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An Extended Unified Theory of Acceptance and Use of Technology model for education contexts

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Abstract

The United Theory of Acceptance and Use of Technology (UTAUT) model has been widely used to study new technological systems and has proven to be a robust theoretical framework for predicting system intentional use. Many of the UTAUT studies have focused on educational technologies like learning management systems, mobile learning, instructional devices, online collaboration tools and educational services. This paper reviews previous work done on the UTAUT model and proposes an extended model to study educational technology acceptance by introducing additional constructs like usability, learnability and attitude.

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Introduction

In early 2020, education institutions around the world were faced with unprecedented circumstances, as schools and universities closed their doors to contain the spread of COVID-19 (UNESCO, 2020). Responses in higher education were diverse, ranging from approaches in which established courses were offered with minimal adaptation through online meeting platforms such as Zoom and Microsoft teams, to the complete redevelopment of course curricula, allowing these to be offered in fully online, self-directed format (Crawford et al., 2020). The degree of challenge incurred in shifting from face-to-face to virtual or online delivery modes will depend on many factors, including technological, e-learning system quality, cultural, self-efficacy and trust factors (Almaiah et al., 2020). One variable that has been cited consistently as a possible impediment to the efficacy of such initiatives is that of end-user acceptance. For instance, user acceptance studies on online meeting platforms like Zoom and Microsoft has been on the rise (Alfadda & Mahdi, 2021; Alshammari, 2021; Bui et al., 2020; Mpungose, 2021; Olugbade & Olurinola, 2021; Pal & Vanijja, 2020).

Technology acceptance models

Even prior to the rapid developments seen in response to the COVID-19 crisis, numerous studies had documented the variable uptake of learning technologies in universities based on end-users' acceptance levels (Al-Adwan et al., 2013; Fathema et al., 2015; Scherer et al., 2019). In connection with this mentioned research area, many theoretical models have been proposed and applied to examine technology acceptance and usage in education over the last few decades. These include the *Theory of Reasoned Action* (TRA), the *Technology Acceptance Model* (TAM), the *Theory of Planned Behaviour*, and the *Model of Personal Computer Utilization* (Ajzen 1991; Davis 1989; Davis et al., 1989; Fishbein & Ajzen, 1975; Thompson et al., 1991). These models offer different accounts of the factors that influence technology acceptance, which include specific attributes of the technology and contextual factors.

Within this group, one of the original theoretical user acceptance models was the TAM, proposed by Davis in 1986. TAM, which is based on the TRA, is designed to explain why a user accepts or rejects information technology (Ajzen & Fishbein, 1980; Davis, 1989; Davis et al., 1989). Within the model, Perceived usefulness (PU) is the extent to which an individual believes that using a particular system or technology will enhance his or her job performance. Perceived ease of use (PEOU) is the extent to which an individual believes that using a particular system or technology will require physical and mental effort. According to the TAM, one's actual use of a technology system is directly or indirectly influenced by the PU and PEOU of the system, as well as by one's behavioural intentions and attitudes. The TAM also proposes that external factors (e.g., system design) will affect intention and actual use through mediated (i.e., indirect) effects on PU and PEOU (Davis, 1989).

In 2003, Venkatesh et al. (2003) developed the Unified Theory of Acceptance and Use of Technology (UTAUT) by consolidating eight previous TAM theories (Davis, 1989, Taylor & Todd, 1995) and models (Ajzen, 1991; Compeau et al., 1999; Fishbein & Ajzen, 1975; Moore & Benbasat, 1991; Thompson et al., 1991). The UTAUT has since been used extensively by researchers to explain technology acceptance and use in a variety of contexts. Researchers have also analysed the strength and robustness of the UTAUT for predicting user behaviours, and have confirmed its strong explanatory power (Khechine et al., 2016). The current paper reviews research on the UTAUT model and proposes an extended UTAUT model which may enhance its power to predict technology acceptance in education contexts. The next sections will examine the UTAUT model and its applicability across various types of educational technology. The proposed extended UTAUT model is then described.

Current issues on technology acceptance models

One of the observations from the examination of the technology acceptance models is the removal of attitude as a construct after the development of TAM2 (Venkatesh & Davis, 2000). Rondan-Cataluña et al. (2015) argued that when the attitude construct was removed from TAM2, the explained variance of the model dropped drastically. Interestingly, attitude was also absent as a construct in the later UTAUT. According to Yousafzai et al. (2007) in their meta-analysis of TAM, they pointed out that although attitude had been removed from later TAM models, research indicated it correlated strongly with usage behaviour, especially in environments where usage was mandatory. That raises a question on whether attitude should rightfully be restored to technology acceptance models.

