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Learning management systems and technology acceptance models: A systematic review

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Abstract

Technology acceptance has become one of the dominant research trends in the domain of learning management systems (LMSs). While a plethora of several research studies conducted in this area, there is still a scarcity of knowledge concerning a holistic review and taxonomy of studies in this field. Thus, the main objective of this systematic review is steered toward understanding the most prevalent theoretical models and the most prominent external factors affecting the LMS adoption in higher educational institutions. Out of 732 collected studies between 2005 and 2020, a total of 68 studies were critically reviewed and analyzed. The main results indicated that the TAM, DeLone and McLean IS success model, UTAUT, TRA, DOI, and UTAUT2 have been dominating the theoretical landscape in LMS research. The results also elucidated that external factors linked to LMS acceptance models fall primarily into three macro-categories, including individual variables, contextual variables, and psychological/behavioral constructs driven from other theories. It is believed that the results of this review can serve as a departure point for synthesizing more advanced hybrid adoption theoretical models on the one hand, and a standardized inventory of factors affecting the LMS adoption on the other hand. Several theoretical contributions, practical implications, and future research paths were discussed.

Keywords Learning management systems · Technology acceptance models · Systematic review · External factors · Adoption · Use

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1 Introduction

As an innovative approach to education delivery, Learning Management Systems (LMS), which manifest the pedagogical assimilation of information systems in higher education institutions, warrant new opportunities and a more compelling means to learning (Al-Fraihat et al., 2020; Salahshour Rad et al., 2018). Prior literature has loosely defined e-learning as the use of ICT to deliver instruction, information, and learning content online (Al-Emran & Teo, 2020). In light of such a broad definition, there has been a trend towards subsuming LMS among other virtual learning modalities within the uniform realm of e-learning (Islam, 2016). That is because LMS shares several standard features with other e-learning formats. Such salient features encompass (1) the expanding spectrum of the utilization of ICT to enhance both collaborative learning and autonomous individual learning, (2) the inclusive benefits to a variety of stakeholders involved in pedagogical processes, including, learners, faculty, administrative, and technical staff, (3) the resilient instrumentality in attaining educational goals, (4) the integration of novel modes of teaching and learning, and (5) dismantling accessibility from spatial and temporal constraints (Alhabeeb & Rowley, 2018).

Based on the features mentioned earlier, LMS, as a modality of e-learning, has been defined from multiple perspectives. From the perspective of instructors, LMS has been defined as an aggregate of complex, multifaceted information technology (IT) tools used to build and maintain course websites as an integral approach to blended learning (Naveh et al., 2010). On the other hand, from the learner-centered perspective, LMS is defined as platforms functioning as mediums that assist learners to gather, construct, and share knowledge (Lin & Wang, 2012). Taken together, and from a holistic organizational perspective, LMS has also been defined as information systems that produce, disseminate, and manage educational data, and learning content as part of their IT infrastructure (Martins et al., 2019). However, the technical peculiarities and the ubiquitous utilization of LMS have jointly transformed LMS into a distinct fully-fledged field of research and practice. That being the case, the exponential growth and widespread deployment of LMS worldwide, have qualified LMS to become equally vital to academia, vocational, and corporate training (Al-Gahtani, 2016).

LMS adoption in higher education is considerably costly in terms of hardware costs, software licenses, faculty training, subject-matter content development, and equipment maintenance among various expenses (Childs et al., 2005). In comparison with the traditionally delivered classroom instruction, LMS adoption initiatives witness enormous dropout rates (Zhang et al., 2004). The failure of LMS initiatives can be attributed to underestimating the significance of systematic investigation, validation, and evaluation of critical factors that influence the success of LMS adoption in higher education institutions (Alsabawy et al., 2016). Therefore, configuring factors that determine LMS adoption is crucial to measuring the worth and cost-effectiveness of management operations and investment in LMS projects, and hence making decisions and modifying practices with the aim of enhancing the success of LMS utilization (Delone & McLean, 2003; Hassanzadeh et al., 2012).

Identifying the influential critical factors is the essential step towards the successful acceptance of LMS. Perceived usefulness and perceived ease of use are the most salient measures of LMS acceptance. This is because perceived usefulness and perceived ease of use are the main constructs that influence the individuals' behavioral intention and their actual system use (Davis, 1989). Examining the external factors that affect perceived ease of use and perceived usefulness of LMS is essential to measuring overall LMS adoption. Since LMS is a particular type of information systems (IS), scholars have examined a myriad of critical success factors from the lenses of well-established technology acceptance theoretical models.

That being the case, a wide range of systematic literature reviews and meta-analyses have scrutinized the consistently accumulating related literature for the factors influencing technology and e-learning acceptance in general (Brown, 2016; Ma & Liu, 2004; Schepers & Wetzels, 2007; Šumak et al., 2011). Despite the comprehensive and multifaceted syntheses presented by previous literature reviews, there are three main persisting gaps, which have been neglected in such reviews. First, previous reviews have not accounted for factors influencing the adoption of LMS as a distinct modality of e-learning. Second, previous reviews have overlooked examining external factors from the perspectives of multiple technology acceptance theories. Third, there is a dearth of systematic reviews of studies investigating LMS adoption in the context of higher education. To bridge these gaps, the current systematic review aims to analyze the gathered studies with a specific focus on the factors that influence LMS adoption in higher education. The current review also seeks simultaneously to shed light on the multitude of technology acceptance theoretical models employed to study LMS acceptance and adoption in higher education. We believe that formulating a synthesis of the factors influencing LMS adoption, alongside their underlying theoretical frameworks would potentially guide LMS researchers to locate, integrate and consequently build theoretical models that can serve as rich sources of hypotheses that can be tested to inspect the factors influencing LMS adoption in higher education. While achieving this goal, the current review may pave the path for subsequent studies to pinpoint and examine new external factors that have never been investigated in previous literature. Furthermore, this review can help in taking theorization in the field of LMS adoption a step forward and may help in giving it a more definitive shape. Overall, the current systematic review aims to answer the following research questions:

RQ1: How are LMS adoption studies distributed by their years of publication?
RQ2: What are the most prevalent theoretical models that have been used to study LMS acceptance and adoption in higher education institutions?
RQ3: What are the external factors influencing LMS adoption in higher education that are being most commonly investigated in existing empirical literature?

2 Literature review

Panigrahi et al. (2018) have recognized and differentiated between factors affecting adoption, intention to continued use, and learning outcomes of online platforms integrated into virtual communities. Based on the Social Cognitive Theory

(SCT), the antecedents of adoption, intention to continued use, and learning outcomes of online platforms respectively have been classified into personal and environmental factors that are compatible with constructs driven from various technology acceptance theories. Accordingly, Panigrahi et al. (2018) have concluded that mobile Apps and cloud computing services can boost the personal and environmental (e.g., technical and pedagogical) factors that can equally enhance the ease of use and engagement with online platforms at the levels of individuals and organizations.

Using a meta-analytic structural equation modeling approach (MASEM), Scherer et al. (2019) have examined the extent to which the pooled correlation matrices extracted from 114 empirical studies substantiate the relations hypothesized among the TAM constructs to explain teachers' adoption of digital tools in education. The fixed and random effects assumptions are utilized to compare between the four competing TAM models in terms of their goodness of fit with the data. Thereby, relations among TAM constructs can be presented by an aggregated correlation matrix, albeit significant variations in correlations exist between studies.

Rodrigues et al. (2019) have broadly reviewed academic journal articles on the proliferation of various forms of e-learning in education. By utilizing the qualitative data analysis, four dominant themes have emerged, including education, content, use, and learning. Accordingly, it has been posited that it is imperative to examine the factors influencing students' satisfaction with online learning tools due to the significant effects of technology-enhanced learning on students' outcomes (Rodrigues et al., 2019). Besides, Shen and Ho (2020) conducted a hybrid bibliometric analysis combining both direct citation network analysis and text analytics with a latent semantic approach to plot the trajectory of the histography development of technology-enhanced learning (TEL) research in higher education. As a result, LMS adoption has been classified as one of the mainstreams of TEL research in higher education.

Abdullah and Ward (2016) have identified the external factors influencing e-learning adoption that have been commonly integrated into TAM. The most frequently occurring external factors have been discerned in terms of several criteria, namely the incorporation of external factors as independent variables influencing perceived ease of use and perceived usefulness as dependent variables, effect sizes, and directions of path coefficients and their significance levels. As a result, the most commonly investigated external factors integrated into TAM in the context of e-learning adoption are self-efficacy, subjective norms, computer anxiety, perceived enjoyment, and experience. Such factors have been, as a consequence, used to develop a general extended technology acceptance model for e-learning (GETAMEL).

A closer glance at related systematic reviews and meta-analyses discloses that these studies offer a macro-level overview of the factors influencing e-learning adoption. Although LMS research is well acknowledged as a major realm of technology adoption research, the borders and defining features of this realm are still unidentified. Despite the variety of analytic approaches used in the existing reviews, they have not yet specifically addressed the external factors influencing LMS adoption at one hand, and the most influential technology acceptance theories on the other hand.

3 Research methodology

The Internet age has boosted scholarly communication with unprecedentedly increasing numbers of articles published in parallel with enhanced open access to original research. Consequently, the simultaneous information overload at individual and organizational levels exacerbates the necessity for systematic literature reviews as a method to rationalize enormous bodies of literature and to map underexplored research territories (Booth et al., 2016; Petticrew & Roberts, 2006). A vital aspect of the efficacy of systematic reviews resides in understanding the context of aggregates of studies that tested similar hypotheses in similar populations (Petticrew & Roberts, 2006).

This review of literature has followed the methodological guidelines set forth by Petticrew and Roberts (2006) and Xu et al. (2015) for performing systematic reviews in social sciences. The main purpose of following these guidelines stems from the fact that these guidelines provide an evidence-based support for analyzing the issues under research and serves as a well-known source for guiding a number of systematic reviews in the domain. The methodological guidelines involve defining the research questions, identifying the relevant studies to answer those questions, screening the identified studies, selecting those that match the inclusion criteria, synthesizing the studies, and disseminating the review results. In the meanwhile, the authors have situated this review within the context of mainstream systematic reviews carried out in the domain of educational technology success and adoption (Al-Qaysi et al., 2020a, b; Garcia et al., 2018; Salahshour Rad et al., 2018; Scherer et al., 2019). Thereby, the procedures of this review have encompassed salient phases, including performing scoping searches, identifying the review questions, writing the review protocol (i.e., the designation of inclusion and exclusion criteria), data sources and search strategies, and data extraction and analysis.

3.1 Inclusion/exclusion criteria

The review protocol has established the inclusion and exclusion criteria, according to which the authors have embraced original research articles into this review for critical evaluation and analysis. Table 1 depicts the inclusion and exclusion criteria.

Table 1 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Should adopt a theoretical model.	Do not adopt a theoretical model.
Should examine the impact of external factors on the main theoretical constructs in a theory.	Do not focus specifically on the adoption or acceptance of LMS.
Should involve the adoption or acceptance of LMS.	Examine the adoption or acceptance of LMS in contexts other than higher education.
Should investigate the use of LMS in higher educational contexts.	Published in languages other than English.
Should be published in English language.	Published before 2005.
Should be published between 2005 and 2020.	Book chapters, reviews, dissertations, editorials, conference proceedings, and point of view papers were excluded.

3.2 Data sources and search strategies

The empirical studies that have constituted this systematic review of literature were gathered using comprehensive literature search strategies to identify and locate all available relevant empirical literature. The literature search has taken place between December 2019 and January 2020. To that end, the researchers have scanned the digital libraries of the salient electronic journal databases to construct an extensive bibliography of original research papers on the adoption and acceptance of LMS in higher education. Therefore, the surveyed databases, include ScienceDirect, Wiley, Sage, and Springer. To accumulate studies, the researchers have employed specific key search terms and Boolean operators, including ("Adoption" AND "Learning Management Systems"), ("Acceptance" AND "Learning Management Systems"), and ("Adoption" OR "Acceptance" AND "Learning Management Systems"). Consequently, the initial screening phase has ultimately aggregated 732 articles utilizing these keywords. Upon omitting 203 duplicate articles, the net total of the collected papers has become eventually 529 articles.

3.3 Data extraction and analysis

Once the initial screening has been completed, the studies that met all the inclusion criteria have undergone a second phase of screening wherein the researchers have scanned those studies to observe specific elements based on which the pooled studies would be classified, critically reviewed, and analyzed. The data of interest were recorded, accordingly, in a data extraction template designed on an Excel spreadsheet. In this data extraction stage, the specific information excerpted from each study is determined from the lenses of the research objectives, and research questions of this review. The data were extracted, and studies were coded by consensus among the researchers, who coded relevant features of the included primary studies. At this level of detailed analysis, the researchers had to exclude more studies from the synthesis as they have appeared to be irrelevant to the research questions addressed by the review, or as some studies were ambiguous on their theoretical frameworks (Phelps & Campbell, 2012).

