THE INFLUENCE OF USABILITY ATTRIBUTES ON STUDENTS’ USE OF LEARNING MANAGEMENT SYSTEMS: A THEORETICAL FRAMEWORK

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Abstract

Learning management systems (LMS) are online mediums that enable students to pursue their education with no limitations in terms of location and time. Although LMS have been widely adopted in universities worldwide, the utilisation of such systems by students is still low in some educational contexts. Addressing this gap, this study aims to propose a conceptual model that may be beneficial in explaining factors that affect student use and acceptance of LMS in higher education. The proposed model was developed based on a wide review of the published literature on technology acceptance in information systems and perceived usability in e-learning. More specifically, eight usability attributes were adopted into the technology acceptance model (TAM). As usability is important in uptake of e-learning systems, the authors believe that extending TAM with usability attributes would be helpful in explaining the variance of TAM constructs and in investigating how usability attributes influence student use and acceptance of LMS. The results of this study show that usability attributes (content quality, learning support, visual design, system navigation, ease of access, system interactivity, instructional assessment and system learnability) influence both perceived ease of use and perceived usefulness, which are the main constructs of TAM. This work opens doors for future research in examining the effect of usability on student use of LMS. Further, understanding the influence of usability attributes might be useful for decision makers and professionals to improve usability as perceived by students and increase uptake.

Keywords: TAM, technology acceptance model, higher education, students, learning management system, LMS, usability.

1 INTRODUCTION

The evolution of information and communication technologies (ICT) has contributed to the adoption of new technologies in the field of education [1]. E-learning is one result of this evolution. It refers to a learning style that uses computer networks to deliver education to users [2]. By using e-learning, students are provided with the control and flexibility to learn at anytime and anywhere [3]. Learning management systems (LMS) are still the most popular medium for conducting e-learning in many higher educational institutions [4, 5]. An American study [6] reported that 99% of educational institutions, 85% of teachers and 83% of students adopted LMS. The size of LMS’s marketplace is more than $3 billion and expected to grow by 24% between 2016 and 2020 [7].

Despite the wide adoption of LMS, the utilisation of such systems is still not within its full potential [8, 9, 10, 11]. For example, a study [12] investigated the usage of Blackboard by medical students and revealed that only 7% of the students use discussion boards. Another study [13] was conducted to evaluate the students’ utilisation of LMS in higher education and found out that students use communication features rarely. It was empirically proved [4] that students primarily use LMS for downloading materials and submitting assignments. Although technology facilitates students’ learning, its effectiveness at the end relies on the students’ actual use [14, 15]. Therefore, the advantage of adopting e-learning systems is minimised if students do not use them [8, 11]. This indicates the existence of issues hindering the utilisation of LMS and the absence of factors encouraging the proper use.

Meanwhile, system usability is one of the important characteristics of LMS that attracts students to use the system [16, 17]. It was concluded [18] that usability is a crucial element in the use of e-learning. Studies [19, 20, 21] demonstrated the presence of a correlation between usability and students’ utilisation of e-learning systems. Furthermore, understanding the determinants of technology use is
important from a practical perspective as a large amount of money is spent on systems rejected due to poor design [22]. Nevertheless, Theng and Sin [23] investigated the influence of usability attributes on students’ perceived satisfaction in e-learning systems and reported that the examination of perceived usability and its attributes has been disregarded.

To address this gap, this study aims to suggest a theoretical framework and extend the TAM model to investigate the effect of the usability attributes on the students’ use of LMS in higher educational institutions. This paper is organised as follows. First, the technology acceptance model is introduced. Then usability is defined, and the selected usability attributes are justified. Followed by a section on the proposed theoretical framework. Finally, the conclusion section is presented.

