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A Model on the Use of Ubiquitous Technology (U-Tech) as a Learning Tool

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Abstract

Reviews of related literature reveal that factors, namely the Technology Competency (TC), Performance Expectancy (PE), Effort Expectancy (EE), Behavioural Intention (BI), Facilitating Conditions (FC) and Social Status (SS) influence ubiquitous technology usage.. Thus, the focus of this study was to confirm whether the determined factors contribute towards ubiquitous technology or u-tech such as laptops, smartphones and tablets. At the same time, it also aims to develop. a new model on the factors that influence the utilisation of u-tech as learning tools among students in the institutions of higher learning, particularly in Malaysia. This study was based on a quantitative research in which the Structural Equation Modelling using AMOS was employed. The results attained from the analysis produced a reliable model towards u-tech usage. The significant paths that, TC significantly influenced u-tech usage (β=.35, p=.000), PE influenced u-tech usage (β=.41, p= .000) and FC influenced u-tech usage (β=.23, p=.000). Meanwhile, the structural paths for EE (β= .26, p= .000) and SS (β=.52, p=.000) towards u-tech usage were mediated by BI. Therefore, from the model, it can be concluded that, 63% of the variance in u-tech usage was described by the five factors. Moreover, this study suggested that the university administration should play an active role in disseminating news that is related to the usefulness of u-tech. Through this approach, students will not feel outmoded as they are provided with the opportunities to progress with the latest technology and and be aware on the benefits in utilising these technologies.

Keywords: New Model; structural equation modelling; ubiquitous technology (u-tech)

1.0 INTRODUCTION

The use of computer-based technology has started with the inception of desktop computers. However, most of the desktop computers are used by students to elicit information and participate in online activities within a static and wired environment (Osman, Masran, Hashim & Taib, 2011a). Eventually, with the birth of the Internet followed with the arrival of the World Wide Web, the use of technology has evolved in a form of a wired environment, to a wireless environment which has been gaining popularity in recent years. By 2010, more than 530 million mobile technology inventions such as laptops and mobile phones were interconnected through the Internet in over 180 countries. The number continues to grow at a dramatic rate in 2012 (Johnson *et al.*, 2013). This type of technology also known as a 'mobile technology' can benefit students in creating an exciting and challenging atmosphere both in and outside the classroom.
Students therefore, are keener in using this new technology replacing the use of desktop computers (Bonk & Graham, 2012).

1.1 Ubiquitous Technology (U-Tech)

In the 21st century and coupled by the fast paced development of technology, students have thrived more on mobility, where they expect to take their technology everywhere they go, and respond to an immediate gratification as well as get feedback straight away (Margaryan, Littlejohn & Vojt, 2011). The students also expect constant connections in using technology concurrently either for social and academic purposes. The students' visions for an ideal learning are by foreseen that using the latest and advanced technology during class as a way to look up information just in time on the Internet (Kilbane & Milman, 2013) and want their learning environment to look more like the 'world' in which they live now, where to use technology anywhere and anytime (Beetham & Sharpe, 2013).

Therefore, these needs have led to the introduction of ubiquitous technology or *u-tech* in education. Today, the most popular u-tech that have been used by many including students are laptops (Awwad, Ayesh & Awwad, 2013), smartphones (Rahamat *et al.*, 2013; Backer, 2010) and tablet computers or tablets (Zain, Mahmud & Hassan, 2013). Apart from that, personal digital assistants or PDA (Shariffudin, Julia-Guan, Dayang, Mislan & Lee, 2012), MP3s (Matias & Wolf, 2013; Tan, Lim & Goh, 2012) and smart boards (Singh & Mohamed, 2012; Al-Qirim, 2011) are other example of u-tech that been used by students in learning. In the context of this study, the focused u-tech were laptops, smartphones and tablets, as these three technologies were identified to be mostly used for learning purposes among students.

