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Student-Teachers' Attitude towards ICT Use: An Application and Modification of the Technology Acceptance Model (TAM) in Education

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Abstract
All over the world, the use of technology has revolutionized a wide variety of processes and procedures in various disciplines, including education. The implementation of ICT in education enhances both the standard and quality of education, hence it is introduced in the teaching, learning, and evaluation processes. However, there are examples of ICT under use, both in rural as well as urban areas, during classroom teaching at different levels of studies in developing countries such as Pakistan. One reason for limited use is students' attitude towards ICT use. The current research used an adapted version of a model called TAM and a self-developed survey questionnaire to gather quantitative data from 270 student teachers enrolled in teacher education programmes in Karachi. Data were analysed using PLS-SEM technique. The results revealed that all factors studied had significant positive contribution towards teachers' attitude towards the ICT adoption. It was recommended that teacher education programmes provider integrate ICT in the teacher education curriculum and ensure extensive professional development for teacher educators teaching these courses.

Keywords: Student teachers' attitude, ICT, subjective norms, facilitating conditions, perceived effectiveness

Introduction

Globally, the 21st century has seen very rapid development Information-Communication-Technology [ICT] which has become an essential and latest source of novelty, and advancement in many areas. The usage of ICT, at a large scale, is changing the daily activities and patterns of life such as learning, communicating, and working with each other (Yasmeen et al., 2015). Yet, the impact of ICT is limited when compared with other fields as the impact in education is contingent on teachers' attitude towards ICT use (Kamal & Banu, 2010). Paechter and Maier (2010) claim that associating effective teaching with more face-to-face contacts is a misconception and there is a need to stress that ICT is not just an exchange of information regarding educational content, but also an opportunity to exchange socio-emotional information which influences leaners' engagement.

Previous research studies have identified an effective ICT usage in Pakistan. For example, Hashim et al. (2016) found that ICT, especially internet, is the most likely source of obtaining information in institutions located in Rawalpindi and Islamabad. On the contrary, Munir and Khan (2015) found that in Karachi, due to either very little training in ICT or lack of attitude and motivation among teachers to use ICT, and due to the inaccessibility of computers and internet, the students do not get the vital advantage of using ICT in their teaching-learning processes. Their research revealed ICT use by teachers in educational institutions in Karachi, but they found teachers' knowledge of ICT was very shallow as it encircles the basic use of computers such as Microsoft Office (Word, Excel & PowerPoint) and internet. This according to them is because the teacher education institutions [TEIs] have not taught them "how to integrate ICT in classroom teaching" (p. 112), hence teachers are not using ICT directly in their teaching-learning process. They also emphasised that even though ICT accessories such as variety of software, multimedia projector, printers, and so on are expensive, such cost is recovered through students' learning and performance. Similar findings are presented by Siddiquah and Salim (2017) who assert that the biggest challenge developing countries, like Pakistan, face is the poor ICT infrastructure and having a very limited access to ICT resources, hence the government and universities should invest more in this area and ensure that ICT is firmly inserted in the teaching, learning, and assessment processes and improvement is brought through the use of technology. However, Irum and Munshi (2015) found that majority of teachers in developing countries (such as Pakistan) highly value their own traditional methodology of teaching, learning, and evaluation than adopting ICT. Shapka and Ferrari (2003) further elaborate that such teachers transmit their typical opposing values and beliefs to their students and this results in limiting the adoption of ICT in education.

Irum and Munshi (2015) argue that developed countries realizing the importance of ICT, have replaced the traditional teaching-learning with technology-based teaching-learning long time back. After many decades, however, this awareness is gaining popularity in developing countries like Pakistan too. Munir and Khan (2015) claim that because of this awareness in Pakistan, especially in Karachi, there has been a tremendous increase in the adoption of ICT in higher education sector, but still in many Higher Education Institutes (HEIs), the computer labs exist without being explored to their true potentials. They further elaborated that the use of ICT is more prominent in physical sciences and not in social

sciences, such as education. Question arises whether the students and teachers of faculty of education's attitude towards ICT usage is being inculcated or enhanced?
The present study analysed student-teachers' perceptions concerning the worldwide growing dependability on technology and its impact on their learning and performance. The rationale of studying student-teachers attitude in the context of ICT adoption is to present whether or not student-teachers' attitude impacts and the adoption of ICT.

