Review of the Major Adoption, Diffusion, and Acceptance Models of Mobile Learning (m-Learning) in Education

إعـــداد

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Abstract:

The paper presents a brief review of the key models employed in understanding the adoption and diffusion of technological innovations. It also highlighted the various factors, strengths and weaknesses of the models were presented with emphasis on current definitions, prospects and challenges of m-learning and mobile device usage for teaching and learning. The findings indicated that m-learning is an innovative technology with the potential to transform teaching and learning through timely and convenient acquisition and dissemination of educational resources. However, m-learning is plagued by social, cultural and economic challenges arising from the high cost of mobile devices, infrastructure, and human behavioural tendencies. Furthermore, the myriad definitions and broad scope of m-learning have resulted in ambiguity and lack of comprehensive understanding of the concept. Therefore, several frameworks, theories and models have been proposed to promote a better understanding of the intrinsic dynamics that influence m-learning. The most notable theories and models are; TRA (theory of reasoned action), TAM (technology acceptance model), TPB (theory of planned behaviour), and UTAUT (unified theory of acceptance and use of technology. The study finds that the UTAUT model provides a solid theoretical basis to understand m-learning and its potential to transform teaching and learning. However, further studies are required to understand the human behavioural, socioeconomic and cultural factors that currently hinder the adoption and diffusion of m-learning using UTAUT and other models in the literature.

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1.0 Introduction

Since its inception in early 2000, the concept of mobile learning or m-learning has evolved significantly. Over the years, the concept has gained significant interest among academics, policymakers, and end users. As a result, various definitions have been proposed to effectively understand, develop, and integrate the concept into modern day learning processes in educational settings. In view of this, many academics have attempted to define and understand the concept based on the nature, applications, mobility and users of the technology. The earliest definitions of m-learning based on the technology described the concept as an educational provision primarily characterised by handheld or palmtop devices [1]. Other definitions describe m-learning as a concept that integrates the benefits of mobile devices and information technology to acquire, distribute and assimilate educational materials [2].

The applications of m-learning have also influenced the nature of the concept, thereby resulting in various definitions [4 ,3]. Most notably, m-learning is defined as the act of receiving educational materials and instructions through the use of mobile devices [6 ,5]. As a result, Sharples and Spikol [7], opine that the use of mobile devices and associated technologies are critical to the concept of m-learning. Typically, the concept requires the adoption of mobile devices or handheld information telecommunication

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technologies such as mobile telephones, laptops, PDAs, and tablet PCs for the delivery of teaching and learning materials [8]. Over the years, the accessibility and availability of these devices and the internet have enhanced the prospects of m-learning as a medium for the delivery of educational materials around the globe. Other studies have attempted to describe m-learning from the perspective of mobility. Therefore, the study by El-Hussein and Cronje [9], defined m-learning as any form of educational dissemination that occurs anywhere and anytime through the use of wide-ranging innovative technologies such as mobile devices. Furthermore, the study emphasized the importance of mobile technologies, learners and learning to the concept of m-learning. However, given the broad scope of the outlined definitions of m-learning, the concept is often described as undergoing sociological metamorphosis. Furthermore, the study by Rossing et al., [10] posits that the numerous definitions of m-learning have resulted in ambiguity and lack of comprehensive understanding of the concept. As a result, numerous researchers have proposed various frameworks and theories to promote a better understanding of the concept of m-learning [12 ,11]. Other studies have proposed various models to understand the adoption, diffusion, acceptance of m-learning along with the use of mobile devices and associated technologies in the teaching and learning in education. Selected examples of these models include; diffusion of innovation (DOI) [13], theory of reasoned action (TRA) [14], theory of planned behaviour (TPB) [15], technology acceptance model (TAM) [16] and unified theory of acceptance and use of technology (UTAUT) [17].

The adoption and implementation of new technologies

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in education were examined by Mumtaz [18]. The findings revealed that the process is multifaceted in nature and typically characterised by numerous factors that influence the adoption rate of teachers and students alike. Furthermore, the study revealed that the successful implementation of information and communications technologies (ICT) in education is based on the "interlocking frameworks of change" which include; the teacher, the school and policymakers. The study concludes by stating that the beliefs of the teacher are critical to the acceptance of ICT in education [18]. Likewise, Dillon and Morris [19], opine that the rate of ICT acceptance by users is characterised by their disposition towards adopting and implementing such technologies for the precise tasks designed to support it. Therefore, based on the context of m-learning, the willingness of educators and students to adopt mobile devices to support the teaching and learning, respectively, is called user acceptance.

Over the years, the newer theories and expanded models have been proposed for describing the adoption, diffusion, acceptance and the implementation of novel innovations such as m-learning in education. To be the best of the author's knowledge, there are limited studies in the literature that critical identify and highlight the models. Therefore, this study presents a concise review of the various factors, theories, and models that influence the adoption, diffusion, acceptance and use of mobile learning (m-learning) in education. It will also highlight the importance of m-learning, mobile devices and users to education.

2.0 Role of M-Learning and Mobile Devices in Education

In the past, the presence of teachers and students in brick and mortar classroom environments was a prerequisite for learning in any educational set up. However, the advent of m-learning in the early 2000s transformed the traditional notions of physical classroom education. As a result, the use of mobile technologies has revolutionised traditional teaching and learning through the timely utilization of low-cost facilities, tools and resources. This has also enhanced accessibility, saved time and lowered commuting costs for teachers and students. In addition, m-learning has enabled students, and teachers to keep in contact through wireless access thereby eradicating the traditional physical boundaries that hitherto constrained access to knowledge or required relocation to areas or countries with internet-enabled devices. The elimination of geographical boundaries enhances social interaction among teachers and students and between fellow students. Furthermore, the concept of m-learning has helped to stimulate effective collaboration among students to achieve both personal and group tasks in diverse learning and training environments. M-learning also avails teachers with simpler, quicker, and increased access to teaching and learning compared to traditional modes of study. This innovative approach has also enhanced the turnaround time and quality of feedback from teachers regarding learner's school work. Furthermore, m-learning has helped to promote free expression and exchange of ideas between students and teachers through enhanced virtual interaction methods. Lastly, recent developments in teaching and learning through mobile

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technologies have also enabled students to effectively adapt and install multimedia services or applications that grant timely and unhindered access to various learning resources accessible on mobile devices [20].