U-tech is known as a multipurpose and refined mobile communication which can be used to make call, browse the Internet to find information or check e-mail, find location using a Global Positioning System (GPS), and take pictures and record video (Zhou, Zhang, Jiang & Freeh, 2011). These features make life of students easier, as there is a surety that they get everything they need in one technology (Lance, 2012). U-tech also permits learners to gain the latest information and knowledge faster and easier with the affordance of the Internet ability (Hwang, Wu, Tseng & Huang, 2011).

U-tech is viewed as a versatile device, combining the mobility and connectivity of many elements such as powerful processors which enable users to organize a number of computing tasks simultaneously (Yahya, Ahmad, Jalil & Mara, 2010). It is lightweight and portable, therefore users can take the technology anywhere they like (El-Gayar, Moran & Hawkes, 2011). U-tech is also interactive due to the colourful interface, speed, response as well as it immediate feedback (Corona, Cozzarelli, Palumbo & Sibilio, 2013).

■2.0 FACTORS INFLUENCING UBIQUITOUS TECHNOLOGY USAGE

The review of past literature and the present studies determines many factors that are able to influence the usage of u-tech. However, in the context of this study, the determined factors include only technology competency, performance expectancy, effort expectancy, behavioural intention, facilitating conditions and social status.

2.1 Technology Competency

According to BrckaLorenz, Haeger, Nailos & Rabourn, (2013) technology competency is the ability of being able to handle a wide range of computer applications for various purposes which can be achieved through the process of learning, acquisition of knowledge and development of skills in using technology. In the context of this study, skills represent behaviours which can be measured in order to assess the degree to which a student has achieved technology competence according to relevant patterns. Passow (2012) interpreted the technology competencies as the perception of skills, abilities, knowledge, attitudes and other characteristics that performed by students. Male, Bush and Chapman (2011) agreed technology competency as the most important skill that should be required by the engineering graduates before they enter the workforce.

2.2 Performance Expectancy

Performance expectancy (PE) refers to the degree to which learners believe that using the technology will help them to achieve gains in learning (Tan, 2013). Many researchers postulate that performance expectancy is the strongest factor of the four factors in the Unified Theory of Acceptance and Use of Technology (UTAUT) (Lakhal, Khechine & Pascot, 2013; Wong, Teo & Russo, 2013; Thowfeek & Jaafar, 2013). Research in the Malaysian context showed that the use of educational computer games (ECG) using laptops were regarded as useful and promising tool due to its fun and engagement features (Ibrahim, 2010). He stated that the use of technology will remain vital when students' perceived PE as one of the salient factor that directly influence their usage of technology. In his study, students found that the ECGs were useful and able to enhance their performance. Meanwhile, another study conducted by Shamsudin (2009) among students from the institution of higher education in Malaysia, revealed that PE acted as one of the salient factors that influenced the students' usage of new developed software in learning the Computer Graphics and Image Processing subjects.

2.3 Effort Expectancy

Effort expectancy (EE) is a perception which a person believes that using a technology is free of physical and mental attempt (Dulle & Minishi-Majanja, 2011). In the study conducted by Loo and Choy (2013) showed that engineering students perceived tablets as an excellent tool, as tablets were easy to use. The students agreed that with the tablets, they did not have to put much effort in understanding and handling them. Due to these benefits, had encouraged students not to use tablets only in their engineering and technical subjects but also expanded their usage pattern as a tool for research purposes, for example to capture categorical data especially for data analyzing as well as for filling out forms that focused on categorical information.

2.4 Social Status

Social status (SS) refer to the degree to which an individual perceives the importance of others believe he or she should use the technology (Venkatesh, Morris, Davis and Davis, 2003). In the context of learning, Tapscott and Williams (2012) agreed that u-tech such as smartphones act as a status symbol among students in higher learning. A study showed that students chose their technology devices largely driven from a desire to emulate those they admired such as from lecturers, family and peers. Here, the use of u-tech was a way to aspire to the status of others or oneself with a particular group as well as a way to impress others. They also reported that students enjoyed showing their technology devices off, because it made them feel important and trendy. They also agreed with this 'feel' and respect they gained from lecturers and friends directly influenced their usage of u-tech.

