Factors Affecting Students' Adoption of ICT Tools in Higher Education Institutions:
An Indian Context

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ABSTRACT

In the recent years, technology has been an important component in teaching and learning. The literature has highlighted many studies investigations on the students' intention to use technology in many Western, African and South East Asian countries. This article brings in the factors influencing students' adoption of ICT tools in higher education institutions in India. The Unified Theory of Acceptance and Use of Technology (UTAUT) model was used to determine the predictors of ICT adoption in learning their coursework in colleges. The results were obtained by structural equation modelling, using the data collected from 398 students doing their undergraduate engineering programs. The findings show that performance expectancy, effort expectancy and social influence has a positive significant relationship on behavioral intention to use ICT tools and facilitating conditions has a direct relationship with usage behaviour. The findings have led to relevant theoretical and practical implications and future researches are suggested.

KEYWORDS

INTRODUCTION

Information technology and its applications have been in the limelight for the past few years in business and management. The application of IT extends itself to education sector too, changing the traditional practices and procedures. Recently, India has seen many universities and colleges giving importance to the usage of Information and Communication Technology (ICT) for teaching and learning in Higher Education. In India adoption of ICTs in education are much quicker. Considering the number of universities and colleges in India, use of ICT is a significant scope of improvement in education. This would help in meeting the demands of the millennial generation where the focus is changing from teacher centric approach to student centric approach. The present generation is growing in the digital environment, unlike their teachers who are digital migrants.

The conventional ways of teaching and learning are increasingly replaced by technology which amplifies the learning capacity of the student and also helps the teacher to teach difficult concepts effectively within short lapse of time (Pyla, 2012). Thus, using ICT is cost effective, less expensive, helps increase desirability for students to learn the subject and increase productivity of teachers. Although there are different advantages of using ICT in the regular coursework learning for students, it is not compulsory for them to use these tools. The greatest challenge of using technology would be its swift and changing developments (Neeru, 2009) and adoption of the same effectively and efficiently by the students become a major concern. This study brings in different factors influencing the students to adopt ICT in their regular coursework in the Indian Higher Education Institutions (HEIs).

A number of research studies have been done on the usage of ICT tools in Indian education sector. But these studies bring in the advantages of usage of ICT and how its usage impacts the quality of education (Meenakshi, 2013; Purushothaman, 2011; Krishnaveni & Meenakumari, 2010; Neeru, 2009). Despite usage and advantages, no study has attempted to measure the factors influencing the adoption of ICT by students in Indian Context. In India, the model has been tested for adoption of online public grievance redressal system, cloud computing, paperless income tax filing by young professionals (Ojha, Sahu & Gupta, 2009), internet banking (Bashir & Madhavaiah, 2015), e-commerce and mobile payment systems (Rakhi & Mala, 2014). Hence, the objective of the study is to identify the factors to measure the level of ICT adoption by students in their regular coursework learning. We used the UTAUT model in order to recognize the factors leading intention to use ICT tools in higher education. Similar study has been done among college students of Ghana where they applied UTAUT model to identify the factors (Attuquayefio & Addo, 2014). However, the moderators in UTAUT are dropped since this is only an initial study that determines only the factors influencing the behaviour. The outcome of the research could be used to facilitate educational institutions in understanding the main contributors of intention to use and actual usage of ICT tools, to enable them to take necessary corrective actions taken to enhance teaching and learning in universities and colleges.

LITERATURE REVIEW AND THEORETICAL BACKGROUND

Several studies have been done on the acceptance or adoption of ICT tools in different sectors for the adoptions like e-commerce, internet banking, software application and other applications of information technology. Adoption of ICT in higher education has not been explored much. Higher education in India can be classified into five categories - central, state, deemed universities, institutions of national importance and private universities. Centre for public policy research in 2015 gave out data on Indian education system stating that it has expanded in a fast pace by an increase in number of universities 34 times from 1950 to 2014.