As outlined, the use of mobile devices is critical to m-learning. The tools and resources for m-learning are typically accessible using mobile devices. Over the years, the proliferation of cheap mobile devices with access to the internet has encouraged people to use and adapt to learning contexts. As a result, numerous researchers have examined the use of specific mobile devices and its effects on the delivery of learning materials to students. For example, Sharples et al., [21], tested a prototype model of the HandLeR which is considered a predated smartphone or mobile device on British students. In principle, many analysts opine that the introduction of smartphones and tablet PCs transformed the concept of m-learning. As such, people began purchasing mobile devices other uses such as including learning. Currently, two companies namely Apple and Google dominate the mobile devices and equipment market which operate on iOS and Android software, respectively [23 ,22]. Over the years, Apple has consistently introduced mobile devices and products such as the iPhone, iPad, and iPod. These devices are currently used widely for accessing, consuming and disseminating information and learning materials displayed as videos, PDF files, and audio files (podcasts). This is made possible by easy to use, intuitive, and widely available resources, programs or applications. As a result, students and teachers conveniently share materials, lecture notes, and other learning resources through audio, video or interactive games. On the other hand, the Android software from Google

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is an open source operating system (OS) for smartphones [24]. It is widely used by Samsung, Motorola, LG, Oppo and HTC and other mobile phone manufacturers to power smartphones. The free availability of Android on many platforms and hardware is based on Google's mission to dominate the global smartphone market. However, this has also presented several unforeseen challenges due to the variety of smartphones which come in different screen sizes, shapes, quality, and ease of use depending on the manufacturer. The variability in features exacerbates the difficulty for developers to design only one version of their app (Richard, 2010). Despite these challenges, mobile devices have continued to influence the adoption, diffusion and acceptance of m-learning around the globe.

3.0 Adoption of M-Learning

The concept of m-learning has gained significant interest as a subject of interest since its establishment in the early 2000s. As a result, the quest to examine the adoption and implementation of m-learning has also gained academic traction particularly in innovation systems (IS) and technologies studies. Majority of these studies have been aimed at discerning the behavioural factors that influence the adoption and use of novel technologies in various aspects of human life. Therefore, numerous researchers have based their investigations on the concepts and theories of other renowned models and theories of technology adoption. These include the theory of reasoned action (TRA) [14], technology acceptance model (TAM) [16], the unified theory of acceptance and use of technology (UTAUT) [17], and lastly, the theory of

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planned behaviour (TPB) [15]. The detailed description of the models is presented in section 5 of this paper.

The study by Huang et al., [25], examined the value of perceived mobility as an external variable of perceived usefulness along with the perceived satisfaction derived from the motivational model using TAM. This approach was used to examine the adoption of m-learning at Taiwan universities based on student data. The results demonstrated that the perceptions of practicality and user-friendliness positively guide students' attitudes towards m-learning. Furthermore, the study observed that students' attitudes positively and significantly influenced their intentions to adopt m-learning. However, the study also observed that user acceptance and the perceptions of enjoyment and mobility are due to individual differences. As such, the model can be used to predict and assess how strong personal preferences can influence a users' intention to adopt m-learning. The study by Liu et al., [26] proposed a conceptual model based on TAM to identify and highlight the dynamics that stimulate the intention of users to adopt the concept of m-learning. The authors revealed that usefulness and personal innovation are important perceptions that significantly influence users' intentions to adopt m-learning. The study also revealed that perceived user-friendliness and perceived usefulness could be predicted from personal innovation. Similarly, Tan et al., [27] examined the factors that influence the intention of users' to adopt m-learning in Malaysia. The authors examined these dynamics by incorporating subjective norm and individual differences using an established conceptual model based on TAM. The results showed that the subjective norm along with the usefulness, and ease of use

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perceptions positively influenced the users' intention to adopt m-learning. However, gender factors did not significantly influence the intentions of users to adopt m-learning. Park et al., [28], examine the factors affecting the intentions of 288 students towards adopting m-learning in a Korean university using a theoretical model based on TAM. The model integrated the theories of self-efficacy, the relevance of students' major, system accessibility, and subjective norm of m-learning into TAM. The results showed that the most significant construct was the attitude of the students. Consequently, the results were used to analyse and explain the fundamental process and the relevance of the major and individual norm of the students on m-learning adoption. Therefore, the studies by Huang et al., [25], Liu et al., [26], Tan et al., [27], Park et al., [28], all proposed TAM based models to describe the adoption of m-learning. The findings demonstrated that the adoption of m-learning is significantly influenced by the users' attitudes and perceptions of usefulness which can differ significantly. However, the use of the technology and its influence on m-learning adoption was not comprehensively evaluated. As a result, the unified theory of acceptance and use of technology (UTAUT) was proposed.

Wang et al., [4], employed the UTAUT model to examine the determinants of m-learning adoption. The study incorporated the learning perceptions of playfulness and self-management into the UTAUT model by excluding the enabling conditions. The objective was to examine and highlight the influence of age, gender, or the combined influence factors on m-learning. The study concluded that effort expectancy, performance expectancy, perceived playfulness, social influence and self-

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management are significant elements of behavioural intention to adopt holistic and m-learning. Furthermore, the authors observed that disparities in age could moderate the influence of effort expectancy and social influence on users' intention to adopt m-learning. Similarly, the study observed that differences in gender could diminish the impact of social influence and self-management on the intention to adopt m-learning for learning. Furthermore, the study by Jairak et al., [29], investigated the adoption and acceptance of m-learning in the higher education system of Thailand. The findings demonstrated that the intention of students to adopt m-learning is restricted to social influence, performance expectancy and effort expectancy.

