Technology Acceptance Model' Concepts, Contribution, Limitation, and Adoption in Education

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Abstract Numerous models have been provided by researchers in the past to determine and assess the success of Information Systems. Every model has been evaluated. Consequently, each model has pros and cons related to it. Here we are studying the Technology acceptance Models (TAM) and debating their features, contributions, and the limits of the earlier version of this theory. The TAM model, created by Davis (1989), is applied to determine the acceptance, adoption, and utilization of information technology. It is prevalent two constructs are used in TAM, perceived ease of use and perceived usefulness. The TAM model gained extensive popularity between the researchers, and it is among the most effective models. TAM is dissimilar to other models as it does not measure success. However, it is employed to investigate and predict the users' intention to use Information technology. Since technology acceptance in an academic environment is becoming well-known, what had resulted in hubs of learning describes as an online learning community. Therefore, this paper gives a review of the present state of research on the Technology Acceptance Model. It offers a concise entry point to the theory's background and its adoption in education, which might be purposely advantageous for novice readers. The knowing of these models allows us to know the factors that impact the adoption of IS in the education environment to take advantage of this tool.

Keywords Technology Acceptance Model, Education, E-learning

1. Introduction

With the massive development of innovation, individuals have a higher chance of utilizing novel technology in their everyday life and work. Indeed, researchers investigated and published a hypothetical model to clarify user's information technology acceptance and use, for example, the theory of reasoned action [1,2], the theory of planned behavior [3,4], as well as the technology acceptance model (TAM) [5,6], and customer adoption of information technology in the direction of a unified view model [7]. Among those speculations and models, "one of a broadly applied models of information technologies acceptance and employ is the TAM" [8]. TAM was applied to clarify the customer acceptance of innovation utilized in a diverse environment setting.

Review in the field of innovation adoption regularly provides a challenge concerning the shortage of comparable studies and consumers' innovation in experience [9]. With the rise in technological reliance in our lives and world economies connection, several researchers linked with the scholarly community and industry have been actively concerned with studying end-user adoption intentions of diverse technologies [10,11].

Regarding education, particularly for electronic learning, in addition to mobile learning, the TAM is enormously functional [12]. It was employed in a study that assessed the recognition of the e-learning platform by learners.

TAM being assessed incorporates firms [13]; the TAM was employed in research that inspected the attitudes of staff and their adoption of e-learning frameworks in the enterprises.

In the area of administration investigation, TAM has obtained comprehensive experiential support throughout practice, approvals, in addition to applications [14] by practitioners and scholars, proposing that TAM is robust over time, environments, communities, plus technologies. The TAM was utilized in research that examined perceived usefulness along with usage intention regarding impact [15]; this was to assess four longitudinal investigations in administration.

Awareness of the aspect that affects an individual's intent to utilize a system before the design of the system is essential to make the system broadly used and received by potential users. In the field of IS, acceptance research is often conducted to figure out consumer intentions, which help in increasing system utilization. Thus, acceptance studies the area of education is also compulsory.

The aim of the study

The point of this study is to explore the technology acceptance model studies in the education area mainly. With this investigation, the aim is to bring forth the existing technology acceptance research pattern in the education area, detect the limitations, and propose an upcoming research path.

This study deals with a vital concern in the TAM. Based on the different versions of this theory, this study tried to analyze researches on technology acceptance in the field of education, in particular online learning.

2. Technology Acceptance Model

Following [16], the TAM is a model that emulates how the customer comes to accept and utilize an innovation. The TAM is further created for indicating end-user

recognition of IS [5]. The conceptual basis for TAM is founded on the theory of reasoned action (TRA) [2]. It was created by [5]. TAM substitutes several of TRA's attitude variables with the two technology acceptance factors—perceived ease of use along with perceived usefulness. TAM concentrates on the approach explanations of intention to apply a particular service or technology. The TAM model has been expanded and customized. Numerous current studies have involved TAM when studying the adoption of online technologies [17].