The theoretical models that accompanied with the studies include Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), Theory of Planned Behaviour (TPB) (Ajzen, 1991), Technology Acceptance Model (TAM) (Davis, 1989), Social Cognitive Theory (SCT) and Diffusion of Innovation Theory (DOI) (Rogers, 1983). Theory of Reasoned Action (TRA) by Ajzen and Fishbein (1980) determined the intention to use and attitude that leads to usage behaviour. Ajzen (1991) developed the Theory of Planned Behaviour proposed that acceptance of a technology or system is influenced by system will help individuals to attain gains in job behavioural, perception on social obligation and control beliefs. The Model of PC utilization developed by Thompson, Higgins and Howell (1991) is appropriate to forecast the behaviour of using a spectrum of information technologies. The mixed models of the above theories also tried to predict an individual's intention to adopt a particular technology. A large number of researchers have empirically studied the variables that cause individuals

to accept, reject or continue the use of new technology using Technology Acceptance Model (TAM). Perceived Ease of Use and perceived usefulness determines the acceptance of technology by the user. Unified Theory of Acceptance and Use of Technology (UTAUT) is deemed to be the modified TAM.

Though there were models to measure the acceptance of technology, no comprehensive instrument existed until the development of UTAUT. UTAUT was discovered to outperform the individual models relating technology acceptance (Venkatesh, Morris, Davis & Davis, 2003). The model gained popularity because of its logical and easy application in any subject or sector. The four key components in the theory, namely, performance expectancy, effort expectancy, social influence and facilitating conditions hold similarity with the constructs in TAM. The results of the study conducted on e-textbook adoption of undergraduates by Hsiao and Tang (2014) indicated that UTAUT appeared to be the best model in terms of the metrics of parsimonious fit and explanatory power when compared to models of TPB, decomposed TPB, TAM and combined model of TAM and TPB. Validity tests of UTAUT were conducted with faculty in large universities on the adoption of personal computers. The results of the study moderately supported the initial relationships of UTAUT as predictors of behavioural intentions (Anderson, Schwager, & Kerns, 2006). The acceptance and adoption of e-learning in higher education institutions was studied in Uganda, which is also a developing country like India, proposed that variables like training, financial budgeting and performance evaluations should be added to the model in order to direct the entire usage of technology (Kasse & Balunywa, 2013). Similar study conducted by Decman (2015) proved that social influence and performance expectancy positively influence the intention to use technology whereas, no significant relationship was found on students' previous education on the model fit.

PERFORMANCE EXPECTANCY

Performance expectancy (PE) is the degree to which the student believes that using ICT tools will bring in gains in his academic career. This also extends to improving the students' performance, increase in understanding levels, ways to achieve high and efficient usage of technology. Performance expectancy is the strongest predictor of intention and was derived from perceived usefulness construct in TAM. The ICT tools which is high in performance outlook tend to reduce task ambiguities and ultimately enhances work related performance (Davis, 1989). When students feel that ICT tools are easy to use and do not require much effort, they will have a high expectation toward acquiring the awaited performance. A related study on e-learning suggests that impact of performance expectancy is higher in students who have less experience of using the system (Chen, Kuan, Lee, & Huang, 2011). The relationship with behavioural intention is supported by various researchers (Carter & Schaupp, 2009; McLeod, Pippin, & Catania, 2009) along with the moderating variables like gender (Gupta, Dasgupta, & Gupta, 2008) and age (Brown, Dennis & Venkatesh, 2010). Therefore, the researchers hypothesized it as:

H1: Performance expectancy has a positive relationship with the behavioural intention of using ICT tools.
H2: Performance expectancy has an indirect positive relationship on usage behaviour.

EFFORT EXPECTANCY

Effort expectancy (EE) is the extent to which the student believes the system is easy to use. The effort expectancy construct within each model is significant in both voluntary and mandatory usage contexts. The variable is known as the intrinsic element in the model. Effort expectancy is derived from the constructs of TAM (Perceived ease of use), Model for PC Utilization (complexity) and IDT (ease of use). Each technology that the individual handles is important to them during the period when he/

she starts using it and later it becomes non-significant over the time of extended and sustained usage (Venkatesh et al., 2003). With a view to that, we anticipate effort expectancy to be more outstanding in the developing stage of every behavioural intention to use ICT tools for learning coursework by students. The technology tools available nowadays are user friendly and do not require much effort to learn especially for the digital natives. Digital migrants might take some extra effort to learn the same. It is also expected that higher levels of effort free use of ICT will also increase the behavioural intention to use ICT. It is evident that skilled and trained users would tend to be less inclined by the ease of using technology since it is familiar to them. Effort expectancy studied on students by the researcher Chen and others (2011) stresses that EE has a positive relationship on BI through technology expectancy. From the above authors hypothesized it as:

H3: Effort expectancy has a positive relationship on the behavioural intention of using ICT tools.
H4: Effort Expectancy has an indirect positive relationship on usage behaviour.