However, Cheon et al., [30] employed the theory of planned behaviour (TPB) to investigate the willingness of 177 American students to adopt m-learning in higher education. Furthermore, the study examined the current state of student's perceptions towards m-learning in higher education in the USA. The data analysis was performed using a disintegrated theoretical model and structural equation modelling (SEM). The findings showed that subjective norm, attitude, and perceptions of behavioural control positively influenced the intention of higher education students to adopt m-learning. Similarly, Fusilier and Durlabhji [31], examined the behavioural processes involved in the acceptance and adoption of internet technologies among 269 students in India using the TAM and TPD models. The study observed that the usage intentions of the students require promoting the usefulness, ease of use and other expectations of internet technologies. The study by Teo and Beng Lee [32], was focused employed the TPB model and SEM to examine the

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intention of 157 student teachers to adopt the technology. The findings showed that behavioural intention to adopt technology is influenced by the attitudes of the student teachers towards usage and subjective norms.

In conclusion, the authors observed the three descriptive variables in TPB accounted for %40 of the differences in the respondent's behavioural intention to adopt the technology. In a separate study, Tagoe and Abakah [33], examined the readiness of distance education students› to adopt m-learning in Ghana. The study was performed at the University of Ghana using the Theory of Planned Behaviour (TPB). The findings revealed that use of mobile devices could transform the teaching and learning at higher institutions in Ghana. Furthermore, the study revealed that although the students owned mobile devices, the majority utilized the devices for texting. However, the factor analyses revealed that attitude, subjective norm and behavioural control influenced the intention of students› to adopt m-learning.

4.0 Diffusion of M-learning

The search for innovative uses of mobile devices catalysed the birth of m-learning and its application in education. As a result, wireless communication and mobile technologies have been applied to teaching, learning and sharing educational resources around the globe. Furthermore, m-learning has ensured that people around the world now have timely, convenient, and low-cost access to education. The wide reach of m-learning and associated technologies has been largely attributed to various factors including the theories of technology diffusion.

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One of the most notable theories of technology diffusion was developed by Rogers [13]. The theory aptly termed the "Rogers› Diffusion of Innovation Theory" (DIT) was first proposed in 1962 to describe the likelihood of people to adopt technologies. The DIT also classifies organisations according to their level of adoption of novel technologies [34]. Furthermore, the theory defines four main elements of the diffusion of innovation namely; innovation, communication channels, time and social system [13]. In the context of m-learning, the concept can be described as an innovation that requires diffusion through a communication channel that delivers it to users. According to the DIT, people are not only required to complete the innovation cycle but also become acquainted, and adapt to the novel technology. As a result, the theory proposes that there are five attributes termed the "characteristics of innovations" that influence an individual's decision to adopt or reject an innovative technology. These include; relative advantage, compatibility, complexity, trialability, and observability. Furthermore, the DIT categorised people into five groups namely; innovators, early adopters, early majority, late majority, and laggards [34 ,13]. Furthermore, the DIT states that the willingness of people to embrace and adapt to innovation depends on the social systems or populations they belong to. As a result, the tenet of social influence is considered an important aspect of the diffusion of innovations as it related to m-learning. It stands to reason then that the ability and willingness of people to adopt and adapt to m-learning is influenced by social networks, which typically include friends or colleagues [35]. This existence of a social circle helps us to eliminate any prevailing uncertainties people harbour about engaging with m-learning

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[36]. The suggestion that social influence an individual's attitudes toward mobile innovations depend on the inspiration gained through innovativeness and enthusiasm for novel technologies [37]. According to Mao et al., [38], the willingness to adopt technological innovations can increase perceptions of the value of m-learning. The rate of m-learning adoption is also predicted by people's moods about an innovation [39]. The accomplishment of m-learning can be contingent on the willingness of users to test run an innovation different from convention [42-40 ,11].

Earlier studies have recommended that the intention of an individual to adopt novel technologies like m-learning is reliant on the impact of social factors [44 ,43]. The significance of these social influences on the educational experience and willingness to adapt to M-learning must be communicated to the students and teachers [45 ,17]. This is because early adopters exhibit more advanced levels of individual innovation in IT compared to others who may be the initial targets of m-learning teachers [37]. As the customers using m-learning attains a climax, the proportion of later adopters will soar geometrically [13].

5.0 Acceptance of M-Learning

The process of evaluating the diffusion of innovation requires considering the procedure for user acceptance proposed by Dillon [46]. The author stated that the features outlined by Rogers [13] are insufficient to inaccurately provide a comprehensive basis for user acceptance of technological innovations. This is based on the premise that the Rogers [13] model focuses on the long-term diffusion of innovation. However, Dillon [46] opined

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that the different stages of diffusion are futile in explaining the acceptance of technology by individuals [47]. As a result, several models have been proposed and developed to address this gap in knowledge [50-48 ,17 ,14]. The outlined models were adopted by various researchers to identify, highlight and explain the acceptance of various innovative technologies [17]. Therefore, the four most quoted models employed for forecasting the adoption and acceptance of technology are the; theory of reasoned action (TRA), the theory of planned behaviour (TPB), technology acceptance model (TAM) [47]. However, recently the new model termed the unified theory of acceptance and use of technology (UTAUT) has become widely applied for predicting technology adoption and acceptance. The UTAUT integrates various adoption models into one to predict the adoption of various technologies such as m-learning [17]. The detailed descriptions of the four models are outlined in the subsequent sections of this paper.