Venkatesh et al. (2003) had suggested that later UTAUT research should focus on identifying constructs that could add to the prediction of behavioural intention (BI) and use behavior (UB) over and above what was already known and understood by the researchers. In a later review, Venkatesh et al. (2016) examined and synthesized the information system literature on UTAUT from September 2003 until December 2014. The researchers made a classification on the types of extensions that could be made to the UTAUT model to enhance its prediction in different contexts. These included:

- (i) the inclusion of new exogenous constructs (i.e., independent constructs, or those that are not dependent on other constructs in the model) and mechanisms;
- (ii) the inclusion of new endogenous constructs (i.e., constructs that are dependent on other constructs in the model) and mechanisms;
- (iii) the inclusion of new moderating constructs or mechanisms (i.e., factors that influence either the strength or valence of relationships between variables in the core model); and

- (iv) the inclusion of new outcome constructs (i.e., end-point endogenous variables) and mechanisms.

Unified Theory of Acceptance and Use of Technology model in educational contexts

UTAUT has been used in a wide variety of technology contexts and has been found a useful model in most of these contexts. For instance, Wedlock et al. (2019) concluded that the UTAUT model and its instrument could be used in the educational research settings to test the relationships between antecedent and posterior constructs of technology usage, user attitudes, integration intentions, and post-adoptive behaviour, when the researchers traced the evolution of education technologies. This argument was corroborated by a European validation study by Nistor et al. (2013) on UTAUT as an educational technology model with a large sample ($n=4589$). The large-scale validation concluded that the UTAUT questionnaire displayed adequate validity and reliability. A similar large-scale study ($n=1723$) was also conducted in Turkey using the UTAUT model in the educational technology context (Gogus et al., 2012). As such, the UTAUT model proves to be a suitable candidate for examining educational technologies.

The Unified Theory of Acceptance and Use of Technology model

In the UTAUT, four constructs play a significant role as direct determinants of user acceptance and UB: (1) performance expectancy (PE), (2) effort expectancy (EE), (3) social influence (SI); and (4) facilitating conditions (FC). In the UTAUT, attitude toward using technology, self-efficacy and anxiety are not direct determinants of behavioural intention (BI). A diagrammatic representation of the UTAUT model is shown in Figure 1.

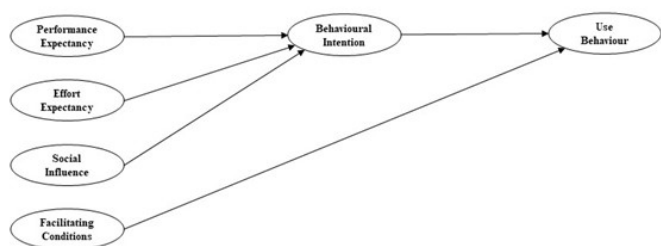


Figure 1: Unified Theory of Acceptance and Use of Technology. Note: Adapted from Venkatesh et al. (2003).

In the UTAUT, PE is the degree to which an individual believes that using a system will benefit him or her in terms of job performance. EE is the degree of ease with which users can adopt the system (Venkatesh et al., 2003). SI is the extent to which an individual perceives that 'important others' consider that he or she should use the system (Venkatesh et al., 2003). FC is the extent to which an individual believes that there is an existing organisational and technical infrastructure to support the use of the system (Venkatesh et al., 2003). BI is

the individual's intention to use the technology.

With respect to the importance of these factors for predicting BI and UB, PE, EE, and SI are all proposed to be predictors of BI, and via BI as a mediator, of UB. Conversely, FC is not theorized to operate via BI, but more directly on UB, unless other predictors in the model are not present. Specifically, Venkatesh et al. (2003) pointed out that if EE is not included as a predictor of BI, FC will act as a significant predictor of BI. However, in the presence of both PE and EE, FC will not be a significant predictor of BI.

