness and perceived ease of use of the E-learning. Moreover, the fifth hypothesis suggesting that perceived usefulness fully mediate the relationship of perceived security and intention to use E-learning was also supported.

In the future, we will examine the relationship of perceived security with E-Learning acceptance in the presence of different antecedents such as organisational, environmental and technological factors, to compare the effect of different variables. In this way, we can elicit the prediction strength of perceived security toward E-learning acceptance in the presence of other factors. Moreover, it will be interesting to examine the views of the university's (management) and faculty members related to the perceived security of E-learning systems.

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