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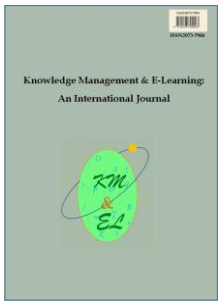
Sami S. Binyamin
King Abdulaziz University, Saudi Arabia
Malcolm J. Rutter
Sally Smith
Edinburgh Napier University, UK



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The moderating effect of gender and age on the students' acceptance of learning management systems in Saudi higher education

Sami S. Binyamin*

Jeddah Community College
King Abdulaziz University, Saudi Arabia
E-mail: ssbinyamin@kau.edu.sa

Malcolm J. Rutter

School of Computing
Edinburgh Napier University, UK
E-mail: m.rutter@napier.ac.uk

Sally Smith

School of Computing
Edinburgh Napier University, UK
E-mail: s.smith@napier.ac.uk

*Corresponding author

Abstract: Despite the widespread adoption of learning management systems (LMS) by universities worldwide, it has been found that the students' use of them is not always optimal. Based on the technology acceptance model (TAM), this quantitative research aims to examine the factors that impact the students' utilisation of LMS in higher-educational institutions in Saudi Arabia. Further, this study investigates the moderating effect of gender and age on the students' behaviour toward LMS. A total of 851 online surveys were submitted by students registered in three Saudi universities, and 833 responses were used for data analysis. The collected data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) along with multigroup analysis (MGA). The results revealed that gender moderates the relationship between content quality and perceived ease of use. However, the findings also confirmed that age has no moderating influence on the students' use of LMS. The results obtained and implications of the study are discussed.

Keywords: Technology acceptance; Learning management systems; Gender; Age; Quality of learning content

Biographical notes: Dr. Sami S. Binyamin is currently an assistant professor at the Department of Computer and Information Technology at King Abdulaziz University, Saudi Arabia. Sami has earned his PhD from the School of Computing, Edinburgh Napier University, United Kingdom. He has a master's degree in information systems from Eastern Michigan University, USA and a bachelor's degree in computer science from King Abdulaziz University. Sami was working as a lecturer at King Abdulaziz University from 2014 until 2019. Prior to his academic career, he was a senior systems analyst and a project

manager at Riyad Bank between 2012 and 2014. He has published on the topics of technology acceptance, usability and user experience, mobile health and online learning.

Malcolm J. Rutter trained as a communications engineer. His research experience started with his PhD in adaptive digital filtering. In the PhD, Dr. Rutter was working on mathematical algorithms, of the sort that are nowadays found inside integrated circuits in applications such as mobile phones and sea divers' communication equipment. In Napier, he worked with optics projects. He mainly worked on fibre-optics for communications, and the use of passive infra-red detection for identifying people by their gait. In the School of computing, Dr. Rutter has done a lot of teaching in the field of HCI, which interests him greatly, and web design. He has published on the topic of student communications in education, which combines his interests in HCI, education and communication. More recently he has become involved in evaluating e-government, involving his interests in web design and HCI.

Professor Sally Smith MA MSc DBA FBCS PFHEA is the Dean of School of Computing at Edinburgh Napier University. Sally has an MA (Hons) in Mathematics from Aberdeen University, Scotland, an MSc in Computer Science from City University, London and a DBA from Edinburgh Napier University. Sally is a Principal Fellow of the Higher Education Academy and a fellow of the British Computer Society. She is the Director of the Centre for Computing Education Research at Edinburgh Napier University and Project Director of e-Placement Scotland, a Scottish Funding Council project creating paid placements for computing students across Scotland. Sally's research and teaching interests combine mobile and pervasive computing with research into the impact of work placements, student/ professional identity and apprenticeships. Between 2011 and 2018 she was on the committee of the UK Council of Professors and Heads of Computing, serving as Chair between 2014 and 2016.

1. Introduction

With the remarkable development of information and communication technologies, higher-educational institutions have widely adopted technology to improve the effectiveness of learning (Kabassi et al., 2016). The field of education has certainly been affected by this development, which has given rise to the emergence and expansion of new learning approaches, such as online learning (Sheerah & Goodwyn, 2016). Learning management systems (LMS) – web-based systems that allow teachers to develop course content – which share content with students, create course activities, and assess student progress, are a typical example of such educational technology (Hussein, 2011).

Learning management systems are the most popular technology for facilitating online learning and are the most commonly used technology in education (Zanjani, Edwards, Nykvist, & Geva, 2017). An American study (Dahlstrom, Brooks, & Bichsel, 2014) revealed that 99% of educational institutions in the United States have adopted LMS. The value of the LMS marketplace is more than $3 billion per year, and is expected to grow by 24% between 2016 and 2020 (Docebo, 2016). The field of education in academic settings in Saudi Arabia has also been influenced by this evolution (Al-Youssef, 2015). The market of e-learning in Saudi Arabia is projected to be $273 billion by 2023, which represents the largest market in the Middle East (Research and Markets, 2017).

Aljuhney and Murray (2016) determined that 87% of Saudi higher-educational institutions have adopted LMS, with Blackboard being the dominant system. The introduction of LMS across Saudi universities is in accordance with the request of the Saudi Government and the Saudi Vision 2030 initiative, which supports the adoption of e-learning to provide equality of access to education (Vision 2030, 2016). Furthermore, the Ministry of Education encouraged universities in Saudi Arabia to reduce student attendance hours by adopting blended learning using LMS (Sheerah & Goodwyn, 2016). This initiative represents a significant investment, including the cost of licences, staff development, and new roles as learning technologists. Therefore, exploring student perceptions toward LMS is an important topic that will help university leaders in Saudi Arabia to make the necessary decisions in this regard.

Even though student academic performance is positively correlated with the use of LMS (Elmahadi & Osman, 2013; Nicholas-Omoregbe, Azeta, Chiazor, & Omoregbe, 2017), the advantages of online learning and LMS are closely related to the context of Saudi Arabia. The local culture has affected the educational environment in Saudi universities and made it a gender-segregated environment. Consequently, female students are not allowed to attend face-to-face classes with male instructors. Given the current insufficiency of female faculty members (Aljaber, 2018) and the increasing number of female secondary school graduates attending universities (Al Alhareth, Al-Dighrir, & Al Alhareth, 2015), many female students are therefore taught by male faculty staff via closed-circuit television with one-way video communications. This setting complicates the learning process and prevents female students from fully participating in class activities. Further, this places more pressure on university facilities and the limited number of human resources. Additionally, Saudi women take the major part in the roles that influence inside the household, such as childcare and upbringing, cooking, washing and cleaning. Thus, online learning provides Saudi women with more flexible education as they can learn at their convenience. In addition, the statistics of higher education published by the Saudi Ministry of Education showed that the population of students attending institutions of higher education has been increasing each year (Ministry of Education, 2017). The rise in the students' demand for higher education and the population of young people contributed to capacity pressure on Saudi universities. As such, it was decided that higher-educational institutions should increase the number of available places in face-to-face classes to emulate the growth in the students' population, which is associated with enormous costs. This obliges higher-educational institutions to offer additional learning channels (e.g. e-learning) with a socially acceptable interaction to accommodate the increasing number of higher-education students.

Despite the massive adoption and perceived advantages of LMS, this success does not necessarily indicate student uptake of such systems (Kanwal & Rehman, 2017). The effectiveness of e-learning systems ultimately relies on student use (Teo, 2016), and the benefits of these systems are minimised if students do not use them (Alenezi, 2012; Tarhini, Hone, Liu, & Tarhini, 2017). Previous literature in developing countries (Baroud & Abouchedid, 2010; Mtebe & Kissaka, 2015; Tarhini, 2013) and Saudi Arabia in particular (Alenezi, 2012; Binyamin, Rutter, & Smith, 2017b; Binyamin, Rutter, & Smith, 2018; Binyamin, Smith, & Rutter, 2016) found that the rich features of LMS are still not widespread. Research (Ariffin, Alias, Abd Rahman, & Sardi, 2014; Back et al., 2016; Islam, 2013; Zanjani, Edwards, Nykvist, & Geva, 2017) has demonstrated that only some LMS features are utilised, and students use LMS, in most cases, for only storing and downloading documents. Thus, this entails understanding and examining factors that affect student acceptance and use of LMS.