Primarily, the extracted data were categorized into three major fields, including the year of publication, theoretical models, and the external factors that have been incorporated into the original theoretical models tested in those studies. It is imperative to report that the collected articles were quantitatively analyzed according to the aforementioned themes. By the end of the data extraction stage, the final number of the included studies has become 68 empirical studies. The list of the analyzed studies ($N=68$) is provided in the Appendix Table 2. As described in Fig. 1, we have followed the preferred reporting items for systematic reviews and meta-analysis (PRISMA) (Moher et al., 2009) for undertaking the review process and determining the number of studies at each phase. This helps in showing the flow of information through the different stages of the review. It also depicts the number of articles identified, included and excluded, and the rationale behind the excluded articles.

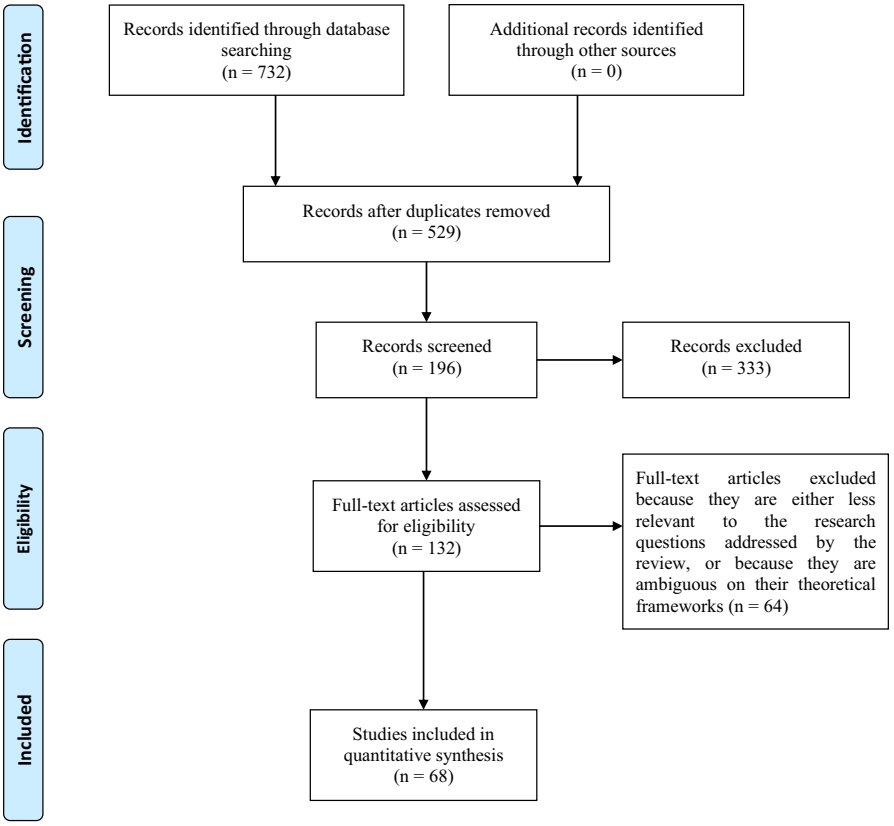

Fig. 1 PRISMA flowchart

4 Results

The 68 articles were critically analyzed to answer the research questions. The results of this review are approached under the following sub-sections.

4.1 Classification by year of publication

Based on the year of publication, Fig. 2 demonstrates the distribution of the reviewed studies over the period between 2005 and 2019. As illustrated, the most obvious trend is that there has been a progressively substantial rise in research endeavors examining the acceptance and adoption of LMS in higher education since 2005. Apart from the years between 2010 and 2019, the rate of empirical published research on LMS acceptance and adoption in higher education stayed constantly parsimonious at an average not exceeding one publication per annum. It was not until the end of the first decade of the third millennium and over the following five years that the interest in researching LMS adoption in higher education has climbed steadily and manifested in nine studies published in 2015. Despite the moderate decline

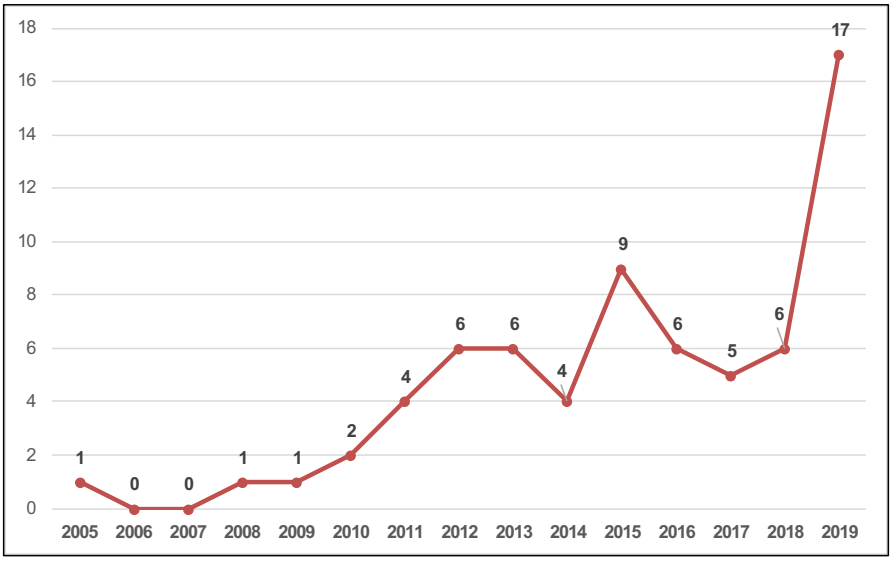

Fig. 2 Distribution of the reviewed studies by year of publication

in the number of published studies from 2015 to 2018 at nine and six studies respectively, a sharp upward in publications has occurred swiftly between 2018 and 2019. More precisely, the number of published studies on the acceptance and adoption of LMS in higher education has considerably boomed as it has increased by approximately three folds, reaching just well under seventeen studies in 2019.

We can attribute this momentous growth in empirical research in the realm of LMS in higher education, particularly towards the end of the last decade, to three main reasons. Firstly, this remarked trend of research is associated with the emergence and evolution of convergent digital media, along with the diffusion of web-based connectivity. Digital ICTs are characterized by interactivity and fluidity and hence, constitute ubiquitous and instantaneous means of transporting digitized information (Ess, 2014). Secondly and consequently, educational institutions have invested immensely in e-learning management systems to the extent that the adoption of e-learning has become the mainstream in higher education (Al-Fraihat et al., 2020). Around 99% of the higher education institutions have installed e-learning management systems, with 85% of them have been in actual use. In the UK alone, 95% of higher education institutions have incorporated e-learning management systems to support their educational services (McGill & Klobas, 2009; Mtebe & Raisamo, 2014; Ramírez-Correa et al., 2017). Thirdly, despite the massive investments in LMS in terms of hardware costs, software licenses, faculty training, subject-matter content development, and equipment maintenance, the rates of LMS utilization in higher education institutions persist in being relatively low among faculty and students as compared to traditionally delivered classroom instruction (Alhabeeb & Rowley, 2018). It has been argued that such pitfalls can be traced back to underestimating the significance of systematic validation and constant evaluation by higher education institutions (Alsabawy et al., 2016). These factors, as mentioned earlier,

have led to a surge for scrutiny into the critical factors that influence the acceptance and adoption of LMS in higher education institutions among several categories of stakeholders at different hierarchal levels.

4.2 Classification by theoretical models

Socio-psychological theories, including the Theory of Social Cognition (TSC) (Bandura, 1977), Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 2011), and Theory of Planned Behavior (TPB) (Ajzen, 1991) have constituted a platform based on which a continuum of theories varying in complexity and hybrid structural relations have emanated and advanced. Socio-psychological theories understand and predict human behavior as being rational and goal-oriented (Ajzen, 2002; Ajzen & Fishbein, 1973, 1977, 2000). On that account, the paradigmatic socio-psychological assumptions tackling the determinants of the acceptance and adoption decisions of LMS are goal-directed, causal, multilevel, and interactive models. These models integrate socio-psychological theories and information systems (IS) theories (Huang et al., 2019; Teo, 2014). Therefore, relevant empirical literature examines models that combine constructs derived from social psychology and IS to investigate the factors influencing behavioral intention towards the adoption of IS in vital sectors such as education (Tarhini et al., 2015; Teo et al., 2018). In the context of virtual learning environments, these theoretical models examine associations and regressions among cognitive (e.g., beliefs and attitudes), contextual (i.e., social, environmental), personal factors, predispositions, capabilities, literacies, and behavioral intentions toward LMS adoption (Cigdem & Topcu, 2015; Islam, 2013; Limayem & Cheung, 2011).

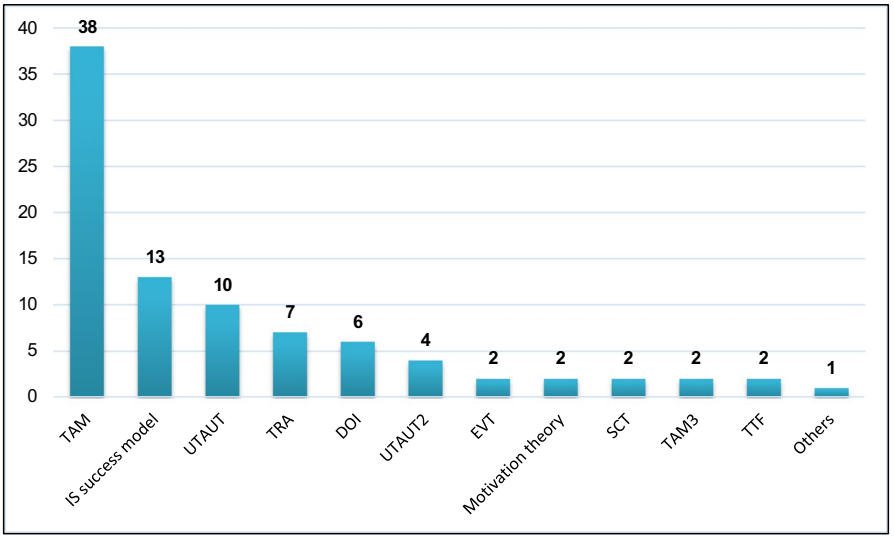

Fig. 3 Classification of the reviewed studies by theoretical models. *Note:* Others include CBAAM, CCC, CET, DTPB, ECM, FBLAM, Flow theory, Media richness theory, SDT, TAM2, TOE, TPB, and USEM

Based on the findings of the 68 included primary studies, we have recognized 24 different theoretical models employed to test the acceptance and adoption of LMS in higher education contexts. Figure 3 shows the most common theoretical models in LMS adoption. The forthcoming subsections report the most frequently replicated theoretical models in the reviewed studies, respectively. It is essential to report that we have only presented the theories that repeatedly occurred at a frequency rate of four studies at a minimum.

4.2.1 Technology acceptance model (TAM)

Technology acceptance has been defined as users' willingness to employ a technology or an IS to perform the tasks it was fundamentally designed to serve and facilitate (Dillon & Morris, 1996). When it initially arose, TAM has manifested a prominent representative of the socio-psychological approach to technology acceptance scrutiny. Simultaneously, TAM has constituted the most viable model for empirical validation to measure the determinants of technology acceptance. Even though TAM appears as a supplemental customized version of TRA, the empirically substantiated explanatory power of the TAM variables in diverse contexts has qualified TAM to stand as a distinct IS theory. At a macro-level, TAM tackles the linear relationships between beliefs, attitudes, intentions, and actual system usage (Davis, 1989).

At the heart of TAM, it is postulated that the intention to use a particular application is grounded on two exogenous variables, namely perceived usefulness and perceived ease of use. Perceived usefulness refers to "the degree to which a person believes that using a particular system would enhance his or her job performance". On the other hand, perceived ease of use denotes "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989). Simultaneously, attitudes mediate the influences of perceived usefulness and perceived ease of use on behavioral intentions, either fully or partially. Moreover, further expanded versions of TAM assume that perceived usefulness and perceived ease of use are regressed on a variety of external variables (Davis, 1989). Because of its adaptability, flexibility, generic, and uncomplicated nature, a wide variety of external variables have been incorporated into the genuine structure of TAM (King & He, 2006). In that, TAM retains its ranking as the most widely used theoretical model to investigate the factors influencing LMS utilization. As previously anticipated, the vast majority of the reviewed studies have embraced TAM at 38 studies.

External variables consolidated into TAM A closer glance into theoretical models adopted in the reviewed studies based on TAM reveals that the external variables amalgamated with the TAM were not limited to prior variables directly influencing perceived ease of use and perceived usefulness. Instead, the external variables transcend perceived ease of use and perceived usefulness to influence endogenous variables in TAM directly, including attitude, behavioral intention, and actual system use. In other words, the TAM-based reviewed studies have integrated and

examined external variables that have functioned as external stimuli affecting cognitive response (i.e., perceived usefulness and perceived ease of use), affective response (i.e., attitude), and behavioral response (i.e., intention).