SOCIAL INFLUENCE

According to the social cognitive theory (Bandura, 1986) an individual's behaviour is influenced by which they believe others will view them. A new behaviour can be obtained by observing what others do. In society individuals learn from observation especially from their role models. They encode their model's behaviour and perceive they behave similarly. Social influence measures the degree to which a student believes that others who he/she cares about feel that he/she should use the system. These characteristics have been adapted by Venkatesh et al. (2003) to draw relations between social influence (SI) and intention to use technology. Social influence can directly affect intention to use ICT tools for learning the regular coursework. People who influence students' behavioural intention to use ICT can be their seniors, teachers and peers (Venkatesh et al., 2003). According to Maldonado, Khan, Moon and Rho (2011), there is a positive impact of social influence on behavioural intention. Thus, we hypothesis as:

H5: Social influence has a positive relationship on behavioural intention of using ICT tools.
H6: Social influence has an indirect relationship on usage behaviour.

FACILITATING CONDITION

Facilitating condition measures the degree to which the student believes that they get organizational support to use ICT tools (Venkatesh et al., 2003). In other words, they are the determinants in the environment of an individual that makes a particular behaviour easier to commit. Facilitating conditions draws the ideas from theory of planned behaviour, adaptability from innovation diffusion theory and the term itself from PC utilization model (Venkatesh and Davis, 2000). According to Venkatesh et al. (2003) facilitating condition has a significant relationship with the intention to use ICT tools. Facilitating condition is influenced by the institutional support, teachers and training that student gets to use the ICT tools for their learning. Previous studies support the positive relationship of facilitating condition and usage behaviour (Chiu and Wang, 2008; Cho, Cheng, and Lai, 2009; Rahmat and dan Au, 2013) There is a positive relationship with facilitating condition and user satisfaction supported in the adoption of e-government technology (Chan, Thong, Venkatesh, Brown, Hu, & Tam, 2010). Hence the authors hypothesized it as:

H7: Facilitating conditions has a positive relationship on usage behaviour of using ICT tools.

BEHAVIOURAL INTENTION

Behavioural intention (BI) refers to the individual's decision whether to use ICT tools. The intention to use is influenced by performance expectancy, effort expectancy and social influence (Venaktesh et.al, 2003) (see Figure 1). Since the study explores the intention of using ICT tools, actual usage is also measured. Behavioural intention in the study is both an independent variable and a dependent variable. The relationship of behavioural intention and actual usage is tested across various subjects and found they have a significant relationship (Jong & Wang, 2009). Therefore, authors suggest:

H8: Behavioural intention has a positive relationship on usage behaviour of ICT tools.

METHODS

Research instrument

The items used in this survey were adapted from earlier studies. The multi item questionnaire developed by Venkatesh et al. (2003) was applied as the base for questionnaire development. However, the items were modified according to the context of the study which captures students' adoption of ICT tools for regular coursework in HEIs. The scale items are measured on a five points Likert scale (5 = "strongly agree" and 1= "strongly disagree"). A total of 18 items were used to measure the variables in the study. 3 items for performance expectancy, 4 items for effort expectancy, 3 items for social influence, 3 items for facilitating condition, 3 items for behavioural intention and 2 for usage behaviour (Venkatesh et al., 2003).