Empirical research using the UTAUT

Since its development, the UTAUT has been used in numerous empirical studies to explore relationships between situational factors and technology use behaviour. For example, Bouzif (2017) examined students' continued intentions towards the use of a learning management system using the UTAUT model, while Al-Adwan et al. (2018) studied mobile learning adoption in higher education. In some of these studies, the UTAUT has been used in its original form (Bervell & Umar, 2017; Liao et al., 2004; Prasad et al., 2018). In others, it has been used as a part of the primary theoretical model or has been used alongside at least one other theoretical model (termed a UTAUT 'integration' study by Venkatesh et al., 2016). An example of a UTAUT integration study was conducted by Chen and Hwang (2019). They examined self-regulation in terms of metacognition and motivation using the UTAUT model, to determine influences upon 312 Taiwanese college students' behavioural intentions to continue online courses. In a different context, Yang et al. (2019) examined a model that integrated UTAUT and Connected Classroom Climate (CCC) in a study with 289 college students in China and found that EE, SI and CCC all significantly impacted cloud classroom acceptance. Other authors that have conducted studies that represent UTAUT integration models include Radovan and Kristl (2017) and Thongsri et al. (2018).

Many of the studies using the UTAUT, however, have incorporated part of or the complete UTAUT as a baseline model, but have modified the model to incorporate additional mechanisms (termed a UTAUT 'extension' study by Venkatesh et al., 2016). Four types of UTAUT extensions have been proposed in this literature: (1) the inclusion of new exogenous constructs (i.e., independent constructs, or those that are not dependent on other constructs in the model) and mechanisms; (2) the inclusion of new endogenous constructs (i.e., constructs that are dependent on other constructs in the model) and mechanisms; (3) the inclusion of new moderating constructs (i.e., factors that influence either the strength or valence of relationships between variables in the core model) and mechanisms; and (4) the inclusion of new outcome constructs (i.e., end-point endogenous variables) and mechanisms.

As an example of a UTAUT extension study, Al-Adwan et al. (2018) added the new factors of trust expectancy, self-management of learning and system functionality to study BI to use mobile learning. Table 1 summarises studies that have applied the UTAUT in education contexts, either in its original form or as part of an integration or extension study.

Table 1: UTAUT in educational contexts.

Technology / Theoretical Framework	Author(s)	Constructs	Additional Construct(s)
Web-based Learning	Liao et al. (2004)	PE; EE; SI; FC; Intention to Use the System; System Usage	-
	Yakubu & Dasuki (2018)	PE; EE; SI; FC; BI; Actual Use	-
Learning Management System	Bouznif (2017)	PE; EE; Superior Influences; Continued Usage Intention	Satisfaction
	Bervell & Umar (2017)	PE; EE; SI; FC; BI; UB	-
Technology / Theoretical Framework	Author(s)	Constructs	Additional Construct(s)
Blended Learning	Prasad et al. (2018)	PE; EE; SI; FC; BI; User Behaviour	-
e-Learning	Salloum & Shaalan (2018)	PE; EE; SI; FC; BI	-
Online Learning	Chen & Hwang (2019)	PE; EE; SI; BI	Metacognition; Motivation
Mobile learning	Wang et al. (2009)	PE; EE; SI; BI to use m-learning	Perceived Playfulness; Self-management of Learning
	Iqbal & Qureshi (2012)	SI; FC; Intention to adopt m-learning	Ease of Use; Perceived Usefulness; Perceived Playfulness
	Abu-Al-Aish & Love (2013)	PE; EE; BI to use m-learning	Influence of Lecturers; Quality of Service; Personal Innovativeness
	Mtebe & Raisamo (2014)	PE; EE; SI; FC; BI	-
	Al-Adwan et al. (2018).	PE; EE; SI; BI	Trust Expectancy; System Functionality; Self-management of Learning
	Ali & Arshad (2018)	PE; EE; SI; FC; BI	Learners' Autonomy; Content Quality Design
	Alasmari & Zhang (2019)	EE; SI; FC; BI to use mobile learning technology; UB of mobile learning technology	Learning Expectancy; M-Learning Technology Characteristics; Self-management of Learning
Desktop Video Conferencing technology	Lakhal et al. (2013)	PE; EE; FC; BI	General SI; Peer SI; Autonomy
Interactive Whiteboards	Wong et al. (2013)	PE; EE; SI; FC; BI	-
Technology / Theoretical Framework	Author(s)	Constructs	Additional Construct(s)
Software Engineering tools	Wrycza et al. (2017)	PE; EE; SI; FC; BI; UB	Professional Training Diffusion; Model Interchange
Video-based Instruction	Kissi et al. (2018)	PE; EE; SI; FC; BI	Task-Technology Fit; Perceived Control Over Time; Learning-Family Conflict
Wiki	Yueh et al. (2015)	PE; EE; SI; FC; BI; actual use	-
Computer-supported Collaborative Environment	Lin & Lin (2019)	PE; EE; SI; FC; BI; UB	Social Network Awareness
Open Educational Resources (OER)	Mtebe & Raisamo (2014)	PE; EE; SI; FC; BI to adopt and use OER; actual use of OER	-