2.1. TAM 1

The TAM was initially established by [18] and further created by Davis et al. [6] to create a model for computer technology acceptance. Surendran [19] verifies that the TAM is one of the concepts that has been base on (TRA) and has been applied to clarify an individual's acceptable behavior. Concurring to [20], TAM substitutes some of TRA's attitude factors with two variables of technology acceptance (perceived ease of use as well as perceived usefulness). It recommends that perceived ease of use as well as perceived usefulness includes an individual's intention to utilize a framework with "intention to use" working as a mediator of framework utilization [21].

Mainly, the TAM is consists of different variables (see Table 1): attitude towards behavior, behavioral intention, actual system use, perceived usefulness as well as perceived ease of use. Figure 1 demonstrates that the actual system usage is instantly affected by behavioral intention, which is impacted by an equal attitude towards behavior and perceived usefulness. Attitude towards behavior is straightly impacted by perceived ease of use in addition to perceived usefulness. The TAM principally relies on two factors, perceived usefulness in addition to perceived ease of use, to inspect persons' beliefs in addition to attitude toward computer technology approval [5]. Perceived Usefulness directly impact by perceived ease of use; also, external factors have an impact on perceived ease of use in addition to Perceived Usefulness.

Table 1. The Constructs of the TAM

Constructs	Literature support	Definition
Behavioral Intention	[22 , 23, 24,25]	An individual intends to act in a manner without guarantees to do so [2].
Attitude Towards Behaviour	[26, 27 , 28 , 29]	The extent to which a person thinks that acting the behavior is negative or positive [7].
Perceived Usefulness	[5 , 30 , 31, 32]	The extent to which an individual accepts that employing a certain application framework will raise his or her work performance inside an organization environment [5].
Perceived Ease of Use	[30, 7, 3, 5]	Measures the level to which a person assumes that employing a system is effortless [6].

Figure 1. TAM1 Source [5]**Table 2.** The Constructs of Perceived Usefulness in the TAM2

Constructs	Literature support	Definition
Subjective Norm	[3 , 29 , 34 , 35]	The extent to which a person feels that individuals suppose he or she has to carry out the behavior [33].
Image	[15,35, 36,37]	can be characterized as the degree to which one's status is viewed to be improved by the employ of innovation in one's status of social systems [35]
Job Relevance	[15,38,39,40]	The level to which the innovation is correlated to the job of someone [15].
Results Demonstrability	[8,35, 40,42]	is distinct as visibility of results [15].
Output Quality	[40,41,42,43]	Distinct as "what extent the novel technology executes work made by the user" [15].

Figure 2. TAM 2 Source [15]

2.2. TAM 2

Venkatesh and Davis [15] expanded TAM to clarify the determining factors of perceived usefulness. The expanded demonstrate, known as the TAM2 (as illustrated in Figure 2), contains social influence processing variables (subjective norms, image, as well as voluntariness), cognitive instrumental processing variables (perceived ease of use, result demonstrability, output quality, job relevance). Table 2 shows the constructs of perceived usefulness in the TAM2

Venkatesh and Davis [15] performed longitudinal research to explore the suggested model on 156 employees in four companies who utilize four systems, where the use of two frameworks was optional, and the use of the other two frameworks was compulsory. The consequences confirmed the accomplishment of the suggested model is either chosen or compulsory use, where subjective norms do not affect voluntary environments. Moreover, the results of subjective norms on perceived usefulness, along with behavioral intention, tend to be reduced when the experience is expanded.

Table 3. The Constructs of Perceived Ease of Use in the TAM3

Constructs	Literature support	Definition
Computer Anxiety	[8,26,45,46]	The concern of utilizes the computer or concern of the potential of utilizing a computer [47].
Perceived enjoyment	[48, 49,50,51]	Define as the level to which "the activity of applying a particular framework considered to be interesting in its own right, regardless of the consequences" [44].
Computer self-efficacy	[26 ,45,53; 54]	Describe as the level to which persons believe they can achieve a particular work utilizing the computer [52].
Computer playfulness	[55,56,57,58]	The fundamental inspiration to cooperate with the new framework [8].
Objective Usability	[5,44 ,59,60]	The technology-based comparison regarding the actual, instead of user perception, effort that is compulsory to achieve specific tasks [44].
Perception of external control	[44,60,61,62]	The level to which a person supposes that organizational assets are obtainable to ease the system use [7].