A wide range of studies has examined the influence of prior individual factors on perceived usefulness and ease of use (Al-Emran & Granić, 2021). This review of literature discloses external factors like training, perceived usefulness for professors (Escobar-Rodriguez & Monge-Lozano, 2012), previous technology experience (Chang et al., 2017), perceived enjoyment, perceived value (Al-Gahtani, 2016; Chang et al., 2017; Cheng, 2011; Shyu & Huang, 2011), perceived playfulness (Padilla-Meléndez et al., 2013; Sánchez & Hueros, 2010), innovativeness, knowledge sharing, quality, and trust (Salloum et al., 2019). A wide range of the reviewed studies has also integrated external variables that represent theoretical constructs from other theories, especially socio-psychological theories. To start with, subjective norms (SN) is a fundamental variable in TRA, which is the parent theory of TAM. There is a trend among the TAM-based reviewed studies towards integrating SN as an external variable influencing both attitudes and intentions (Chang et al., 2017; Cigdem & Topcu, 2015; Farahat, 2012; Huang et al., 2017; Pan et al., 2005; Rejón-Guardia et al., 2019; Revythi & Tselios, 2017; Teo et al., 2019).

In addition to the constructs gleaned from TRA, some of the reviewed studies have incorporated a fundamental socio-cognitive construct that has its roots in social learning theory, more specifically, self-efficacy (Bandura, 1977, 1991). The construct of perceived behavior control from TPB is quite well compatible with the construct of self-efficacy. However, the reviewed studies have tended to adopt the general construct of self-efficacy to formulate a more specific construct, namely, computer self-efficacy that functions as a more reliable proxy of the perceived behavior control beliefs of users' capabilities to harness LMS applications. Such beliefs are conducive to significantly increase the acceptance of LMS (Agudo-Peregrina et al., 2014; Al-Gahtani, 2016; Chang et al., 2017; Cheng, 2011; Cigdem & Topcu, 2015; John, 2015; Pan et al., 2005; Revythi & Tselios, 2017).

On the contrary, a few studies have examined the influence of perceived behavioral control as an external variable that is extracted from TPB (Teo et al., 2019). Concurrently, the influence of computer self-efficacy and perceived behavioral control have been studied along with the influence of computer anxiety on LMS adoption (Agudo-Peregrina et al., 2014; Al-Gahtani, 2016; Cigdem & Topcu, 2015). In the meantime, some of the reviewed studies have integrated "task importance" as an external construct derived from the value-expectancy theory (Schoonenboom, 2012, 2014). Furthermore, the external variables included constructs driven from Rogers' Diffusion of Innovation Theory (DOI), such as "perceived compatibility" (Escobar-Rodriguez & Monge-Lozano, 2012; Islam, 2016; John, 2015; Lai et al., 2012). In addition, other studies have adopted the construct of "organization" that is drawn from the Task-technology Fit (TTF) theory (Akugizibwe & Ahn, 2020), as well as the "e-learning presentation types" from the Media Richness Theory (Liu et al., 2009).

In a wide variety of instances, studies have employed TAM in association with constructs pooled from the DeLone and McLean IS success model. In this regards, the extended theoretical models tested in such studies involved external variables

like course delivery, tutor quality (Bhuasiri et al., 2012; Teo, 2010; Teo & Wong, 2013), system quality, institutional, information, and service quality (Bhuasiri et al., 2012).

This review further reveals that researchers have been also interested in investigating the influence of external contextual variables on TAM genuine variables when being applied to LMS adoption. The external contextual variables recognized in the reviewed studies include perceived organizational support (Amornkitpinyo & Wannapiroon, 2015; Huang et al., 2017), technical support (Sánchez & Hueros, 2010), workplace encouragement, and infrastructure (Walker & Hong, 2017). Furthermore, various studies have integrated variables like perceived resources (Abdel-Wahab, 2008; Chen et al., 2013), e-learning environment (Bhuasiri et al., 2012), perceived system interactivity and functionality (Agudo-Peregrina et al., 2014; Cheng, 2011), perceived system accessibility (Revythi & Tselios, 2017), perceived e-learning assistance, and community building assistance (Islam, 2013).

4.2.2 DeLone and McLean IS success model

DeLone and McLean IS success model, which appeared in 1992, demonstrates a proxy of the user satisfaction approach to examine technology acceptance. The model sought foremost to build an accumulative view of IS research that is not equivocal on its definition of the dependent variable, which is the IS success. To achieve this goal, DeLone and McLean model has posited a taxonomy of the most decisive factors contributing to IS success in various contexts. The original version of the model identified and defined the IS success factors based on a comprehensive review of pertinent literature. The rationale underlying such a taxonomy is the crucial influence of IS success and its vital importance to the functionality and operational efficiency in any institution. To synthesize over 180 previous studies and to put them into a unified perspective, DeLone and McLean (1992) identified six primary categories of IS critical success factors, including system quality, information quality, information use, user satisfaction, individual impacts, and organizational impacts (DeLone & McLean, 1992). However, despite this thorough conceptual taxonomy, there were no empirical validations of the rudimentary IS success model (Al-Fraihat et al., 2020).

The subsequent decade of IS success research has witnessed intensive endeavors to develop the conceptualizations of IS success constructs and to empirically measure and verify the proposed paths in DeLone and McLean IS original framework (Igbaria & Tan, 1997; Jurison, 1996; Seddon, 1997). Some studies have gone further steps forward, attempting to extend the IS success model. Subsequently to those collective investigations, the updated IS success model has incorporated "service quality" as a major dimension in addition to the other semantic dimensions of quality (i.e., "information quality" and "system quality"), each of which should be measured respectively.

Given the multidimensional aspects of the "use" construct and its flaccidly defined conceptualization that interferes with its measurement and interpretation, the updated IS success model has replaced the behavioral construct of "use" with the cognitive construct of "intention to use". Simultaneously, the contemporary model has retained the

causal path indicating the influence of "user satisfaction" on "intention to use". "User satisfaction" is directly proportional to "intention to use", and thus to "use". The qualitatively fundamental extension of the IS success model is the "net benefits" construct. The updated model predicts that "net benefits" will occur because of "use" and "user satisfaction". Furthermore, the model presumes that net benefits from the perspective of the owner or sponsor of the system correlates positively with continuance intention to sustain the use of the system, with feedback loops between "intention to use", "user satisfaction", and "net benefits". Overall, the structural model of IS success assumes the existence of associations among the major constructs, which makes the model process-oriented. Therefore, the updated model of IS success represents a rich source of hypotheses, and hence, measuring instruments to examine the pivotal factors of IS success (Delone & McLean, 2003).

External variables combined into IS success model Most of the reviewed studies have investigated the principal factors of the updated IS success model. However, studies have employed variant operational definitions of "net benefits" on a continuum of individual and institutional gains, such as perceived learning effectiveness (Chaw & Tang, 2018), blended learning benefits, perceived academic performance (Fisher et al., 2018), and cost-effectiveness of institution's educational services (Ramírez-Correa et al., 2017). Nevertheless, certain studies have operationalized "net benefits" of LMS in terms of the individual and organizational impacts of the application (Ghavifekr & Mahmood, 2017; Mtebe & Roope, 2014).

Beyond the net benefits of LMS, another stream of IS success research in the context of LMS has expanded and replaced external quality factors in the IS success model. More specifically, studies have added quality factors such as LMS quality, instructor expertise, instructor support, and general learner self-efficacy (Bhuasiri et al., 2012; Diep et al., 2017; Teo, 2010; Teo & Wong, 2013). Moreover, extended versions of the IS success model have involved quality factors related to the organizational characteristics, including institutional management support, incentive policies, and instructors' training (Al-Busaidi & Al-Shihi, 2012). In addition to the institutional quality, studies have scrutinized characteristics of the e-learning environment, such as course interactivity and flexibility (Turhangil Erenler, 2020).

4.2.3 Unified theory of acceptance and use of technology (UTAUT)

The UTAUT has emanated from a thorough review of technology acceptance theoretical literature (Venkatesh et al., 2003). The objective underlying UTAUT is to predict and explain technology acceptance and adoption-related behavior from the lens of a holistic socio-psychological model (Garone et al., 2019). While doing so, UTAUT has been constructed to bridge gaps in technology acceptance models that have fallen short in accounting for salient acceptance factors related to the users' and systems' characteristics (Thong et al., 2004). On that account, the UTAUT as a seminal evolution in technology acceptance theorization presents a paradigm shift towards a more inclusive framework that encompasses both the instrumental factors

linked to the system and personal factors linked to the users' subjective experience (Cho et al., 2009; Van der Linden & van de Leemput, 2015; Venkatesh & Bala, 2008). Having said that, intention and actual use of technology, rather than attitude, remain central in UTAUT (Garone et al., 2019). As a unified model, UTAUT has resulted from an empirical comparison of eight competing models, including TRA, TAM, TPB, combined TAM and TPB (C-TAM-TBP), Motivation Model (MM), Model of PC Utilization (MPCU), DOI theory, and SCT. Such a comparison has led to theorizing that four core constructs play a key role in directly determining user acceptance, and hence, usage behavior. The four constructs include performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) (Venkatesh et al., 2003).

PE, which is the most significant predictor of intention in both voluntary and compulsory contexts of system use, refers to the degree to which a person believes that using the system would assist him/her to earn increased effectiveness in job performance. Perceived usefulness in TAM, extrinsic motivation in MM, job fit in MPCU, relative advantage in DOI, and outcome expectations in SCT capture the PE construct. EE denotes the degree of perceived ease linked to using the system. Perceived ease of use in TAM, complexity in MPCU, and ease of use in DOI, equally depict the EE. SI is defined as the degree to which an individual perceives that significant referents believe that he/she should use the system. The UTAUT assumes that SI is conceptually equivalent to SN in TRA, TAM2, TPB, C-TAM-TPB, social factors in MPCU, and social image in DOI. FC signifies the degree to which an individual perceives that organizational and technological infrastructures are readily available to assist system use. This definition embodies as the same as the concepts manifested by perceived behavioral control in TPB, facilitating conditions in MPCU, and compatibility in DOI (Pynoo et al., 2012; Venkatesh et al., 2003).

This research reveals that UTAUT is a relatively prevalent theory to study the decisive factors predicting acceptance and adoption of LMS. Yet, such studies are inclined to employ adapted versions of UTAUT that are more parsimonious than the original UTAUT. In this regard, two lines of research can be distinguished. Firstly, a noticeable proportion of studies have focused solely on the predictors linked to the users' (i.e., instructors and learners) subjective experiences and expectancies. For instance, studies have examined the influence of students' previous educational backgrounds (Dečman, 2015), self-management learning (Sultana, 2020), and attitude strength on the intention to use LMS (Nistor et al., 2019). Secondly, a stream of research adopting UTAUT has been oriented towards investigating the factors associated with system characteristics that either facilitate or otherwise impede LMS acceptance and adoption. Examples of such studies have scrutinized factors like the flexibility of accessing the system (Sultana, 2020) and connected classroom climate (Yang et al., 2017).

4.2.4 Theory of reasoned action (TRA)

The TRA is a modified version of the theory of propositional control (Dulany, 1968). According to the TRA, the behavioral intention is the central motivational

factor, which predicts the performance of a specific course of action in a given situation at a given point of time. Hence, the TRA stipulates that the behavioral intentions are determined by two major factors, namely the attitudinal and social normative factors (Ajzen & Fishbein, 1973).

Like a wide range of content areas, TRA is a significant source of the theoretical foundations of the prominent technology acceptance models, especially TAM. Owing to its mere psychosocial nature, TRA nevertheless, has not been eligible to stand alone as an extended theoretical framework in the mainstream LMS acceptance research. Instead, the vast majority of LMS acceptance research borrows specific constructs from TRA and merges such constructs into expanded TAM frameworks. In spite of this state of affairs, there are scarce instances of studies that have built on TRA to examine determinants of technology acceptance. Such studies have integrated cultural dimensions from Hofstede's taxonomy of national culture into the basic structure of TRA, such as individualism-collectivism, power distance, uncertainty avoidance, and indulgence-constraint (Huang et al., 2019). The construct of SN driven from TRA has received a great deal of attention in several studied related to the expansion of technology acceptance models (Amornkitpinyo & Wannapiroon, 2015; Escobar-Rodriguez & Monge-Lozano, 2012; Nistor et al., 2019; Pan et al., 2005; Shyu & Huang, 2011).

4.2.5 Diffusion of innovations (DOI)

Diffusion is a unique process of communication (i.e., convergence or divergence) by which innovations are conveyed through specific channels over time among members of a social framework. When new ideas, practices, or objects are invented, diffused and implemented social change occurs. Consequently, the process of diffusion of innovations, whether it is centralized or decentralized, functions as a means to reform the structure and practices of a social system (van Braak & Tearle, 2007). Accordingly, this implies that DOI consists of four elemental components, namely innovation, communication channels, time, and members of a social system. From the lens of DOI, technology and innovation are synonyms. Additionally, DOI tackles technological innovations from a dual perspective to reduce uncertainty about the outcomes of any technological innovation (Rogers, 2003). In that, the technological innovation is addressed in terms of its software information, meaning information embodied in technology, and innovation-evaluation details on its expected outcomes. Based on such a binary perspective, five characteristics of technological innovation have been recognized as key determinates of the adoption rates of a particular technological innovation (Rogers, 1962).