Figure 1. Theoretical framework for the study. Adopted from Venkatesh et al. (2003)
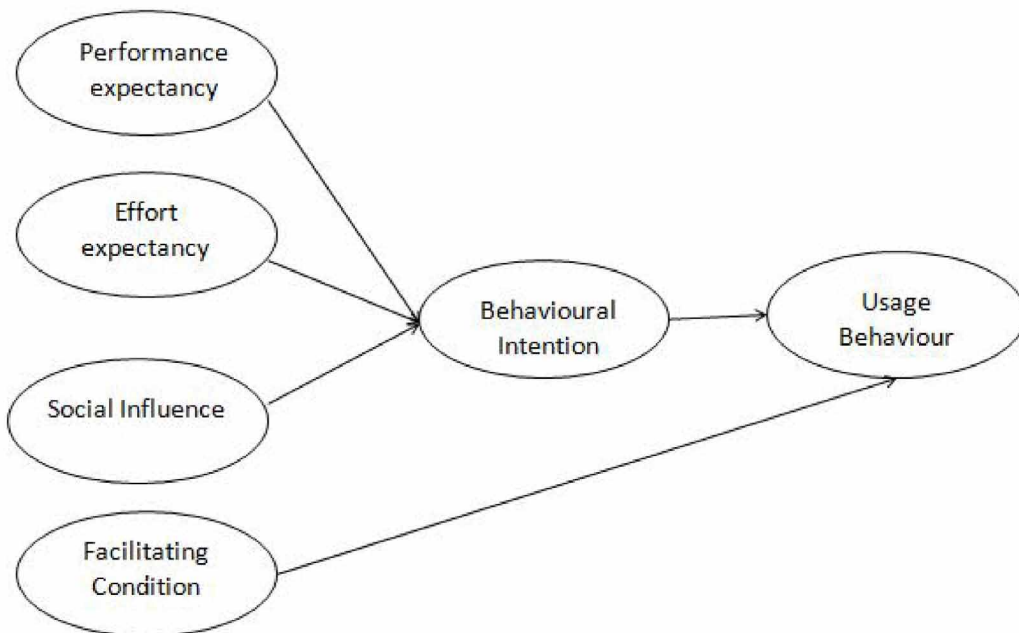
Sample

The data for the study was collected from 5 engineering colleges affiliated to Anna University in Chennai region, India. Anna University is a technical university that became the affiliating University for Engineering Colleges in Tamil Nadu from year 2011. Response was collected from students who are currently pursuing their undergraduate studies in various disciplines like mechanical, computer science, electronics and civil. The questionnaire was administered to the participants during their regular courses, programmes, and seminars. Almost all of the potential participants who were approached by the researchers agreed to take part in the study. A total of 440 questionnaires were distributed and among them 397 fully filled response were used for the study yielding a response rate of 90.2%.

DATA ANALYSIS

Demographic Data

The average age of the students who has responded for the study is 20 years. 35.8% of the students use ICT tools daily for their regular studies, 37% of the students use ICT tools 2-3 times a week, 17% of the students use it 2-3 times a month and only 10% use it just once a month. Among the total sample females constituted for 52.6% and males for 47.4%. The experience of students using ICT tools are as follows: Not more than 6 months 8.1%, 6 months - 1 year 10.1% and more than 1 year 81.9%.

Reliability Test

The questionnaire was adopted from the earlier studies of Venkatesh et al. (2003). Hence, the composite reliability was tested and the Cronbach's alpha coefficient obtained was 0.725.

Exploratory Factor Analysis

In order to arrive at appropriate model, a questionnaire was used and exploratory factor analysis (EFA) was conducted. The rotation method was varimax with Kaiser-Meyer Olkin measure of sampling adequacy at 0.722. The value indicates that small correlations exist among the variables. The Bartlett's Test of Sphericity should be significant ($p<0.05$) and the results of the test suggests the data is suitable for factor analysis. EFA was run for the 13 items in the questionnaire. Principal component method of factor analysis was used with varimax rotation extracting 4 factors. This resulted in 12 items with 3 items in performance expectancy, 4 in effort expectancy, 3 in social influence and 2 in facilitating conditions. 1 item from facilitating condition, "A specific person (group) is available for assistance with ICT usage difficulties" after factor analysis was inappropriately loaded. Hence the researcher removed the item and factor analysis was re-run. The result of factor analysis is shown in Table 1.