Figure 3. TAM 3 Source[8]

2.3. TAM3

The foremost later modification, the TAM generated an innovative model, described as the TAM3. The main participants of the TAM3 are addressing the key factors of perceived usefulness in addition to perceived ease of use [8]; as a result, the TAM3 was born from the integration of the TAM2 [15] with the paradigm of perceived ease of use determinants [44]. Figure (3) shows the constructs of the TAM3.

Venkatesh and Davis [15] assumed that perceived usefulness impacted by job relevance, output quality, image, perceived ease of use, results demonstrability, along

with subjective norms. Output quality, experience, in addition to voluntariness, are categorized as moderators.

On the other side of the model, [8] assumed that perceived ease of use is impacted by what they call anchors and adjustments. Table (3) contains the declarations of the factors of perceived ease of use. These constructs were called 'anchors' for the reason that when the facts about the system's ease of use are deficient, persons tend to depend on general information (anchor) to perceive the system's ease of use. Venkatesh [44] theorized that the anchors, associated with computers and their use, drive people's preliminary opinion about the system's ease of use.

The four anchors that influence perceived ease of use are

computer playfulness, perceptions of external control, computer self-efficacy, and computer anxiety [8, 44]. The effect of computer playfulness along with computer anxiety on perceived ease of use is often reduced when an experience is increased; in contrast, the consequence of perceptions of external control and computer self-efficacy on perceived ease of use is often enhanced when an experience is increased [8,44]. However, the individual's attitude will be adjusted after gaining experience with the system, although still depends upon the primary anchors. Additionally, Venkatesh [44] theorized that the consequence of the adjustments, objective usability, and perceived enjoyment on perceived ease of use would be more significant when more experience has been achieved.

3. Technology Acceptance Model' Concepts, Contribution, and Limitation

TAM has been extensively criticized, even with its numerous utilizes. Critical comments of TAM as a "hypothesis" contain incomplete descriptive and analytical power and lack of practical value [63]. Separate tries by many scientists to develop TAM to adjust it to the energetic IT contexts have led to a "state of hypothetical confusion and uncertainty" [64]. Table (4) shows Technology acceptance Models and discussing their features, contributions, and the limits of each version of this theory.

Table 4. How TAMs concepts, contribution, and limitation

TAM	Developed by	Concept	Contribution	Limitation
TAM1	Davis et al. [5]	TAM utilizes the theory of reasoned action as a conceptual basis to link actual system usage behavior, perceived ease of use, users' intentions, attitudes, as well as perceived Usefulness. TAM hypothesized that perceived ease of use plus perceived usefulness act as a mediator for the impact of external factors.	Initial theory devoted to IS, due to its great number of quotations, its permanence [67], or due to it was the earliest technology acceptance model considering wide-ranging of experimental support [68].	1) inadequacy emphasis of external factors: comprising variables as an example prior experience, facilitating conditions, or perceived enjoyment. 2) poor variance in investigative studies[65,66]
TAM2	(Venkatesh and Davis, [15]	The social influence processes with the cognitive instrumental procedures are incorporated into this model. The Couple procedures were measured to be critical to examine user adoption	The developer search for the factors of perceived usefulness, initial, to enhance design the institutional involvement made upon acceptance of the user and then to anticipation the utilize of innovations when they are provided in a professional situation". This model comprises more factors and particularly the factors that impact the perceived usefulness.	The TAM 2 may be criticized as being a non-complete model because it does not determine the factors that impact the perceived ease of use.
TAM3	Venkatesh et al. [8]	The developer proposes that experience as a mediator to the relationships among perceived ease of use with behavioral intention usefulness, computer anxiety with perceived ease of use, as well as perceived ease of use with perceived. TAM3 (Venkatesh and Bala, [8] are derived from a theoretical framework composed of four groups. Each of the four groups: individual difference, system distinctiveness, societal influence, as well as facilitating conditions, made up of their factors based on the two critical elements of perceived usefulness as well as perceived ease of use [70].	TAM3 offered a full nomological network of the factors of users' Information Technology System acceptance [8] TAM3 has made considerable hypothetical, contributed by identifying the factors of perceived usefulness in addition to perceived ease of use (Fig 3). It has included elements of context, content, process, and individual differences [8]	In accordance with the research consequences of [69], the complex models do not inevitably have better clarification ability. Therefore, since the TAM3 provides an extremely long and complicated model, it represents a constraint that could prevent its employ.