Literature Review

Theoretical Framework and Development of Hypotheses

The technology acceptance model (TAM) (Davis, 1989) which is based and the leading theories within the research of ICT (Venkatesh & Bala, 2008), and per se it is influenced by both social-cognitive and decision-making theories (Boe, 2014) and theory of reasoned action (Ajzen & Fishbein, 1980). It is effective not only for describing the attitude and behaviour of individuals but also for understanding the decisions of technology acceptance or adoption by the users within a wide variety of educational contexts, technologies, populations and organisations (Boe, 2014; Teo, 2011).

Attitude towards ICT Use (Dependent Variable)

The most important determinant of an intention to exhibit any behaviour in social science research is attitude (Ajzen, 1988). It is also used as a robust mediator to behavioural intention to ICT use (Taylor & Todd, 1995) in the original TAM. Student-teachers' attitudes which is considered as continuous feelings or beliefs about ICT, whether positive or negative will affect their view and implementation of technology which in turn will impact their students view too (Teo et al., 2008) and would affect their students' current and future usage of technology. If teachers' perceived technology use does not fulfil their own or their students' needs, their expected technology use will decline drastically (Askar & Umay, 2001).

Subjective norm (SN) and attitude toward ICT use (ATIU)

Subjective norm (SN) is categorised under environmental factors and is considered as a very important factor towards ICT acceptance and usage (Teo, 2010).
Subjective norm is defined as the people who are important and are significant referents of vicarious learning for student-teachers as they can guide them to decide whether or not they should use computer technology (Fishbein & Ajzen, 1975; Ajzen, 1988) With respect to technology acceptance, Venkatesh and Davis (2000) state that if people are not positive towards a behaviour or its consequence but their colleagues and important referents consider ICT as very important and very useful, they too will be influenced by the opinion of their 'important others' and will develop the same idea and will act in the similar way. Ma et al. (2005) considers SN as the possible influence of external expectations. .
According to Ballone and Czermiak (2001), the student-teachers develop tremendous positive opinions if they see their instructors or teachers integrating ICT in the classrooms. However the studies by Ma et al. (2005) and Teo (2011) showed no direct or indirect significant effect between the two variables. On the contrary, Marcinkiewicz and Regstad's (1996) identified SN as the most predictive of ICT usage alongside with its other variables such as self-competence. The literature reviews thus guided to formulate the first hypothesis (H_1).
H_1**:** Subjective norm (SN) has a significant positive effect on student teachers' attitude towards ICT use (ATIU).

Facilitating conditions (FC) and attitude toward ICT use (ATIU)

Facilitating conditions (FC) is categorised under environmental factors, and as stated by Teo (2010), the ICT usage is contingent on the users' perception of the ICT environment or facilitating conditions. Facilitating conditions is defined as the environmental variables that effect student-teachers' choices of using technology (Thompson et al., 1991) or the factors that exert an influence over an individual's attitude and desire to accomplish a task (Teo, 2010) such as using ICT. To Kasse et al. (2015), FC is the perception of an individual that whether or not the required technical support and infrastructure to use ICT are available. They further emphasised that FC represents the external constraints on the adoption of ICT which is contrary to the reality of desire to perform. Kasse et al. (2015) contend that for adoption and implementation of ICT, both organizational and personal factors of users are important. They even separated the organisational environment into two groups including, tangible infrastructure and support mechanism out which support mechanism is emphasized more, especially for facilitating the adoption of ICT. Even to Groves and Zemel (2000), the conditions that facilitate ICT usage within the educational environment were the support system or the support environment available to the user. These included the support in training ICT skills, the support in having the resources available to the users (teachers), whether in relation to availability of information or to the materials, and the support given by the administration in creating conducive environment.
H_2: Facilitating conditions (FC) has a significant positive effect on student teachers' attitude towards ICT use (ATIU).

