

# HOW IS TECHNOLOGY ACCEPTED BY USERS? A REVIEW OF TECHNOLOGY ACCEPTANCE MODELS AND THEORIES

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**Abstract**—This paper provides a literature review of the popular theories and models of technology acceptance of relevance to today's technology developments in the 4E context. The original technology acceptance model (TAM) was derived from the theory of reasoned action and has since been developed and extended to include factors of age, gender, prior experience, ability, etc. It provides the framework to measure users' perceptions of and intentions to use technology within and across organisations. Through research TAM has been empirically proven to be a robust model for understanding end-user adoption of technology and for examining the acceptance of new and developing technology by users with different characteristics in different organisations. The flexibility of TAM to be extended and modified to take into account other relevant factors makes it a powerful framework. This paper identifies the underpinning theories and potential application in a concise way and concludes that TAM has and will provide underpinning for further understanding of the pedagogy-technology-epistemology relationship in the development of technology use.

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**Keywords**— E-Education, E-Learning, Epistemology, Information Technology, Perceptions, Technology Acceptance.

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## INTRODUCTION

Interaction between humans and technology is influenced by a number of social and psychological factors and characteristics (Taiwo & Downe, 2013). Because of the complexities involved in predicting human behaviour, research has generated a variety of theories and models to explain patterns of adoption and use of new technologies. Technology acceptance research is a mature field and has now been active for two decades as technology has invaded every domain of life. Several theoretical models have been developed to explain the acceptance behaviour of end users. Therefore, the study of technological innovation acceptance requires psychological models and theories to explain and rationalise whether users benefit from new devices. Several technology acceptance models have been developed, and they have their own specific characteristics which are reviewed below. The models have been ordered in chronological order.

## DEVELOPMENT OF ACCEPTANCE MODELS

### 1. Theory of Reasoned Action (TRA) (1975)

The theory of reasoned action was introduced by Ajzen and Fishbein first in 1975 and later in 1980 (Ajzen & Fishbein, 1980; Davis et al., 1989; Fishbein & Ajzen, 1975) within which the individual's attitude towards a given situation combines with subjective norms to shape the behaviour intention, which in turn influences the individual's actual behaviour. It has acted as a starting point for technology acceptance models (Davis et al., 1989). It links the perception, norms, and attitudes to the intentions of a person in making a decision, and from there predicts the behaviour which may result as a consequence of this intention. It has been criticised, however, because it

does not consider the individual's ability to control (Yusuf & Derus, 2013).

### 2. Social Cognitive Theory (SCT) (1986)

The social cognitive theory (SCT) was developed by Albert Bandura in 1986. It theorises that learning occurs in a social context with a dynamic and reciprocal interaction of the personal factors, environmental factors, and behaviours (Bandura, 1986). It posits that users acquire and maintain behaviour while considering the social environment in which they develop the behaviour. It gives prominence to the concept of self-efficacy (Compeau et al., 1999). The theory of planned behaviour (TPB), the technology acceptance model (TAM), and the innovation diffusion theory assume that there are only unidirectional causal relationships across the main variables in their models. On the other hand, the social cognitive theory proposes that environmental factors, personal factors and behaviours are determined reciprocally (Bandura, 1989).

### 3. Technology Acceptance Model (TAM) (1986, 1989)

Fred Davis developed the TAM first in 1986 in his doctoral study. The TAM originated as an adaptation of the more generalised TRA and was developed more specifically later to predict and explain technology usage behaviour and it was developed to identify the factors which lead to user's acceptance or rejection a technology by integrating technological aspects with organisational behaviour concepts (Davis et al., 1989; Davis, 1989). Two important factors are perceived usefulness and perceived ease of use. Shroff et al. (2011) reported that by manipulating these two determinants, system developers can have better control over users' beliefs about the system and so can predict their behavioural intention and actual usage of the system. Attitude towards using a new

system has been classified as a determinant that guides future behaviour or as a cause of intention which eventually leads to certain behaviour. In TAM, attitude towards using a system refers to the evaluative effect of positive or negative feelings of individuals in performing a certain behaviour (Shroff et al., 2011).

So, the TAM has used the TRA as a theoretical basis to find the links between these two factors as well as the user's attitude, intention and actual technology behaviour (Fig. 1).