To explain different rates of technology adoption, relative advantage, comparability, complexity, trialability, and observability are considered critical parameters of success. First, relative advantage refers to the degree to which perceived more efficient and cost-effective than the idea or object that it displaces. Second, compatibility is the perceived degree to which an innovation is compatible with the existing values, previous experiences, and actual needs of prospective users. Third, technological complexity is the degree to which members of a social system perceive

technology to be difficult to understand and use. Fourth, trialability is the degree to which an innovation can be experimented on a limited basis. Fifth, observability refers to the degree to which members of a social system can observe and witness the outcomes of using an innovation (Rogers, 1962).

Six of the 86 reviewed studies in this review have embraced the DOI theory wholly or partially. The adoption of DOI in LMS acceptance research can be attributed to the fact that the use of LMS represents an innovative way of using information and communication technologies to deliver instructional activities. Albeit varying in degree, some of the reviewed studies have adopted certain constructs from DOI, whereas other studies have employed the whole DOI and have expanded it. In addition to the five original constructs of DOI, the extended DOI models used in LMS research involved factors like function evaluation, reliability, and effectiveness (Lin & Chen, 2012a, b; Lin et al., 2014). A number of studies have integrated the construct of "educational compatibility" (John, 2015; Lai et al., 2012), "technological complexity and trialability" (Teo et al., 2019), and "personal innovativeness" (Al-Busaidi & Al-Shihi, 2012) into the original model.

4.2.6 Unified theory of acceptance and use of technology (UTAUT2)

The UTAUT2, which extends the UTAUT by leveraging a new context, has emerged to study technology acceptance and use in a consumer's context. Thus, the UTAUT2 has integrated three additional key constructs from prior marketing research and has altered some of the formerly existing relationships into the original UTAUT. Specifically, the UTAUT2 has included "hedonic motivation", "price value", and "habit" (Viswanath Venkatesh et al., 2012). The UTAUT2 has adopted such constructs because it builds on the UTAUT utilitarian approach to technology acceptance, which manifests itself in the conceptualizations of these additional constructs. For instance, hedonic motivation is defined as the fun or pleasure attained from using technology, which determines technology acceptance and adoption to a great extent (Brown & Venkatesh, 2005). Hedonic motivation, which is also conceptualized as "perceived enjoyment" has been empirically proven to directly influence IS acceptance and actual usage (Thong et al., 2006; van der Heijden, 2004). While the UTAUT has been developed in organizational settings, the UTAUT2 has been developed in marketing settings. Therefore, the cost and pricing structure exert significant impacts on consumers' acceptance and adoption of a given application (Chan et al., 2008). As far as "habit" is concerned, it is distinct from the construct of "experience" in terms of how each construct is operationalized (Venkatesh et al., 2012). To illustrate this, "experience" is operationally defined as the opportunity to use technology over a period that has passed since the initial use of that technology by an individual (Kim & Malhotra, 2005). On the other hand, "habit" is operationally defined as the degree to which an individual believes that he or she has tended to perform a prior behavior automatically because of learning (Limayem & Hirt, 2003).

The outcomes of this research divulge a consensus among studies adopting UTAUT2 on examining the variances in intention to use LMS due to the variations in hedonic motivation, habit, and price value in addition to PE, EE, and FC. Nevertheless, the reviewed studies differed in their operational definitions of these

constructs. For example, the construct of "price value" has been operationally defined as "learning value". This refers to the cost-effectiveness of LMS in enhancing self-regulated learning, knowledge sharing, catering for individual differences in learning pace, and saving time and effort in learning (Ain et al., 2015; Masood & Musman, 2015). Furthermore, some studies have replaced the construct of "price value" with the construct of "experience", although UTAUT2 does not encompass "experience". Additionally, some studies have ventured into testing the moderating effects of demographic factors on the relationships between UTAUT2 factors and intention to use LMS (Dakduk et al., 2018).

5 Discussion and synthesis of research

This systematic review of literature has pursued a twofold aim. First, this review has endeavored to grasp an insight into the most commonly tested theoretical frameworks in empirical literature to investigate the factors influencing LMS acceptance and adoption in higher educational institutions. Second, this review has simultaneously sought unrevealing and classifying the novel external factors that have been incorporated into the original structure of each theory, respectively.

As observed in this review, the surge into LMS acceptance and adoption research has commenced since quite the initial years of the current millennium. Nonetheless, the scope of relevant theoretical underpinnings persists in being limited. Since 2005, the original TAM continues to dominate the theoretical landscape of LMS adoption research. Despite that, the extended versions of TAM, UTAUT, and UTAUT2 have evolved and have proven their viability to test predictors of LMS adoption over time. The remainder of this section critically synthesizes and discusses the predominately employed theoretical frameworks and the frequently investigated external factors that expanded each theory, as recognized in the reviewed studies.

5.1 Most prevalent theories in LMS acceptance and adoption

Despite the multitude of technology acceptance models, almost all of these models originate from goal-oriented socio-psychological and sociological theories that emanate from purposive behaviorism, with a particular reference to SCT, TRA, and TPB. Several remarks arise from such a state of affairs. To start with, technology acceptance models assume combining IS theories into socio-psychological theories. That is to say, technology acceptance models are inclined to examine the causal relationships among beliefs, attitudes, and IS design features. Attitudinal and motivational paradigms in social psychology constitute the rationale for technology acceptance or rejection (Davis, 1993). This rationale stems from the three elemental constituents of socio-psychological theories, namely (1) specifications of the behavior-related component of attitude, (2) distinctions between beliefs, attitudes, and motivations, and (3) designations of the casual links between external stimuli related to the objective features, beliefs, attitudes, and motivations (Fishbein & Ajzen, 2011). In the meantime, technology acceptance models tend to amplify

the explanatory powers of socio-psychological constructs, whereas the empirical weights assigned to external stimuli associated with IS features on actual system usage are comparatively negligible. Thereby, the propositions of technology acceptance models attribute the use or non-use of LMS to "digital choice" rather than to "digital divide" (Van der Linden & van de Leemput, 2015).

A common attribute among the most eminent theories in the realm of LMS acceptance, including TAM, IS success model, UTAUT, TRA, DOI, and UTAUT2 is the stance that user acceptance, adoption, and satisfaction are crucial determinants of LMS development and deployment in a given context (Taherdoost, 2018). Accordingly, technology acceptance models have introduced and examined central socio-psychological factors such as intention as immediate predictors of user acceptance, adoption, and satisfaction. Correspondingly, models such as IS success model and DOI have incorporated factors that address characteristics of LMS in terms of effectiveness, quality, technological complexity, trialability, and observability. Notwithstanding, such technical factors remain subordinate, retaining a peripheral albeit substantive relevance. Evidently, these factors are always exogenous in almost all of the implemented models. Additionally, the vast majority of the models used in the reviewed studies maintain ambiguity on the operational definitions of the salient constructs of acceptance, adoption, and satisfaction concerning LMS use. Admittedly, the multidimensional and interdependence of these models require recasting conceptual and operational definitions of each aspect of user, acceptance, adoption, and satisfaction. Otherwise, evaluating LMS acceptance and adoption would be a thorny exercise (Delone & McLean, 2003).

It is acknowledgeable that the reviewed studies have availed themselves of the generic nature of technology acceptance models to add and examine new external factors. Despite that, the extended models that emerged in those studies have not tackled some decisive factors pertinent to the specific contexts where those studies took place. Rarely, there have been extended technology acceptance models that investigate the influences of cultural dimensions, including individualism/collectivism, masculinity/femininity, power distance, and uncertainty avoidance, and socio-economic factors, including gross national income (GNI), quality of work-life, and human development index (HDI) (Tarhini et al., 2017). In this regard, it has been indicated that cultural dimensions have the potential of affecting the casual relationships within technology acceptance models (Sánchez-Franco et al., 2009). On top of that, the exogenous factors in each theory, such as PU and PEOU in TAM, quality factors in the IS success model, SN in TRA, PE, EE, SI, and FC in UTAUT are viewed as broad sets of criterions each of which is measured on a continuum. By contrast, roughly none of the models used in the reviewed studies has ventured into examining and classifying exogenous factors into catalysts, or vice versa inhibitors of LMS use.

Although it is the most commonly used model, TAM is criticized for being a linear, unidirectional, recursive, and stringently behavioral model. That is to say, TAM does not encompass feedback loops, and hence, does not permit for measuring reciprocal effects among user-motivational factors, nor does it allow for the evaluation of IS use outcomes. To illustrate this further, scarcely have been there technology acceptance models, among the reviewed ones, that integrate academic performance.

Such a state discloses that LMS adoption in the vast majority of the contexts, where the reviewed models have been tested is still in its embryonic trial stages considering that the majority of the reviewed models are primarily concerned with the initial acceptance of LMS. Such a drift towards examining the initial acceptance and adoption of LMS suggests the steadily increasing numbers of higher education institutions that have recently launched their LMS. Although LMS has become an indispensable tool in both purely online distance education and blended learning, it is still inconclusive and seemingly too early to judge whether the use of LMS bears a significant influence on academic performance, especially among collectivistic societies and developing countries.

The results of this review have revealed that TAM and DeLone and McLean IS success model are the most frequently used models to study the acceptance and adoption of LMS, respectively. Usually, TAM and DeLone and McLean IS success model have been extended by integrating constructs from other theories, especially TRA, DOI, TPB, SCT, UTAUT, and TTF. Such models have concentrated exclusively on the factors influencing LMS adoption, but have not examined how acceptance and adoption factors and the actual LMS usage are conducive to the attainment of specific learning outcomes (Hassanzadeh et al., 2012; Islam, 2013). Thus, the reviewed technology acceptance models can be subsumed within the research paradigm that tacitly implies that LMS post-adoption behavior is an extension to LMS users' initial acceptance behavior. Further, the reviewed models have not employed the IS continuance models, such as the expectation confirmation model (ECM), as their basic theoretical foundations (Bhattacherjee, 2001). Thereby, it would be plausible to presume that the reviewed models would use the same set of factors to predict and explain LMS continued use.

It has been noticed in this review that technology acceptance models do not embrace a holistic approach to studying the LMS acceptance among current and prospective users. That is to say, scarcely are there models that reconcile both technology acceptance factors and user satisfaction factors (Wixom & Todd, 2005). The lack of a holistic approach to LMS acceptance research would pose the question as to whether there is a need for more thorough models that take into account both schools of thought, specifically, social technology acceptance and user satisfaction (Van der Linden & van de Leemput, 2015).

It can be observed that some of the technology acceptance models, specifically the ones embracing UTAUT and UTAUT2, have stressed the habituation perspective, which stems from the routinization of behavior in that UTAUT and UTAUT2 involve factors like "experience" and "habit", respectively. The habitual perspective is fundamentally distinct from the reasoned action approach to the routinization of behavior, even though UTAUT and UTAUT2 assume that TRA is their main theoretical stance. The ability of "habit" to explain the relationship between prior and later behavior has constituted a prolonged controversy among opponents of the reinforcement theory of learning and opponents of purposive behaviorism. The strong relation between past and later behavior does not transcend being an indicator of the temporal stability of behavior. That being the case, temporal stability of behavior is not due to habituation. Rather, behavior stability is attributed to the unchanged cognitive and motivational factors that are existing whenever the behavior is enacted

and observed (Ajzen, 2002; Eagly & Chaiken, 1993). Just as temporal stability of behavior is not attributable to habituation, the residual effect of past behavior on later behavior is not a sufficient indication of habituation (Ajzen, 2002).

Albeit embracing variant schools of thought, socio-psychological theories have been dominating theorization in LMS adoption research. Nevertheless, such a dominant trait is not invariant. For instance, the DOI, which is one of the prevalent theories in LMS research, has its roots in sociology rather than social psychology. In essence, the DOI establishes and addresses the characteristics of innovative technologies that contribute to their diffusion among members of a social system (Rogers, 2003). Thereby, DOI per se has not proposed a structural model for measuring the reciprocal influences among the characteristics of innovations, and the individuals' beliefs, attitudes, and intentions toward the adoption of innovations. To make it amenable for empirical testing, the DOI has been given a definitive shape by elaborating it into a multilevel causal model from a psychological theoretical lens. The socio-psychological modality of DOI adds evidence to the socio-cognitive propositions that self-regulation, forethought, and intentionality lie at the very heart of causal processes that provide bases for all facets of human agency manifested in purposeful action (Bandura, 1991).

5.2 External variables assimilated into widespread technology acceptance models

This review of the literature has indicated that a considerable proportion of LMS acceptance models have been tested after interaction with prototype LMS programs under development. In the meantime, a plethora of external variables has been incorporated to expand LMS acceptance models from an end-user perspective. The abundance of external factors integrated into LMS acceptance models can be explained by the wide variety of LMS applications investigated, the various technology acceptance theories tested, and diverse types of end-users recruited in the empirical literature. That being said, there is a dearth of taxonomies that systematically classify external variables in LMS acceptance models into distinct categories. Irrespective of the different theoretical frameworks used to establish LMS acceptance models, the results of this review elucidate that external factors linked to LMS acceptance models fall primarily into three macro-categories, including individual variables, contextual variables, and psychological/behavioral constructs driven from other theories. Figure 4 shows through a mind map the external factors predicting LMS acceptance and adoption in higher education. Such a categorization is compatible with the socio-cognitive theoretical underpinnings of the plurality of technology acceptance models. In this regard, the socio-cognitive perspective presumes a triadic causal interactive view among environmental, cognitive, and behavioral variables (Wood & Bandura, 1989).