Perceived effectiveness (PE) of ICT and attitude toward ICT use (ATIU)

Perceived effectiveness (PE) of ICT is a new terminology coined for this research which has been adapted and formed by combining two original determinants of TAM including perceived usefulness (PU) and perceived ease of use (PEOU) of ICT. These two terms were combined because previous researchers (such as Teo, 2010; Teo, 2011; and Teo et al, 2008) found that both PU and PEOU jointly affect user's attitude towards ICT use and are primary motivators for ICT use. For the current research it was analysed if the PE has a direct effect on ATIU and whether or not it mediates the effect of SN and FC on the ATIU.

Perceived usefulness (PU) of ICT

Perceived usefulness (PU), one of the fundamental determinants of ICT usage is defined as the positive feeling and subjective belief in the student-teachers that using ICT would enhance their job performance (Davis, 1989). According to Ma et al. (2005), teachers tend to believe that they can achieve their learning goals through the exploration and learning experiences of ICT. If their subjective beliefs assure them that they can show better performance they would be motivated to use ICT (Mahmood et al., 2001; Venkatesh & Davis, 2000). Similarly, Teo (2010; 2011) elaborated that the amount of usage of an application of ICT is associated with their attitude and belief that how much their job performance or their productivity will improve which includes decrease of time in the completion of task and becoming more effective that is being more accurate and efficient.

Perceived ease of use (PEOU) of ICT

Perceived ease of use is the willingness to use ICT considering its use easy and effortless (Davis, 1989). According to Ma et al. (2005), though the teachers may consider and perceive ICT as very useful tool but at the same time if they perceive it to be very difficult to use, then the benefits of performance will be overshadowed by the effort required to use ICT (Davis et al., 1989). Ma et al (2005) reported that teachers consider limited ICT competence as a major barrier toward their usage because if they perceive it hard to use, they would not evaluate ICT as something useful which could hamper their job performance. Thus, the review of literature guided to formulate hypotheses H_3, H_4, H_5 for the current research.

H_3: Perceived effectiveness (PE) of ICT has a significant positive effect on student teachers' attitude towards ICT use (ATIU).

H_4: Perceived effectiveness (PE) of ICT mediates the effect of subjective norm (SN) on student teachers' attitude towards ICT use (ATIU).

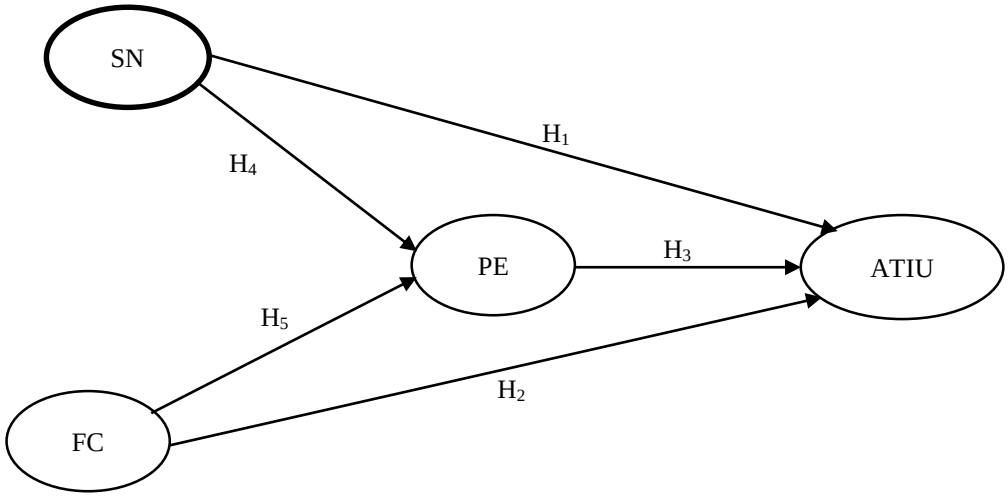
H_5: Perceived effectiveness (PE) of ICT mediates the effect of facilitating conditions (FC) on student teachers' attitude towards ICT use (ATIU).

