Technology Adoption Models – Adoption of ICT in Educational Institutions in India

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***Abstract*— Educational technology can be defined as the study and ethical practice of facilitating learning and improving performance by creating, using and managing suitable technological processes and resources. The technology utilizes both educational system and physical hardware. It involves several domains including theoretical learning, computer-based training, web-based learning, etc. Corporates, nations and individuals adopt each evolving technology, only if, it adds value. To recognize the value of such technology, it is essential to be familiar with the technology adoption process and factors affecting it. Well established proven models explain the factors in adoption process. In this paper, the sources, technologies and delivery methods of ICT in Educational Institutions, have been discussed. Six significant models (one model from each decade 1960-1970, 1970-1980, 1980-1990, 1990-2000, 2000-2010 and 2010-2020) have also been discussed for adoption of evolving technologies in Educational Institutions.**

Keywords*— *Adoption factors, Diffusion of Innovation (DOI), E- learning, Moore and Benbasat Model, Technology Adoption models, Technology Acceptance Model, Theory of Reasoned Action, UTAUT model, Revised UTAUT model

I. INTRODUCTION

Technology has brought profound changes in all walks of life. At home, electricity has changed the lifestyle with the use of mixer, grinder, microwave oven, Refrigerator, TV, Mobile phones. At office, the first thing that everyone does is to switch on the computer and check emails. Every day in office is packed with email, internet, video-conference and VOIP phones. Even socializing has been happening only through Chat, Skype, Facebook, Twitter, etc. It is not surprising that education has not escaped this phenomenon. The methods and principles of teaching and learning have also changed. Information and communication technologies (ICT) have created a revolution in education with the introduction of E- learning, smart board, video classrooms, online learning [1] [2].

The adoption of evolving technologies is possible only if they enhance value to the industries, firms, individuals and countries who adopt them. It is essential to recognize the adoption process before recognizing the advantages of the technology. To recognize the adoption process we need to be aware of the factors affecting the adoption process. There are hundreds of established and proven models to explain the factors in the adoption factors.

It becomes complex while trying to change the usual way things is done and one that is challenging to be accomplished successfully. It is difficult to find and to convince people to support an innovator because success is always doubtful in innovation.

"There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new order of things.....Whenever the enemies have the ability to attack the innovator, they do so with the passion of partisans, while the others defend sluggishly, so that the innovator and his party alike are vulnerable.."

--Niccolo Machiavelli, The Prince (1513)

In this paper, six models (one model from each decade 1960-1970, 1970-1980, 1980-1990, 1990-2000, 2000-2010 and 2010-2020) are given to show the factors in adoption process. The models presented here are shown in Table 1.

Table 1. Technology Adoption models

Model	Year
Diffusion of Innovation (DOI)	1962
Theory of Reasoned Action (TRA)	1975
Technology Acceptance Model (TAM)	1989
Moore and Benbasat Model	1991
Unified theory of acceptance and use of technology (UTAUT)	2003
Revised UTAUT	2017

The primary objective of this paper is to throw some light on the existing models of technology adoption and to use it to

accelerate the adoption of ICT/E-learning in educational institutions.

II. E-Learning Definition

The European commission defines E-learning as "The use of new multimedia technologies and the internet to improve the quality of learning by facilitating access to resources and services as well as remote exchanges and collaboration."

The Open and Distance Learning Quality Council (UK) describes E-learning as "*...effective learning process created by combining digitally delivered content with (learning) support and services.*" [1]

Only two common factors however endure out of all the E- learning definitions generally available:

- E-learning involves IT (the 'E-' from E-learning)
- E-learning is used for part of a developmental process (the learning).

III. E – learning Sources and Technologies

To support access to electronic resources, libraries organize online tools to provide metadata for online materials, link online index entries to individual journal articles online, and provide mechanisms for requesting printed articles. Librarians must be integral to the decision-making process when it comes to selecting and implementing a campus-based learning management system and determining best practices. The latest external knowledge is increasingly available in the electronic form are E-journals, E-reference books, E-text books and database. Libraries negotiate for licenses to electronic resources and provide an access to them. Libraries can digitize printed materials for E-learning.

Libraries can take responsibility for managing copyright agreements. E-learning may involve the use of some, or all, of the following technologies such as desktop and laptop computers, software, interactive whiteboards, digital cameras, mobile and wireless tools, including mobile phones, electronic communication tools, including E-mail, discussion boards, chat facilities and video conferencing, virtual learning environments (VLEs) and learning activity management systems.