5.1 Theory of Reasoned Action (TRA)

The TRA was developed by social psychologists to predict the behaviour of an individual or group of individuals Ajzen and Fishbein [14], Fishbein and Ajzen [51]. As a result, the theory can be applied to a broad spectrum of human behaviours. In the context of technology adoption, the TRA model has been applied to examine how users perceive a positive benefit (outcome) associated with the adoption of information technology [52]. Based on the model, an individual's intention or behavioural intention to adopt technology is examined based on their actual behaviour [53]. The premise of TRA is that personalities

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make decisions and take actions in accordance with coherent and logical thoughts [14]. Hence, the TRA model states that behavioural intention is determined by two elements, which include an individual's attitude and subjective norms as depicted in Figure 1. The attitude comprises an individual's positive or negative feelings about performing a pattern of behaviour [17]. This is typically considered the belief or objective behaviour of the individual under evaluation. However, the second element of the TRA model, termed subjective norms, typically signifies social influence [53]. Therefore, social influence is the normative belief of how an individual's behaviour is perceived by others. If others who are perceived as significant to the individual feel that the behaviour is important, then the individual is likely to feel the same way.

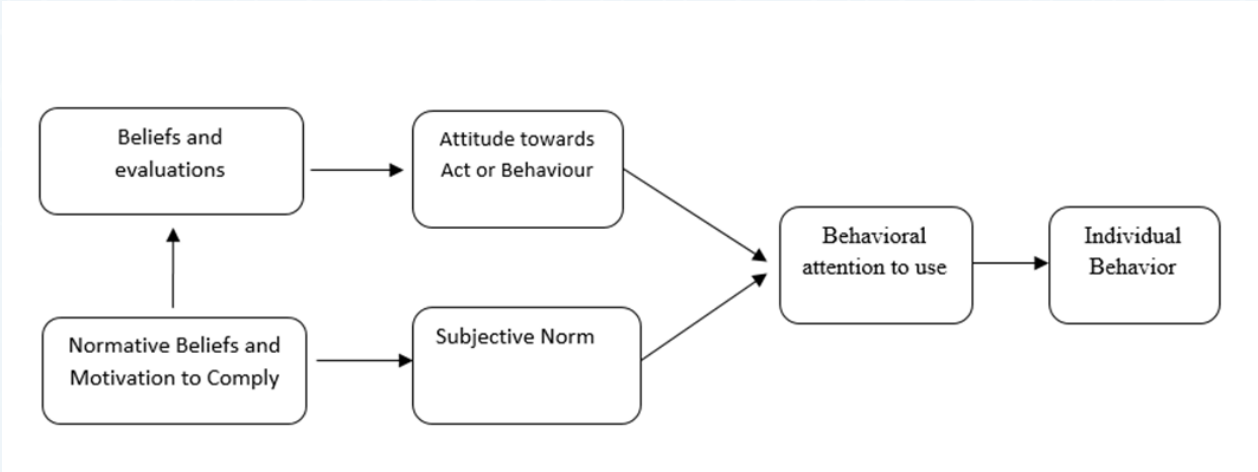

Figure 1: Theory of Reasoned Action Model [51].

The TRA model has been widely developed to explain individual behavioural choices despite criticisms of the model [53]. The major criticism is its inability to anticipate social norms and other external barriers that influence behaviour [53]. According to Fishbein [54], the two elements of TRA (attitude and subjective norms) are prominently connected, which means constructs it

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measures are analogous. This view is also shared by Dutta-Bergman [55], who posits that adopting logical or reasoned behaviour as a basis for human behaviour is inappropriate.

5.2 Theory of Planned Behaviour (TPB)

Given the criticism of the TRA, Ajzen [15] proposed an alternative theory termed the theory of planned behaviour (TPB). The proposed model amalgamated the concept of perceived behavioural control with the two original factors (attitude and subjective norm) of the TRA model. The TPD model is depicted in Figure 2.

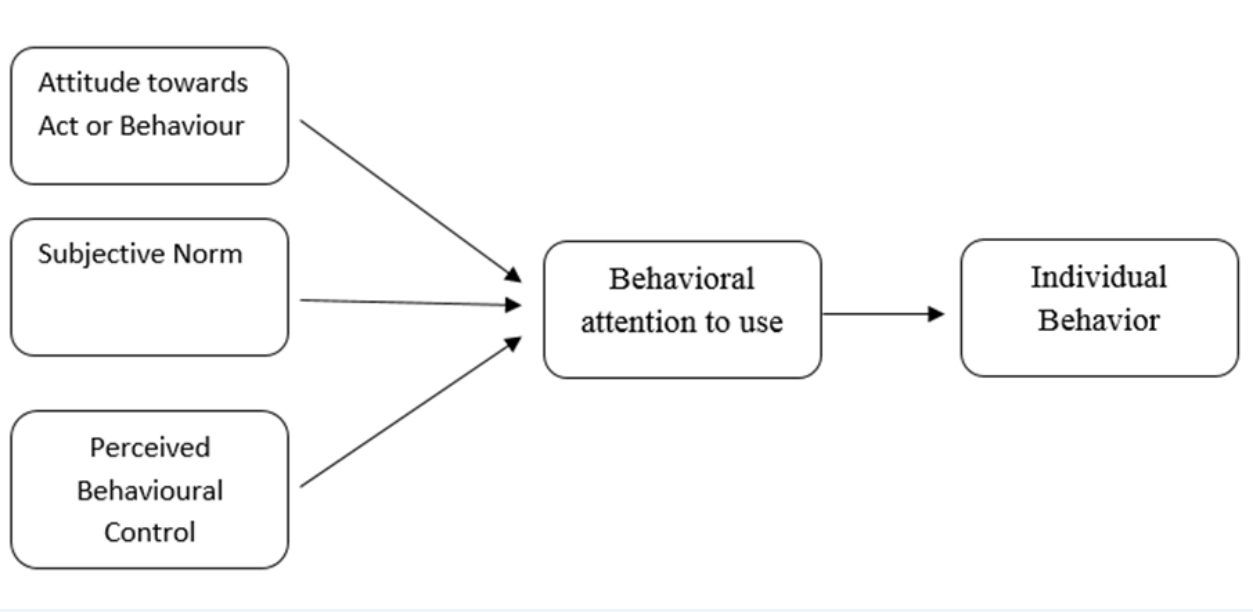

Figure 2: Theory of Planned Behaviour Model [15].