Conceptual Framework Developed from the Literature

Keeping all the literature and hypotheses in view, the teacher acceptance model (TAM) was applied in this research but not in its original form. It is modified and extended to incorporate the external variables chosen for this research that is the subjective norm (SN) and facilitating condition (FC).The following model was formulated for this research (Refer to Figure. 2).

Figure 1

Conceptual Framework of the Research



Methodology

Using the quantitative methodology, data were gathered from student-teachers studying in five institutes in Karachi, Pakistan

Sample and Data Collection

The survey method was adopted to collect data from two public, two private and teacher education colleges from Karachi, Pakistan. Altogether 277 survey questionnaire were distributed among student-teachers, out of which seven (7) were identified as incomplete and thus 270 valid cases were used for the data analysis.

Survey instrument and Procedure

A self-prepared questionnaire (See Appendix A) was used in this study to gather data from the sample cases. Initially a questionnaire with 60-items based on six hypotheses was prepared for the pilot testing. The questionnaire was then sent to five ICT and research experts to establish the inter-rater reliability. The overall percentage agreement of the five raters regarding each hypothesis ranged from 91 to 95 thus the questionnaire was pilot tested. The data from the pilot testing revealed that the reliability of the items in one of the constructs was low ($\alpha < .7$), therefore items in that hypothesis were not counted. The questionnaire with 50 items (10 items for each hypothesis) was used for the main study (Refer to Appendix A). The data of the current research was analysed through structural equation modelling (SEM), using one of its useful statistical approaches called Partial Least Squares SEM (PLS-SEM) (Ringle, Wende & Becker, 2015).

Respondents' Profile

As presented in Table 1, males respondents were nearly one-fifth (19.3%) of the female (80.7%) respondents, while age-wise the respondents were mostly young, as 53.7% of them were in 30 years or less than 30 years of age. They were enrolled in either of the five different teacher education programmes such as ADE, BEd (Hons.), MEd, MPhil, and PhD, with the majority (71.1%) enrolled in either BEd (Hons.) or MPhil programmes. Most of the respondents (96.3%) possessed a computer, laptop, or a mobile device while 90.4% of them also had a Wi- FI device at their homes, hence having access to internet even during non-working hours. With respect to the respondents' years of experience of using computers, it was noticed that 62.9% had five or more years of experience. Out of the total sample, 6.7% said that they had no experience before joining their respective current programme. Nearly half of the respondents (49.3%) use the computer or internet for three or more than three hours per day. However, there were 23 respondents (8.5%) who do not use computer daily. The purpose of computer or internet usage to 89.2% of the respondents was for both personal and academic use while the reaming 25 respondents (9.3%) used it for academic purposes only. Detailed demographic information regarding respondents is shown in Table 1.

Table 1.
Respondent's Profile (n= 270)

Indictors	Frequenc y	Percentage
	Composition of Gender	
Male	52	19.3
Female	218	80.7
	Composition of Age	
< 20 years	27	10.0
20.1 – 30 years	118	43.7
30.1 – 40 years	89	33.0
> 40 years	36	13.3
	Program Currently Pursuing	
ADE	25	09.3
BEd (Hons)	105	38.9
MEd	29	10.7
MPhil	87	32.2
PhD	24	08.9
	Possession of ICT Devices	
Yes	260	96.3
No	10	03.7
	Internet at Home	
Have wi-fi	244	90.4
Use data package	26	09.6
Internet not available	0	00.0
	Years of Experience Using Computer/Internet	
No experience	18	06.7
0.1 – 5 years	82	30.4
5.1 – 10 years	70	25.9
>10 years	100	37.0
	Duration of Computer/Internet usage per Day	
Do not use daily	23	08.5
0.1 – 3 hours/day	114	42.2
3.1 – 6 hours/day	64	23.7
> 6 hours/day	69	25.6
	Purpose of Computer/Internet usage	
Academic activities	25	09.3
Personal use	04	01.5
Both	241	89.2