First, individual variables have been defined as "an individual's characteristics in terms of their subconscious perceptions and previous experiences" (Chavoshi & Hamidi, 2019). Thus, individual variables encompass intrinsic cognitive and personal characteristics of the end-users themselves. For example, the cognitive factors describe how individuals conceive of the perceived value, perceived enjoyment,

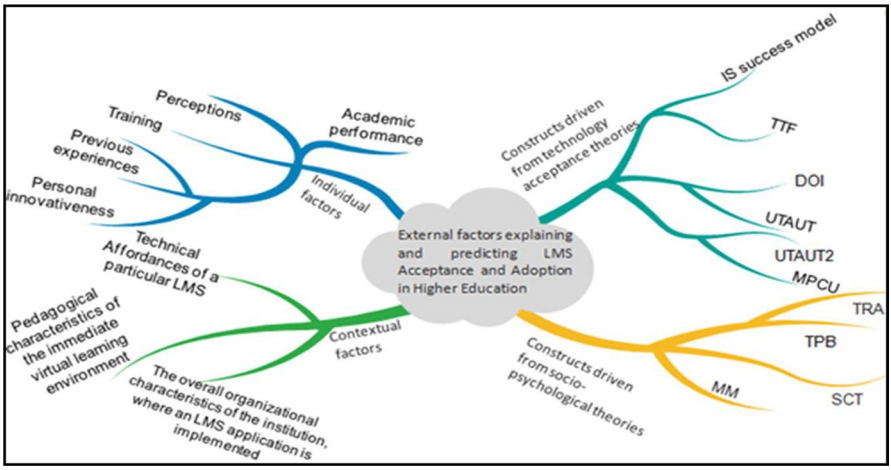

Fig. 4 A mind map of the external factors predicting LMS acceptance and adoption in higher education

and perceived playfulness associated with LMS usage in addition to factors like trust, motivation, computer anxiety, and computer self-efficacy. On the other hand, personal characteristics of users include their previous subjective experiences with the system, and skills such as experience, training, personal innovativeness, and academic performance. It is worth mentioning that the current review has treated individual factors as external variables influencing beliefs of the LMS utility and ease of use rather than moderating variables influencing the relationships between beliefs, behavioral intentions, and actual system usage such as gender or age. A wide range of studies has substantiated the critical influences of individual factors on LMS acceptance, adoption, and user satisfaction among students and instructors (Ball & Levy, 2008; Hamidi & Chavoshi, 2018; Hao et al., 2017; Kim et al., 2017; Šumak et al., 2011).

Second, contextual factors comprise the largest macro-category of external variables since contextual factors are manifold. For the most part, the results of this review have led to conceptualizing contextual variables as the technical affordances of LMS and the pedagogical characteristics of the immediate virtual learning environment where an LMS functions. On a broader encapsulating level, contextual variables additionally embody the overall organizational characteristics of the institution, where an LMS application is implemented. In conformity with the abovementioned conceptualization, contextual factors related to the system characteristics that can be recognized in this review involve system quality factors (e.g., service quality, technical support, interface design, and infrastructure). Besides, the contextual factors related to the pedagogical characteristics of the system include interactivity, learning content quality, information quality, tutor quality, learning support, scaffolding, course delivery, learning assistance, community building assistance, reliability, suitability, recentness, and educational compatibility of any designed digital sources such as images, videoconferencing, lectures, assignments, and quizzes. Furthermore, the contextual factors related to the organizational characteristics are concerned mainly

with the logistic merits available at an institution, which have the potential of impeding or facilitating LMS acceptance and adoption such as incentives, training, maintenance, and institutional support. While some studies have differentiated between contextual and pedagogical factors as two distinct macro-categories, the results of this review have substantiated the plausibility of subsuming pedagogical and technical characteristics of LMS as well as the organizational properties of an institution under the inclusive umbrella of contextual factors.

The rationale behind merging technical, pedagogical, and organizational characteristics within a unified macro-category emanates from the fact that each micro-category of contextual factors represents a unique aspect of the virtual learning environment and the institutional environment where the LMS operates and serves different stakeholders. Although different previous studies have adopted different classifications of contextual factors influencing LMS acceptance, most of those studies have not tackled any further supplemental contextual factors beyond the technical, pedagogical, and organizational characteristics of the e-learning system (Almaiah et al., 2016; Cheng et al., 2012; Cheng, 2015; Mohammadi, 2015).

Behavioral and psychological constructs induced from other theories account for the third macro-category of external factors attached to LMS acceptance models. External factors drawn from other theories and incorporated into LMS acceptance models are principally integrated into the theoretical underpinnings underlying LMS acceptance models to serve two main purposes. First, constructs from other theories complement, consolidate, and extend technology acceptance theories underlying those LMS acceptance model. For instance, TAM, which is the most prominently used in LMS acceptance research, has been complemented by constructs from two theoretical streams. This includes (a) technology acceptance theories, including IS success model, TTF, DOI, and UTAUT, and (b) socio-psychological theories, namely SCT, TRA, and TPB (Islam, 2011; Larsen et al., 2009; Liao et al., 2007). Second, the incorporation of constructs from other theories into LMS acceptance models is intended to elevate the explanatory and predictive power of those models (King & He, 2006).

The results of this systematic review revealed that the most commonly used external factors that are not genuine into the theories through which they have been integrated are perceived quality factors, subjective norms, computer anxiety, perceived value, computer self-efficacy, and experience, respectively. These results are consistent partially with the results of previous meta-analyses conducted with the aim of discovering the most common external factors used to extend TAM in studies that examine e-learning adoption (Abdullah et al., 2016; Abdullah & Ward, 2016). The current review has found that quality factors, extracted from the IS success model, constitute a majority of the external factors involved into LMS acceptance models, whereas previous meta-analyses have discovered that more psychological factors that can be measured on the level of individual users are the most frequently incorporated external factors into LMS acceptance model. Such a discrepancy can be attributed to the fact that the current study has reviewed a wide range of empirical studies that have employed hybrid LMS acceptance models that are built on diverse theoretical frameworks let alone TAM and IS success models.

The resolute and recurrent integration of quality factors into LMS acceptance models is purposeful and persistent. We can interpret and hence justify the frequent

integration of quality factors in light of three main rationales. First, it is acknowledgeable that the accelerating embarkation on LMS adoption in higher education institutions on an international scale, especially during the last decade, has been in the meantime, accompanied by a skeptical research nativity, aiming to evaluate the success of LMS adoption. Second, many LMS adoption initiatives worldwide have not achieved their recruiting targets (Alsabawy et al., 2016; McGorry, 2003; Rovai & Downey, 2010). Such a condition has motivated the genesis and evolution of two parallel lines of research, namely research concerned with investigating the factors influencing LMS acceptance and adoption (whether initial or sustained), and research focusing on the quality factors that are deemed to be decisive to user satisfaction with LMS adoption (Islam, 2011, 2012; Šumak et al., 2011). Therefore, several endeavors have arisen in an attempt to adopt a holistic joint approach combining elements from both lines of research. Third, the high levels of competitiveness among higher education institutions globally, especially on technology adoption, e-learning adoption, distance education, and cost-effectiveness have been conducive to the increasingly stringent implementation of quality assurance measures and criteria. Such quality measures have been comprehensive in that they cover various facets of e-learning quality determinants, to name a few, organizational, institutional, pedagogical, interface design, learning content, and delivery accepts.

6 Conclusion

We have conducted this review of literature in pursuit of bridging two salient gaps in previous research. First, the vast majority of systematic reviews and meta-analyses have not provided a comprehensive insight into various theoretical frameworks implemented to study the acceptance and adoption of LMS in higher education contexts. Instead, previous literature reviews have concentrated exclusively on reviewing TAM and the external factors associated with it. By contrast, the current study has reviewed a variety of theories and their external factors. Second, previous reviews have not sufficiently emphasized the adaptation of technology acceptance theories to LMS adoption, even though some of the reviews have surveyed empirical literature related to e-learning in broad terms.

The present review has arrived at a revisited conceptualization of the current state of technology acceptance theories in LMS empirical research. Such a visualization manifests itself in several outcomes. There has been a steady growth in the number of empirical studies examining what influences LMS acceptance and adoption in higher education institutions since 2005. Nevertheless, the year 2019 has had the lion's share of those studies, reaching a peak of 38 studies. Moreover, the original TAM, DeLone and McLean IS success model, UTAUT, TRA, DOI, and UTAUT2 have been dominating the theoretical landscape in LMS research, since 2005. Therefore, we presume that the most substantial part of LMS research investigates the factors influencing the initial adoption of LMS. Since almost none of the reviewed studies has incorporated the ECM, we can assume that the reviewed studies would employ the same set of variables to examine the continued use of LMS. Furthermore, quality factors have accounted for the recurrent external factors integrated into LMS acceptance models to

complement them and increase their predictive power. The ascending interest in examining quality factors reflects an orientation towards emphasizing LMS post-adoption user satisfaction in parallel with examining LMS user acceptance and adoption.

Besides, the most significant bulk of studies have recruited samples among undergraduate students. In contrast, only a minority of studies have investigated the factors influencing LMS adoption from the perspectives of other stakeholders in higher education institutions such as instructors, IS professionals, administrators, and curriculum developers. Additionally, a plurality of the reviewed studies has devised predictive and comparative research designs based on structured self-report survey tools. Further, the majority of LMS research has predominantly investigated respondents from among affiliates of specific departments like business administration, information systems, and educational technologies. On the contrary, LMS adoption in specific fields of study, such as medical education, legal education, language, and literacy education remains an underexplored territory. Further, rarely has there been studies examine acceptance and adoption of specific tools and features available in the LMS, while the majority of studies have examined the acceptance and adoption of LMS as a whole.

6.1 Theoretical contributions

The current review has strived to contribute to the development of the foundational theoretical underpinnings of LMS acceptance and adoption research, with a particular emphasis on several threads. First, the current study has attempted to arrive at a better understanding of how and why IS theories and socio-psychological theories are jointly and systematically employed to formulate theoretical models that serve as sources of hypotheses on LMS adoption especially in higher education contexts. To that end, the present review has strived to analyze an epistemological frame of reference for establishing LMS acceptance theoretical models. Second, the current review has differentiated between several theories of technology acceptance that function as a basis for LMS acceptance and adoption models in terms of their comprehensiveness, predictive power, and amenability for empirical testing. Third, this review has grasped an in-depth insight into the recent research trends in LMS adoption by recognizing, locating, and classifying novel external factors affirmed and investigated in LMS adoption models. Reviewing research trends in this respect would assist in setting a pool of factors that are crucial to the success of LMS adoption. Hence, such a pool of factors has the potential of constituting a standardized inventory of criteria for evaluating LMS success in future studies.

Fourth, the results of the current review can serve as a point of departure for launching and synthesizing more advanced hybrid multilevel LMS adoption theoretical models and consequently would lead to the exponential growth and maturation of theorization in LMS adoption as a fully-fledged and distinct branch of the broader technology acceptance theorization. Fifth, the current review has contributed to comprehending the critical rationales underlying the divergences and convergences among various schools of thought from which technology acceptance theories have emanated, especially concerning LMS adoption and post-adoption.

6.2 Practical implications

The findings of this review bear several practical implications for educators and e-learning management system designers in higher education. That is because the findings of this systematic review depict a detailed picture of the most pivotal factors that drive influential stakeholders in higher education institutions to accept, adopt, and be satisfied with LMS usage on various levels. For example, determining the essential individual factors that impact LMS acceptance and adoption among students would guide educators' endeavors to cultivate a set of cognitive and meta-cognitive skills within those learners. Furthermore, it would inform and steer the pedagogies in higher education to offer students a multitude of enriched learning and training experiences to harness tools and features of LMS. On more macro-contextual levels, recognizing a wide array of quality factors related to the characteristics of the system, service and technical support, organizational, and institutional assistance, would stimulate making, and modifying policies and best practices to control. This would augment the cost-effectiveness of LMS utilization, their net benefits, pedagogical efficiency, and their impact on academic performance and learning outcomes.

6.3 Directions for further research

The findings of the study convey implications for future research in the realm of LMS acceptance and adoption. For researchers, undergraduate students can function as surrogates for prospective employees in research studies that seek to scrutinize the factors affecting LMS acceptance and adoption among workers in various sectors. Consequently, the findings of prospective studies that recruit student respondents have the potential to expand knowledge of the drivers and incentives that motivate employees to adopt the LMS when it is initially launched. Future studies can benefit from the findings of this review on the most commonly tested technology acceptance models and external factors by revisiting and re-examining those models and external factors in more depth in subsequent replications of LMS acceptance models. This review has observed that most of the reviewed studies tend to adopt technology acceptance models to investigate the LMS use, and thus, further studies would employ the same models and sets of variables to study the continued use of LMS. Thereby, the results of this review can pave the path into integrating technology acceptance models and continued technology adoption models such as ECM. In this respect, the findings of this review encourage subsequent studies and reviews that attempt to discover and analyze lines of research that stem from the primary research streams into LMS adoption and post-adoption. Ultimately, the findings of this review can assist in informing the development of expanded LMS acceptance and adoption models as a unique and well-defined sub-domain of technology theorization.