The technology acceptance model (TAM) (Davis, 1989) is one of the most popular theories to examine user behaviour in information systems. Primarily, the TAM is composed of four constructs: perceived ease of use, perceived usefulness, behavioural intention, and actual system use. Davis, Bagozzi, and Warshaw (1989) proposed that the actual system use (AU) is directly influenced by behavioural intention (BI), which is affected by both perceived ease of use (PEOU) and perceived usefulness (PU). PEOU affects PU directly, and both PEOU and PU are influenced by external variables. PEOU is the extent to which students believe that utilising LMS would be free of effort (Davis, 1989), and PU is the degree to which students believe that utilising LMS would improve their performance (Davis, 1989). The influence of moderating variables on technology acceptance has not been well understood (Morris, Venkatesh, & Ackerman, 2005; Sun & Zhang, 2006). Indeed, TAM has been criticised by researchers (Al-Gahtani, 2008; Venkatesh & Morris, 2000; Venkatesh, Morris, Davis, & Davis, 2003) for a low explanatory power and lack of moderating variables. Venkatesh et al. (2003) examined eight models and demonstrated that the explanatory power of six models increased after extending the models with moderators. Venkatesh et al. (2003) found that the explanatory power was raised to 52% after the inclusion of a gender moderating effect into the TAM. Further, the awareness of gender moderating effect in student acceptance of LMS might provide a more profound understanding of the decision to use LMS among different groups of students. This understanding, in turn, helps to design strategies for each segment of students; thus, increasing the chance of them using LMS.

On the other hand, researchers usually analyse the full set of collected data assuming that the data were derived from a homogenous population; however, this assumption is not always correct (Hair, Hult, Ringle, & Sarstedt, 2017; Sarstedt, Henseler, & Ringle, 2011). Not considering the heterogeneity between observations might affect the validity of the analysis and lead to incorrect interpretations (Hair, Sarstedt, Ringle, & Mena, 2012). For example, when the relationship between two constructs is negatively significant for male participants and positively significant for female participants, the analysis of the full set of data might not find any significance.

Addressing these gaps, this study examines the moderating effect of gender and age on the students' use of LMS in the context of higher education in Saudi Arabia using the TAM and eight external factors. This paper is organised as follows. Section 2 introduces the proposed model for this study. This is followed by a section on the research methodology. In section 4, the proposed model is tested using SmartPLS software. Finally, the discussion, implications and conclusion sections are presented.

2. Literature review

Many technology-acceptance theories have been employed to investigate the acceptance and usage of LMS from the perspective of students. Table 1 provides a summary of those studies conducted in the context of Saudi higher education, including the theory used, additional factors, moderating variables, target population and data collection method.

Based on this review, several interesting points and research gaps need to be addressed. First, a common limitation in the reviewed studies is that they targeted students registered at specific institutions with a small sample size. Therefore, the generalisability of their results to all students in Saudi higher education is questionable. Additionally, most of these studies used a quantitative research approach through the utilisation of surveys for data collection and statistical techniques for data analysis. Thus, this current research considers these points and targets all students registered at Saudi

public universities. A quantitative approach is employed in common with all but one of the studies previously conducted. To obtain the necessary broad geographical spread, the data were collected via an online survey in the current study also.

Table 1
The summary of LMS acceptance studies in Saudi Arabia

Study	Theory	Additional Factors	Moderators	Target Population	Data Collection
Abdel-Maksoud (2018)	TAM	Satisfaction	N/A	Students at a single university	Online survey
Binyamin, Rutter, & Smith (2018)	TAM	Computer self-efficacy Social influence	N/A	Students at a single university	Paper-based survey
Alotaibi (2017)	UTAUT	Lab practice	N/A	Students at a single university	Focus groups
Binyamin, Rutter, & Smith (2017a)	TAM	N/A	N/A	Students at a single university	Paper-based survey
Binyamin, Rutter, & Smith (2017b)	TAM	Computer self-efficacy Social influence Satisfaction Experience with LMS Teacher role	N/A	Students at a single university	Paper-based survey
Almarashdeh & Alsmadi (2016)	TAM	N/A	N/A	Students at a single university	Paper-based survey
Al-Gahtani (2016)	TAM3	N/A	Experience Voluntariness	Students at a single university	Paper-based survey
Muniasamy, Eljailani, & Anandhavalli (2014)	TAM	N/A	N/A	Students at a single university	Paper-based survey
Al-Aulamie (2013)	TAM	Information quality Functionality Accessibility User interface design Computer playfulness Enjoyment Learning goal orientation	Gender	Students at three universities	Online survey
Al-Mushasha (2013)	TAM	University support Computer self-efficacy	N/A	Students at three universities	Paper-based survey
Alenezi (2012)	TAM	System performance System functionality System response System interactivity	N/A	Students at five universities	Paper-based survey
Al-Harbi (2011)	TAM + TRA	University support Computer self-efficacy Accessibility	N/A	Students at a single university	Paper-based survey

The TAM is the one of the most popular frameworks for assessing user acceptance and usage of new technologies in the field of information systems (Doleck, Bazelais, & Lemay, 2017). Table 1 reveals that the overwhelming majority of the studies used the TAM. This finding indicates the importance and robustness of the TAM for understanding student use of LMS in Saudi Arabia, which justifies the utilisation of the TAM in this current research. However, some of the studies in Table 1 did not extend the original models using external factors. This result is in accordance with Bousbahi and Alrazgan (2015), who found that a large number of TAM studies did not investigate the influence of external variables regarding the student use of LMS. Adopting external variables contributes to the understanding of factors affecting technology use and explaining greater variance in dependent variables (Davis, 1989). This current study, therefore, adopts that recommendation and adds eight external factors to the proposed model.

Finally, the review of the studies regarding Saudi students' acceptance of LMS demonstrated that several factors have been examined, such as satisfaction, social influence, computer self-efficacy, perceived enjoyment, and lab practice. Although researchers (Al-Gahtani, 2016; Tarhini, 2013; Tarhini, Hone, Liu, & Tarhini, 2017) emphasise the importance of moderating variables in the domain of e-learning systems, most studies listed in Table 1 did not investigate the effect of moderators on the student use of LMS in Saudi Arabia. Moderating variables help us to understand the differences between groups and enhance the explanatory power of models. Thus, the moderating effect of two demographic characteristics (gender and age) is examined in this study.

3. Conceptual framework

The research conceptual framework was mainly developed based on the TAM (Davis, Bagozzi, & Warshaw, 1989), two demographic moderators (gender and age) and eight external variables, namely content quality, learning support, visual design, system navigation, ease of access, system interactivity, instructional assessment and system learnability. The eight variables were adopted from the work done by Zaharias and Poylymenakou (2009), as they were carefully selected based on a profound review of many studies in the domain of usability, e-learning and educational technologies. The constructs included in the conceptual framework are described in the next subsections.