Data Analysis and Findings
All together five hypotheses having a total of 50 items were tested. Hair et al. (2013) recommend that items with loadings ≥ .7 are acceptable however, the items between .4 and .7 can be retain if validity and reliability is in the required ranges. Thus 19 out of 50 items were retained in for the further analysis (Refer to Table 2)

The Measurement Model
The factor loadings ranging between .641 and .883 were retained (Hair et al., (2013) as they confirmed content validity (Refer to Table 2). Referring to Table 2, the values of α and CR were > .7 which indicates that the internal consistency (reliability) of the research model was established. Moreover, the values of CR remained below .95 which specifies that indicator redundancy was not present (Hair et al., 2018). Two measures, including the factor loadings (factor loading > .6) and the average variance extracted (AVE > .05) confirmed the convergent validity of the research model (Hair et al., 2018). All items strongly loaded to their respective constructs (Refer to Table 2), all sloping values of the constructs (Refer to Table 3), are larger than the values present in their respective rows and columns (Fornell & Lacker, 1981) and all the values for Hetrotrail-Monotrait (HTMT) ratios were < .85 (Refer to Table 4). Thus, discriminant validity was maintained.

Table 2.
Loadings and Convergent Validity

Items	Factor loadings *(> 0.60)**	(Cronbach's alpha) *(> 0.70)**	Composite reliability(CR) *(> 0.70)**	Average variance extracted (AVE) *(> 0.50)**
Subjective norms (SN)				
SN2	0.676	0.752	0.843	0.574
SN3	0.713			
SN4	0.826			
SN5	0.806			
Facilitating conditions (FC)				
FC1	0.762	0.755	0.839	0.565
FC2	0.711			
FC3	0.765			
FC4	0.768			
Perceived effectiveness of ICT use (PE)				
PE1	0.769			
PE2	0.730	0.831	0.876	0.542
PE3	0.716			
PE4	0.812			
PE5	0.641			
PE6	0.738			
Attitude towards ICT use (ATIU)				
TIU1	0.806			
TIU2	0.883	0.871	0.907	0.662
TIU3	0.810			
TIU4	0.851			
TIU5	0.710			

*Indicate an acceptable level of reliability and validity.

Table 3.
Discriminant Validity (Fornell & Larcker, 1981)

	ATIU	FC	PE	SN
ATIU	**0.814**			
FC	0.450	**0.752**		
PE	0.619	0.455	**0.736**	
SN	0.484	0.433	0.481	**0.758**

Table 4.
Heterotrait-Monotrait Ratio of Correlation (HTMT)

	ATIU	FC	PE	SN
ATIU				
FC	**0.511**			
PE	0.708	**0.536**		
SN	0.585	0.577	**0.589**	

The Structural Model and Hypotheses Testing

Proposed hypotheses for the current research were tested through PLS-SEM in the Smart PLS (Ringle et al., 2015). Table 5 indicates that three variables, including, subjective norms (SN) ($t = 2.469$, $p = .014$), facilitating conditions ($t = 2.390$, $p = .017$) and perceived effectiveness ($t = 6.836$, $p < .001$) have a significant positive effect on student teachers' attitude towards ICT use (ATIU). Thus the outcomes of the current research (Refer to Table 5) supported H_1, H_2 and H_3.

Table 5.
Inner Model Results & Path Coefficients for Hypotheses

Hypotheses	Reg. Path	Orig. sample (β)	t-value *(>1.96)*	p-value *(CI<0.05)*	Decision
H_1	SN → ATIU	0.199	2.467	0.014	Supported
H_2	FC → ATIU	0.158	2.390	0.017	Supported
H_3	PE → ATIU	0.452	6.836	0.000	Supported

Note: Decision based on [t-value > 1.96 (Hair et al., 2011); p-value < 0.05]