6.4 Study limitations

The reviewing process in this literature review suffered from several limitations in terms of the search strategies, inclusion and exclusion criteria, and the critical

appraisal of the included studies. First, the reviewing process did not adopt exhaustive lists of possible keywords and search terms on LMS acceptance and adoption. Further, this review of the literature did not discuss the publication bias of the reviewed studies. Moreover, the current review could have conducted searches for primary sources within a variety of databases.

Appendix

Table 2 List of analyzed studies

Study No.	Source
S1	(Escobar-Rodriguez & Monge-Lozano, 2012)
S2	(Chang et al., 2017)
S3	(Watty et al., 2016)
S4	(Ali et al., 2016)
S5	(Farahat, 2012)
S6	(Agudo-Peregrina et al., 2014)
S7	(Amornkitpinyo & Wannapiroon, 2015)
S8	(Bhuasiri et al., 2012)
S9	(Huang et al., 2019)
S10	(Teo, 2010)
S11	(Islam, 2016)
S12	(Shyu & Huang, 2011)
S13	(Al-Gahtani, 2016)
S14	(Baharin et al., 2015)
S15	(Khasawneh, 2015)
S16	(Liu et al., 2009)
S17	(Kanthawongs & Kanthawongs, 2013)
S18	(Islam, 2013)
S19	(Dečman, 2015)
S20	(Ramírez-Correa et al., 2017)
S21	(Sánchez & Hueros, 2010)
S22	(Padilla-Meléndez et al., 2013)
S23	(Cigdem & Topcu, 2015)
S24	(Prasad et al., 2018)
S25	(Almarashdeh, 2016)
S26	(Estriegana et al., 2019)
S27	(John, 2015)
S28	(Schoonenboom, 2012)
S29	(Schoonenboom, 2014)
S30	(Cigdem & Ozturk, 2016)

Table 2 (Continued)

Study No.	Source
S31	(Lai et al., 2012)
S32	(Teo et al., 2019)
S33	(Sultana, 2020)
S34	(Revythi & Tselios, 2017)
S35	(Salloum et al., 2019)
S36	(Ghavifekr & Mahmood, 2017)
S37	(Teo et al., 2019)
S38	(Tawafak et al., 2020)
S39	(Kumar & Bervell, 2019)
S40	(Lin & Chen, 2012a, 2012b)
S41	(Al-Busaidi & Al-Shihi, 2012)
S42	(Akugizibwe & Ahn, 2020)
S43	(Rejón-Guardia et al., 2019)
S44	(Larmuseau et al., 2018)
S45	(Antwi-Boampong, 2020)
S46	(Lin et al., 2014)
S47	(Nistor et al., 2019)
S48	(Mtebe & Raisamo, 2014)
S49	(Turhangil Erenler, 2020)
S50	(Cheng, 2011)
S51	(Ritchie et al., 2011)
S52	(Garone et al., 2019)
S53	(Eraslan Yalcin & Kutlu, 2019)
S54	(Abdel-Wahab, 2008)
S55	(Yuen et al., 2019)
S56	(Diep et al., 2017)
S57	(Walker & Hong, 2017)
S58	(Dakduk et al., 2018)
S59	(Boateng et al., 2016)
S60	(Pan et al., 2005)
S61	(Yakubu & Dasuki, 2018)
S62	(Teo & Wong, 2013)
S63	(Waheed et al., 2016)
S64	(Ain et al., 2015)
S65	(Fisher et al., 2018)
S66	(Yang et al., 2017)
S67	(Chen et al., 2013)
S68	(Chaw & Tang, 2018)

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

References

Abdel-Wahab, A. G. (2008). Modeling students' intention to adopt E-learning: A case from Egypt. *The Electronic Journal of Information Systems in Developing Countries, 34*(1), 1–13. https://doi.org/10.1002/j.1681-4835.2008.tb00232.x.

Abdullah, F., & Ward, R. (2016). Developing a General Extended Technology Acceptance Model for E-Learning (GETAMEL) by analysing commonly used external factors. *Computers in Human Behavior, 56*, 238–256. https://doi.org/10.1016/j.chb.2015.11.036.

Abdullah, F., Ward, R., & Ahmed, E. (2016). Investigating the influence of the most commonly used external variables of TAM on students' Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) of e-portfolios. *Computers in Human Behavior, 63*, 75–90. https://doi.org/10.1016/j.chb.2016.05.014.

Agudo-Peregrina, Á. F., Hernández-García, Á., & Pascual-Miguel, F. J. (2014). Behavioral intention, use behavior and the acceptance of electronic learning systems: Differences between higher education and lifelong learning. *Computers in Human Behavior, 34*, 301–314. https://doi.org/10.1016/j.chb.2013.10.035.

Ain, N., Kaur, K., & Waheed, M. (2015). The influence of learning value on learning management system use: An extension of UTAUT2. *Information Development, 32*(5), 1306–1321. https://doi.org/10.1177/0266666915597546.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.

Ajzen, I. (2002). Residual effects of past on later behavior: Habituation and reasoned action perspectives. *Personality and Social Psychology Review, 6*(2), 107–122. https://doi.org/10.1207/S15327957PSPR0602_02.

Ajzen, I., & Fishbein, M. (1973). Attitudinal and normative variables as predictors of specific behavior. *Journal of Personality and Social Psychology, 27*(1), 41–57. https://doi.org/10.1037/h0034440.

Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin, 84*(5), 888–918. https://doi.org/10.1037/0033-2909.84.5.888.

Ajzen, I., & Fishbein, M. (2000). Attitudes and the attitude-behavior relation: Reasoned and automatic processes. *European Review of Social Psychology, 11*(1), 1–33. https://doi.org/10.1080/14792779943000116.

Akugizibwe, E., & Ahn, J. Y. (2020). Perspectives for effective integration of e-learning tools in university mathematics instruction for developing countries. *Education and Information Technologies, 25*(2), 889–903. https://doi.org/10.1007/s10639-019-09995-z.

Al-Busaidi, K. A., & Al-Shihi, H. (2012). Key factors to instructors' satisfaction of learning management systems in blended learning. *Journal of Computing in Higher Education, 24*(1), 18–39. https://doi.org/10.1007/s12528-011-9051-x.

Al-Emran, M., & Granić, A. (2021). Is it still valid or outdated? A Bibliometric analysis of the technology acceptance model and its applications from 2010 to 2020. *Recent Advances in Technology Acceptance Models and Theories*. https://doi.org/10.1007/978-3-030-64987-6_1.

Al-Emran, M., & Teo, T. (2020). Do knowledge acquisition and knowledge sharing really affect e-learning adoption? An empirical study. *Education and Information Technologies, 25*, 1983–1998. https://doi.org/10.1007/s10639-019-10062-w.

Al-Fraihat, D., Joy, M., Masa'deh, R., & Sinclair, J. (2020). Evaluating E-learning systems success: An empirical study. *Computers in Human Behavior, 102*(August 2019), 67–86. https://doi.org/10.1016/j.chb.2019.08.004.

Al-Gahtani, S. S. (2016). Empirical investigation of e-learning acceptance and assimilation: A structural equation model. *Applied Computing and Informatics, 12*(1), 27–50. https://doi.org/10.1016/j.aci.2014.09.001.

Alhabeeb, A., & Rowley, J. (2018). E-learning critical success factors: Comparing perspectives from academic staff and students. *Computers & Education, 127*, 1–12. https://doi.org/10.1016/j.compedu.2018.08.007.

Ali, F., Nair, P. K., & Hussain, K. (2016). An assessment of students' acceptance and usage of computer supported collaborative classrooms in hospitality and tourism schools. *Journal of Hospitality, Leisure, Sport and Tourism Education, 18*, 51–60. https://doi.org/10.1016/j.jhlste.2016.03.002.

Almaiah, M. A., Jalil, M. A., & Man, M. (2016). Extending the TAM to examine the effects of quality features on mobile learning acceptance. *Journal of Computers in Education, 3*(4), 453–485. https://doi.org/10.1007/s40692-016-0074-1.

Almarashdeh, I. (2016). Sharing instructors experience of learning management system: A technology perspective of user satisfaction in distance learning course. *Computers in Human Behavior, 63*, 249–255. https://doi.org/10.1016/j.chb.2016.05.013.

Al-Qaysi, N., Mohamad-Nordin, N., & Al-Emran, M. (2020a). Employing the technology acceptance model in social media: A systematic review. *Education and Information Technologies*, 1–42. https://doi.org/10.1007/s10639-020-10197-1.

Al-Qaysi, N., Mohamad-Nordin, N., & Al-Emran, M. (2020b). Factors affecting the adoption of social media in higher education: A systematic review of the technology acceptance model. In *Recent Advances in Intelligent Systems and Smart Applications* (pp. 571–584). Springer.

Alsabawy, A. Y., Cater-Steel, A., & Soar, J. (2016). Determinants of perceived usefulness of e-learning systems. *Computers in Human Behavior, 64*, 843–858.

Amornkitpinyo, T., & Wannapiroon, P. (2015). Causal relationship model of the technology acceptance process of learning innovation in the 21ST century for graduate students. *Procedia - Social and Behavioral Sciences, 174*, 2090–2095. https://doi.org/10.1016/j.sbspro.2015.02.006.

Antwi-Boampong, A. (2020). Towards a faculty blended learning adoption model for higher education. *Education and Information Technologies, 25*(3), 1639–1662. https://doi.org/10.1007/s10639-019-10019-z.

Baharin, A. T., Lateh, H., Nathan, S. S., & Nawawi, H. M. (2015). Evaluating effectiveness of IDEWL using technology acceptance model. *Procedia - Social and Behavioral Sciences, 171*, 897–904. https://doi.org/10.1016/j.sbspro.2015.01.207.

Ball, D. M., & Levy, Y. (2008). Emerging educational technology: Assessing the factors that influence instructors' acceptance in information systems and other classrooms. *Journal of Information Systems Education, 19*(4), 431–443.

Bandura, A. (1977). *Social learning theory*. Prentice-Hall, Inc..

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes, 50*(2), 248–287.

Bhattacherjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. *MIS Quarterly*, 351–370.

Bhuasiri, W., Xaymoungkhoun, O., Zo, H., Rho, J. J., & Ciganek, A. P. (2012). Critical success factors for e-learning in developing countries: A comparative analysis between ICT experts and faculty. *Computers & Education, 58*(2), 843–855.

Boateng, R., Mbrokoh, A. S., Boateng, L., Senyo, P. K., & Ansong, E. (2016). Determinants of e-learning adoption among students of developing countries. *The International Journal of Information and Learning Technology, 33*(4), 248–262.

Booth, A., Sutton, A., & Papaioannou, D. (2016). Taking a systematic approach to your literature review. *Systematic Approaches to Successful Literature Review*, 9–35.

Brown, M. G. (2016). Blended instructional practice: A review of the empirical literature on instructors' adoption and use of online tools in face-to-face teaching. *Internet and Higher Education, 31*, 1–10. https://doi.org/10.1016/j.iheduc.2016.05.001.

Brown, S. A., & Venkatesh, V. (2005). Model of adoption of Technology in Households: A baseline model test and extension incorporating household life cycle. *MIS Quarterly, 29*(3), 399–426. https://doi.org/10.2307/25148690.

Chan, K. Y., Gong, M., Xu, Y., & Thong, J. Y. L. (2008). Examining user acceptance of SMS: An empirical study in China and Hong Kong. *Proceedings of 12th Pacific Asia Conference on Information System*.

Chang, C.-T., Hajiyev, J., & Su, C.-R. (2017). Examining the students' behavioral intention to use e-learning in Azerbaijan? The general extended technology acceptance model for E-learning approach. *Computers & Education, 111*, 128–143.

Chavoshi, A., & Hamidi, H. (2019). Social, individual, technological and pedagogical factors influencing mobile learning acceptance in higher education: A case from Iran. *Telematics and Informatics, 38*, 133–165. https://doi.org/10.1016/j.tele.2018.09.007.

Chaw, L. Y., & Tang, C. M. (2018). What makes learning management systems effective for learning? *Journal of Educational Technology Systems, 47*(2), 152–169. https://doi.org/10.1177/0047239518795828.

Chen, B., Sivo, S., Seilhamer, R., Sugar, A., & Mao, J. (2013). User acceptance of Mobile technology: A campus-wide implementation of Blackboard's Mobile™ learn application. *Journal of Educational Computing Research, 49*(3), 327–343. https://doi.org/10.2190/EC.49.3.c.

Cheng, Y. (2011). Antecedents and consequences of e-learning acceptance. *Information Systems Journal, 21*(3), 269–299.

Cheng, Y. M. (2015). Towards an understanding of the factors affecting m-learning acceptance: Roles of technological characteristics and compatibility. *Asia Pacific Management Review, 20*(3), 109–119. https://doi.org/10.1016/j.apmrv.2014.12.011.

Cheng, B., Wang, M., Moormann, J., Olaniran, B. A., & Chen, N.-S. (2012). The effects of organizational learning environment factors on e-learning acceptance. *Computers & Education, 58*(3), 885–899. https://doi.org/10.1016/j.compedu.2011.10.014.