3.1. Content quality

Content quality (CQ) refers to the accuracy of used terms, sufficiency of materials to support the course objectives and relevance of information (Junus, Santoso, Isal, & Utomo, 2015). DeLone and McLean (1992) asserted the significance of information quality in their information systems success model and postulated that information quality influence user satisfaction and intention. The direct influence of content quality on student use of LMS has been empirically demonstrated (Cidral, Oliveira, Di Felice, & Aparicio, 2017; Saba, 2012). Furthermore, Tran (2016) provided evidence that when the content quality of LMS is high, students tend to perceive the system as useful. In Emirates, it was concluded (Salloum, Al-Emran, Shaalan, & Tarhini, 2019) that CQ directly impacts student acceptance of e-learning systems.

3.2. Learning support

Learning support (LS) refers to the ability of e-learning systems to provide users with tools and features needed to support learning activities (Zaharias & Poylymenakou, 2009). Good e-learning systems should provide high-quality tools that support individual and group-based learning activities (Junus, Santoso, Isal, & Utomo, 2015), such as discussion boards and communication tools. Reviewing past literature related to e-learning, it was found that studies investigating the effect of learning support on student use are scarce. The majority of research examined technical support rather than learning support. Nonetheless, one study (Wang, 2018) was conducted in China and concluded that perceived learning support influences behavioural intention to use e-learning.

3.3. Visual design

Visual design (VD) refers to how the interface layout and menus are appropriate and attractive to users (Scholtz, Mandela, Mahmud, & Ramayah, 2016). Previous research in e-learning acceptance disclosed that the effect of VD on the two main constructs of the TAM is established. Al-Aulamie (2013) examined factors that affect student use of LMS in Saudi universities and demonstrated that VD is a determinant of PEOU. Similarly, it has been found (Cho, Cheng, & Lai, 2009; Khedr, Hana, & Shollar, 2012) that when students perceive that e-learning systems have good visual design, they are more likely to perceive the system as easy to use and useful.

3.4. System navigation

System navigation (SN) refers to the degree to which the organisation of the system is understandable and appropriate (Naveh, Tubin, & Pliskin, 2012). Studies have demonstrated the effect of SN on both PEOU and PU. In e-learning systems, Theng and Sin (2012) found that the navigation of LMS has a positive influence on student perceived ease of use in Singapore. Naveh et al. (2012) examined the success factors of LMS and concluded that SN is an important factor for student use of LMS. The 40 students expressed the importance of reaching the desired information easily and efficiently. In respect to digital libraries, Pakistani students said that SN has a positive impact on their perceived ease of use and perceived usefulness (Khan & Qutab, 2016). In e-commerce, Green and Pearson (2011) established the effect of navigation on the perceived usefulness of online shopping websites using 344 undergraduate students.

3.5. 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 (Naveh, Tubin, & Pliskin, 2012). The poor accessibility of LMS, such as a long login process and slow download of elements, causes students frustration (Naveh, Tubin, & Pliskin, 2012). Ease of access is important as it affects student attitude toward e-learning systems (Lee, 2008). Al-Harbi (2011) combined the theory of reasoned action (TRA) and the TAM and found that EOA plays an important role in the students' intention to use e-learning systems in a single university in Saudi Arabia. Furthermore, a study of 306 students in a Saudi higher-educational institution confirmed that EOA is a critical success factor for e-learning systems (Alhabeeb & Rowley, 2018).

3.6. System interactivity

System interactivity (SI) represents how students are engaged with e-learning systems during their education (Zaharias, 2009). The relationship between SI and PEOU and PU is significant. Alkandari (2015) examined student acceptance of LMS at Kuwait University using the TAM and found that SI is a determinant of PEOU. Similar results were demonstrated by Lin, Persada, and Nadlifatin (2014) who examined student acceptance of Blackboard at a single university in Taiwan. Tran (2016) provided evidence that when LMS have good interactivity, students tend to perceive LMS as easy to use. Regarding PU, studies investigated and agreed upon the effect of LMS interactivity on university student perceptions of usefulness in Saudi Arabia (Alenezi, 2012; Al-Harbi, 2011), Kuwait (Alkandari, 2015), Singapore (Theng & Sin, 2012) and Taiwan (Lin, Persada, & Nadlifatin, 2014).

3.7. Instructional assessment

Instructional assessment (IA), sometimes called formative assessment, can give feedback about student accomplishments in relation to course objectives (Kayler & Weller, 2007), enable students to learn more by answering questions (Wang, 2014) and enhance student academic achievements (de Rosario Uribe, 2014). As IA should be designed into online learning systems (Kayler & Weller, 2007), learning management systems usually provide a variety of assessment tools including surveys, quizzes, and tests. These should be good self-assessment tools to help students in understanding the content of courses.

3.8. System learnability

System learnability (SL) refers to the degree to which users can learn how to use the system without difficulty (Nielsen, 1993). The impact of SL of e-learning systems on student PEOU and PU has not yet received much attention from researchers. Scholtz et al. (2016) empirically concluded that interface usability including SL has a positive influence on both PEOU and PU of ERP systems. In the same line, Aziz and Kamaludin (2014) revealed that the SL of a Malaysian university website positively influenced PEOU and PU of 82 users. However, it was found (Lin, 2013) that there is no significant correlation between the SL of e-learning systems and student PEOU.

3.9. Gender moderating effect

Several technology-acceptance models, such as UTAUT (Venkatesh, Morris, Davis, & Davis, 2003) and UTAUT2 (Venkatesh, Thong, & Xu, 2012), adopted gender as a moderator variable, as there is a difference in the process of making decisions between men and women (Venkatesh & Morris, 2000). Past studies (Venkatesh, Thong, & Xu, 2012; Sun & Zhang, 2006; Morris, Venkatesh, & Ackerman, 2005; Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh & Morris, 2000; Venkatesh, Morris, & Ackerman, 2000) consider that gender plays an important role in explaining user behaviour in information systems. In terms of e-learning, review studies on gender (Goswami & Dutta, 2016; Shaouf & Altaqqi, 2018) found that gender is an important variable in e-learning. Research has concluded that there are differences between male and female students in perception (Al-Youssef, 2015), patterns of use (Ng & Tan, 2017) and acceptance of LMS (Tarhini, Hone, & Liu, 2014a). Specially in Saudi Arabia, it is expected that gender differences would influence student use of LMS as the Saudi educational system implements gender segregation in all academic stages. Nevertheless, it has been stated

(Brinson, 2016; Ramírez-Correa, Arenas-Gaitán, & Rondán-Cataluña, 2015; Tarhini, Hone, & Liu, 2014a) that the scarcity in research related to the gender moderating effect in e-learning systems acceptance is very evident, especially in the Arab world (Tarhini, 2013; Smeda, 2017).