Online Information Services	Oh & Yoon (2014)	PE; EE; SI; FC; BI; UB	Flow experience; Trust
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Based on the literature summarised in Table 1, the UTAUT has been applied extensively in empirical research on technology use behaviours. This is likely to reflect the high predictive power of the model compared with alternatives in the field. In their evaluations of various technology acceptance models, Samaradiwakara and Gunawardena (2014) compared existing theories and models and concluded that the UTAUT had the highest explanatory power amongst available models for explaining users' technology usage intentions. They concluded that this was because the determinants of BI and UB in the UTAUT incorporated eight earlier technology acceptance models. During the development of UTAUT, longitudinal data from entertainment, telecom services, banking, and public administration were used. The conceptualised UTAUT model was empirically tested using original data from the four organisations and then cross-validated using new data from another two organisations from the financial services and retail electronics industries. This careful approach to development ensured that the UTAUT integrated elements of different models that had appeared previously, enhancing its ability to predict user behaviours across a variety of contexts.

Empirical results on the predictions of the UTAUT model

PE as a predictor of BI

Venkatesh et al. (2003) posited that PE would have the strongest influence on BI, a proposition that has been borne out in many later empirical studies. Liao et al. (2004) adopted the UTAUT in its original form and found a significant positive influence of PE on the variable 'Intention to Use the System' in their study of student acceptance of web-based environments. Similarly, Prasad et al. (2018) found in their study on international students' reactions to blended learning that PE had a significant influence on BI. PE has also been found to remain an influencing factor on BI in 'UTAUT extension' studies (i.e., when additional constructs are included within the model). For instance, in addition to all original UTAUT constructs, Oh and Yoon (2014) extended the UTAUT to include 'flow experience' (i.e., the 'flow' is defined as an overall sense when a person acts with full consciousness) and trust mechanisms (i.e., trust is defined as 'a positive expectation and attitude towards others and the degree of confidence with which one can depend on others'), and found PE continued to have a significant positive influence on BI. In another study by Wrycza et al. (2017), the model was extended with professional training diffusion elements (i.e., the perceived flexibility and expressiveness of a training tool) and model interchange constructs (i.e., the capability of the tool to integrate seamlessly). PE continued to have a significant positive effect on BI, despite the inclusion of these additional constructs.

EE as a predictor of BI

In contrast to the consistent results obtained for PE, the empirical results on EE as a predictor have been largely inconsistent. This has been true irrespective of whether the model tested is the original UTAUT or an extended form of the model. For instance, EE had a negative influence on BI in the study by Liao et al. (2004) but had a significant impact on BI in the study by Mtebe & Raisamo (2014) and Prasad et al. (2018). Disparate results have also been obtained in extended UTAUT studies as disparate results were discovered with more findings on EE having no significant influence or impact on BI (Ali & Arshad, 2018; Lakhal et al., 2013; Kissi et al., 2018; Lin & Lin, 2019; Wrycza et al., 2017). The inconsistent results can be attributed to the nature of the technology UTAUT is used to explain or predict the users' intention. For instance, in UTAUT studies on learning management systems, EE is often found to have no significant effect on BI (Ali & Arshad, 2018; Bouznif, 2017; Liao et al., 2004; Salloum & Shaalan, 2018). However, when the UTAUT model is applied in mobile learning studies, EE is often found to have a significant effect on BI (Abu-Al-Aish & Love, 2013; Al-Adwan et al., 2018; Alasmari & Zhang, 2019; Almaiah et al., 2019; Mtebe & Raisamo, 2014; Wang et al., 2009).

SI as a predictor of BI

The empirical results of SI as a predictor of BI have also not been entirely consistent across studies that have used the UTAUT model. In those that tested the original UTAUT, SI has been found to have a significant positive influence on BI (Liao et al., 2004; Prasad et al., 2018; Yueh et al., 2015; Mtebe & Raisamo, 2014; Salloum & Shaalan, 2018). However, in other studies, such as that by Wong et al. (2013), SI did not have any significant influence on BI. Similar disparities have also appeared across studies of extended UTAUT models. For example, Wang et al. (2009) extended the UTAUT by adding the constructs of perceived playfulness and self-management of learning in a study of 330 Taiwanese participants from five organisations (i.e., Aerospace Industrial Development Corporation, IBM Taiwan, National Changhua University of Education, Chung Chou Institute of Technology and Yuanlin Community University) and found that SI had a positive effect on BI, while Iqbal and Qureshi (2012) did not in their study of an extended UTAUT model (which included ease of use, perceived playfulness and perceived usefulness) with 250 students from 10 universities in Pakistan.