Childs, S., Blenkinsopp, E., Hall, A., & Walton, G. (2005). Effective e-learning for health professionals and students—Barriers and their solutions. A systematic review of the literature—Findings from the HeXL project. *Health Information & Libraries Journal, 22*, 20–32.

Cho, V., Cheng, T. C. E., & Lai, W. M. J. (2009). The role of perceived user-interface design in continued usage intention of self-paced e-learning tools. *Computers & Education, 53*(2), 216–227.

Cigdem, H., & Ozturk, M. (2016). Factors affecting students' behavioral intention to use LMS at a Turkish post-secondary vocational school. *International Review of Research in Open and Distance Learning, 17*(3), 276–295. https://doi.org/10.19173/irrodl.v17i3.2253.

Cigdem, H., & Topcu, A. (2015). Predictors of instructors' behavioral intention to use learning management system: A Turkish vocational college example. *Computers in Human Behavior, 52*, 22–28. https://doi.org/10.1016/j.chb.2015.05.049.

Dakduk, S., Santalla-Banderali, Z., & van der Woude, D. (2018). Acceptance of blended learning in executive education. *SAGE Open, 8*(3), 1–16. https://doi.org/10.1177/2158244018800647.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008.

Davis, F. D. (1993). User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies, 38*(3), 475–487.

Dečman, M. (2015). Modeling the acceptance of e-learning in mandatory environments of higher education: The influence of previous education and gender. *Computers in Human Behavior, 49*, 272–281. https://doi.org/10.1016/j.chb.2015.03.022.

DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research, 3*(1), 60–95.

Delone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems, 19*(4), 9–30. https://doi.org/10.1080/07421222.2003.11045748.

Diep, A.-N., Zhu, C., Struyven, K., & Blieck, Y. (2017). Who or what contributes to student satisfaction in different blended learning modalities? *British Journal of Educational Technology, 48*(2), 473–489. https://doi.org/10.1111/bjet.12431.

Dillon, A., & Morris, M. G. (1996). User acceptance of new information technology—Theories and models. In M. Williams (Ed.), *Annual review of information science and technology* (pp. 3–32). Information Today.

Dulany, D. E. (1968). Awareness, rules, and propositional control: A confrontation with SR behavior theory. In *Verbal Behavior and General Behavior Theory* (pp. 340–387).

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Harcourt Brace Jovanovich College Publishers.

Eraslan Yalcin, M., & Kutlu, B. (2019). Examination of students' acceptance of and intention to use learning management systems using extended TAM. *British Journal of Educational Technology, 50*(5), 2414–2432. https://doi.org/10.1111/bjet.12798.

Escobar-Rodriguez, T., & Monge-Lozano, P. (2012). The acceptance of Moodle technology by business administration students. *Computers & Education, 58*(4), 1085–1093.

Ess, C. (2014). *Digital media ethics*. Polity Press.

Estriegana, R., Medina-Merodio, J. A., & Barchino, R. (2019). Student acceptance of virtual laboratory and practical work: An extension of the technology acceptance model. *Computers and Education, 135*, 1–14. https://doi.org/10.1016/j.compedu.2019.02.010.

Farahat, T. (2012). Applying the technology acceptance model to online learning in the Egyptian universities. *Procedia - Social and Behavioral Sciences, 64*, 95–104. https://doi.org/10.1016/j.sbspro.2012.11.012.

Fishbein, M., & Ajzen, I. (2011). Predicting and changing behavior: The reasoned action approach. *Predicting and Changing Behavior: The Reasoned Action Approach*. https://doi.org/10.4324/9780203838020.

Fisher, R., Perényi, Á., & Birdthistle, N. (2018). The positive relationship between flipped and blended learning and student engagement, performance and satisfaction. *Active Learning in Higher Education, 00*(0), 1–17. https://doi.org/10.1177/1469787418801702.

Garcia, R., Falkner, K., & Vivian, R. (2018). Systematic literature review: Self-regulated learning strategies using e-learning tools for computer science. *Computers and Education, 123*(December 2017), 150–163. https://doi.org/10.1016/j.compedu.2018.05.006.

Garone, A., Pynoo, B., Tondeur, J., Cocquyt, C., Vanslambrouck, S., Bruggeman, B., & Struyven, K. (2019). Clustering university teaching staff through UTAUT: Implications for the acceptance of a new learning management system. *British Journal of Educational Technology, 50*(5), 2466–2483. https://doi.org/10.1111/bjet.12867.

Ghavifekr, S., & Mahmood, H. (2017). Factors affecting use of e-learning platform (SPeCTRUM) among university students in Malaysia. *Education and Information Technologies, 22*(1), 75–100. https://doi.org/10.1007/s10639-015-9435-z.

Hamidi, H., & Chavoshi, A. (2018). Analysis of the essential factors for the adoption of mobile learning in higher education: A case study of students of the University of Technology. *Telematics and Informatics, 35*(4), 1053–1070. https://doi.org/10.1016/j.tele.2017.09.016.

Hao, S., Dennen, V. P., & Mei, L. (2017). Influential factors for mobile learning acceptance among Chinese users. *Educational Technology Research and Development, 65*(1), 101–123. https://doi.org/10.1007/s11423-016-9465-2.

Hassanzadeh, A., Kanaani, F., & Elahi, S. (2012). A model for measuring e-learning systems success in universities. *Expert Systems with Applications, 39*(12), 10959–10966. https://doi.org/10.1016/j.eswa.2012.03.028.

Huang, F., Teo, T., & Zhou, M. (2017). Factors affecting Chinese English as a foreign language teachers' technology acceptance: A qualitative study. *Journal of Educational Computing Research, 57*(1), 83–105. https://doi.org/10.1177/0735633117746168.

Huang, F., Teo, T., Sánchez-Prieto, J. C., García-Peñalvo, F. J., & Olmos-Migueláñez, S. (2019). Cultural values and technology adoption: A model comparison with university teachers from China and Spain. *Computers and Education, 133*(January), 69–81. https://doi.org/10.1016/j.compedu.2019.01.012.

Igbaria, M., & Tan, M. (1997). The consequences of information technology acceptance on subsequent individual performance. *Information & Management, 32*(3), 113–121. https://doi.org/10.1016/S0378-7206(97)00006-2.

Islam, A. K. M. N. (2011). The determinants of the post-adoption satisfaction of educators with an e-learning system. *Journal of Information Systems Education, 22*(4), 319–330.

Islam, A. K. M. N. (2012). The role of perceived system quality as educators' motivation to continue e-learning system use. *AIS Transactions on Human-Computer Interaction, 4*(1), 25–43.

Islam, A. K. M. N. (2013). Investigating e-learning system usage outcomes in the university context. *Computers and Education, 69*, 387–399. https://doi.org/10.1016/j.compedu.2013.07.037.

Islam, A. N. (2016). E-learning system use and its outcomes: Moderating role of perceived compatibility. *Telematics and Informatics, 33*(1), 48–55. https://doi.org/10.1016/j.tele.2015.06.010.

John, S. P. (2015). The integration of information technology in higher education: A study of faculty's attitude towards IT adoption in the teaching process. *Contaduría y Administración, 60*, 230–252. https://doi.org/10.1016/j.cya.2015.08.004.

Jurison, J. (1996). The temporal nature of IS benefits: A longitudinal study. *Information & Management, 30*(2), 75–79. https://doi.org/10.1016/0378-7206(95)00050-X.

Kanthawongs, P., & Kanthawongs, P. (2013). Individual and social factors affecting Student's usage intention in using learning management system. *Procedia - Social and Behavioral Sciences, 88*, 89–95. https://doi.org/10.1016/j.sbspro.2013.08.484.

Khasawneh, M. (2015). Factors influence e-learning utilization in Jordanian universities - academic staff perspectives. *Procedia - Social and Behavioral Sciences, 210*, 170–180. https://doi.org/10.1016/j.sbspro.2015.11.356.

Kim, S. S., & Malhotra, N. K. (2005). A longitudinal model of continued IS use: An integrative view of four mechanisms underlying Postadoption phenomena. *Management Science, 51*(5), 741–755. https://doi.org/10.1287/mnsc.1040.0326.

Kim, H. J., Lee, J. M., & Rha, J. Y. (2017). Understanding the role of user resistance on mobile learning usage among university students. *Computers & Education, 113*, 108–118. https://doi.org/10.1016/j.compedu.2017.05.015.

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information & Management, 43*(6), 740–755. https://doi.org/10.1016/j.im.2006.05.003.

Kumar, J. A., & Bervell, B. (2019). Google classroom for mobile learning in higher education: Modelling the initial perceptions of students. *Education and Information Technologies, 24*(2), 1793–1817. https://doi.org/10.1007/s10639-018-09858-z.

Lai, C., Wang, Q., & Lei, J. (2012). What factors predict undergraduate students' use of technology for learning? A case from Hong Kong. *Computers & Education, 59*(2), 569–579. https://doi.org/10.1016/j.compedu.2012.03.006.

Larmuseau, C., Evens, M., Elen, J., Van Den Noortgate, W., Desmet, P., & Depaepe, F. (2018). The relationship between acceptance, actual use of a virtual learning environment and performance: An ecological approach. *Journal of Computers in Education, 5*(1), 95–111. https://doi.org/10.1007/s40692-018-0098-9.

Larsen, T. J., Sørebø, A. M., & Sørebø, Ø. (2009). The role of task-technology fit as users' motivation to continue information system use. *Computers in Human Behavior, 25*(3), 778–784. https://doi.org/10.1016/j.chb.2009.02.006.

Liao, C., Chen, J.-L., & Yen, D. C. (2007). Theory of planning behavior (TPB) and customer satisfaction in the continued use of e-service: An integrated model. *Computers in Human Behavior, 23*(6), 2804–2822. https://doi.org/10.1016/j.chb.2006.05.006.

Limayem, M., & Cheung, C. M. K. (2011). Predicting the continued use of internet-based learning technologies: The role of habit. *Behaviour & Information Technology, 30*(1), 91–99. https://doi.org/10.1080/0144929X.2010.490956.

Limayem, M., & Hirt, S. G. (2003). Force of habit and information systems usage: Theory and initial validation. *Journal of the Association for Information Systems, 4*(1), 65–95. https://doi.org/10.17705/1jais.00030.

Lin, A., & Chen, N.-C. (2012a). Cloud computing as an innovation: Percepetion, attitude, and adoption. *International Journal of Information Management, 32*(6), 533–540. https://doi.org/10.1016/j.ijinfomgt.2012.04.001.

Lin, T.-C., & Chen, C.-J. (2012b). Validating the satisfaction and continuance intention of e-learning systems: Combining TAM and IS success models. *International Journal of Distance Education Technologies (IJDET), 10*(1), 44–54.

Lin, W. S., & Wang, C. H. (2012). Antecedences to continued intentions of adopting e-learning system in blended learning instruction: A contingency framework based on models of information system success and task-technology fit. *Computers and Education, 58*(1), 88–99. https://doi.org/10.1016/j.compedu.2011.07.008.

Lin, S., Shih, T.-H., & Chuang, S.-H. (2014). Validating innovating practice and perceptions of course management system solutions using structural equation modeling. *Quality & Quantity, 48*(3), 1601–1618. https://doi.org/10.1007/s11135-013-9864-y.

Liu, S. H., Liao, H. L., & Pratt, J. A. (2009). Impact of media richness and flow on e-learning technology acceptance. *Computers & Education, 52*(3), 599–607. https://doi.org/10.1016/j.compedu.2008.11.002.

Ma, Q., & Liu, L. (2004). The technology acceptance model: A meta-analysis of empirical findings. *Journal of Organizational and End User Computing (JOEUC), 16*(1), 59–72.

Martins, J., Branco, F., Gonçalves, R., Au-Yong-Oliveira, M., Oliveira, T., Naranjo-Zolotov, M., & Cruz-Jesus, F. (2019). Assessing the success behind the use of education management information systems in higher education. *Telematics and Informatics, 38*(September 2018), 182–193. https://doi.org/10.1016/j.tele.2018.10.001.

Masood, M., & Musman, A. (2015). The usability and its influence of an e-learning system on student participation. *Procedia - Social and Behavioral Sciences, 197*(February), 2325–2330. https://doi.org/10.1016/j.sbspro.2015.07.261.

McGill, T. J., & Klobas, J. E. (2009). A task–technology fit view of learning management system impact. *Computers & Education, 52*(2), 496–508.

McGorry, S. Y. (2003). Measuring quality in online programs. *The Internet and Higher Education, 6*(2), 159–177. https://doi.org/10.1016/S1096-7516(03)00022-8.

Mohammadi, H. (2015). Factors affecting the e-learning outcomes: An integration of TAM and IS success model. *Telematics and Informatics, 32*(4), 701–719.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., Altman, D., Antes, G., Atkins, D., Barbour, V., Barrowman, N., Berlin, J. A., Clark, J., Clarke, M., Cook, D., D'Amico, R., Deeks, J. J., Devereaux, P. J., Dickersin, K., Egger, M., Ernst, E., … Tugwell, P. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*. https://doi.org/10.1371/journal.pmed.1000097.

Mtebe, J. S., & Raisamo, R. (2014). Challenges and instructors' intention to adopt and use open educational resources in higher education in Tanzania. *The International Review of Research in Open and Distance Learning, 15*(1), 249–271.