Considering the relationships between TAM's constructs, the moderating effect of gender is still not clear. Venkatesh and Morris (2000) found that gender does not moderate the relationship between PEOU and PU. In contrast, Ong and Lai (2006) demonstrated that gender does affect this relationship, and the relationship is stronger for women. Padilla-MeléNdez, Aguila-Obra, and Garrido-Moreno (2013) provided an empirical evidence that gender moderates the relationship between the students' PEOU and PU of LMS. More specifically, the relationship was stronger for male students. For PEOU and BI, Venkatesh and Morris (2000) found that gender moderates this relationship using the TAM model. They determined that this relationship is stronger for women compared to men and argued that women are more associated with a high-level of computer anxiety that causes a low-level of computer self-efficacy, which could contribute to lowering ease of use perceptions. A meta-analysis study (Maricutoiu, 2014) revealed that computer anxiety is negatively correlated with computer ease of use and intention. Venkatesh et al. (2003) proposed the UTAUT model and demonstrated that gender affects the relationship between effort expectancy (same as PEOU) and BI, where the relationship is stronger for women than men. Supporting this argument, Sun and Zhang (2006) revealed that the relationship between PEOU and BI is stronger for females. However, it was found (Dečman, 2015; Raman, Don, Khalid, & Rizuan, 2014; Wong, Teo, & Russo, 2012; Khechine, Lakhal, Pascot, & Bytha, 2014; Alkhasawneh & Alanazy, 2015) that gender does not influence the relationship between effort expectancy (same as PEOU) and BI in e-learning systems. In line with Venkatesh and Morris (2000) and Venkatesh et al. (2003), other studies (Ilie, Slyke, Green, & Hao, 2005; Tarhini, Hone, & Liu, 2014a) in e-learning systems concluded that there was a student gender moderating effect on the relationship between PEOU and BI. In respect to the relationship between PU and BI, Venkatesh and Morris (2000) found that the relationship between PU and BI in TAM is moderated by gender, and men are more motivated by PU. They reported that their demonstration is compatible with previous literature in psychology, which confirms that men are more task-oriented than women. Further, men are more motivated by gaining and accomplishment needs, which is directly associated with usefulness. Supporting this argument, Venkatesh et al. (2003) demonstrated that gender affects the relationship between performance expectancy (same as PU) and BI, where the relationship is stronger for men. In workplace settings, Ong and Lai (2006) and Sun and Zhang (2006) revealed that technology use by male workers is more influenced by PU. However, studies (Alkhasawneh & Alanazy, 2015; Khechine, Lakhal, Pascot, & Bytha, 2014) demonstrated the lack of gender influence on performance expectancy (same as PU) and BI. In contrast with several studies (Dečman, 2015; Raman, Don, Khalid, & Rizuan, 2014; Tarhini, Hone, & Liu, 2014a; Wong, Teo, & Russo, 2012), Tarhini, Hone, and Liu (2014b) confirmed that gender moderates PU and BI when students use e-learning systems.

Past studies (Al-Harbi, 2011; Al-Youssef, 2015; González-Gómez, Guardiola, Rodríguez, & Alonso, 2012; Ong & Lai, 2006; Padilla-MeléNdez, Aguila-Obra, & Garrido-Moreno, 2013; Ramírez-Correa, Arenas-Gaitán, & Rondán-Cataluña, 2015) found statistically significant differences between men and women on the perception of e-learning systems. Padilla-MeléNdez et al. (2013) examined the influence of perceived playfulness on TAM's constructs in a blended learning scenario and revealed that there is a significant difference between male and female students in their attitude and behavioural intention to use LMS. Female students rated the attitude toward LMS higher

than male, and vice versa in behavioural intention to use LMS. In Spain, González-Gómez et al. (2012) concluded that female students accept e-learning more than male students. Ong and Lai (2006) extended TAM to investigate the effect of gender difference between men and women in accepting e-learning systems. They showed that men are more likely to rate PEOU, PU and BI higher than women. In the same direction, Ramírez-Correa et al. (2015) conducted a study for 201 males and 188 female students in both Chile and Spain, and the t-test examination indicated that there is a statistically significant difference between male and female students in PEOU, BI and AU, and that females had a more positive perception than male students.

3.10. Age moderating effect

Age is one of the demographic characteristics that has an impact on an individual's perception, attitude and behaviour (Nosek, Banaji, & Greenwald, 2002). Prior research in information systems (Morris & Venkatesh, 2000; Morris, Venkatesh, & Ackerman, 2005; Sun & Zhang, 2006; Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh, Thong, & Xu, 2012) found that age plays an important moderating role in explaining user behaviour. Venkatesh et al. (2003) concluded that after the inclusion of age as a moderator, the explanatory power of the theory of planned behaviour was raised to 47%. In spite of this, it was reported that age as a moderating element in technology acceptance has not sufficiently given consideration (Tarhini, Hone, & Liu, 2014a).

Regarding the age moderating effect on the relationships between TAM's constructs, prior studies have failed to provide consistent results. In terms of PEOU and PU, Abbasi (2011) investigated the acceptance of e-learning in Pakistan and found that age influences the relationship between PEOU and PU, where the relationship was stronger for younger than older users. Nevertheless, reviewing the past literature revealed that the moderating effect of age on PEOU → PU did not receive enough attention. For PEOU and BI, Venkatesh et al. (2003) demonstrated that age affects the relationship between effort expectancy (same as PEOU) and BI, where the relationship is stronger for older than younger users. They argued that prior research (Morris & Venkatesh, 2000) supports their finding that older users are more motivated by effort expectancy. On the contrary, research (Alkhasawneh & Alanazy, 2015; Khechine, Lakhal, Pascot, & Bytha, 2014) found that there is no age influence on the relationship between effort expectancy (same as PEOU) and BI in Saudi Arabia. In line with Venkatesh et al. (2003), studies in e-learning systems (Tarhini, Hone, & Liu, 2014a, 2014b) concluded that student age moderates the relationship between PEOU and BI. In respect to PU and BI, Venkatesh et al. (2003) demonstrated that age affects the relationship between performance expectancy (same as PU) and BI, where the relationship is stronger for younger users. They reported that their demonstration is compatible with previous literature on attitude, that confirms that younger users are more motivated by extrinsic rewards, which is directly associated with usefulness. In the same vein, Sun and Zhang (2006) revealed that the relationship between PU and BI is stronger for younger users. In contrast with Khechine et al. (2014), scholars (Alkhasawneh & Alanazy, 2015; Wang, Wu, & Wang, 2009) have demonstrated the lack of age influence on the relationship between performance expectancy (same as PU) and BI. Tarhini, Hone, and Liu (2014a) in a study of student use of e-learning systems supported the existence of an age moderating effect on PU and BI. This evidence encourages the examination of an age moderating effect.

4. Methodology

4.1. Research model and hypotheses

The research model is depicted in Fig. 1, which comprises eight independent variables, four dependent variables (TAM's constructs) and two moderators (gender and age). However, the direct relationships between the independent and dependent variables were proposed, tested and discussed in the authors' prior work (Binyamin, Rutter, & Smith, 2019). In this present paper, the proposed model is extended and examined with two personal moderators, namely gender and age. To examine the moderating effect of gender and age on the direct relationships, the following hypotheses are proposed.

H1a: *Gender moderates the effect of CQ on students' PEOU of LMS.*

H1b: *Gender moderates the effect of LS on students' PEOU of LMS.*

H1c: *Gender moderates the effect of VD on students' PEOU of LMS.*

H1d: *Gender moderates the effect of SN on students' PEOU of LMS.*

H1e: *Gender moderates the effect of EOA on students' PEOU of LMS.*

H1f: *Gender moderates the effect of SI on students' PEOU of LMS.*

H1g: *Gender moderates the effect of IA on students' PEOU of LMS.*

H1h: *Gender moderates the effect of SL on students' PEOU of LMS.*

H2a: *Gender moderates the effect of CQ on students' PU of LMS.*

H2b: *Gender moderates the effect of LS on students' PU of LMS.*

H2c: *Gender moderates the effect of VD on students' PU of LMS.*

H2d: *Gender moderates the effect of SN on students' PU of LMS.*

H2e: *Gender moderates the effect of EOA on students' PU of LMS.*

H2f: *Gender moderates the effect of SI on students' PU of LMS.*

H2g: *Gender moderates the effect of IA on students' PU of LMS.*

H2h: *Gender moderates the effect of SL on students' PU of LMS.*

H3: *Gender moderates the relationships between TAM's constructs (PEOU, PU, BI and AU).*