2 TECHNOLOGY ACCEPTANCE MODEL

Despite the variety of existing technology models, TAM is the predominant theory in explaining users’ acceptance and utilisation of technologies [24] and has been used in many e-learning studies [25, 26, 27, 28, 29, 30, 31]. TAM was initially introduced by [32] and further developed by [33] with the aim of producing a model for computer technology acceptance. TAM postulates that the acceptance of new technologies can be determined by assessing users’ perceived ease of use (PEOU) and the perceived usefulness (PU) of the system [33]. PEOU can be described as the extent to which an individual believes that utilising the technology under investigation would require limited cognitive effort, and PU can be described as the degree to which an individual believes that utilising the technology under investigation would improve his or her performance [34]. Both PEOU and PU impact users’ behavioural intention to use the technology (BI), which in turn leads to users’ actual use (AU). BI is defined as an individual’s aim or plan to perform the behaviour [35].

It was proposed [32, 33] that PEOU and PU are influenced by external variables that are related to a particular technology, including but not limited to, psychological, political, technical or organisational variables. Through the mediation of PEOU and PU, TAM explains the effect of technology characteristics on individuals’ BI and AU [33]. In past literature, many studies in the domain of e-learning [26, 36, 29, 27, 37, 10, 38] have extended TAM. Nevertheless, the influence of usability attributes on the utilisation of LMS is still not well researched [39].

3 USABILITY

The term usability has been defined in various ways [40], and it seems to be that scholars have never agreed on a single definition [41]. Usability has been widely defined as the degree to which individuals can use products to achieve certain tasks with effectiveness, efficiency and satisfaction within a certain environment [42]. Shackel [43] defined technology usability as one used effectively and easily by specific users to accomplish specific tasks within a specific environment. Scientists explain usability variously. Usability can be defined as the quality of systems [44]; users’ experience with systems [45] and an important component of any user interface, that helps in assessing the easiness of user interfaces [46].

For this study, the eight usability attributes identified by Zaharias and Poiylenakou [47] were integrated into TAM: content quality, learning support, visual design, system navigation, ease of access, system interactivity, instructional assessment and system learnability. The adoption of these usability attributes was derived from several dimensions. First, these usability attributes were carefully chosen based on a profound review of many studies in the domain of usability, e-learning and educational technologies. Second, the attributes emphasise the importance of pedagogical usability when evaluating the usability of e-learning systems by considering both technical and instructional design attributes. Scholars [9, 48, 49, 47, 50, 51] pointed out that the evaluation of e-learning systems has to comprise both technical and pedagogical principles. Finally, the robustness and ability of these attributes to detect usability problems have been examined in various studies [52, 3].

4 RESEARCH CONCEPTUAL MODEL

The proposed conceptual model of this study is depicted in Figure 1 and is mainly developed based on the TAM model [33] and eight usability attributes [47]. The model consists of three types of variables: independent, mediating and dependent variables. The first group comprises the independent variables (usability attributes) that might influence the students’ use of LMS, namely content quality, learning support, visual design, system navigation, ease of access, system
interactivity, instructional assessment and system learnability. According to [33], those variables are the external variables of the TAM model, which precede the PEOU and PU constructs. The second category comprises the intervening or mediating variables. This type of variable is usually placed between independent and dependent variables and mediates the relationship between them [53]. This category contains three constructs: PEOU, PU and BI. The third group comprises the dependent variables that might be influenced by the determinants. Students’ actual use of LMS is the only construct included in this group. The variables included in the research conceptual model are described in the next subpoints.

![Figure 1. The proposed conceptual model](image)

### 4.1 Content Quality

Content quality (CQ), as a usability attribute, includes the accuracy of used terms [52], sufficiency of materials to support the course objectives [54] and relevance of information [52]. The content of e-learning systems should be organised in an appropriate sequence and provide adequate resources [47]. As some content problems are associated with the way information is displayed to the users of e-learning systems, this might generate usability problems too [55]. DeLone and McLean [56] asserted the significance of information quality in their information systems success model and postulate the influence of information quality on users' satisfaction and intention (see for example [57, 36]). The direct influence of content quality on students' use of LMS has been empirically proved [58].