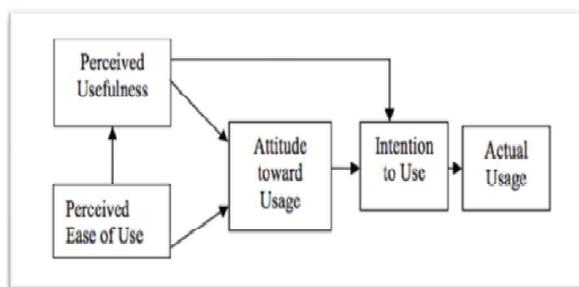


Figure 1 Technology acceptance model (TAM) (Davis et al., 1989)

In contrast with TRA, the TAM does not include subjective norms because of the weak psychometric results which are generated (Davis et al., 1989; Wu et al., 2011). Researchers of ICT have criticised this model for not including subjective norms, however, as this is considered to be a crucial factor, despite that the inclusion of subjective norms in TRA is known to have theoretical and psychometric issues (Galletta, 1999). Galletta (1999) stated that social influence does not seem to have a direct relationship with behaviour intention although it has a relationship with attitude.

Some researchers argue that the TAM does not consider any barriers that would prevent the individual from adopting a particular technology (Taylor & Todd, 2001). Bogozzi has pointed out that the TAM is too simple and leaves out important variables (Bogozzi, 2007). However, it has also been recognised by others as a powerful, valid and highly reliable predictive model that can be used in several contexts (Legris et al., 2003; Sharma & Chandel, 2013). Moreover, it constitutes an important theoretical contribution towards understanding ICT usage and acceptance behaviours (Chen & Li, 2011; Galletta, 1999). Therefore, with regard to the ICT field, researchers have used the TAM to study the adoption of different technologies and it has become the most significant theory in this field.

#### 4. Theory of Planned Behaviour (TPB) (1991)

The TPB was conceived with the intention to improve upon some of the drawbacks of TRA. It was developed by Ajzen in 1991 as an extension of TRA, with the additional determinant of intention-perceived behaviour control. Perceived behavioural

control refers to the perception of whether performing the behaviour is easy or difficult (Ajzen, 1991). This theory examined the factors of attitude, subjective norms, perceived behavioural control, and intentions on the actual behaviour. This theory focused on mandatory situations, whereas TRA focused only on voluntary situations (Sharma & Chandel, 2013). Ajzen conceptualized that PBC is a function of skills, resources, and opportunities to achieve the outcome, which are closely related to the efficacy belief. The PBC is defined as the perception of internal and external limitations on behaviours (Sharma & Chandel, 2013). Researchers have concluded that the TPB has a greater ability to predict behaviour than the TRA (Kok et al., 1991; Liang & Huang, 1998).

#### 5. Model of PC Utilization (MPCU) (1991)

Thompson et al. (1991) predict PC utilization behaviour model. According to them, "Behaviour is determined by what people would like to do (attitudes), what they think they should do (social norms), what they have usually done (habits), and by the expected consequences of their behaviour" (Thompson et al., 1991, p.126). They identified six determinants to technology acceptance in this model which are job fit, complexity, long-term consequences, affect toward use, the social factor and the facilitating conditions.

Tirandis' study (1997) forms the basis of the MPCU, which considers the theory of human behaviour in connection with technology acceptance. His theory of attitudes and behaviour is a competing perspective to those of the TRA and TPB. Triandis (1977) made a distinction between the cognitive and affective components of attitudes.

#### 6. Motivation Model (MM) (1992)

The motivation model has been applied by Davis et al. to study ICT adoption and use (1992). It posits that the individual's behaviour is based on intrinsic and extrinsic motivation. Intrinsic motivation arises from a person's inner drive to perform the task and relates to perceptions of pleasure and satisfaction (Davis et al., 1992; Vallerand, 1997). On the other hand, extrinsic motivation arises when the cause of motivation is outside the person or outside the task (Cheng & Yeh, 2009). In this model, computer playfulness and enjoyment are determinants of intrinsic motivation (Davis et al., 1992; Venkatesh, 2000) and perceived usefulness, perceived ease of use, and subjective norm are determinants of extrinsic motivation. This model is based on the psychological aspects of technology acceptance.

#### 7. Combined TAM – TPB (1995)

This model was developed by Taylor and Todd in 1995 by linking the predictors of TPB with the constructs of perceived usefulness and ease of use from TAM (Surendran, 2012; Taylor & Todd, 1995). It is also known as the 'decomposed' theory of

planned behaviour because the belief structure is decomposed in this model (Lau, 2011). Attitude is thus decomposed to be affected by perceived usefulness (relative advantage), perceived ease of use (complexity) and compatibility. The normative belief structure is affected by peer influence and superior influence. The control belief structure is affected by self-efficacy and facilitating conditions.