2.5 Facilitating Conditions

Facilitating conditions (FC) refers to as the degree to which an individual believes that an organizational and technical infrastructure exists to support the usage of the u-tech as a learning tool (Alryalat, Williams & Rana, 2013). A study by Alryalat *et al.* (2013), Smith (2012), Abrahams (2004) and El-Gayar *et al.* (2011) reported that FC, in terms of administrator support can influence the success of technology usage among students. The next party is the technical support provided by the organization. Technology or technical support refers to someone who has the access to personnel guidance and help (Reed, 2010). According to Lee, Hsieh and Chen (2013), technical support includes the ICT facilities vendor, internal helpdesk and their availability in helping and assisting users to solve any problems related to the technology usage. The support given is also to ensure that users are satisfied in using technology.

2.6 Behavioural Intention

Behavioural intention (BI) was identified as a mediating factor that influences PE to technology usage. A study in Malaysia was conducted by Tan (2013) in examining the core factors effecting students usage of e-placement tests using technology. The study has confirmed that SS as one of the core factors that had a positive influence on behavioural intention, which in turn lead to an effective use of technology. The researcher found that the influence of lecturers, family and friends was important in influencing students' BI to use e-placement tests continuously. Therefore, this showed that BI acts as a mediating factor that influence the students' percieved SS towards technology usage.

Various researchers revealed that numerous factors affect the implementation of technical and vocational education in Nigeria which

■3.0 STATEMENT OF PROBLEM

Studies in identifying the factors that contribute towards technology usage among students in Malaysia were conducted by many researchers (Amirnudin & Sulaiman, 2013; Tan, 2013; Hussin, Manap, Amir and Krish, 2012; Yusof, Goolamally, Latif & Fadzil, 2012; Mohd Suki & Mohd Suki, 2011). Although a lot of studies have been conducted in the recent years on the usage of technology for learning in Malaysia, little is known about the factors that contribute towards the usage of u-tech as not many comprehensive studies have been done related to it. In Malaysia itself, research that uncover the factors related to usage of new technology only focused on the use of LMS and software and not on the u-tech such as laptops, smartphones and tablets. Khalid (2012) reported that unattractive and dull are the main factor that hinder the usage of LMS which has negatively affected the students' intention in using it continuously. Ibrahim (2010) found that the developed software in learning Calculus provided to the students are perceived as difficult to use, as the students have to put more effort in using and understanding the software.

■4.0 METHODOLOGY

4.1 Research Design

The type of research that was carried out in this study was a survey research and in order to reconfirm the minimum recommended sample for this study, a Raosoft® software was employed. For sampling purpose, the proportional stratified sampling was used and the questionnaires were distributed randomly to the identified sample. All responses were stored and directly imported to the SPSS Version 21.0 and AMOS Version 21.0. The reliability test was conducted in order to find the consistency of scores or answers provided by an instrument. From the analysis, the range of the instruments' reliability was between 0.819 and 0.901. Overall the reliability of the instrument was good.

In order to conduct an analysis using the Structural Equation Modeling (SEM), the Confirmatory Factor Analysis (CFA) was the first step conducted prior the SEM analysis (Hair *et al.*, 2010). Initially, there were 137 items before the CFA was conducted. After the CFA, the number of items reached at 76 only. This showed that, these 76 items were the most reliable items that capable in measuring the factors that influence the use of u-tech as learning tools.

4.2 Structural Equation Modeling (SEM)

According to Hair, Black, Babin, Anderson and Tatham (2010), SEM is an extension of various multivariate methods encompasses a Confirmatory Factor Analysis (CFA), measurement model and structural model. There are three characteristics that distinguish SEM from the other analyses. The first characteristic is the ability to estimate the multiple and interrelated dependence influences simultaneously (Hair *et al.*, 2010). The second feature of SEM is its ability to include items into the analysis. According to Awang (2013), by including the items in the analysis. researcher will be able to define the individual constructs and test for convergent validity and construct reliability simultaneously. The last characteristic of SEM is its potential to define a model (Awang, 2013).