H4a: *Age moderates the effect of CQ on students' PEOU of LMS.*

H4b: *Age moderates the effect of LS on students' PEOU of LMS.*

H4c: *Age moderates the effect of VD on students' PEOU of LMS.*

H4d: *Age moderates the effect of SN on students' PEOU of LMS.*

H4e: *Age moderates the effect of EOA on students' PEOU of LMS.*

H4f: *Age moderates the effect of SI on students' PEOU of LMS.*

H4g: *Age moderates the effect of IA on students' PEOU of LMS.*

H4h: *Age moderates the effect of SL on students' PEOU of LMS.*

H5a: *Age moderates the effect of CQ on students' PU of LMS.*

H5b: *Age moderates the effect of LS on students' PU of LMS.*

H5c: *Age moderates the effect of VD on students' PU of LMS.*

H5d*: Age moderates the effect of SN on students' PU of LMS.*

H5e: *Age moderates the effect of EOA on students' PU of LMS.*

H5f: *Age moderates the effect of SI on students' PU of LMS.*

H5g: *Age moderates the effect of IA on students' PU of LMS.*

H5h*: Age moderates the effect of SL on students' PU of LMS.*

H6: *Age moderates the relationships between TAM's constructs (PEOU, PU, BI and AU).*

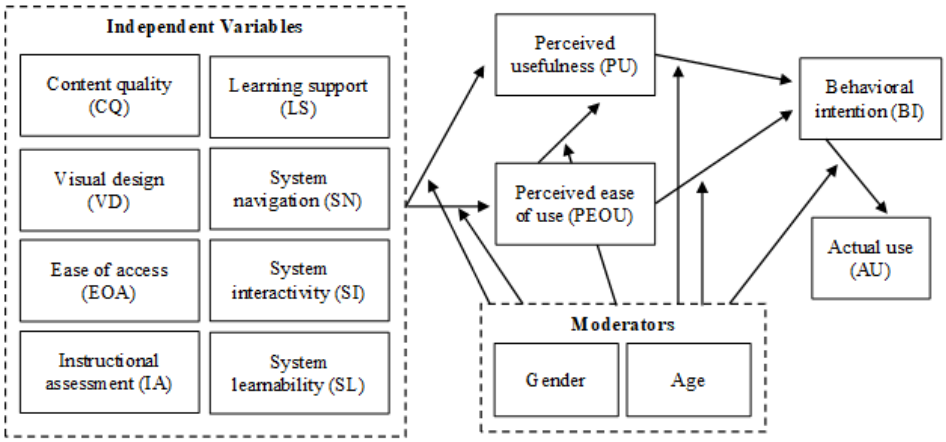

Fig. 1. The conceptual model

4.2. Population and sampling

The target population was higher education students at Saudi public universities. According to the Saudi Ministry of Education (Ministry of Education, 2017), 26 public universities have LMS, and the total number of students was over 1.3 million. As the population is quite large and widely dispersed across the country, the probability multi-stage cluster sampling technique was employed as suggested by Bryman (2016). The steps of defining the study sample are described, below:

1. The population of the study was divided into clusters, with each cluster representing one public university adapting LMS for student use. The first stage of clustering resulted into 26 clusters (or universities).
2. The 26 clusters or universities were grouped based on the geographical regions. The second stage of clustering yielded three groups: Western region (11 universities), Central region (8 universities), and Eastern region (7 universities), which reveals that the three regional clusters share similar characteristics, such as user type (students), educational levels, and gender balance.

3. From each of the three regional clusters, one university was selected randomly. The selected universities were: King Abdulaziz University from Western region, King Saud University from Central region, and Imam Abdulrahman Bin Faisal University from Eastern region.
4. A simple random sampling technique was employed within each of the selected universities.

4.3. Instrumentation

Following most technology acceptance studies i.e. (Binyamin, Rutter, & Smith, 2017a; Khechine, Lakhal, Pascot, & Bytha, 2014; Smeda, Shiratuddin, & Wong, 2017), this study benefits from utilising online surveys for data collection. The survey comprises three sections. The first section includes the demographic information, and participants were required to select their gender and university and input their age. The second section represents the eight factors with 34 positive statements (see Appendix I). For each statement, the participants were asked to select the answer that best represented their level of agreement. based on a five-point Likert scale, where 1 indicates strongly disagree and 5 indicates strongly agree. The third section includes the four TAM constructs with 17 positive statements. For each statement, the participants were asked to select the answer that best represented their level of agreement based on a five-point Likert scale, where 1 indicates strongly disagree and 5 indicates strongly agree. These items were adapted from previous literature in technology acceptance e.g. (Davis, 1989; Islam, 2013).

To ensure the content validity of the developed questionnaire, it was tested in collaboration with five experts from relevant academic fields. The questionnaire was reviewed by experts from the United Kingdom, Nigeria, Oman, and Saudi Arabia. In addition, this study was conducted in the Kingdom of Saudi Arabia, where Arabic is the first language and which most students speak. To ensure that respondents understand the survey items and are not excluded from participation due to language barriers, the questionnaire was translated from English into Arabic.

4.4. Data collection

Electronic mails were sent to 2000 students registered in different academic programs and various levels of education in the three universities: King Abdulaziz University, King Saud University and Imam Abdulrahman Bin Faisal University. A total of 851 responses were submitted by participants, equivalent to a response rate of 42.6%. After the preliminary examination for outliers, normality and unengaged responses, 833 responses (41.65% response rate) were used for data analysis. Table 2 includes the demographic information of the participants.

Table 2
The profile of participants

	Characteristics	Frequency	Percent
Gender	Male	273	32.8
	Female	560	67.2
University	King Abdulaziz University	375	45.0
	King Saud University	418	50.2
	Imam Abdulrahman Bin Faisal University	40	04.8
Age	<= 21	442	53.1
	> 21	391	46.9

5. Results and model testing

This study used the PLS-SEM technique along with multigroup analysis (MGA) and SmartPLS 3 (Ringle, Wende, & Becker, 2015) to test the proposed model. PLS-SEM is convenient for complex models and when the primary objective of the research is to extend an existing theory (Hair, Hult, Ringle, & Sarstedt, 2017; Hair, Ringle, & Sarstedt, 2011). A multi-stage procedure was followed to evaluate the proposed model: (1) measurement model assessment and (2) structural model assessment. The results of this analysis are presented in the next subsections.

5.1. Measurement model assessment

The measurement model refers to the relationships between the constructs and their indicators (Hair, Ringle, & Sarstedt, 2011). In other words, the measurement model refers to how the constructs are measured via indicators (Hair, Sarstedt, Ringle, & Gudergan, 2018). If the measurement model evaluation does not meet the minimum requirements of reliability and validity, the structural model evaluation in the second stage has no value (Hair, Sarstedt, Ringle, & Mena, 2012). Table 3 summarises the criteria used for evaluating the measurement model in this study. Review studies on PLS-SEM (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014; Hair, Sarstedt, Ringle, & Mena, 2012) found that researchers usually report those criteria when examining the measurement model.

Table 3
The Criteria of measurement model assessment

Validity Type	Criteria	Guidelines	References
Indicator reliability	Loadings	Loading ≥ 0.7	Chin (1998)
Construct reliability	Composite reliability (CR)	CR ≥ 0.7	Hair, Hult, Ringle, & Sarstedt (2017)
Convergent validity	Average variance extracted (AVE)	AVE ≥ 0.5	Fornell & Larcker (1981)
Discriminant validity	Fornell-Larcker criterion	√AVE > correlation with other constructs	Fornell & Larcker (1981)

Given those criteria, the results of measures' reliability and validity assessments are presented in the following subsections.