IV. E-learning Delivery Methods

E-learning is done over the "World Wide Web" or by CD-ROM, and some variations (distance learning) incorporate traditional media. Some of the other common delivery methods used in E-Learning are given in Table 2:

Table 2: Delivery Methods for E-learning

Video	**Audio**	**Print**	**Review and Exams**
Streaming video, video tape, satellite transmission and cable	Streaming audio and audio tape	E-text, textbooks and E-zines	Electronic, interactive and paper

IV. Technology Adoption Models

A. Model 1: Diffusion of Innovation

Originally a rural sociologist, Rogers [3] published the first edition of Diffusion of Innovations. As the advertisement on the back cover of the latest edition indicates, the name Everett Rogers is virtually synonymous with the study of the Diffusion of Innovations to the extent, that to many people, Diffusion of Innovations is Everett Rogers.

Diffusion of Innovation is a theory that seeks to explain how, why, and at what rate new ideas and technology spread through cultures as shown in Fig. 1. Rogers stresses that it is the perception of change that is important; if the idea seems new to the potential adopter then it should be considered to be an innovation. The "Newness" of an innovation may be expressed in terms of knowledge, persuasion or a decision to adopt.

Rogers synthesized research from over 508 diffusion studies and produced a theory for the adoption of innovations among individuals and organizations. He approaches the topic of innovation diffusion by considering a variety of case studies on topics including:

Controlling scurvy in the British Navy, diffusion of hybrid corn in Iowa, diffusion of the news, bottle feeding of babies in the third world, how the refrigerator got its hum, apple computer, black music in white America, Minitel in France, the non-diffusion of the Dvorak keyboard, and causes of the Irish potato famine. The prime concern in all these studies is the identification of factors that affect the speed with which an innovation is adopted, or that cause it not to be adopted at all.

Diffusion is the process in which an innovation is communicated over time, through various types of communication channels, among the members of a social system. There are thus four main elements of theory of innovation diffusion.

There are four elements of diffusion. 1) Innovation - idea, practice, or object that is perceived as new by an individual or other unit of adoption 2) A communication channel - the means by which messages get from one individual to another 3) Time - The innovation-decision period is the length of time required to pass through the innovation-decision process. Rate of adoption is the relative speed with

4. Social System is a class of connected segments which are involved in cooperative problem solving to achieve a typical objective.

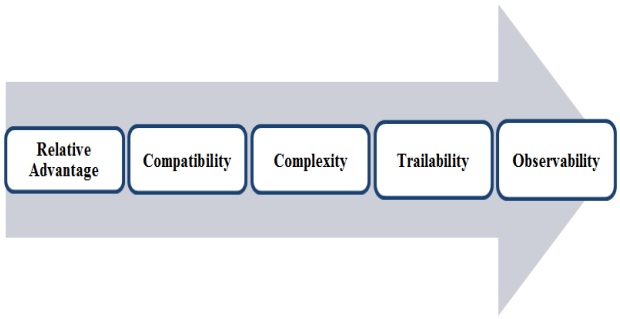

Fig. 1. Roger's Perceived Attributes Influencing Individual Rate of Adoption

B. Model 2: Theory of Reasoned Action Model

Fishbein and Ajzen designed the Theory of Reasoned Action (TRA) in 1975 [4]. The TRA model is initially introduced from the field of social psychology. This model defines the association among beliefs, perspectives, standards, purposes, and behaviors of individuals.

According to this model, an individual's behavior is determined by its social aim to perform it. This aim is itself controlled by the individual's states of mind and his personalized standards towards the conduct. Fishbein and Ajzen define the personalized standards as "the person's perception that most people who are important to him think he should or should not perform the behavior in question" [4]. This hypothesis can be represented by Equation (1):

$$Behavioral\ Intention = Attitude + Subjective\ Norms \quad (1)$$

As given by TRA, the behavioral attitude of an individual is deduced by his beliefs on the behavioral effects, increased by his assessment of these effects as shown in Fig. 2. Beliefs are characterized by the individual's instinctive possibility of showing a specific behavior, producing particular outcomes. Thus, this model proposes that external motivations impact an individual's attitude by changing his beliefs. Behavioral aim is determined by the emotional standards which bridges standard beliefs and acting in accordance with the self-driven standards of an individual.