■5.0 FINDINGS

5.1 Confirmatory Factor Analysis

The Confirmatory Factor Analysis (CF) was the first step in data preparation prior to SEM analysis. The CFA was meant to define the individual constructs and was employed for three major purposes, namely to test for, (1) model fit, (2) convergent validity and (3) construct reliability (Awang, 2013; Loehlin, 2013; Rencher & Christensen, 2012; Hair *et al.*, 2010). For the model fit test, two criteria were referred, (1) the fit indices and (2) the individual factor loadings of each item in a construct. The set of criteria for fit indices and their recommended value is shown in Table 1.

Table 1 Fit indices and recommended value

Fit Indices	Recommended value
CMIN/DF	< 5.0
Relative x²	< 5.0
CFI	> .90
RMSEA	< .80
Factor loadings	> .5
	Positive
	< 1.0

Once the three analyses were conducted, it was expected that the number of items for each constructs will be reduced. From the CFA analysis the confirmed items for Section D: Factors Influencing the U-tech Usage showed that PE had four items (PE1, PE2, PE4 and PE5), four confirmed items (EE1, EE2, EE3, EE4) for EE, four confirmed items (SS1, SS2, SS3, SS4) for SS, four confirmed items (FC1, FC2, FC3, FC4) for FC and four confirmed items (BI1, BI2, BI3, BI4) for BI. As the confirmed items (PE1, PE2, PE4 and PE5) for PE were not in sequence, therefore the items have been renumbered to PE1, PE2, PE3 and PE4.

5.2 Measurement Model Test

After the CFA analysis, the analysis of measurement model was conducted and prior to this analysis, the normality and outliers tests were conducted. The analysis of measurement model strived to test for model fit and discriminant validity. For model fit, two criteria were referred, (1) the fit indices and (2) the individual factor loadings of each item in a construct. The set of criteria for fit indices that used were similar in the CFA.

5.3 Test for Model Fit

The complete measurement model for this study with its seven constructs and it fits well according to the criteria set, as shown in Figure 1. The input covariance matrix was generated from 35 indicators measured in the measurement model and it contains 465 sample moments. There were 60 regression weights, 21 covariances, 37 variances and a total of 81 distinct parameters to be estimated. Hence, this measurement model had 384 (465-81) degrees of freedom and the chi-square goodness-of-fit statistic, X^2 (N=388, df=384) = 930.665, p .000 which was <.05.

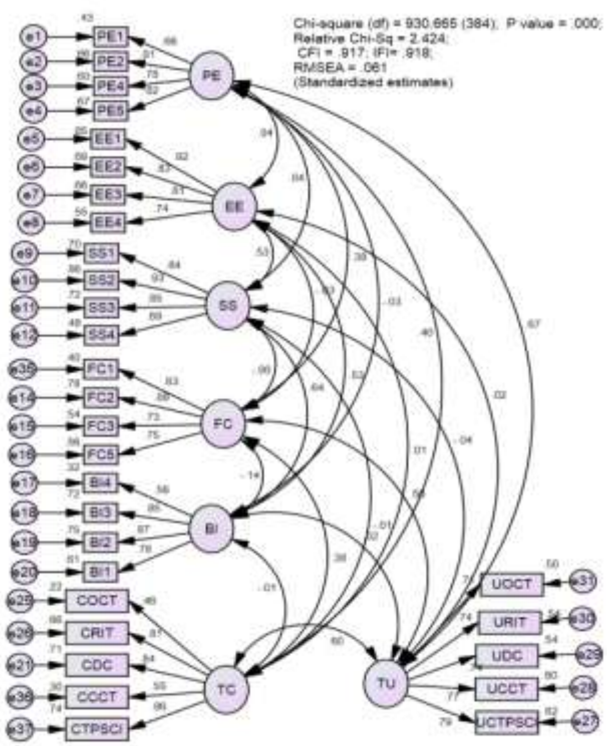


Figure 1 The measurement model

5.4 Results for Discriminant Validity

From the calculation, the AVE for PE and EE were .59 and .68 and their r^2 was .16. Meanwhile, the AVE for SS and FC were .69 and .57 and their r^2 was .36. The AVE for BI and TC were .60 and .53 and their r^2 was .10. Finally, from the calculation, the AVE for TC and technology usage were .53 and .56 and their r^2 was .36. Therefore, it can be concluded that all the constructs showed sufficient discriminant validity.