The concept of perceived control is based on the aptitude and resources an individual possesses for perception and assessment. In particular, it defines the feeling of controls the user exerts when using innovative technology. Lastly, it can be described as the belief, ability, or resources required by the user to use the technology [56]. Therefore, the model presupposes that the

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acceptance of innovative technologies by any user is reliant on their perception of control. Therefore, a positive attitude towards the use of any technology can occur if the user decides to adapt to the expectations of others [57]. However, the modifications of Ajzen [15], failed to address the criticism of Muilenburg [53]. Furthermore, the oversimplification of the model also fails to truly determine the adoption and the criticism of Fishbein [54] that the two factors originally proposed are very comparable.

5.3 Technology Acceptance Model (TAM)

The technology acceptance model, or TAM emphases that specific environment and the brand of innovation are crucial to the adoption of any technology [17 ,16]. The model was explicitly proposed to describe technology adoption in contrast to the TPB and TRA. As a result, TAM is centred on the perceived user-friendliness and practicality of the innovation according to the perception and future adoption of the end user. The perceived user-friendliness is described by Davis [16], as the difficulty or effort required to use any technology.

Likewise, Venkatesh and Davis [50] described user-friendliness as the confidence threshold or notion of an individual about yield or improved outcomes of using technology as opposed to ignoring it. The strong belief a technology will afford an advantage is integral to the ideals of TAM [50]. More so, the model states that the integral characteristics of innovation include simplicity, user-friendliness, and adaptability. According to the model, the tenet of simplicity is akin to Roger's complexity characteristic and fosters adaptability and adoption of an innovation. Lastly, lack of complexity serves to ensure that the adoption of the

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innovation does not negate its practicality [58].

Based on TAM the attitude of an individual is one of the drivers of technology adoption [59]. The faith that the technology is understandable and beneficial is largely due to the positive attitude of the user [60]. Therefore, an individual's intention to adopt or use technology can be enhanced by a positive attitude. The core elements of TAM include; perceived user-friendliness, perceived usefulness and the attitude. The relationship between the TAM variables is presented in Figure 3.

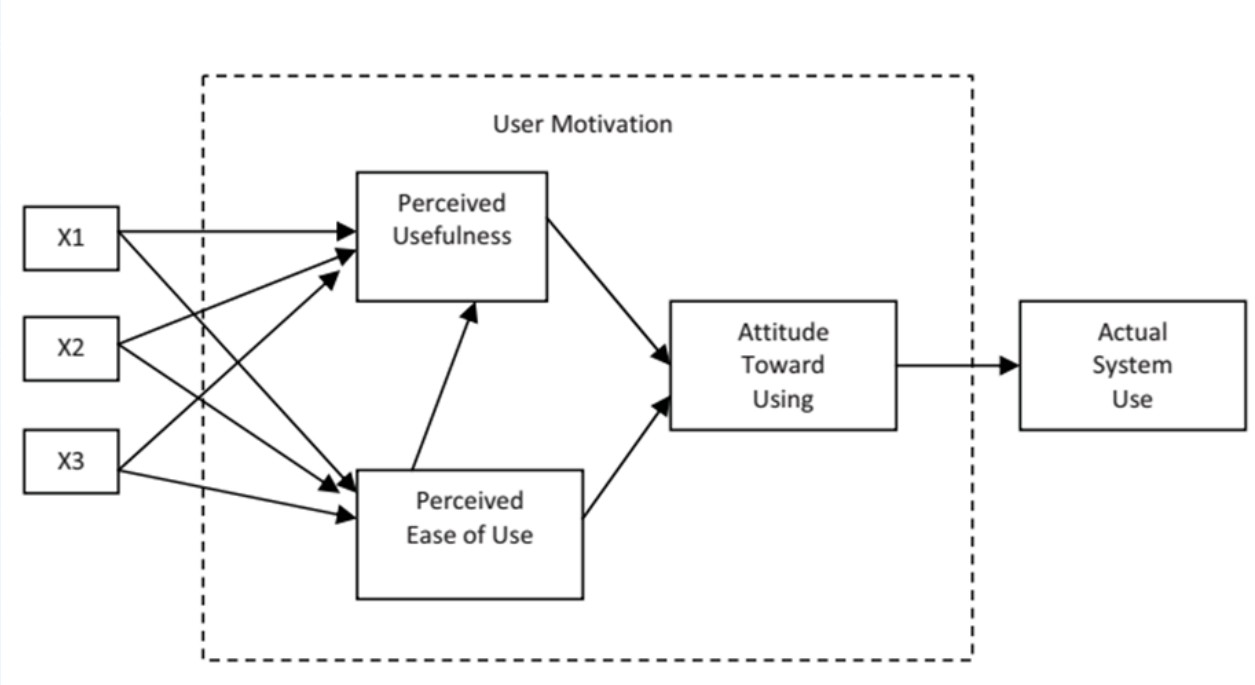

Figure 3: Original TAM proposed by Fred Davis (Davis, 1986).

Based on empirical evidence, TAM can describe %50 variance within acceptable limits when applied to technology acceptance models [61]. As a result, the model has been extensively adopted to examine the adoption rates of instructional technology by educators and students under educational settings [,44 ,17 50]. Furthermore, TAM has been revised to take account of supplementary antecedent variables that increase its subjective

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norms, experience, motivation and powers of prediction [17]. Although widely adopted by numerous academics, TAM still faces myriad criticisms for lack of consistency and convincing results [62]. The disapproval was addressed in the study by Liu and Ma [62] who showed a meta-analysis of TAM based on experimental studies. The inference from 26 empirical studies, the authors surmised that technology adoption could not be accurately described by TAM. Furthermore, the study revealed that perceived usefulness and behavioural intention are significantly connected along with perceived usefulness and user-friendliness. Nonetheless, the connection between perceived ease of use and behavioural intention suggested that the former operates through perceived usefulness. Therefore, Liu and Ma [62] proposed an improvement of the original TAM resulting in the first modified version of the TAM. The revised version proposes that perceived usefulness is moderated by the perceptions of ease of use as presented in Figure 4.