4. Literature Review

Technology Acceptance and Adoption in Education

The fast growth of information technologies has been recognized as brought a large revolutionize in education organizations. Web-based e-learning (electronic learning) as a substitute education form has developed an advanced learning context and granted learners with an excellent chance to cooperate with others. With e-learning systems, internet distribution of instruction and computer-based resources of knowledge can be achieved without the restriction of space and time. Sánchez and Hueros [71] designated that e-learning contexts assisted educational systems to cross spatial and sequential difficulties, fostered significant learning, and offer convenience in addition to flexibility. Yoon and Kim [72] recommended that perceived convenience would be measured as a vital factor of the users' recognition as well as utilize of information technology.

Recently, With the expansion of information communication technology, a variety of manuscripts have been issued on the environment of application of TAM in the academic community, E.g., :[72,74,75,76,77]. numerous investigation have utilized TAM to inspect learners' motivation to adopt e-learning platforms E.g.: [78, 79, 80 ,81; 82; 83, 84] , or to expect learners' intentions to apply web-based learning society [85].The consequences of these studies indicated that TAM could professionally predict and clarify users' adoption of information technology.

The intention of a user towards employing an e-learning technology was essentially explained by applies or expanding the TAM investigated model with other related constructs. While, for instance, [86] have experienced the application of the original TAM in the educational field, [87] and [88] have utilized the extended TAM model.

Diverse acceptance researches in the field have been examining TAM's suitability for various learning technologies, similar to mobile learning [89], Personal Learning Environments (PLEs) [90], Learning Management Systems (LMSs) in general [91] in addition to open-source LMS Moodle [71] and commercial LMS Blackboard [92] in particular.

Dasgupta, Granger, and McGarry [93] evaluated the adoption of courseware management technology as an e-collaboration tool by bachelor's learners. They concluded that the year of a user in school was an essential factor in the utilization. Moreover, Selim[94] examined TAM through web-based learning. He suggested the course website acceptance model (CWAM) and examined the associations between perceived ease of use, perceived usefulness, plus intention to use between learners of the university. The outcome of the study stated that the model accommodates the collected data.

Furthermore, [94] stated that the ease of use and usefulness are essential variables of the recognition and utilization of the course website. With the incorporation of the motivational hypothesis with TAM, [95]examined students of university acceptance behavior towards an Internet-based learning medium (ILM) presenting TAM. [94] incorporated perceived enjoyment as a primary aspect besides perceived ease of use in addition to perceived usefulness. The outcome pointed out that perceived usefulness, in addition to perceived enjoyment, influenced equally learners' intention to use as well as an attitude toward ILM. Yet, perceived ease of use was concluded to be not linked to attitude.

Van Raaij and Schepers [84] investigated the adoption and utilization of the online learning context in China. The outcome pointed out that perceived usefulness has a direct consequence on the employ of virtual learning environments (VLE). Subjective norms, as well as perceived ease of use, had an indirect impact on perceived usefulness. Also, it confirmed that perceived ease of use had been directly impacted by new factors associated with personal characteristics such as sensations of concern about utilizing the computer. [96] investigated the level to which TAM was capable to clarify faculty adoption of web-based education sufficiently. Outcome specify that perceived usefulness is a good indicator of school adoption; but, perceived ease of use provides slight supplementary predictive power beyond that participated by perceived usefulness of web-based learning technology.