5.5 The Model

As the main objective of this study was to develop a model on the usage of u-tech, the R^2 for each constructs (variables) and every β value for each structural path were referred, as shown in Table 2.

Table 2 Regression weights: Full mediation

			Estimate	S.E.	C.R.	*p*
BI	<---	TC	.051	.059	.960	.337
BI	<---	PE	-.037	.056	-.667	.505
BI	<---	EE	.267	.083	4.642	.000
BI	<---	FC	-.110	.053	-2.057	.060
BI	<---	SS	.494	.081	7.731	.000
TU	<---	TC	.306	.053	5.786	.000
TU	<---	BI	.156	.057	2.482	.013
TU	<---	PE	.485	.054	8.290	.000
TU	<---	EE	-.014	.068	-.258	.796
TU	<---	FC	.216	.045	4.258	.000
TU	<---	SS	-.126	.069	-2.078	.038

*S.E.: Standard Error of regression weight
*C.R.: Critical Ratio for regression weight
**P*: Level of significance

The structural path for the predictive model was considered significant by determined its (C.R >± 1.96, β and p <.05) for each and every structural path. From the analysis, the identified significant structural path for TC to BI was identified as insignificant (β=.051, p=.337). Meanwhile, the structural path for PE to BI (β=-.037, p=.505) and FC to BI (β=-.110, p=.060) were identified as insignificant too. However, the structural paths for EE to BI was significant (β=.267, p=.000). Meanwhile, the structural paths for TC to TU (β=.306, p=.000), BI to TU (β=.156, p=.013), PE to TU (β=.485, p=.000) and FC to TU (β=.216, p=.000) were all significant, but, the structural path for EE to TU (β=-.014, p=.796) was not significant.

From the analysis, the structural path for SS to TU (β=-.126, p=.038) and SS to BI (β=.494, p=.000) were both significant. However, the β value for SS to BI's path was bigger, and therefore, it can be concluded that the path for SS to BI was more significant as compared to the path for SS to TU. Subsequent validation of the model found it to account for an impressive 48% of the variance in BI and about 63% in u-tech. Therefore, from these results, it can be explicated that this predictive model was able to explain 63% of u-tech usage. The complete model is shown in Figure 2.

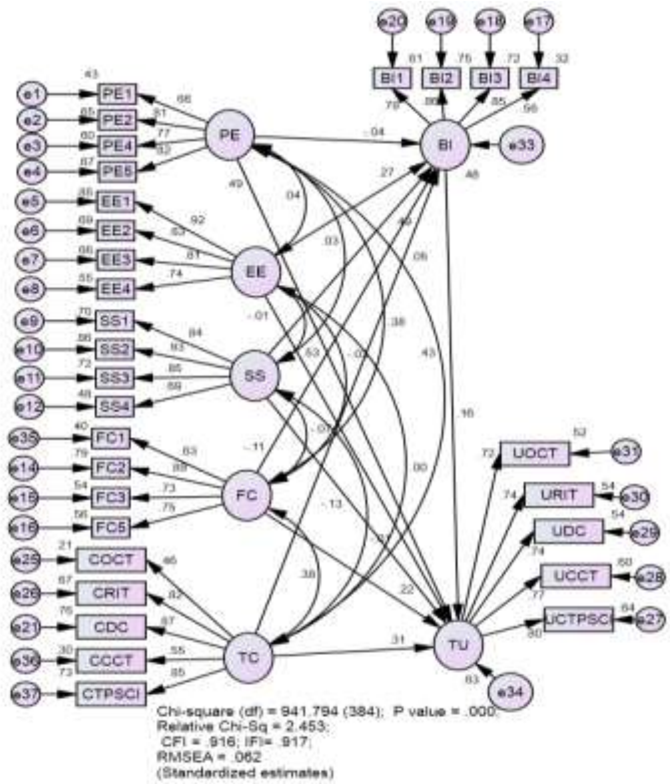
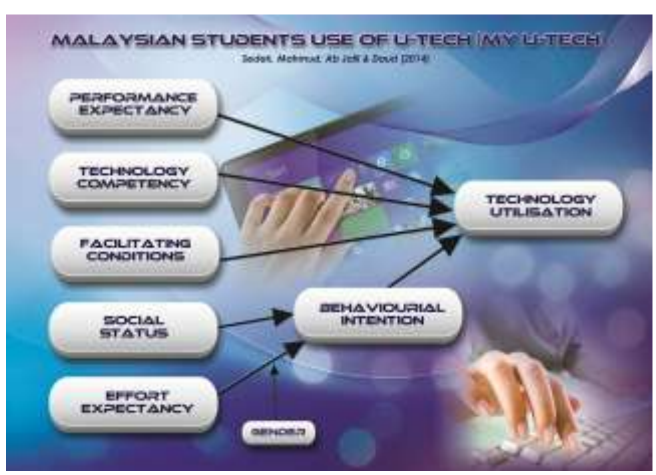