It seems that there is no solid ground regarding the relationship between the CQ of LMS and PEOU. It was revealed [31, 30] that students’ PEOU is not influenced by the content quality of e-learning systems in South Korean and Yemen respectively. By contrast, it was empirically found [38, 59, 60] that the content of LMS is a determinant of students’ PEOU in Indonesia, Thailand and Pakistan respectively. To examine this relationship, the following hypothesis was proposed.

**H1:** CQ influences students’ PEOU of LMS.

On the other hand, many studies have demonstrated that the system's content has an effect on PU. It was demonstrated [38, 61, 62, 59, 28, 30, 60] that students who perceive the content of LMS as high quality, they are more likely to perceive the system as useful. Even though the majority of studies supported the relationship between CQ and PU, it was concluded [31] that the content of LMS does...
not influence students’ PU in South Korea. Therefore, the relationship between the content of LMS and PU is, to some extent, established. To examine this relationship, the following hypothesis was proposed.

H2: CQ influences students’ PU of LMS.

4.2 Learning Support

It is important to provide students with the required learning support (LS) in any educational environment as it impacts their motivation for learning [49]. It was reported [63] that researchers expressed their concerns regarding the implementation of computer-based learning systems without LS. Since LMS are educational systems, the required support is far from purely technical. In the view of Zaharias and Poylymenakou [47], LS refers to the ability of e-learning systems to provide users with tools and features needed to support learning activities. Further, those e-learning systems should support students in terms of help documents. Zaharias [49] found that students were unable to achieve difficult learning tasks using e-learning systems without help. Those help documents of e-learning systems should be written in a clear language for students [49], rich with the information that students need [64] and available for students whenever necessary [51]. In addition, a good e-learning system should provide high-quality tools that support individual and group-based learning activities [52] such as discussion boards and communication tools.

Reviewing past literature related to e-learning, it was found that studies investigating the effect of LS on students’ use are scarce. The majority of research locked at technical support rather than learning support. Nonetheless, it was concluded [65] that LS influences the intention to use e-learning. To examine the influence of LS, the following hypotheses were proposed.

H3: LS influences students’ PEOU of LMS.
H4: LS influences students’ PU of LMS.

4.3 Visual Design

Visual design (VD) refers to how the interface layout and menus are appropriate and attractive [66]. User interface has become more and more complicated [67], and students usually make their judgments regarding e-learning systems based on the interface design [62]. In e-learning systems, good VD enables users to easily understand the interface elements, such as fonts, graphics and layout [52]. Interfaces should be appealing to look at and should have an appropriate use of aesthetics to improve the navigation of e-learning systems [64]. Systems with good VD place important information in an area to which students will be attracted [47]. However, systems with poor design make it difficult to understand the information presented [66]. Thus, VD has become an important determinant for users’ satisfaction in online environments [68].

Several studies have reported the effect of VD on both PEOU and PU of systems [69]. It has been found [62, 23, 70, 28] that when students perceive that e-learning systems have good VD are more likely to perceive the system as easy to use. However, the relationship between VD and PU in e-learning is still not well understood. It was demonstrated [62] that interface design affects students’ PU of e-learning systems, while Al-Aulamie [28] found that VD of LMS did not influence the PU of 766 undergraduate students. Therefore, the following hypotheses were proposed to examine the influence of VD.

H5: VD influences students’ PEOU of LMS.
H6: VD influences students’ PU of LMS.

4.4 System Navigation

System navigation (SN) refers to the degree to which the organisation of LMS is understandable and appropriate [36]. Even though links are of considerable importance in systems, SN is more than hyperlinks [71]. SN is a map that connects the components of a system and is expected to enable users to move within the system in a clear and easy way. The navigation of e-learning systems should allow students to leave when they desire and easily return to the system [47]. In addition, the desired information in LMS should be reached easily and efficiently [36]. With a system that has good SN, users are informed where they are [71] and where they can go within the system [48].