### **8. Innovation Diffusion Theory (IDT) (1995)**

The innovation diffusion theory was developed by Rogers in 1995 (Rogers, 1995). Innovation is an idea, process, object, or practice that can be considered to be new, and diffusion is the process by which it gets into the social system (Rogers, 1995). This theory is considered to be the permanent theory of acceptance of innovation and is appropriate in both an individual or organizational context (Yusuf & Derus, 2013). In this theory, there are five determinants of the rate of innovation that affect adoption and acceptance behaviour. They are relative advantage, compatibility, complexity, trialability, and observability.

### **9. Extension of TAM (TAM2) (2000)**

Venkatesh & Davis (2000) developed the TAM2 by adding two more determinants to the original TAM: social influences and cognitive instrumental processes. The social influences include subjective norms and images. On the other hand, the cognitive instrumental processes includes job relevance, output quality, result demonstrability and perceived ease of use. TAM2 keeps the concept of perceived ease of use from the original TAM as a direct determinant of perceived usefulness. All of these additional elements are believed to influence the acceptance of technology. There are two moderating variables in this model, which are experience and voluntariness. In contrast with TAM, the variable of attitude has been removed in TAM2 (Wu et al., 2011). Davis has argued that in the TAM, the influence of subjective norms on behavioural intention to use can be ignored and so subjective norms were not considered. Nevertheless, in the extension of TAM, TAM2, Venkatesh & Davis (2000) have reconsidered these variables.

### **10. Unified Theory of Acceptance and Use of Technology (UTAUT) (2003)**

Combining the various theories and models of technology acceptance, Venkatesh et al. (2003) developed a unification theory in which they integrated the components of eight technology acceptance models and theories: TRA, TAM, the motivational model, TPB, combined TAM-TPB, the model of PC utilization, innovation diffusion theory and social cognitive theory. The UTAUT model used four main determinants of usage and intention; these are performance expectancy, effort expectancy, social influence and facilitating conditions. These stand

alongside four moderators of gender, age, experience and voluntariness of use.

This theory has been criticised for having too many independent variables for predicting intentions and behaviour (Bagozzi, 2007). However, it is considered to be more robust than other technology acceptance models in evaluating and predicting technology acceptance (Venkatesh et al., 2003).

### **11. Technology Acceptance Model (TAM3) (2008)**

The TAM was further modified by Venkatesh & Bala (2008) to give a higher level of significance to 'perceived ease of use'. They also added the dimensions of computer self-efficacy, perception of external control, computer anxiety and computer playfulness. Two adjustment variables have also been added, which are perceived enjoyment and objective usability. TAM3 is constructed on a theoretical framework of four classifications which Venkatesh and Bala claim is a synthesis of all prior TAM research (2008). These four classifications are individual differences, system characteristics, social influence and facilitating conditions (Howard et al., 2010). According to this model, the perceived ease of use is determined by computer self-efficacy, computer playfulness, computer anxiety, perception of external control, perceived enjoyment and objective usability. The perceived usefulness is determined by subjective norms, job relevance, result demonstrability and image. However, one of the criticisms of the model is that there are too many variables and too many relationships between the variables.

### **12. Extending Unified Theory of Acceptance and Use of Technology (UTAUT2) (2012)**

The extension of the unified theory of acceptance and use of technology has been developed by Venkatesh et al. (2012) to pay particular attention to the consumer use context. This model included the independent variables of UTAUT but added three more which are hedonic motivation, price value and habit. They have integrated these three independent variables into UTAUT in order to tailor it to the consumer technology use context. Moreover, by combining these three salient constructs into UTAUT, Venkatesh et al. expand the overall framework with regard to technology use. This theory includes age, gender and experience as moderating variables; however, voluntariness has been ignored.

## **CONCLUSION**

TAM has been widely used in information and communication technology research to help understand as well as explain user behaviours. This paper has summarised the technology acceptance models and theories, including the factors relevant to each model, and has attempted to review the origins and evolution of TAM from 1975 to 2012. TAM has

succeeded in providing a robust model which is applicable across a broad range of end-user computing technologies. This review paper concludes that the TAM framework has and can be the basis of robust and developing models of technology use in learning environments. However, the lack of consideration of the human computer interface design in this wide range of applications suggests that a technology acceptance model that is sensitive to design issues is needed.

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