Fishbein and Ajzen [4] evaluated the difference between attitude and behavior and developed TRA. According to them, *"TRA corresponds to optional behavior. Subsequently, behavior was not completely optional and was dominant. This added perceived behavioral control to the model. Thus, the theory was termed as Theory of planned Behavior (TpB). The theory anticipated intentional behavior since behavior could be deliberative and planned"* [4].

Intention is the key aspect of behavior. Intention is one's thinking power to accomplish any specific behavior. It is observed as the prior level of behavior. Intention is based on three characteristics such as particular behavioral attitude, personalized standards and perceived behavioral control.

The theory of planned behavior states that the anticipation of a behavior is based on certain attitudes of that behavior. It is necessary to assess personalized standards of individuals (i.e.) beliefs that how concerned people perceive the behavior. The knowledge of such beliefs is essential, just like how understanding an individual's attitude is important for prediction of an individual's intentions. Thus, perceived behavioral control impacts intentions. Generally, when the attitude and the personalized standards are highly agreeable and when the perceived control is higher, the individual's intention should be stronger to accomplish the behavior.

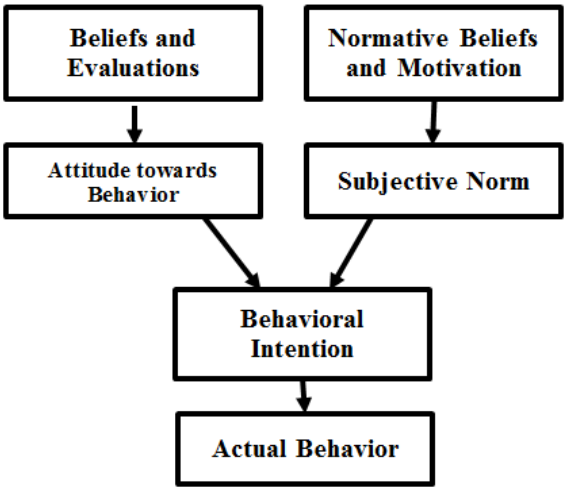

Fig. 2. Theory of Reasoned Action

C. Model 3: Technology Acceptance Model

Technology Acceptance Model (TAM) is one among the extended models of the TRA model introduced by Fishbein and Ajzen [4]. Davis, Bagozzi and Warshaw [5] [6] proposed TAM model. The attitude measure of TRA is replaced by TAM using two acceptance measures such as ease of use and functionality. Both TRA and TAM models have powerful behavioral components. Suppose that an individual creates an intention to act upon, he will freely act without any limits where real world consists of limitations and conditions [6].

TAM information system is used to design user acceptance model and helping them to use emerging technologies. As shown in Fig. 3, the model identifies the various factors that influence the decision of user to use any new technology. The factor such as how easy is to use the technology and also the frequency of usage can be modelled as noted below.

Perceived/Estimated usefulness (PU) – It denotes the extent user believes that the given technology could be useful for them in their job in terms of enhancement or performance.

Perceived /Estimated easy-to-use (PEOU) – The extent to which a user believes that the given technology would reduce his effort or labor.

D. Model 4: Moore and Benbasat Model

Moore and Benbasat Model can be used for easy recasting of estimated characteristics related to innovation [7].

Fig 4. Moore and Benbasat Model

The characteristics that contribute for innovation are refined as per the potential of the user who is adopting the technology, trial ability, observability etc. These features are identified as Perceived Characteristics of Innovation (PCI) which is depicted in Fig 4.

E. Model 5: Unified Theory of Acceptance and Use of Technology(UTAUT)

UTAUT is a model that perceives the acceptance of a technology by the user. This model was designed by Venkatesh et al. in 2003 [8]. This model identifies the intentions of the user on why they would want to use the information system.

Four building blocks used in this model that directly determines the system usage and behavior are performance expected by the user, expected reduction of effort, influence on society and facilitating conditions as shown in Fig. 5.

In addition to these four building blocks, user's age, gender, experience with similar technologies and proactive nature of the user to get accustomed to new technology have high impact on system usage and user's behavior.