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Studies have demonstrated the effect of SN on both PEOU and PU. In e-learning systems, Theng and Sin [23] proved that SN has a positive influence on students’ PEOU. It was examined [36] the success factors of LMS and concluded that SN is an important factor for students’ use of LMS. In respect to digital libraries, Pakistani students said that SN has a positive impact on their PEOU and PU [72]. Moreover, students in Hong Kong demonstrated that the SN of an e-library affects its PEOU [73]. To examine the influence of SN, the following hypotheses were proposed.

H7: SN influences students’ PEOU of LMS.
H8: SN influences students’ PU of LMS.

4.5 Ease of Access

Ease of access (EOA) refers to the degree to which users can access the system without difficulty from the login process to the course content [36]. In terms of our research, EOA means the perceived ability of LMS to provide students with flexible access to all features [74]. EOA includes, but not limited to, the support of different platforms [50], smooth login, response time, quick download, appropriate use of texts [49] and freedom from technical issues [47]. The poor accessibility of LMS, such as a long login process and slow download of elements, might cause students frustration [36]. Multimedia files and graphics usually require more time to load, and this delay can make users disappointed [40]. Further, the slow response of systems may force students to reduce their learning because of waiting and time limitations [49].

In past research, the effect of EOA on PEOU has been demonstrated. Studies [13, 36, 75] examined the success factors of LMS and concluded that EOA is a critical element for students’ use of LMS. Studies [74, 38, 31, 15, 28, 76] provided empirical evidence that students tend to perceive LMS easy to use when they are highly accessible. However, this relationship was not supported in a study in a Pakistani university [10]. To examine the relationship between EOA and PEOU, the following hypothesis was proposed.

H9: EOA influences students’ PEOU of LMS.

On the other hand, it seems that scholars do not agree on the relationship between the EOA of LMS and PU. In South Korea, it was revealed [31, 15] that EOA does not affect the students’ PU of e-learning systems. In Taiwan, it was found that EOA does not have an influence on students’ PU [76]. In Hong Kong, students proved that EOA of e-library does not affect PU [73]. By contrast, Al-Aulamie [28] demonstrated that the EOA of LMS influences the students’ PU in Saudi Arabia. To examine the relationship between EOA and PU, the following hypothesis was proposed.

H10: EOA influences students’ PU of LMS.

4.6 System Interactivity

System interactivity (SI) is a key factor in learning activities [77] that represents how students are engaged with e-learning systems during their education [49]. In the view of Theng and Sin [23], SI refers to how students learn by interacting with other students, teachers and objects in the LMS. It was defined that SI as including all sort communications via e-learning systems during the learning experience [52]. This communication can be (1) between students and teachers, (2) between students themselves and (3) between students and LMS. It was shown that SI affects students’ intention to use LMS [77, 8] and their perceived learning success [78].

The relationship between the SI of LMS and students’ PEOU is still ambiguous. Tran [74] showed that when LMS have good level of SI, Thai students tend to perceive the system easy to use. It was demonstrated [79] that students’ PEOU is correlated with Blackboard interactivity. Moreover, the interactivity of e-learning systems was empirically found to affect Malaysian students’ PEOU [80]. However, other studies [81, 29] in e-learning systems contradict these findings. To examine the relationship between SI and PEOU, the following hypothesis was proposed.

H11: SI influences students’ PEOU of LMS.

Studies [29, 80, 23, 81, 79] showed that SI affects the students’ PU in e-learning systems. Following the previous literature, it is expected that when LMS have good SI, students are more likely to perceive the system useful. To examine the influence of SI, the following hypothesis was proposed.

H12: SI influences students’ PU of LMS.
4.7 Instructional Assessment

Instructional assessment (IA), also known as individual self-assessment, is a crucial element in designing e-learning systems [49] as it is a good way to assess students’ learning [82]. Researchers [49, 47, 63, 83] have stressed the importance of IA when implementing educational technologies. IA can give feedback about the students’ accomplishments in relation to course objectives [83], enable students to learn more by answering questions [84] and enhance students’ academic achievement [63]. As self-assessment should be designed into online learning systems [83], learning management systems usually provide a variety of assessment tools including surveys, quizzes and tests. These should be self-assessment tools to help students in understanding the content of courses. Therefore, the researchers expect that when students perceive that LMS have good IA, they are more likely to have a positive attitude to use the system. To the best of our knowledge, this variable has never been adopted into TAM. To examine the influence of IA, the following hypotheses were proposed.