The measurement model fit was determined using the confirmatory factor analysis. The first index used was χ^2, degrees of freedom (df) and *p* value. The *p* value should be more than 0.05 in order to call it a good fit of the data. Other indices used to determine the model fit are goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), Tucker-Lewis Index (TLI), the comparative fit index, Root-Mean Square-Error-of-Approximation (RMSEA). Inter-correlations were investigated to test the existence of multi-co linearity. Inter-correlations in Table 2, show low (r=.00) to high correlations (r=.63) indicating no evidence of multi-co linearity (Green, Tull, & Albaum, 1999).

RESULTS

In this study, confirmatory factor analysis (CFA) was conducted to assess the overall measurement models. It allows specification of the construct and item relationships so that they can be tested to evaluate the model fit of the measurement model and to confirm the hypothesized structure. AMOS 19 was used to conduct CFA, the study engaged maximum likelihood to minimize the discrepancy

Table 1. Exploratory factor analysis

	Component			
	1	**2**	**3**	**4**
Learning to operate ICT tools provided by my institution is easy for me	**.656**	-.079	.231	.242
My interaction with ICT tools available in my institution is clear and understandable	**.635**	.102	.139	-.228
I find it easy to use ICT tools provided by my institution	**.589**	.126	.037	.343
It is easy for me to become skilful at using the ICT tools provided by my institution	**.582**	.277	-.076	.108
i find ICT tools provided by my institution useful for my coursework	-.042	**.732**	.208	.176
Using ICT tools provided by my institution increase my productivity	.170	**.730**	.103	.001
Using ICT tools provided by my institution increase my chances of getting good grade in the coursework	.366	**.508**	-.014	.044
People who are important to me think I should use the ICT tools provided by my institution	-.075	.168	**.735**	.062
People who influence my behaviour think that I should use ICT tools for my coursework	.102	-.030	**.688**	.088
Professors in my institution have been helpful in the use of ICT tools	.285	.186	**.482**	-.054
I have the knowledge necessary to use ICT tools	.144	-.064	.077	**.814**
I have the resources necessary to use the ICT tools	.041	.284	.037	**.624**

Table 2. Correlation coefficients, Mean and Standard Deviation

Sl. No.	Variables Mean (Std. deviation)		**1**	**2**	**3**	**4**	**5**	**6**
1.	Performance Expectancy	3.91 (.48)						
2.	Effort Expectancy	3.91 (.41)	.363**					
3.	Social Influence	3.92 (.46)	.283**	.272**				
4.	Facilitating Condition	3.91 (.47)	.274**	.312**	.219**			
5.	Behavioural Intention	4.17 (.49)	.235**	.215**	.178**	.298**		
6.	Usage Behaviour	3.52 (.75)	.179**	.134**	.125*	.206**	.190**	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Note: Standard Deviation in parenthesis

in the fit and to provides complete information about the parameter of interest, true parameter value and parameterization invariance.

CFA yielded a chi-square value of 59.973 with df = 48 and p = 0.115. Chi-square value was non-significant which indicates a good fit; however, the researcher has also used a measure where chi-square is divided by its degrees of freedom (Bentler & Bonett, 1980). χ^2 / df = 1.249 is less than the guided value of 3. Other indices used to establish model fitness are GFI (Goodness-of-fit index) = 0.975 (>0.90); AGFI (Adjusted Goodness-of-fit index) = 0.959 (>0.80); CFI (Comparative fit index) = 0.913 (>0.90); NFI (Normed fit index) = 0.706; RMR = 0.018 (<0.05); RMSEA = 0.025 (<0.08). The model received support from the fit indices as reported above.

The structural model is diagrammatically represented in Figure 2 below. χ^2 / df = 2.7 which is less than the guided value of 3. Other indices used to establish model fitness are GFI (Goodness-of-fit index) = 0.903 (>0.90); AGFI (Adjusted Goodness-of-fit index) = 0.872 (>0.80); CFI (Comparative fit index) = 0.725; RMR = 0.046 (<0.05); RMSEA = 0.067 (<0.08). These indices estimate the fitness of the model. The model received support from the fit indices as reported above. On examination of the regression weights and its significance, it is seen that performance expectancy, effort expectancy and social influence predict behavioural intention (see Table 3). Also, facilitating condition predicts usage behaviour. Hence, H1, H2, H3, H4 and H5 are supported. The indirect relationships of performance expectancy (0.133), effort expectancy (0.138) and social influence (0.574) on usage behaviour are tested.