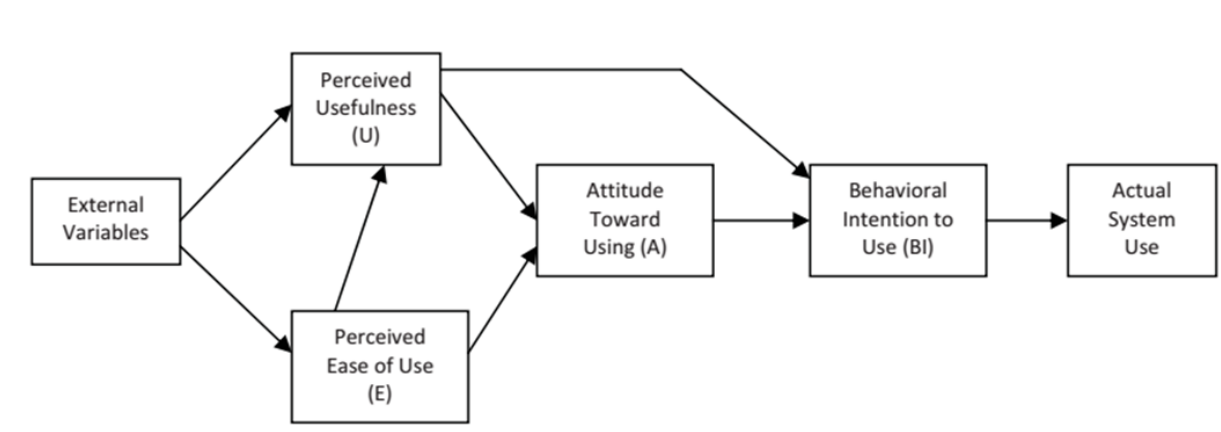

Figure 4: First modified version of TAM by Davis [16].

Despite the criticisms of TAM, the model has evolved over time resulting in various modifications by authors in literature. The most critical modification to the TAM model was introduced by

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Venkatesh and Davis [44], who proposed the TAM2 presented in Figure 5. The authors identified numerous limitations of TAM by justifying the basis in which an individual perceives the usefulness of innovative technology. Therefore, the study proposed extra variables as precursors to the perceived usefulness resulting in the new model termed TAM2.

Based on TAM2, the authors offered comprehensive reasons why a given system can be beneficial to users. The results further indicated that TAM2 was successfully executed in voluntary and mandatory environments. However, the exception was that voluntary settings were insusceptible to the subjective norm where the opposite effect was observed in mandatory sets. The second important addition to the original TAM was also proposed by Venkatesh and Davis [44]. The objective was to identify the variable precursors of perceived ease of use as presented in Figure 6.

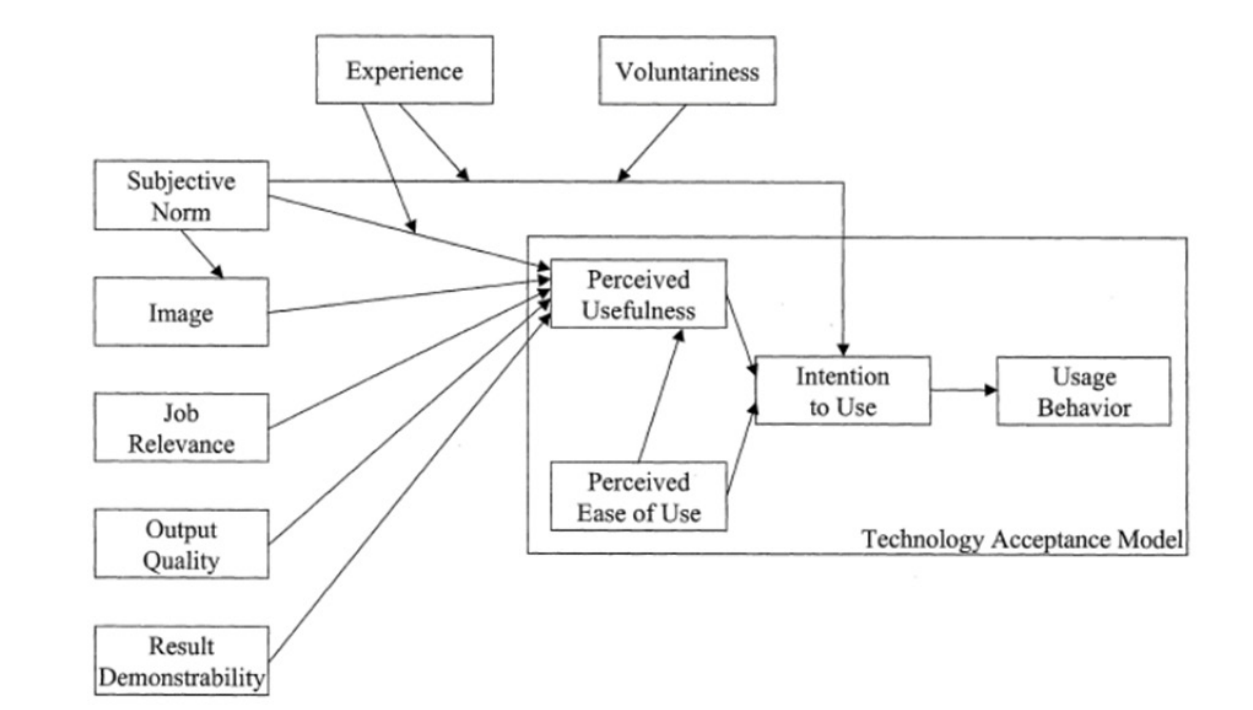

Figure 5: TAM2 by Venkatesh and Davis [44].