H13: IA influences students’ PEOU of LMS.
H14: IA influences students’ PU of LMS.

4.8 System Learnability

According to Nielsen [46], system learnability (SL) refers to the degree to which users can learn how to use the system without difficulty. It is very important especially for novice users to be able to successfully interact with the system within a short time [85]. With a highly learnable system, users believe that they can start using the system with minimum training, help and orientation [86]. Systems with poor learnability can lead to more user training, technical support and maintenance cost. In an ideal world, e-learning systems should not have a learning curve, so students will learn how to use the system from the first attempt [49].

Scholars [87, 66] empirically concluded that interface usability including SL has a positive influence on both PEOU and PU of systems. In terms of university websites, Aziz and Kamaludin [40] revealed that the SL of a Malaysian university website positively influenced PEOU and PU of 82 users. Further, it was demonstrated [88] that SL affects the use of social media websites indirectly. However, it was found [89] that there is no significant correlation between the SL of e-learning systems and students’ PEOU. Following the majority of studies, we believe that the SL of LMS has a positive influence on the students’ PEOU and PU. To examine the influence of SL, the following hypotheses were proposed.

H15: SL influences students’ PEOU of LMS.
H16: SL influences students’ PU of LMS.

4.9 PEOU, PU and BI

The significance of PEOU, PU and BI was suggested by various technology models, such as TAM [33], TAM2 [90], the model of PEOU determinants [91] and TAM3 [92]. In the context of this research, PEOU can be defined as the extent to which students believe that utilising LMS would be free of effort, PU can be defined as the degree to which students believe that utilising LMS would improve their performance and BI refers to the students’ aim or plan to use LMS [34].

Reviewing past literature in LMS demonstrated the TAM model. Previous studies in LMS revealed the influence of PEOU on PU [25, 26, 8, 38, 93, 37, 94]. A positive influence of PEOU on the students’ intention to use e-learning systems was found [95, 8, 96, 38, 60]. Further, many studies [97, 80, 95, 57, 98, 96, 25] concluded that when students perceive that LMS are useful, they usually intend to use the system. Past research [8, 99, 25, 29, 100, 57] in e-learning systems supported the relationship between BI and AU. To examine the influence of PEOU, PU, BI and AU, the following hypotheses were proposed.

H17: PEOU influences students’ PU of LMS.
H18: PEOU influences students’ BI to use LMS.
H19: PU influences students’ BI to use LMS.
H20: BI influences students’ AU of LMS.
5 CONCLUSION

In this paper, the authors propose a conceptual framework that may be useful in explaining the effect of usability attributes on the students’ use of LMS within the context of higher education. The proposed model was developed based on the most popular technology model in the domain of information systems, TAM, and the published literature regarding usability heuristics within the context of educational technologies. The research conceptual model is composed of three types of variable, independent, mediating and dependent variables. These variables are: content quality, learning support, visual design, system navigation, ease of access, system interactivity, instructional assessment, system learnability, perceived ease of use, perceived usefulness, behavioural intention and actual use.

Consequently, the research model examines 20 hypotheses for the relationships between the model constructs. Among those hypotheses, 16 hypotheses (H1 – H16) were proposed between the independent and mediating variables. In the second category, three hypotheses (H17 – H19) were proposed between the mediating variables themselves (PEOU, PU and BI). Finally, one hypothesis (H20) was proposed between the mediating and dependent variables. The authors of this paper advocate that the TAM model alone is insufficient to model students’ actual behaviour. We further advocate that extending TAM with the usability attributes would better explain the behaviour of PEOU and PU constructs. We also believe that it is worthwhile to investigate the influence of usability attributes on the students’ use of LMS in higher educational institutions.

ACKNOWLEDGEMENTS

We appreciate the Saudi Arabian Ministry of Education for the support of this research.

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