Table 5 presents the latest studies that adopt TAM in the education field for different platforms in different countries besides the sample size and conclusion for each study.

Table 5. Latest studies that show TAM adoption in education

Num	Year	Platform	User Type	Sample Size	Country	study
[97]	2012	E-Learning system (Moodle platform)	students	162	Spain	utilize TAM for illumination or predicting students of university' adoption of the Moodle platform
[98]	2009	statistical software	student	207	United States	conducted an experimental study to analyze the acceptance of statistical soft-ware between internet-based MBA students
[99]	2016	Blended e-learning	student	396	Vietnam	the aspire of this research is to inspect the learner's attitude in the environment of e-learning; three factors in the TAM were chosen for the hypothetical model: Attitude, Perceived Ease of Use, in addition to perceived usefulness."
[100]	2015	E-Learning system	Students & teachers	156	Australia	State that utilizes of E-Learning system in the education area is serving as new forms to offer learning content to everyone without the constraint of time and place. accurate utilization of Information Technology items can improve users' adoption for successful E-Learning
[101]	2010	E-learning system (Wikis)	students	126	United States	The study noted that wiki use intention, perceived usefulness, perceived ease of use, in addition to wiki self-efficacy have a direct plus considerable indirect impact on wiki utilization in the classroom.
[102]	2007	E-Learning system (Web Course Tools-WebCT)	Students	1,263	Hong Kong	examined the variables that impact WebCT utilization in higher educational institutions in applying the TAM model
[103]	2011	E-learning system (e-government learning)	students	307	Taiwan	carried out that perceived enjoyment has a positive impact on perceived ease of use for adopting recognition of government information system
[91]	2014	Learning management systems	Faculty members	59	Saudi Arabia	encourages that TAM has been assumed and experienced as a positive framework in the field of information science and Learning Management Systems
[104]	2018	Moodle environment	students	89	Hungary	The study was to inspect the influential factors of students' video utilization and their learning fulfillment relating to the corresponding application of educational videos, available in a Moodle context in a Business Mathematics Course.
[105]	2019	E-learning technology/tools (Social Networking)	teachers and administrative employees	523	Iran	This research deal with examining the adoption of social networks by those concerned about the educational system of Ahwaz
[106]	2020	E-learning technology/tools (Mobile)	students	71	China	This study tries to conclude the recognition of Rain Classroom based on constructs of UTAUT and to recognize the efficiency of Rain Classroom based on learning results in linguistics courses.
[107]	2008	E-learning technology/tool. (E-collaboration)	students	225	Spain	This paper has two primary goals. The first one is to analyze the utilize of e-collaboration technologies between management students experimentally. The second goal is to analyze the factors that efficiently influence that utilization.

5. Conclusions

Last few years, institutes of higher education investment in incorporate web-based innovations in the classes within

the context of the learning when compared with studies on another information technology users' behavior towards this type of system, nevertheless, have not been evaluated and understood comprehensively. (TAM) in general,

regarded as a remarkable hypothesis as a consequence of the escalating volume of related researches over the last few years. This theory has applied to diverse sectors, different conditions, or fundamental determinants. TAM plays a considerable role in the information systems field, as Davis developed this hypothesis in (1989). The purpose of this study was to present the progress of TAM and show the restrictions of the prior version of this theory, furthermore, to study the technology acceptance and adoption in education to have more knowledge about individual behaviors in the multimedia learning context. A detailed consideration of technology acceptance research in the education area published in quality journals was offered. From the study of these studies, many vital patterns in the current research were found. It was found that the more significant part of the acceptance studies in the education area has been on e-learning.

As described, acceptance previously varied based on types of users; as a result, acceptance research on user type lecturers or teachers is essential, and future studies necessitate to be done. This comprehensive review of adopting TAM in education can be beneficial to future researchers as they can quickly recognize the variables, causal relationships, user types studied, and the education area in which technology acceptance has been considered. The information gathered in this study can be used for future technology acceptance studies in the education domain.

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