Figure 2 The Model

■6.0 DISCUSSION OF RESULTS

The discussion is on the findings related to the development of a predictive model that can be used in identifying factors influencing the use of u-tech. The data analysis was executed from SEM revealed that there was a significant influence of performance expectancy, technology competency, and facilitating conditions on the use of u-tech directly. Social status and effort expectancy was found to influence the use of u-tech indirectly. In this study, a predictive model was formulated, with five core factors of u-tech usage, with one mediator and one moderator. This predictive model was tested among undergraduates in MTUN and it was able to explain (adjusted R^2 of 63%) of u-tech utilisation; and this was considered high. The relative importance of each factor was shown by using the beta value (β), where the perception on performance expectancy (β=.49) contributed the most to the use of u-tech, followed by technology competency (β=.31) and facilitating conditions (β=.22). The social status perception towards u-tech utilisation mediated by behavioural intention accounted for (β=.49) and the effort expectancy perception accounted for (β=.27). The proposed predictive model, known as the Malaysian Students Use of U-Tech or MyU-Tech, is presented in Figure 3.

Figure 3 Malaysian Students Use of U-Tech (MyU-Tech)



7.0 IMPLICATION AND RECOMMENDATION

Based on the research findings, the theoretical implications and practical implications are discussed.

7.1 Theoretical and Practical Implications

The findings of this study have provided practical implications to further infuse technology, especially u-tech, as a teaching and learning tool. The investigated factors are manifested in different manners, depending on the individual, supporting environment and so forth. Consequently, it suggests productive directions for students, university administrators, curriculum planners, policy makers and other pertinent authorities to allow, adapt and alter not only the learning, but also the teaching environment to provide a superior education system for the 21st century learners. Hence, this study may act as a catalyst to establish a deliberate vision mutually among the stakeholders and to successfully diffuse and utilise u-tech as learning tools among students in Malaysia.

7.2 Recommendations for Future Research

More studies could be conducted to compare the level of technology usage and its impacts on students' achievements, such as grades or standardized tests. Furthermore, it is suggested to conduct a scientific study with a pre-test/post-test design in determining the effectiveness of technology usage for learning purposes.

Finally, the current research involved only among the engineering and technical students in utilising u-tech namely laptops, smartphones and tablets. The results of this study verified that the technology competency, performance expectancy, effort expectancy, facilitating conditions and social status act as factors in influencing the utlisation of u-tech. However, students from different fields may vary in their u-tech usage for learning depending on their subject specific-needs, environment and others. It is recommended to conduct future studies that can examine other factors which may lead to the effective use of u-tech among students in different fields in higher learning in Malaysia. Consequently, the outcome may generate noteworthy findings to the body of knowledge concerning subject specific and programmes variation in the usage of u-tech

Acknowledgement

The authors thank several members of Universiti Teknikal Malaysia Melaka and Universiti Putra Malaysia as well as the Ministry of Higher Education, Malaysia for financial support.

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