The theory is a model that was thoroughly reviewed and is a consolidation of eight different constructs/models that were used in literature to perceive usage behavior. The models are

1. Technology acceptance
2. Theory of reasoned action
3. Motivational model
4. Theory of planned behavior/technology acceptance model
5. Combined theory of planned behavior/technology acceptance model
6. Model of personal computer usage
7. Diffusion of innovations theory
8. Social cognitive theory.

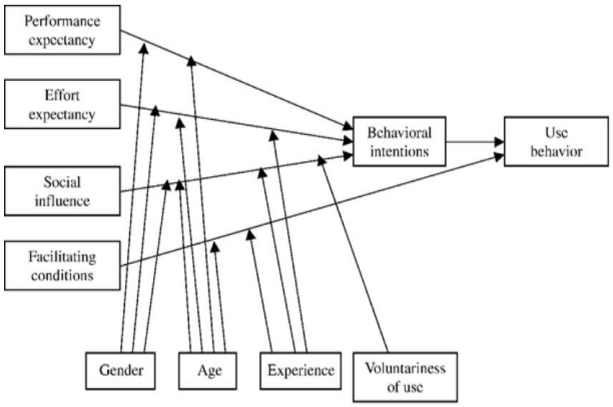

Fig. 5. Unified Theory of Acceptance and Use of Technology [9]

The UTAUT model when applied in E-learning environment, analyses the effects of age and gender on the E-learning tools, unlike its predecessor models.

The effects of UTAUT on the adoption of different E-learning tools can be envisaged on both theoretical and practical orientations such that the outcome benefits both students and academicians. Thereby exact E-learning tool can be brought into usage according the age and gender of the students. It also indirectly benefits the instructors and administrators by widening the usage of the most apt E-learning tool according to the requirement of the student community. The knowledge also helps the administrators in making better investments in technologies to reach a wide range of global clients through blended learning techniques.

F. Model 6: Revised Unified Theory of Acceptance and Use of Technology

The revised UTAUT model [9] has been proposed after critically examining the original UTAUT method as shown in Fig.6. The revised UTAUT model has been formalized as an alternative model in accepting the use of information system and information technology in education. When compared to UTAUT method [8], the revised UTAUT model emphasis on two more parameters namely the social influence (culture) and facilitating condition (location) of the user.

Since the cultural and locality parameters are considered, the revised UTAUT model provides the prevailing situations in a particular city or country regarding the popularity or failure of a particular E-learning tool. Hence the administrators and instructors may use required solutions which will benefit the student community. The revised UTAUT model examines each and every E-learning tool from both system perspective and individual perspective in determining the factors that affect user from accepting any new learning tools.

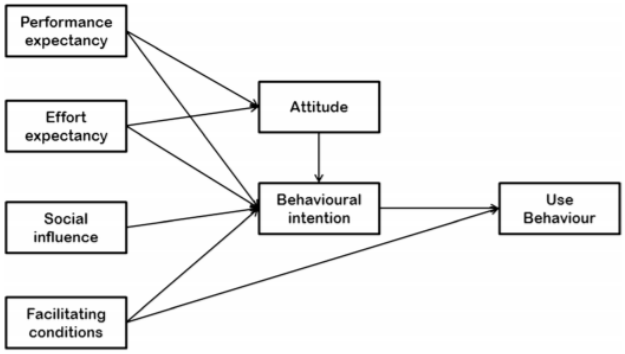

Fig. 6. Revised Unified Theory of Acceptance and Use of Technology [9]

VI. CONCLUSION

The present task is to clarify, albeit in brief form, different technology adoption models and concepts that have been used to affect the rates of adoption of various E-learning techniques in the educational institutes of developing countries like India. The research presented clearly shows the need for a thorough understanding of user attitudes and preferences towards the ICT acceptance in education field.

Future research on adoption may examine the consequences of technology to create a holistic understanding of how technology change influences the educational institution and the student. Whereas technology adoption may be viewed in terms of ramp-up time, or how much time is lost in the learning of technology, researchers should also be looking at how technology changes alter student's views of technology.

Each and every technology adoption model discussed in this paper shows how various E-learning techniques can be employed to improve educational system. This also aids in evaluating the impact of the models on behavioral intention of adopting E-learning technique in educational system.

The future research should not just focus on adoption and implementation of information technology in the formal education but how students understand, adopt, and learn technology outside the institution. Adoption models generally focus on the specific characteristics of the context, the individual, and the innovation to predict future use.

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