5.1.1. Gender

The indicators' reliability is achieved when the loading of each indicator is above 0.7 (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). High outer loadings mean that the indicators of a construct have a large degree of similarity (Hair, Hult, Ringle, & Sarstedt, 2017). Loadings vary between 0 and 1, and the value closer to 1 indicates more reliability (Garson, 2016). The results demonstrated that all indicators were reliable except AU02 (0.50) and SN05 (0.67), which were therefore removed. This result indicates that the indicators of each construct used in this study have a large degree of similarity. The constructs' reliability was done by calculating the composite reliability of each construct. Reliability refers to the indicators' internal consistency and their ability to generate the same findings under the same situations (Field, 2013). As seen in Table 4, the values

obtained exceeded the threshold of 0.7 as suggested by Hair et al. (2017), providing evidence of the high reliability of the constructs. For convergent validity, it refers to the extent to which an indicator is positively correlated with other indicators in the same construct (Sekaran & Bougie, 2016). Convergent validity is achieved when the loading of each indicator is above 0.7 and the AVE value of each construct is 0.5 or above (Hair, Ringle, & Sarstedt, 2011). The findings showed that all AVE values were above 0.5, and therefore all constructs had adequate convergent validity. This indicates that indicators used in this study are positively correlated with other indicators in the same construct.

Table 4
The summary of the measurement model assessment

	Male Students		**Female Students**		**Younger Students**		**Older Students**	
	CR	AVE	CR	AVE	CR	AVE	CR	AVE
AU	0.94	0.84	0.92	0.79	0.93	0.81	0.93	0.80
BI	0.95	0.82	0.97	0.88	0.96	0.86	0.96	0.86
CQ	0.89	0.68	0.89	0.66	0.90	0.68	0.88	0.66
EOA	0.89	0.67	0.87	0.62	0.87	0.63	0.88	0.65
IA	0.95	0.82	0.94	0.79	0.94	0.79	0.95	0.82
LS	0.93	0.72	0.90	0.63	0.92	0.70	0.89	0.62
PEOU	0.95	0.82	0.93	0.77	0.94	0.79	0.93	0.77
PU	0.96	0.82	0.96	0.82	0.96	0.83	0.96	0.82
SI	0.93	0.77	0.91	0.71	0.92	0.74	0.91	0.72
SL	0.91	0.73	0.91	0.72	0.92	0.74	0.91	0.71
SN	0.92	0.75	0.92	0.73	0.93	0.76	0.91	0.72
VD	0.93	0.76	0.91	0.72	0.92	0.75	0.91	0.71

Note. CR: composite reliability, AVE: average variance extracted

Discriminant validity means that a construct is different from other constructs in the model and captures the intended variable (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). In other words, each construct should have more correlation with its indicators than with the indicators of the other constructs (Hair, Hult, Ringle, & Sarstedt, 2017). The values of the Fornell-Larcker discriminant validity for both genders are shown in Table 5. The results indicated that the square root of each construct's AVE, presented on the diagonal line, was larger than that construct's correlation with other constructs (Fornell & Larcker, 1981). In doing so, the measurement model assessment was successful for both sub-samples. This means that each construct has more variance with its indicators than with the other constructs in the model (Hair, Hult, Ringle, & Sarstedt, 2017).

5.1.2. Age

The age moderator variable was measured using a ratio scale, and therefore there is a need for further refinement. It was decided (Iacobucci, Posavac, Karde, Schneider, & Popovich, 2015) that the median-split method is quite common in analysis and there is no strong reason preventing its use. Using median-split procedures (median = 21), there were 442 students within the younger students' group (median <= 21) and 391 students within the older students' group (median > 21).

Table 4 and Table 6 display the results of the measurement model assessment for younger and older students. As can be seen, CR, AVE and discriminant validity of each

construct in both sub-samples exceeded the cut-off points. Therefore, the measurement model assessment was successful for both younger and older students.

Table 5
Fornell-Larcker discriminant validity for gender groups

	Male Students											
	AU	BI	CQ	EOA	IA	LS	PEOU	PU	SI	SL	SN	VD
AU	**0.92**											
BI	0.58	**0.90**										
CQ	0.56	0.59	**0.82**									
EOA	0.42	0.53	0.63	**0.82**								
IA	0.59	0.58	0.69	0.53	**0.91**							
LS	0.57	0.56	0.75	0.54	0.73	**0.85**						
PEOU	0.56	0.69	0.73	0.65	0.71	0.68	**0.90**					
PU	0.63	0.76	0.67	0.50	0.74	0.72	0.75	**0.91**				
SI	0.60	0.60	0.70	0.54	0.75	0.79	0.73	0.74	**0.88**			
SL	0.56	0.64	0.65	0.64	0.72	0.64	0.84	0.68	0.68	**0.85**		
SN	0.54	0.64	0.73	0.68	0.73	0.71	0.76	0.66	0.68	0.74	**0.87**	
VD	0.49	0.55	0.72	0.57	0.65	0.68	0.70	0.61	0.69	0.65	0.76	**0.87**
	Female Students											
	AU	BI	CQ	EOA	IA	LS	PEOU	PU	SI	SL	SN	VD
AU	**0.89**											
BI	0.59	**0.94**										
CQ	0.45	0.54	**0.81**									
EOA	0.36	0.46	0.51	**0.79**								
IA	0.43	0.61	0.63	0.52	**0.89**							
LS	0.45	0.53	0.69	0.52	0.67	**0.80**						
PEOU	0.55	0.66	0.62	0.56	0.69	0.62	**0.88**					
PU	0.59	0.77	0.59	0.47	0.70	0.65	0.70	**0.91**				
SI	0.45	0.61	0.61	0.50	0.72	0.68	0.62	0.71	**0.84**			
SL	0.42	0.57	0.59	0.55	0.66	0.55	0.77	0.60	0.54	**0.85**		
SN	0.43	0.50	0.63	0.58	0.63	0.58	0.71	0.51	0.53	0.65	**0.86**	
VD	0.33	0.45	0.64	0.53	0.57	0.57	0.62	0.45	0.52	0.56	0.72	**0.85**

5.2. Structural model assessment

The structural model refers to the relationships between the constructs themselves, and its assessment includes evaluating the relationships between the constructs in the model (Hair, Ringle, & Sarstedt, 2011). Table 7 summarises the criteria used for evaluating the structural model in this study. Review studies on PLS-SEM (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014; Hair, Sarstedt, Ringle, & Mena, 2012) found that researchers usually report those criteria when examining the structural model.

Given those criteria, the results of those assessments are presented in the following subsections.

Table 6
Fornell-Larcker discriminant validity for age groups

	Younger Students											
	AU	BI	CQ	EOA	IA	LS	PEOU	PU	SI	SL	SN	VD
AU	**0.90**											
BI	0.61	**0.93**										
CQ	0.54	0.60	**0.83**									
EOA	0.43	0.51	0.56	**0.79**								
IA	0.57	0.67	0.71	0.55	**0.89**							
LS	0.57	0.58	0.75	0.55	0.70	**0.83**						
PEOU	0.59	0.68	0.69	0.60	0.74	0.65	**0.89**					
PU	0.65	0.79	0.65	0.50	0.76	0.69	0.71	**0.91**				
SI	0.60	0.63	0.67	0.54	0.77	0.75	0.67	0.76	**0.86**			
SL	0.52	0.64	0.64	0.57	0.72	0.59	0.83	0.65	0.62	**0.86**		
SN	0.55	0.60	0.73	0.66	0.72	0.64	0.76	0.60	0.62	0.71	**0.87**	
VD	0.49	0.56	0.73	0.60	0.63	0.62	0.68	0.53	0.62	0.64	0.77	**0.87**
	Older Students											
	AU	BI	CQ	EOA	IA	LS	PEOU	PU	SI	SL	SN	VD
AU	**0.90**											
BI	0.56	**0.93**										
CQ	0.43	0.50	**0.81**									
EOA	0.33	0.46	0.55	**0.81**								
IA	0.40	0.50	0.59	0.50	**0.90**							
LS	0.40	0.49	0.68	0.51	0.69	**0.79**						
PEOU	0.50	0.66	0.63	0.60	0.64	0.65	**0.88**					
PU	0.56	0.74	0.59	0.48	0.65	0.67	0.73	**0.90**				
SI	0.39	0.56	0.62	0.49	0.69	0.69	0.65	0.68	**0.85**			
SL	0.43	0.54	0.59	0.62	0.64	0.60	0.77	0.60	0.57	**0.84**		
SN	0.37	0.47	0.58	0.57	0.59	0.62	0.68	0.52	0.55	0.65	**0.85**	
VD	0.27	0.38	0.60	0.49	0.57	0.59	0.60	0.49	0.55	0.54	0.68	**0.84**