Testing Mediation

The current research, a single-mediator model, having the perceived effectiveness as a mediating. As shown in Figure 3 and Table 6, PE mediates the effect of SN and FC on ATIU. It is evident from the table as well as the figure that for SN both the indirect (mediated) effect path (*c'= a x b*) and the direct effect path (*c*) have significant p values of 0.000 and 0.014 respectively, thus establishing a 'complementary mediation effect'. Zhao et al. (2010) contend that complementary mediation has occurred because the indirect (mediated) effect path (*a x b*) and the direct effect path (*c*) "both exist and point at the same direction" (p. 200). In this case, both have a positive direction. It was also noticed that hypothesis H_4 that the direct effect (0.199) was greater than the indirect effect (0.158). Similarly for hypothesis H_5, the indirect (mediated) effect path (*c' = a x b*) and the direct effect path (c) have significant p values (p = 0.000 and p= 0.017 respectively), thus establishing complementary mediation for both H_4 and H_5 hypotheses, as both exist and point at the same and positive directions (Zhao et al., 2010). It was also noticed that for hypothesis H_5 too, the direct effect (0.158) was greater than the indirect effect (0.137).

Figure 3.
Mediation between the predators and the dependent variable

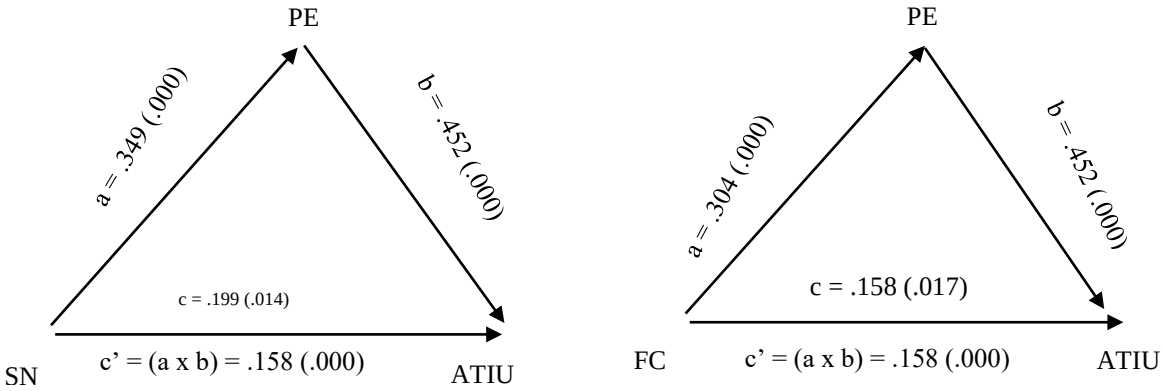


Table 6.
Indirect and Direct Effect Paths

Hypotheses	Path a (SN→PE) (FC→PE)	Path b (PE→ ATIU)	Indirect Effect Path (c'=a * b)	Direct Effect Path Path c (SN→ATIU) (FC→ATIU)	Decision
SN → PE → ATIU	0.349 (0.000)	0.452 (0.000)	0.158 (0.000)	0.199 (0.014)	Complementary Mediation
FC → PE → ATIU	0.304 (0.000)	0.452 (0.000)	0.137 (0.000)	0.158 (0.017)	Complementary Mediation

Predictive Accuracy and Relevance of the Model
The predictive relevancy of the research model was assessed by R^2 (Hair et al., 2013) and Q^2 (Geisser, 1974). Table 7 indicates that 44.1 percent (R^2 = .441) of ATIU was predicted by SN, FC and PE which is greater the threshold (Hair, Hollingsworth, Randolph, & Chong, 2017). Additional, the values of Q Square was .275 which is > 0 (Geisser, 1974), thus predictive relevance of the research model was established.

Table 7.
R Square (R^2) and Q Square (Q^2)

	R Square (R^2)	Adjusted R^2	Q Square (Q^2)
Attitude towards ICT use (ATIU)	0.447	0.441	0.275