Mtebe, J. S., & Roope, R. (2014). A model for assessing learning management system success in higher education in sub-Saharan countries. *The Electronic Journal of Information Systems in Developing Countries, 61*(1), 1–17. https://doi.org/10.1002/j.1681-4835.2014.tb00436.x.

Naveh, G., Tubin, D., & Pliskin, N. (2010). Student LMS use and satisfaction in academic institutions: The organizational perspective. *The Internet and Higher Education, 13*(3), 127–133.

Nistor, N., Stanciu, D., Lerche, T., & Kiel, E. (2019). "I am fine with any technology, as long as it doesn't make trouble, so that I can concentrate on my study": A case study of university students' attitude strength related to educational technology acceptance. *British Journal of Educational Technology, 50*(5), 2557–2571. https://doi.org/10.1111/bjet.12832.

Padilla-Meléndez, A., Del Aguila-Obra, A. R., & Garrido-Moreno, A. (2013). Perceived playfulness, gender differences and technology acceptance model in a blended learning scenario. *Computers and Education, 63*, 306–317. https://doi.org/10.1016/j.compedu.2012.12.014.

Pan, C.-C., Sivo, S., Gunter, G., & Cornell, R. (2005). Students' perceived ease of use of an Elearning management system: An exogenous or endogenous variable? *Journal of Educational Computing Research, 33*(3), 285–307. https://doi.org/10.2190/7M4G-R742-W9FT-JX1J.

Panigrahi, R., Srivastava, P. R., & Sharma, D. (2018). Online learning: Adoption, continuance, and learning outcome—A review of literature. *In International Journal of Information Management*. https://doi.org/10.1016/j.ijinfomgt.2018.05.005.

Petticrew, M., & Roberts, H. (2006). *Systematic reviews in the social sciences a practical guide*. Blackwell Publishing.

Phelps, S. F., & Campbell, N. (2012). Systematic reviews in theory and practice for library and information studies. *Library and Information Research, 36*(112), 6–15.

Prasad, P. W. C., Maag, A., Redestowicz, M., & Hoe, L. S. (2018). Unfamiliar technology: Reaction of international students to blended learning. *Computers & Education, 122*, 92–103. https://doi.org/10.1016/j.compedu.2018.03.016.

Pynoo, B., Tondeur, J., van Braak, J., Duyck, W., Sijnave, B., & Duyck, P. (2012). Teachers' acceptance and use of an educational portal. *Computers & Education, 58*(4), 1308–1317. https://doi.org/10.1016/j.compedu.2011.12.026.

Ramírez-Correa, P. E., Rondan-Cataluña, F. J., Arenas-Gaitán, J., & Alfaro-Perez, J. L. (2017). Moderating effect of learning styles on a learning management system's success. *Telematics and Informatics, 34*(1), 272–286. https://doi.org/10.1016/j.tele.2016.04.006.

Rejón-Guardia, F., Polo-Peña, A. I., & Maraver-Tarifa, G. (2019). The acceptance of a personal learning environment based on Google apps: the role of subjective norms and social image. In *Journal of Computing in Higher Education* (Issue 0123456789). Springer. https://doi.org/10.1007/s12528-019-09206-1.

Revythi, A., & Tselios, N. (2017). Extension of Technology Acceptance Model by using System Usability Scale to assess behavioral intention to use e-learning. *ArXiv Preprint ArXiv:1704.06127*.

Ritchie, W. J., Drew, S. A., Srite, M., Andrews, P., & Carter, J. E. (2011). Application of a learning management system for knowledge management: Adoption and cross-cultural factors. *Knowledge and Process Management, 18*(2), 75–84. https://doi.org/10.1002/kpm.371.

Rodrigues, H., Almeida, F., Figueiredo, V., & Lopes, S. L. (2019). Tracking e-learning through published papers: A systematic review. *Computers & Education, 136*, 87–98.

Rogers, E. M. (1962). *Diffusion of innovations*. The Free Press.

Rogers, E. M. (2003). Diffusion of innovations theory. *New York: Free Press*, 5th ed. https://doi.org/10.1111/j.1467-9523.1970.tb00071.x.

Rovai, A. P., & Downey, J. R. (2010). Why some distance education programs fail while others succeed in a global environment. *The Internet and Higher Education, 13*(3), 141–147. https://doi.org/10.1016/j.iheduc.2009.07.001.

Salahshour Rad, M., Nilashi, M., & Mohamed Dahlan, H. (2018). Information technology adoption: A review of the literature and classification. *Universal Access in the Information Society, 17*(2), 361–390. https://doi.org/10.1007/s10209-017-0534-z.

Salloum, S. A., Al-Emran, M., Shaalan, K., & Tarhini, A. (2019). Factors affecting the E-learning acceptance: A case study from UAE. *Education and Information Technologies, 24*(1), 509–530. https://doi.org/10.1007/s10639-018-9786-3.

Sánchez, R. A., & Hueros, A. D. (2010). Motivational factors that influence the acceptance of Moodle using TAM. *Computers in Human Behavior, 26*(6), 1632–1640.

Sánchez-Franco, M. J., Martínez-López, F. J., & Martín-Velicia, F. A. (2009). Exploring the impact of individualism and uncertainty avoidance in web-based electronic learning: An empirical analysis in European higher education. *Computers & Education, 52*(3), 588–598. https://doi.org/10.1016/j.compedu.2008.11.006.

Schepers, J., & Wetzels, M. (2007). A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects. *Information & Management, 44*(1), 90–103. https://doi.org/10.1016/j.im.2006.10.007.

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers and Education.* https://doi.org/10.1016/j.compedu.2018.09.009.

Schoonenboom, J. (2012). The use of technology as one of the possible means of performing instructor tasks: Putting technology acceptance in context. *Computers & Education, 59*(4), 1309–1316. https://doi.org/10.1016/j.compedu.2012.06.009.

Schoonenboom, J. (2014). Using an adapted, task-level technology acceptance model to explain why instructors in higher education intend to use some learning management system tools more than others. *Computers and Education, 71*, 247–256. https://doi.org/10.1016/j.compedu.2013.09.016.

Seddon, P. B. (1997). A Respecification and extension of the DeLone and McLean model of IS success. *Information Systems Research, 8*(3), 240–253. https://doi.org/10.1287/isre.8.3.240.

Shen, C., & Ho, J. (2020). Technology-enhanced learning in higher education: A bibliometric analysis with latent semantic approach. *Computers in Human Behavior, 104*, 106–177. https://doi.org/10.1016/j.chb.2019.106177.

Shyu, S. H. P., & Huang, J. H. (2011). Elucidating usage of e-government learning: A perspective of the extended technology acceptance model. *Government Information Quarterly, 28*(4), 491–502. https://doi.org/10.1016/j.giq.2011.04.002.

Sultana, J. (2020). Determining the factors that affect the uses of Mobile cloud learning (MCL) platform blackboard- a modification of the UTAUT model. *Education and Information Technologies, 25*(1), 223–238. https://doi.org/10.1007/s10639-019-09969-1.

Šumak, B., Heričko, M., & Pušnik, M. (2011). A meta-analysis of e-learning technology acceptance: The role of user types and e-learning technology types. *In Computers in Human Behavior.* https://doi.org/10.1016/j.chb.2011.08.005.

Taherdoost, H. (2018). A review of technology acceptance and adoption models and theories. *Procedia Manufacturing, 22*, 960–967. https://doi.org/10.1016/j.promfg.2018.03.137.

Tarhini, A., Hone, K., & Liu, X. (2015). A cross-cultural examination of the impact of social, organisational and individual factors on educational technology acceptance between British and Lebanese university students. *British Journal of Educational Technology.* https://doi.org/10.1111/bjet.12169.

Tarhini, A., Hone, K., Liu, X., & Tarhini, T. (2017). Examining the moderating effect of individual-level cultural values on users' acceptance of E-learning in developing countries: A structural equation modeling of an extended technology acceptance model. *Interactive Learning Environments.* https://doi.org/10.1080/10494820.2015.1122635.

Tawafak, R. M., Romli, A. B. T., Arshah, R. B. A., & Malik, S. I. (2020). Framework design of university communication model (UCOM) to enhance continuous intentions in teaching and e-learning process. *Education and Information Technologies, 25*(2), 817–843. https://doi.org/10.1007/s10639-019-09984-2.

Teo, T. (2010). Development and validation of the E-learning Acceptance Measure (ElAM). *Internet and Higher Education.* https://doi.org/10.1016/j.iheduc.2010.02.001.

Teo, T. (2014). Unpacking teachers' acceptance of technology: Tests of measurement invariance and latent mean differences. *Computers & Education, 75*, 127–135. https://doi.org/10.1016/j.compedu.2014.01.014.

Teo, T., & Wong, S. L. (2013). Modeling key drivers of E-learning satisfaction among student teachers. *Journal of Educational Computing Research, 48*(1), 71–95. https://doi.org/10.2190/EC.48.1.d.

Teo, T., Huang, F., & Hoi, C. K. W. (2018). Explicating the influences that explain intention to use technology among English teachers in China. *Interactive Learning Environments.* https://doi.org/10.1080/10494820.2017.1341940.

Teo, T., Zhou, M., Fan, A. C. W., & Huang, F. (2019). Factors that influence university students' intention to use Moodle: A study in Macau. *Educational Technology Research and Development*. https://doi.org/10.1007/s11423-019-09650-x.

Thong, J. Y., Hong, W., & Tam, K. Y. (2004). What leads to user acceptance of digital libraries? *Communications of the ACM, 47*(11), 78–83.

Thong, J. Y. L., Hong, S.-J., & Tam, K. Y. (2006). The effects of post-adoption beliefs on the expectation-confirmation model for information technology continuance. *International Journal of Human-Computer Studies, 64*(9), 799–810.

Turhangil Erenler, H. H. (2020). A structural equation model to evaluate students' learning and satisfaction. *Computer Applications in Engineering Education, 28*(2), 254–267. https://doi.org/10.1002/cae.22189.

van Braak, J., & Tearle, P. (2007). The computer attributes for learning scale (CALS) among university students: Scale development and relationship with actual computer use for learning. *Computers in Human Behavior, 23*(6), 2966–2982. https://doi.org/10.1016/j.chb.2006.08.014.

van der Heijden, H. (2004). User acceptance of hedonic information systems. *MIS Quarterly, 28*(4), 695–704. https://doi.org/10.2307/25148660.

Van der Linden, J., & van de Leemput, C. (2015). Observatory of students' uses of computer-based tools. *Psychologie Française, 60*(2), 145–157. https://doi.org/10.1016/j.psfr.2015.02.002.

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences, 39*(2), 273–315. https://doi.org/10.1111/j.1540-5915.2008.00192.x.

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478. https://doi.org/10.2307/30036540.

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology : Extending the unified theory. *MIS Quarterly, 36*(1), 157–178. https://doi.org/10.1017/CBO9781107415324.004.

Waheed, M., Kaur, K., Ain, N. U., & Hussain, N. (2016). Perceived learning outcomes from Moodle: An empirical study of intrinsic and extrinsic motivating factors. *Information Development, 32*(4), 1001–1013. https://doi.org/10.1177/0266666915581719.

Walker, S. K., & Hong, S. (2017). Workplace predictors of parenting educators' technology acceptance attitudes. *Family and Consumer Sciences Research Journal, 45*(4), 377–393. https://doi.org/10.1111/fcsr.12218.

Watty, K., McKay, J., & Ngo, L. (2016). Innovators or inhibitors? Accounting faculty resistance to new educational technologies in higher education. *Journal of Accounting Education, 36*, 1–15. https://doi.org/10.1016/j.jaccedu.2016.03.003.

Wixom, B. H., & Todd, P. A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research, 16*(1), 85–102. https://doi.org/10.1287/isre.1050.0042.

Wood, R., & Bandura, A. (1989). Social cognitive theory of organizational management. *Academy of Management Review*. https://doi.org/10.5465/amr.1989.4279067.

Xu, J., Kang, Q., & Song, Z. (2015). The current state of systematic reviews in library and information studies. *Library & Information Science Research, 37*(4), 296–310. https://doi.org/10.1016/j.lisr.2015.11.003.

Yakubu, M. N., & Dasuki, S. I. (2018). Factors affecting the adoption of e-learning technologies among higher education students in Nigeria: A structural equation modelling approach. *Information Development, 35*(3), 492–502. https://doi.org/10.1177/0266666918765907.

Yang, H. H., Feng, L., & MacLeod, J. (2017). Understanding college students' acceptance of cloud classrooms in flipped instruction: Integrating UTAUT and connected classroom climate. *Journal of Educational Computing Research*. https://doi.org/10.1177/0735633117746084.

Yuen, A. H. K., Cheng, M., & Chan, F. H. F. (2019). Student satisfaction with learning management systems: A growth model of belief and use. *British Journal of Educational Technology, 50*(5), 2520–2535. https://doi.org/10.1111/bjet.12830.

Zhang, D., Zhao, J. L., Zhou, L., & Nunamaker Jr., J. F. (2004). Can e-learning replace classroom learning? *Communications of the ACM, 47*(5), 75–79.