Table 7
The Criteria of structural model assessment

Criteria	Guidelines	References
Collinearity	VIF < 5 or tolerance > 2	Hair, Ringle, & Sarstedt (2011)
Path coefficients	Use bootstrapping function Significance: $p \leq 0.05$ Sign: one-tailed option	Hair, Hult, Ringle, & Sarstedt (2017)
Coefficient of determination (R^2)	Weak effect: $R^2 = 0.19$ Moderate effect: $R^2 = 0.33$ High effect: $R^2 = 0.67$	Chin (1998)
Permutation test	Use Permutation function Significance: $p \leq 0.05$	Matthews (2017)

5.2.1. Collinearity

Collinearity occurs when there is a high correlation between two constructs, which produces interpretation issues (Hair, Hult, Ringle, & Sarstedt, 2017). If more than two constructs are involved, it refers to multicollinearity. Collinearity can be assessed using the variance inflation factor (VIF), which is obtained by dividing one by tolerance referring to the variance explained by one independent construct not explained by the other independent constructs (Hair, Hult, Ringle, & Sarstedt, 2017). A VIF value of 5 or higher (tolerance value of 0.20 or lower) indicates a high collinearity (Hair, Ringle, & Sarstedt, 2011). Table 8 shows that all VIF values were below the cut-off point providing evidence that the collinearity of independent constructs was not critical.

Table 8
The results of VIF values

	Male Students				**Female Students**			
	AU	BI	PEOU	PU	AU	BI	PEOU	PU
BI	1.00				1.00			
CQ			3.23	3.39			2.57	2.57
EOA			2.13	2.15			1.75	1.76
IA			3.25	3.25			2.96	2.99
LS			3.61	3.61			2.61	2.63
PEOU		2.26		4.73		1.97		3.48
PU		2.26				1.97		
SI			3.54	3.64			2.50	2.54
SL			2.93	4.11			2.25	2.85
SN			3.98	4.01			2.74	2.92
VD			2.94	2.96			2.42	2.43
	Younger Students				**Older Students**			
	AU	BI	PEOU	PU	AU	BI	PEOU	PU
BI	1.00				1.00			
CQ			3.38	3.38			2.36	2.38
EOA			1.93	1.94			1.86	1.87
IA			3.70	3.74			2.63	2.63
LS			3.14	3.15			2.83	2.84
PEOU		2.03		4.28		2.15		3.32
PU		2.03				2.15		
SI			3.26	3.28			2.43	2.52
SL			2.58	3.53			2.44	2.98
SN			3.78	3.93			2.54	2.61
VD			2.98	3.00			2.19	2.20

5.2.2. Path coefficients and coefficients of determination

Path coefficients refer to the estimates of the relationships between the model's constructs (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). Those coefficients range from +1 to -1, where +1 means a strong positive relationship, 0 means a weak or non-existence relationship and -1 means a strong negative relationship (Garson, 2016).

Coefficient of determination (R2) refers to the effect of independent variables on the dependent latent variables (Hair, Sarstedt, Ringle, & Mena, 2012), which is one of the quality measures of the structural model (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014).

Table 9
The summary of the moderating effect for gender

Path	Male Students		Female Students		Permutation Test	
	Coefficient	R^2	Coefficient	R^2	Difference	p-Value
CQ → PEOU	0.182***	0.782	0.001	0.708	0.181*	0.035
LS → PEOU	-0.022		0.081*		-0.103	0.138
VD → PEOU	0.061		0.044		0.017	0.819
SN → PEOU	0.076		0.223***		-0.147	0.056
EOA → PEOU	0.059		0.038		0.021	0.725
SI → PEOU	0.146*		0.112**		0.033	0.628
IA → PEOU	0.006		0.092*		-0.085	0.248
SL → PEOU	0.500***		0.416***		0.084	0.212
CQ → PU	0.048	0.677	0.070*	0.653	-0.022	0.779
LS → PU	0.183**		0.146***		0.037	0.640
VD → PU	-0.053		-0.121**		0.068	0.378
SN → PU	-0.004		-0.089*		0.085	0.324
EOA → PU	-0.053		0.004		-0.057	0.378
SI → PU	0.198**		0.301***		-0.103	0.225
IA → PU	0.250***		0.193***		0.057	0.516
SL → PU	-0.011		0.026		-0.037	0.690
PEOU → PU	0.349***		0.364***		-0.016	0.908
PEOU → BI	0.280***	0.614	0.224***	0.618	0.056	0.516
PU → BI	0.554***		0.613***		-0.059	0.465
BI → AU	0.583***	0.338	0.592***	0.350	-0.009	0.876

Note. *** $p<.001$, ** $p<.01$, * $p<.05$, R2: coefficient of determination

Table 9 and Table 10 present the summary of path coefficients and the R^2 values of the two sub-samples beside the test of differences between the sub-samples. First, the bootstrapping technique with 10,000 subsamples was used for a path coefficients test, as recommended by Hair et al. (2017). Then, the statistically significant differences between the two sub-samples were examined. Unlike the liberal parametric test and the one-tailed PLS-MGA, the permutation test is non-parametric, two-tailed, more conservative and recommended by Hair, Sarstedt, Ringle, and Gudergan (2018) and Matthews (2017). In terms of the male students' sample, the paths CQ → PEOU, SI → PEOU, SL → PEOU, LS → PU, SI → PU, IA → PU, PEOU → PU, PEOU → BI, PU → BI and BI → AU are significant. The highest significant path is BI → AU (β = 0.583), whereas the lowest significant path is SI → PEOU (β = 0.146). Regarding female students, LS → PEOU, SN → PEOU, SI → PEOU, IA → PEOU, SL → PEOU, CQ → PU, LS → PU, VD → PU, SN → PU, SI → PU, IA → PU, PEOU → PU, PEOU → BI, PU → BI and BI → AU are significant paths. This indicates that more relationships are significant in the model of female students. The strongest significant path is PU → BI (β = 0.613), whereas the weakest significant path is CQ → PU (β = 0.070). For both male and female students, the variance explained by the independent variables is highest in PEOU, followed by PU and BI. The permutation test showed that gender moderated only one relationship between

CQ → PEOU, indicating that the effect of CQ on PEOU is stronger and more important for male students.