FC as a predictor of UB

In many studies that appeared subsequent to the original UTAUT development studies, UB has often been omitted as a construct, and as a result, FC as a predictor of UB has also often been omitted. For instance, in the UTAUT study on interactive whiteboard acceptance by Wong et al. (2013), UB was omitted. For UTAUT studies that included UB as a construct, findings have again been inconsistent. Some studies have reported that FC has significant influence or impact on UB (Oh & Yoon, 2014; Prasad et al., 2018; Salloum & Shaalan, 2018) while various others have not (Alasmari

& Zhang, 2019; Mtebe & Raisamo, 2014; Yueh et al., 2015). Therefore, the role of FC in predicting UB is unclear.

Implications for the application of UTAUT across different forms of technology

The UTAUT has been found to have a high level of general applicability. In other words, elements of this model have been found to be able significantly to predict user intentions and behaviours across a vast array of user groups, situations, and forms of technology. Venkatesh et al. (2016) summarised UTAUT research contexts into (1) types of users (e.g. students, teachers, government employees and physicians); (2) technology (e.g. tablet PC, internet, web-based learning environment); (3) task (e.g. learning, research, social networking); (4) time of users' adoption decisions (e.g. adoption, use or adoption and use); (5) organisations (e.g. educational institutions, academic societies, government organisations); (6) geographical locations; and (7) relationships validated (e.g. UTAUT main effects and moderating variables effects).

The next sections summarise some of the research that has been conducted using the UTAUT across different forms of technology use within education. These applications have indicated different relationships between the constructs within UTAUT depending on the form of technology that is being studied. Various studies have incorporated extensions to the UTAUT depending again on the type of technology under study, with these kinds of study being particularly prevalent in the mobile learning area.

UTAUT and web-based Learning Management Systems

A web-based learning management system (LMS) is an online software application that presents and manages educational content and determines and evaluates educational objects (Forouzesh & Darvish, 2012). The UTAUT model has been utilised in various studies on the acceptance of web-based LMSs. This has included studying undergraduates' acceptance of LMSs across four countries (Bounzif, 2017; Liao et al., 2004; Salloum & Shaalan, 2018; Yakubu & Dasuki, 2018) and postgraduate students' behavioural intentions towards the use of blended learning programs in Australia (Prasad et al., 2018). In Malaysia, Bervell and Umar (2017) identified new relationships among the UTAUT constructs in a study on LMS acceptance by tutors. In a UTAUT extension study, Chen and Hwang (2019) integrated self-regulation theories and the UTAUT to examine how metacognition and motivation influenced students' behavioural intentions to continue online LMS-based courses in a Taiwanese college. All of these studies indicated that elements of the UTAUT were able to significantly predict users' intentions and behaviours in the LMS setting.

Numerous studies that have explored the use of the UTAUT model to study user acceptance in web-based LMS settings have, however, suggested that EE has no significant influence on BI (Ali & Arshad, 2018; Bouznif, 2017; Liao et al., 2004; Salloum & Shaalan, 2018) and that similarly, SI has no significant influence on BI (Bervell & Umar, 2017; Bouznif,

2017; Prasad et al., 2018; Yakubu & Dasuki, 2018). These observations are consistent with those reported outside the LMS setting in other UTAUT studies (Ali & Arshad, 2018; Lakhal et al., 2013; Lin & Lin, 2019; Wrycza et al., 2017). One possible explanation for this is that the main participants in the studies on web-based LMS have been university students, who do not use the LMS voluntarily. When the use of the system is non-voluntary, it is intuitively reasonable that the effect of EE and SI would be minimal. Like in the case of SI, there would be no effect on BI as the students are required to use the system, regardless of whether their peers or instructors expect them to. Thus, the results of UTAUT studies in the LMS context are tenable.