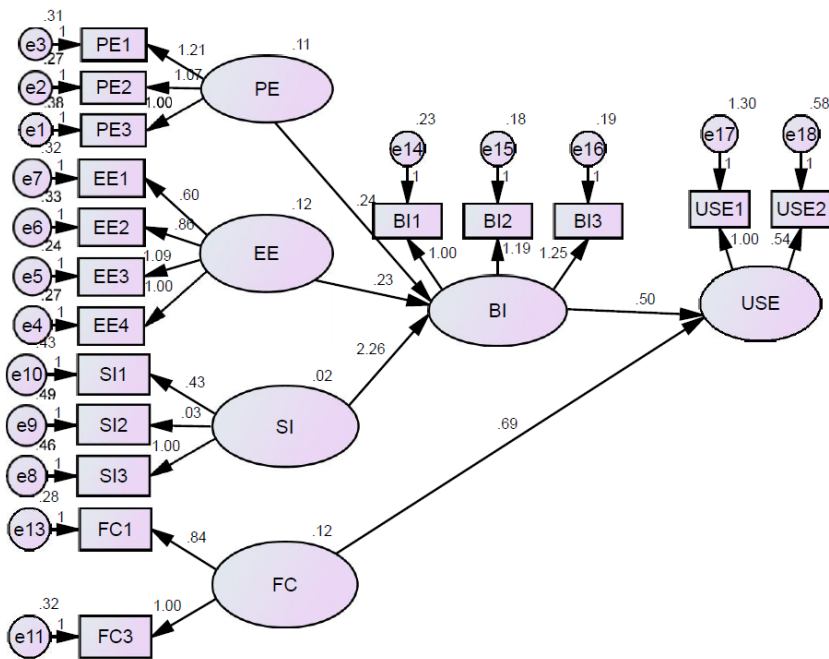**Figure 2. Structural Model for students' ICT adoption**

Table 3. Standardised regression weights

Variables		Estimate
Behavioural Intention	Performance Expectancy	.220
Behavioural Intention	Effort Expectancy	.228
Behavioural Intention	Social Influence	.948
Usage Behaviour	Facilitating Condition	.796
Usage Behaviour	Behavioural Intention	.605

Note: PE - Performance Expectancy; EE - Effort Expectancy; SI - Social Influence; FC - Facilitating Condition; BI - Behavioural Intention; USE - Usage Behaviour

DISCUSSION AND IMPLICATIONS

In this paper, factors affecting students' adoption of ICT tools is identified from a broad review of literature linked to the UTAUT model. Based on the earlier study by Venkatesh et al. (2003) there was a significant relationship between the factors such as performance expectancy, effort expectancy and social influence on behavioural intention. The current study also identifies the same relationship with the behaviour intention to adopt ICT tools among students. Facilitating condition has a direct positive relationship with usage behaviour. Hence, we suggest that the results obtained here in this study congruent with the original study.

Based on the observations from the data analysis, each hypothesis is tested. First, the study explains the relationship between performance expectancy and behavioural intention. The result signifies the positive impact of performance expectancy on intention to use ICT tools. This shows that a student having high performance expectancy in using ICT tool for their coursework is more likely to use ICT tools than a student with low performance expectancy. Performance expectancy was one of the predictor of usage intention of ICT tools by students in universities and colleges. Students in their higher education feel that using ICT tools provided by their institution makes them more productive, increase effectiveness and helps them get good grades for the subject. The result is consistent with the study by Decman (2015) in an e-learning environment. Meta-analysis studies by various researchers show that performance expectancy was one construct that shows significant relationship with behavioural intention (Dwivedi, Rana, Chen & Williams, 2011; Taiwo & Downe, 2013).

Relationship between effort expectancy and behavioural intention was consistent with similar studies. The observation from the results indicates similar results of the earlier studies in educational institutions (Chen, Wu & Yang, 2008; van Schaik, 2009). The results conclude that learning to operate ICT tools, using ICT tools for their coursework makes the student more skilful and they can learn them effortlessly. When the students feel they can interact with the tools clearly their intention to use them is positive. But there are studies which also contradict to this and it could be because of more user friendly technology and reduced discriminating power (Šumak, 2010; Decman, 2015).