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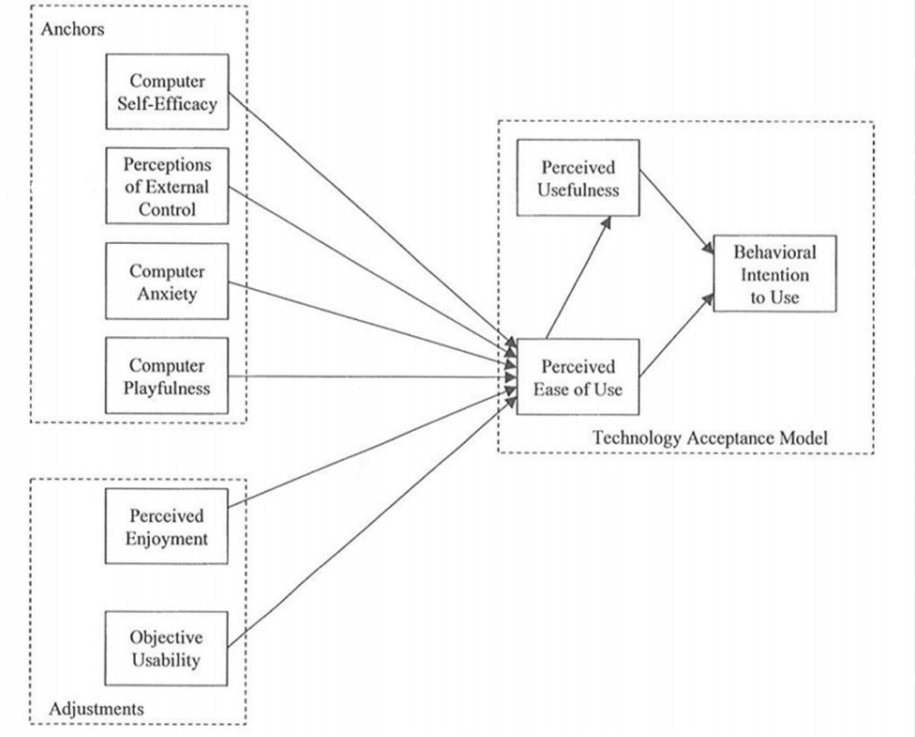

Figure 6: TAM3 by Venkatesh and Davis [44]

The authors identified two major groups of precursors; anchors and adjustments for perceived ease of use. The term anchors describe the extensive beliefs about the use of technologies for example computers, whereas adjustments are beliefs openly shaped by the user›s experience with the objective system. Therefore, Venkatesh and Davis [44] proposed various determinants based on previous research in the literature [61 ,50]. This was aimed at enhancing the identification of the precursors that influence the ease of user perception.

5.4 Unified Theory of Acceptance and Use of Technology (UTAUT)

The conceptualisation of the UTAUT (unified theory of acceptance and use of technology) model was aimed at proposing an integrated theoretical model that combines the basic elements of intention to adopt and technology usage based on the various

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behavioural models of information systems (IS). Therefore, the UTAUT model was proposed to merge the various adoption models in the literature and provide a better understanding of the holistic process of technology adoption [17]. According to the study by Donaldson [63], the developers of UTAUT experimentally evaluated, correlated and merged eight (8) conflicting models of IS in literature.

The findings gave rise to the unified theory termed "UTAUT" that comprises the four (4) critical elements of behavioural use of IT. Furthermore, the UTAUT integrates the core features of eight (8) different models; Motivational Model (MM), TRA, TPB, TAM, Combined TAM-TPB model (C-TAM-TPB), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT), and the Social Cognitive Theory (SCT) into one model [52]. The UTAUT comprises four (4) key moderators for interactions namely: performance expectancy, effort expectancy, social influence and facilitating conditions [17] as depicted in Figure 7.