UTAUT and mobile learning

Mobile learning refers to learning mediated with handheld devices and is made available anytime, anywhere (Barzegar, 2016). As compared to UTAUT studies in other educational technologies, a higher proportion of studies in mobile learning have extended the model to include other variables and constructs. For instance, in the studies conducted by Wang et al. (2009) and Iqbal and Qureshi (2012), the construct of perceived playfulness was incorporated in the UTAUT model when studying mobile learning adoption. Self-management is another variable that has been of considerable interest to researchers in the mobile learning area. For example, studies by Al-Adwan et al. (2018) at four Jordanian universities, Alasmari and Zhang (2019) at a Saudi Arabian higher education institution, and Wang et al. (2009) at five organisations (i.e. Aerospace Industrial Development Corporation, IBM Taiwan, National Changhua University of Education, Chung Chou Institute of Technology and Yuanlin Community University) all introduced self-management as an additional construct in their UTAUT studies on this form of technology use.

Other, more situation-specific extensions to the UTAUT have also been studied with respect to users' acceptance of mobile learning systems. For instance, Iqbal and Qureshi (2012) included ease of use while Abu-Al-Aish and Love (2013) included additional constructs of influence of lecturers, quality of service, and personal innovativeness to examine the factors influencing the acceptance of mobile learning in the study of 250 university students. Ali and Arshad (2018) added learners' autonomy and content quality as additional constructs to the original UTAUT when studying 386 students' acceptance of mobile learning. Besides examining self-management, Al-Adwan et al. (2018) also added trust expectancy and system functionality, whereas Alasmari and Zhang (2019) extended the UTAUT model by adding Learning Expectancy and M-Learning Technology Characteristics in a study of 1203 users' acceptance levels.

Among the studies that have applied the UTAUT model to explore the acceptance of mobile learning, the findings have mostly been aligned with Venkatesh et al.'s (2003) predictions. Specifically PE, EE and SI have been found to be significant determinants of mobile learning acceptance, across numerous contexts (Abu-Al-Aish & Love, 2013; Al-Adwan et al., 2018; Alasmari & Zhang, 2019; Chao, 2019; Wang et al., 2009). However, some important departures

have been evident. Specifically, several studies have suggested that FC directly influences BI, which departs from the theorisation in the original UTAUT model (Ali & Arshad, 2018; Almaiah et al., 2019; Bervell & Umar, 2017; Lakhal et al., 2013; Radovan & Kristl, 2017). For mobile learning acceptance studies, however, the relationship between BI and UB has rarely been examined.

UTAUT and instructional devices

UTAUT has also consistently been extended to study educational technology tools. Lakhal et al. (2013) added autonomy to the UTAUT model. Wrycza et al. (2017) introduced two constructs, professional training diffusion (i.e. the perceived flexibility and expressiveness of a training tool) and model interchange (i.e., the capability of the tool to integrate seamlessly) to the original UTAUT model, to examine the acceptance of software engineering tools within Information Systems Development courses. Kissi et al. (2018) extended the UTAUT model by introducing constructs such as Learning–Family Conflict (i.e. household chores or outdoors activities that impede and interfere on students attention to study at home), Perceived Control Over Time and Task-Fit Technology to investigate urban-rural high school students' acceptance of video-based instruction in the flipped learning approach. Findings in these contexts have been similar to those found in applications of the UTAUT model to explore users' responses to web-based LMSs. In other words, the findings typically showed that: (1) EE has no significant influence on BI (Kissi et al., 2018; Lakhal et al., 2013; Wrycza et al., 2017) and that (2) SI had no significant influence on BI (Kissi et al., 2018; Lakhal et al., 2013; Wong et al., 2013; Wrycza et al., 2017).

UTAUT and online collaboration tools

While the studies on web-based LMSs and mobile learning are many, there are only a few studies on using the UTAUT model to study online collaboration tools. Two studies have, however, used the UTAUT model to study online collaboration in Taiwanese universities. Yueh et al. (2015) adopted UTAUT to study Wiki use with 103 Taiwanese students, while Lin and Lin (2019) studied how computer-supported collaborative learning environments with social networking awareness would impact on the acceptance levels of 186 undergraduates at a Taiwanese university. Given the focus of both studies on online collaboration tools, SI was found to be the primary determinant of BI in both cases, while PE and EE did not influence BI significantly.

UTAUT and online educational services

Online educational services refer to any education-related information and services provided over the Internet. Mtebe and Raisamo (2014) adopted the UTAUT to examine barriers to instructors adopting and using open educational resources. Oh and Yoon (2014) added two additional constructs, flow experience and trust (i.e., the 'flow' is defined as an overall sense; trust is defined as 'a positive expectation and attitude towards others and the degree of confidence with which

one can depend on others') to the original UTAUT in their study on predicting the use of online information services. In both of these studies, EE was found to have a positive influence on BI. However, results for other relationships between elements of the model have been more variable. For instance, Mtebe and Raisamo (2014) found that FC, PE and SI did not have a significant effect on BI.