Discussion
This research aimed at the identifying factors that would explain this ATIU through the Teachers Acceptance Model (TAM). It was found that perceived effectiveness of ICT use (PE), which in this research was the combination of perceived usefulness and perceived ease of use, was the key determinant, as it has a direct significant effect on ATIU. Besides PE, the two external variables, subjective norm (SN) and facilitating conditions (FC) which were taken in this research as an extension to TAM, also have a direct significant effect on ATIU. Besides direct effect, both external variables (SN & FC) also had an indirect significant effect on ATIU when PE is used as a mediator. This study contributed to the existing literature by adding a new construct under the name of 'perceived effectiveness' of ICT use (ATIU). The research found that collectively the two constructs had a greater impact and was a key determinant for student teachers'

attitude towards ICT use. The data revealed that student-teachers did not perceive ICT difficult to use and their positive attitude is indicated by they spending a lot of time on ICT usage. This finding affirms Sime and Priestley's (2005) study who found that teachers were reluctant to use any instrument which is difficult to use. Since the student teachers perceive computer as easy to use, they develop a positive attitude towards it.

'Subjective norm' was also identified as a factor that has a significant direct effect on 'student teachers' attitude toward ICT use' as well as indirect effect via 'perceived effectiveness'. This research contributes and shows that the direct effect of subjective norm on attitude towards ICT use was greater than the indirect effect. In other words, the student-teachers perceived the views of people or the referents important to them, as very important and those views influence their attitude towards ICT usage very much. Teo (2010) has also affirmed this notion.

'Facilitating conditions' was also recognized to have a significant direct effect on 'attitude toward ICT use' as well as indirect effect via 'perceived effectiveness'. The current research contributes and shows that the direct effect of facilitating conditions on attitude towards ICT use was greater than the indirect effect. In other words, the student-teachers perceive the views that factors in the environment especially in relation to support structures influence their decision to use technology and those views then influence their attitude towards ICT usage very much. Lim and Khine (2006) has also affirmed this notion.

Various studies have shown that 'teachers' attitude' is a critical factor that affects both the ICT use as well as integration of ICT in the teaching-learning process. As stated by Shapka and Ferrari (2003) and Yildirim (2000), teachers who possess a positive attitude toward ICT not only use computers in teaching but also adopts efficient teaching strategies using ICT, henceforth increasing the chance of successfully implementing ICT in their teaching-learning process. Therefore it is very essential for the teacher educators to remain updated, be conscious of their students' beliefs and perceptions regarding ICT, model technology use in their practice by integrating it effectively, and preparing both current and future teachers more effectively for their profession. It is more important for pre-service teachers because once they enter the profession and adopt an attitude, changing that would be difficult (Teo, 2010). Sugar et al. (2004) argue that when ICT is integrated in the classroom, students' expectations enhances and a positive attitude is developed among them. Once they are trained in ICT, they will become change agents which will henceforth develop a positive impact as a whole on the teaching profession, and teaching-learning process in general.

As attitude predicts usage of ICT, an understanding of student-teachers' current usage will determine their future usage, therefore if their teacher educators have effectively used and integrated ICT strategies, the student-teachers' learning will be greatly enhanced. This can only occur if the teacher educators themselves have positive attitude toward ICT use (Yuen, Law, & Chan, 1999). It is for these reasons that within the framework of TAM, few researchers have used 'attitude' as a dependent variable (Raman, Malik, Kasa, Sofian, & Hussin, 2015; Yang & Yoo, 2004) so as to study the possible links to ICT use.

Conclusion

The study investigated the hypothesized Technology Acceptance Model (TAM) and measured 270 student-teachers attitude towards the ICT use (ATIU). The seven outliers were removed and the data was then analysed through PLS-SEM which had an outer and an inner model. The outer model was evaluated through content, convergent and discriminant validity which were established in this study because the scores obtained were according to the acceptance levels of variety of thresholds. Item reliability, Cronbach's alpha, composite reliability and AVE were used to confirm the convergent validity while Fornell and Larcker and HTMT criterion were used to establish the discriminant validity.

After being assured that the data is accurate, the inner model was then evaluated through bootstrapping, and path coefficients were estimated. Five hypotheses, three of which were direct, and two were indirect and had mediators, were supported. It was noted that the direct effect between the constructs assed for mediation were stronger than the mediating effect. The predictive accuracy and relevance of the inner model were measured and both were established in the inner model. Hence the dependent constructs in this research were accurately and relevantly predicted by the independent constructs.

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