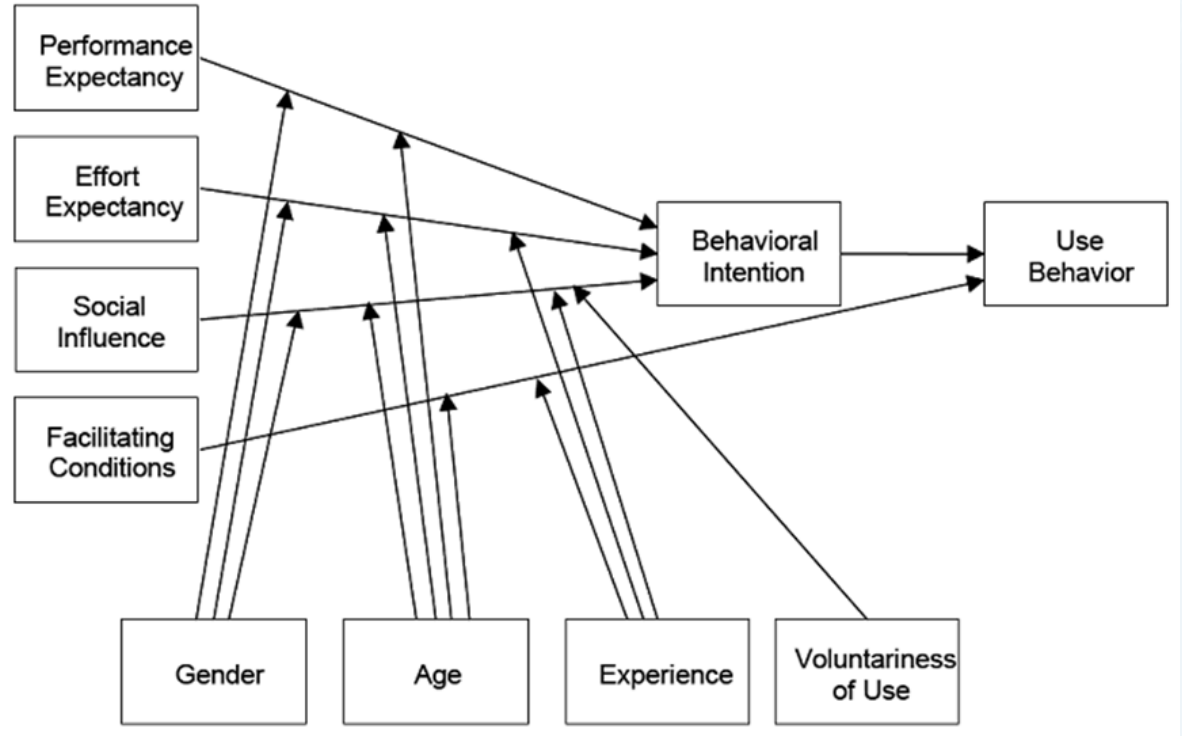

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Figure 7: UTAUT Model by Venkatesh et al., [17].

The performance expectancy factor is a measure of the degree of an individual's perception of a target system that improves with performance. The factor draws solid parallels to the TAM construct of usefulness with rooted elements in extrinsic motivation [17]. Conversely, the effort expectancy measures the extent of an individual's perception of the user-friendliness of the system [64]. It is therefore akin to the ease of use perception in TAM as described by Venkatesh et al., [17]. On the other hand, social influence measures the extent of beliefs about others who the user feels is concerned about the use of the system [52]. Therefore, the construct is related to the subjective norm construct in the TRA and TPB models. Lastly, the facilitating condition is the factor that measures the extent of an individual's perception that guidance and support are available for the use of the system [52]. Hence, the factor is correlated to the TPB factor of perceived control.

Fundamentally, the dependent variables of UTAUT are based on user behaviour, and behavioural intention whereas the independent variables include performance and effort expectancies, social influence, facilitating conditions, along with demographic parameters such as gender, age, experience, and willingness to use. The elements of performance and effort expectancies, social influence, and facilitating conditions, directly determine the individual's use and intent to use. However, the variables including gender, age, experience, and willingness to use can either facilitate or influence individual behaviour or usage intention [17].

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6.0 Comparison of the models and application to m-learning

The major shortcomings of UTAUT and TAM are the inability of the models account for systematic and organisational variables. These factors can adversely impact on a user's adoption of IT due to the financial implications, managerial support or technical system characteristics such as training and support [65]. However, the UTAUT offers solutions to the outlined challenges based on social influence, facilitating experience, and voluntariness constructs. Furthermore, Van Biljon [66] pronounced that unlike the UTAUT, social and cultural factors can influence TAM. In the absence of basic infrastructure or organisational contexts for new technology adoption, the important construct becomes facilitating infrastructure.

Based on the educational framework of m-learning and users, the prices of mobile devices like smartphones, and internet connectivity can be unaffordable. Hence, the majority of users with scarce resources may reconsider the cost benefits of ease of use. Therefore, the UTAUT model was revised to examine the behavioural intention of the users to adopt m-learning. The UTAUT model of Venkatesh et al., [17], was tested in a longitudinal study and found to outperform all the eight individual models; TAM, IDT, TRA, MM, TPB, C-TAM-TPB, MPCU, and SCT. Furthermore, the results showed UTAUT could reliably explain about %70 and %50 of the variance in behavioural intention and actual use, respectively [17].

Consequently, the UTAUT model is now extensively used to investigate m-learning acceptance around the world. The model

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has been successfully implemented for the assessment of the acceptance of m-learning by higher education students in Thailand [67], Pakistan [68], Guyana [69], Saudi Arabia [70], China [71], Malaysia [72] among others.

7.0 Conclusions

The paper presented an overview of the major models typically employed to define and examine technological innovation with an emphasis on mobile learning (m-learning) in educational settings. The paper presented an overview of current definitions, prospects and challenges of m-learning and the role of mobile devices in teaching and learning in education. Lastly, the key models for adoption, diffusion, and acceptance of m-learning technologies along with the various factors, strengths and weaknesses of the models were presented.

The findings indicated that m-learning is an innovative concept that integrates the benefits of information technology and mobile devices such as mobile telephones, laptops, PDAs, and tablet PCs. In essence, m-learning can potentially transform the ways in which teachers and students timely and conveniently acquire, distribute, and assimilate educational materials. However, the broad scope and myriad definitions of m-learning have led to the conclusion that the concept is undergoing sociological and pedagogical metamorphosis. Therefore, various authors opine that numerous dispositions on the concept have resulted in ambiguity and lack of comprehensive understanding of the concept.

Other researchers have sought to address these issues by

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proposing frameworks, theories and models to promote a better understanding of the concept of m-learning along. In addition, the quest for better understanding has led to several studies aimed at understanding the human behavioural factors that influence the adoption of novel technologies like m-learning. The findings of these studies have led to the development of several theories and models aimed at understanding the human behavioural and sociocultural factors that influence the adoption of novel technologies like m-learning.

The results showed that the most notable theories and models typically employed to examine innovative concepts include; the theory of reasoned action (TRA), technology acceptance model (TAM), the theory of planned behaviour (TPB), and lastly, the unified theory of acceptance and use of technology (UTAUT). Furthermore, the findings of this paper showed that the models TRA, TAM, and TPB have several weaknesses which resulted in the development of UTAUT, which integrates and builds upon the strength of eight other models. These models include the; MM, TRA, TPB, TAM, C-TAM-TPB, MPCU, IDT, and SCT.

In conclusion, the paper revealed that m-learning in innovative technology with the potential to transform the scope of teaching, learning and dissemination of educational resources. However, the various challenges of the concept such as adoption/ acceptance rates, costs of infrastructure such as internet and mobile smartphones need to be addressed. In addition, further studies are required to identify and examine the behavioural, social and cultural factors that currently hinder the adoption and diffusion of m-learning in educational settings.

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