From the literature, some general observations can be drawn from the UTAUT research findings on various forms of educational technology. The original UTAUT model posits that PE is the strongest determinant of BI. However, in the UTAUT studies on online collaboration tools, PE was found to have no significant influence on BI. In other words, the belief that online collaboration tools may not necessarily improve user performance did not deter them from using the technology. Among the UTAUT studies on web-based LMS, instructional devices and online collaboration tools, EE was not found to influence BI in several studies. That is, in these studies, even when educational technologies were not perceived to be easy to use, prospective users still intended to use them for the affordances that they might bring. SI also did not consistently influence BI across all studies. It is likely that the nature of the technologies studied in these cases (mobile learning and online collaboration tools) are highly adaptable in social contexts. Based on the diverse findings reported here, it appears that while the UTAUT has been found to be a strong and versatile predictive model across contexts, it is the power of the constructs in the model to predict users' intentions that can vary depending on the specific form of technology under study.

The proposed extended UTAUT model

As noted previously, various researchers have proposed extensions to the original UTAUT model, incorporating additional constructs within specific settings. This has been particularly apparent in research that has applied the UTAUT to study mobile learning applications. Here, we propose an alternative extended UTAUT to determine the factors influencing users' adoption of technology, particularly within education contexts (Figure 2). Additional exogenous mechanism constructs, usability and learnability, are proposed for incorporation within the model, to study its effects on PE, FC and SI. EE has not been included in the extended model, as many UTAUT studies have shown that its influence has not been as consistent that of the other original constructs (Ali & Arshad, 2018; Alshehri et al., 2019; Bouznif, 2017; Chao, 2019; Kissi et al., 2018; Lakhal et al., 2013; Lin & Lin, 2019; Salloum & Shaalan, 2018; Thongsri et al., 2018; Wrycza et al., 2017). In the absence of EE, usability and learnability were added to examine the degree of ease of use and how quickly users become familiar with system features and functions. Attitude, included an earlier TAM model, has also been re-included as a predictor of the extended UTAUT model.

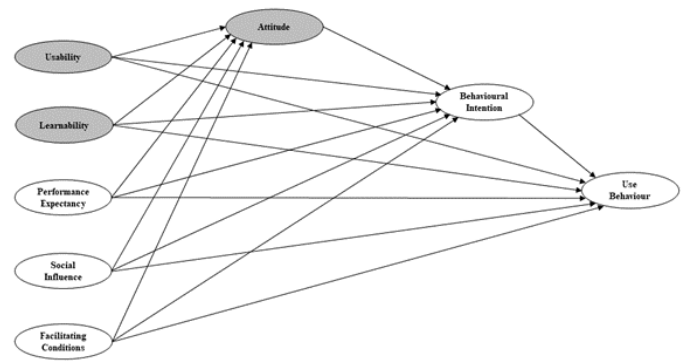


Figure 2: Extended UTAUT Model. Note: Adapted from Venkatesh et al. (2003).

Usability is referred to as the degree of ease of use, to achieve system objectives with effectiveness, efficiency and satisfaction (Bevan et al., 2015; Jokela et al., 2003; Shackel, 2009). This definition relates directly to user and business requirements as effectiveness refers to success in achieving goals; efficiency refers to not wasting time, and satisfaction refers to a willingness to use the system. This new construct has been proposed because various studies outside the UTAUT literature have reported that factors of this kind have a significant influence on users' acceptance of educational technologies (Holden & Rada, 2011; Juarez Collazo et al., 2014; Lah et al., 2020; Lin, 2013; Tsakonas & Papatheodorou, 2008).

Learnability is defined as the quality of system interfaces that allow users to become familiar quickly with them and able to make use of all the features and capabilities (Jeng, 2005; Nielsen, 1994). Although Zbick et al. (2015) had included usability and learnability in a TAM model to study mobile learning adoption, the two constructs have yet to be used in a UTAUT study. Learnability has been incorporated in light of findings outside the UTAUT literature that have reported the ease with which systems can be learned can significantly influence their acceptance of different types of technology (Burney et al., 2017; Chiou et al., 2009; Jeng, 2005; Zbick et al., 2015).