Effect of social influence construct on behavioural intention to use ICT tools was strongly positive. Students intend to use ICT tools for their studies when there is an external effect such as teachers or peers. Teachers can adopt systems where students submit assignments online, use ICT tools for class presentations and flipped classrooms techniques. Social influence which has been evolved from the variable subjective norm (Ajzen & Fishbein, 1980) defines the person's perception about accepting a behaviour depends on the person who influences them and they think it is important for him /her or not. The results incline with studies conducted in similar backgrounds (Maldonado et al., 2011; Decman, 2015). Thus, educational institutions can see social influence as the most advantageous factor for intention to use ICT tools

Facilitating condition had a significant positive relationship with usage behaviour. The observation from data analysis is that students those who have necessary resources in the class and the knowledge to use them they will definitely use the ICT tools for the coursework learning. Earlier studies of Al Awadhi and Morris (2008), Azlina, Razak, and Abdulla (2013), Sumak (2010) also supports the positive direct relationship facilitating condition and actual usage. The result also confirms the positive significance of behavioural intention on actual usage. Intention to use ICT tools by students for learning their subject depends on the behaviour intention. Hence, we deduce that students in higher education institutions identify the constructs of UTAUT model as the factors influencing them in usage behaviour to adopt ICT tools. Performance expectancy, effort expectancy and social influence had significant indirect effects on actual use through behavioural intention. The result obtained shows that the institutions can trigger the use of ICT in students in classroom learning by conducting group forums, team activities and other social learning methods where the students can learn from one another.

Today most of the universities and colleges in India aim for quality education. Introducing technology into daily curriculum will be a challenge if students and teachers do not adopt the same.

The students' reliability on computers, mobile technology, emails and daily use softwares like MS Office can enhance their performance in academics. The results obtained can present a great deal of knowledge for HEIs how to bring in systems for usage of ICT. For example, the institutions can plan mandatory usage of ICT tools in their classrooms, identify the obstacles for usage, plan for sufficient resources and rewards for those who use it efficiently. HEIs could significantly benefit from ICT implementation and gradually receive better results. The study furnishes useful findings that institutions can use to enhance ICT usage among students and hence reinforce on strategies to inspire students for lifelong learning. The findings show that students' intention to use ICT in their regular coursework is determined by performance expectancy, effort expectancy and social influence. The universities and colleges can also bring in training programmes that focuses on learning different tools which makes them feel these tools can be used effortlessly or else they might discontinue to use ICT tools because of its complexity.

The study is one of the first to investigate the factors affecting ICT adoption by students in Indian universities and colleges. The results also contribute well to the theoretical model of the UTAUT. The researchers believe that this study can be considered as the first step in validating UTAUT model. To generalize the findings, more research can be encouraged with a different age group and different branches of education. A differential study on the behaviour intentions of using technology by students and teachers in HEIs can also be studied. The study has also contributed to the literature on the usage of ICT tools in HEIs especially in India. However, the authors feel that the relationships that influence the intention to adopt ICT tools still needs further exploration.

LIMITATIONS AND FUTURE RESEARCH

Even though our study showed significant results, there are some limitations that need to be addressed. The study was conducted excluding the moderating variables age, gender, experience and voluntariness as the authors needed only the major factor affecting the students' ICT adoption. Future studies can be conducted with the moderating variables. The study was conducted among the undergraduate students who had an average age of 20 years. The younger generation students are more tech savvy and they are can adopt new technologies effortlessly. Another limitation is that the study was conducted using the same items as in the previous studies; more items could be brought in to measure the acceptance of technology. The study has considered only in the Chennai region for the study, in the future research a larger sample from different cities in India can be considered. It is recommended to check for other factors that influence technology adoption such as students' anxiety, technological complexity, computer self-efficacy, personality traits and students' attitude. Bringing in cross cultural factors that influence students' behaviour can also be an interesting subject for research. According to Trichenor, Donohue, and Olien (1970) people from a higher socio-economic status learn technology faster and easier. Hence, an expansion of the current research in India can also include factors of socio-economic status.

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