From previous studies, PE is the strongest predictor of BI in the original UTAUT model (Venkatesh et al., 2003). While attitude has been omitted in the initial UTAUT development, follow-up studies have shown that there was a significant influence of PE on attitude (Botero et al., 2018; El-Gayar et al., 2011; Jairak et al., 2009; Shuhaiber, 2015; Šumak et al., 2010; Yakubu & Dasuki, 2018). Nassuora (2012) found in the study on students' acceptance of mobile learning that FC had a positive influence on attitude towards behaviour. Past studies had also found that SI is positively related to attitude (Botero et al., 2018; Nassuora, 2012; Shuhaiber, 2015; Šumak et al., 2010).

Attitude, which was adapted from the TRA, was included in the earlier version of TAM (Ajzen & Fishbein, 1980; Davis, 1986; Davis et al., 1989). The theory explains that the individual's attitude towards a given situation combines with subjective norms shapes the behavioural intention,

which in turn influences the individual's actual behaviour. It links the perception, norms, and attitudes to the intentions of a person in making a decision and predicts the behaviour, which may result as intention. Attitude towards technology is included in the earlier TAM but was not included in the development of UTAUT. In the UTAUT studies on tablet PC adoption by El-Gayar and Moran (2006), Moran et al. (2010) and El-Gayar et al. (2011), attitude toward using technology appeared to influence BI. In the three studies, PE and EE also significantly influenced attitude toward technology. In another context, in the UTAUT studies on mobile learning adoption, attitude was also found to influence BI (Jairak et al., 2009; Nassuora, 2012; Thomas et al., 2013). Among the mobile learning adoption studies, FC was found to be influencing users' attitudes towards using technology. Other UTAUT studies on educational technology tools like virtual lecturing system, mobile-assisted language learning system and social learning platform also found that attitude significantly influenced BI (Botero et al., 2018; Khechine & Augier, 2019; Shuhaiber, 2015).

Since its introduction, the UTAUT has been highly regarded as a robust model with a high level of predictive power in technology acceptance studies. Venkatesh et al. (2003), however, acknowledged that across different contexts, extensions to the original UTAUT could be considered. The extended UTAUT added usability, learnability and attitude to the UTAUT model, and examined their relationships in predicting acceptance of a form of technology that has thus far been under-researched in the UTAUT literature.

The introduction of usability, learnability and attitude would enrich and expand explanations of the factors that influence users' intentions and usage in such settings. The new relationships amongst traditional elements of the UTAUT model also suggest a promising line for future studies to explore. The introduction of the additional constructs in the extended model could enhance the efficacy with which user's intentions to engage with technology could be predicted. It underscores the need for higher education to take steps during system design and implementation to improve usability and learnability, as well as users' attitudes towards the use of relevant technology in efforts to enhance their intentions and actual usage behaviours.

Conclusion

The UTAUT is a reliable and robust model to study and explain technology acceptance and use across various educational contexts. Venkatesh et al. (2003) had proposed that UTAUT be further developed and validated with appropriate scales and then revalidating the model or extending it with new measures. They also encouraged future researchers to examine alternative measures of intention and behaviour in revalidating or extending the research to other contexts. The extended UTAUT model is versatile and robust and can be applied across various contexts. Although the initial conceptualisation of the extended model was meant for UTAUT studies in the educational contexts, the additional constructs proposed here might also be relevant in business and government contexts.

The extended UTAUT model proposed in this paper incorporates three new constructs: usability, learnability and attitude, which are proposed potentially to enhance the predictive power of the UTAUT. With the proposed model, not only it addresses both the affective and cognitive aspects of technology acceptance (Taherdoost, 2018), it further examines possible relationships between the various constructs not theorised in the original UTAUT model.

Venkatesh et al. (2016) recommended that extensions that could be made to the UTAUT model to enhance its prediction in different contexts. One of such extensions involves the addition of new moderating constructs or mechanisms (i.e., factors that influence either the strength or valence of relationships between variables in the core model). The limitation of this proposed model is that it does not consider moderating variables to explain technology acceptance as it focuses solely on the direct effects of the various constructs on both BI and UB.

Future research is clearly needed to validate the utility of the extended model, perhaps comparing this with the original to determine which of the two have the highest explanatory power across different contexts. One of the challenges that remain is to develop and validate an instrument that can be used to assess these various constructs. The availability of such a standardised instrument would be useful not only to individual researchers and teams but would also enable better knowledge building across studies within the field. The authors intend to validate the extended UTAUT model with a developed instrument in the near future.

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