Table 10
The summary of the moderating effect for age

Path	Younger Students		Older Students		Permutation Test	
	Coefficient	R^2	Coefficient	R^2	Difference	p-Value
CQ → PEOU	0.025	0.762	0.075*	0.692	-0.050	0.414
LS → PEOU	0.056		0.063		-0.007	0.916
VD → PEOU	0.056		0.056		-0.001	0.994
SN → PEOU	0.189***		0.145**		0.044	0.531
EOA → PEOU	0.047		0.072		-0.026	0.646
SI → PEOU	0.073		0.166***		-0.093	0.149
IA → PEOU	0.088*		0.027		0.061	0.383
SL → PEOU	0.471***		0.405***		0.067	0.294
CQ → PU	0.074	0.690	0.052	0.637	0.022	0.756
LS → PU	0.132**		0.196***		-0.064	0.384
VD → PU	-0.128**		-0.061		-0.067	0.364
SN → PU	-0.064		-0.082		0.018	0.818
EOA → PU	-0.008		-0.013		0.005	0.933
SI → PU	0.309***		0.211***		0.098	0.218
IA → PU	0.283***		0.154**		0.129	0.098
SL → PU	0.047		-0.017		0.064	0.487
PEOU → PU	0.262***		0.447***		-0.186	0.116
PEOU → BI	0.233***	0.643	0.246***	0.574	-0.013	0.866
PU → BI	0.620***		0.560***		0.060	0.435
BI → AU	0.605***	0.365	0.564***	0.317	0.041	0.458

Note. *** p<.001, ** p<.01, * p<.05, R2: coefficient of determination

Table 10 presents the path analysis of the two sub-samples of the age variable. In terms of the younger students' sample, PEOU is affected by SN, IA and SL, while PU is affected by LS, VD, SI, IA and PEOU. The highest significant path is PU → BI (β = 0.620), whereas the lowest significant path is IA → PEOU (β = 0.088). The variance explained by the independent variables is highest in PEOU (R^2 = 0.762 or 76.2%) followed by PU (R^2 = 0.690 or 69.0%). Regarding older students, PEOU is influenced by CQ, SN SI and SL, while PU is affected by LS, SI, IA and PEOU. The strongest significant path is BI → AU (β = 0.564) followed by PU → BI (β = 0.560), whereas the weakest significant path is CQ → PEOU (β = 0.075) followed by SN → PEOU (β = 0.145). The explained variance is strongest in PEOU (R^2 = 0.692 or 69.2%) followed by PU (R^2 = 0.637 or 63.7%). Regarding the permutation test, age had no moderating effect on the relationships between the model's variables. This indicates that age does not change the strength of the proposed relationships.

6. Discussion

6.1. Gender

The findings of the path testing for male and female students are displayed in Table 9. In accordance with e-learning studies e.g. (Smeda, 2017; Tarhini, 2013), the explained variance of BI and AU was higher in female students. Nevertheless, the results suggested a good model fit for the dependent variables in both genders.

According to previous literature reviewed in this study, gender is an important element in technology acceptance as there are differences between male and female students in the acceptance of LMS. Compared to males, females had more statistically significant relationships in the model, indicating that the proposed model could be used to reason about LMS enhancements for female students. For males, the effect of PU → BI was stronger than PEOU → BI. This result is in line with the argument of Venkatesh and Morris (2000) and Venkatesh et al. (2003) who found that men are more motivated by PU as men are more task-oriented. The lowest significant path was SI → PEOU, which implies that although interactions with other students, teachers and content exist, and support the perceived ease of use of LMS, their importance is weak compared to the other factors. For female students, the relationship between PU and BI was the strongest across the other relationships, consistent with past literature (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989). This means that females' intention to use LMS was driven, to a large extent, by the usefulness and functions provided by the system. This result suggested that more consideration should be dedicated to the functionality provided by the system when dealing with female students. The weakest significant path in the females' model was CQ → PU. One possible interpretation is that regardless of the importance of content quality, its effect on the females' perceived usefulness of LMS is limited compared to the other factors.

The MGA analysis revealed that the path between CQ → PEOU was moderated by gender. This is expected in Saudi Arabia due to the cultural influence of gender segregation, in which males and females are physically separated in education. More specifically, the effect between CQ and PEOU was stronger for male students. The path between CQ and PEOU was significant in males and insignificant in the females' sample. This implies that males are more affected when LMS have an easy to reach, up-to-date, sufficient and well-organised content which, in turn, makes them perceive their education to be effortless. Reviewing past literature has demonstrated that this result is consistent with another study (Al-Aulamie, 2013) conducted in Saudi higher education. Al-Aulamie (2013) extended the TAM to investigate the students' acceptance of LMS at three universities in Saudi Arabia. He justified this result by arguing that men are more interested in the system content quality, particularly the textual content (i.e. accurate, well-organised, updated content). This is different from female students who find the non-textual content more attractive (Cyr, Head, & Ivanov, 2006). Therefore, the findings suggested accepting the hypothesis H1a, i.e. that gender moderates the effect of CQ on students' PEOU of LMS. This has an implication for university staff when implementing LMS, and individual lecturers when designing content. Regarding the moderating effect of gender on the relationships between TAM's internal constructs, the findings demonstrated the lack of this effect. This result is consistent with past studies in student acceptance of e-learning systems (Dečman, 2015; Raman, Don, Khalid, & Rizuan, 2014; Wong, Teo, & Russo, 2012; Khechine, Lakhal, Pascot, & Bytha, 2014; Alkhasawneh & Alanazy, 2015).

6.2. Age

The findings of the hypotheses' testing for younger and older students are summarised in Table 10. The results demonstrated that the proposed model explained more variance in the younger students' sample compared to the older students, meaning a better model fit for younger students in PEOU, PU, BI and AU.

In line with previous literature reviewed in this study, age is an important element in technology acceptance as there are differences between younger and older students in the acceptance of LMS. In terms of the number of statistically significant relationships, younger and older students almost maintained comparable results, indicating that the model is important for younger and older students alike. Amongst the independent variables, the highest significant path for both groups were SL → PEOU, implying that the use of LMS strongly relies on the students' perceived learnability. In terms of the younger students' model, the relationship between PU and BI was the strongest across the other relationships, in accordance with the TAM (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989). This means that younger students were significantly motivated by the usefulness of the system, indicating that special attention should be given to the functions of LMS when targeting younger students. The lowest significant path for younger students was IA → PEOU. This implies that although providing good assessment tools is necessary in the students' use of LMS, its importance is weak compared to the other independent factors. For older students, the weakest significant path was CQ → PEOU. A possible interpretation is that regardless of the importance of easy to reach, updated, sufficient and well-organised content, its effect on the perceived ease of use of LMS of older students is limited compared to the other independent factors.

The multigroup analysis revealed that no matter what age group a student belongs to, those with a higher respect toward LMS systems are more likely to use them. Therefore, universities can utilise similar policies to prompt younger and older students toward using LMS. This finding is compatible with e-learning studies in developing countries (Abbasi, 2011; Altawallbeh, Thiam, Alshourah, & Fong, 2015). Similar results were also reached in other domains, such as decision support systems (Jaradat, Imlawi, & Mashaqba, 2012), e-library (Rahman, Jamaludin, & Mahmud, 2011), ICT (Alkhasawneh & Alanazy, 2015) and internet marketing (Isa & Wong, 2015). This result can be attributed to an increasing awareness about technology among users despite their age groups (Jaradat, Imlawi, & Mashaqba, 2012). Thus, the hypotheses that age had a significant effect on the relationships in the proposed model (H4, H5 and H6) could not be confirmed. Regarding the moderating effect of age on the relationships between TAM's constructs, the findings demonstrated the lack of this effect. This result is consistent with past studies in student acceptance of e-learning systems (Alkhasawneh & Alanazy, 2015; Wong, Teo, & Russo, 2012).

7. Implications

The results presented in this paper have several implications. From a practical viewpoint, our research examined the influence of eight external variables on the students' use of LMS in Saudi public universities. Understanding the effect of these variables is important for decision makers. This is because they need to implement effective policies and strategies that aim to increase the students' engagement with LMS in Saudi higher education. Thus, the stakeholders in Saudi Arabia should ensure that the LMS used adequately reflects the relationships uncovered in the proposed model.

Moreover, our work sheds light on the differences between male, female, younger and older students in the proposed model. This study hypothesised that the students' demographic characteristics could indirectly influence the students' actual use of LMS by moderating the relationships between the independent and dependent variables. An awareness of the moderating effect of the demographics might provide a more profound understanding of the decision to use LMS among different groups of the students. This in turn, would help to design strategies for each students' segment, thus increasing the chance of using LMS. In particular, this study found that female students were less affected by content i.e. the effect between CQ and PEOU was stronger for male students. To encourage the use of LMS amongst males, attention must be paid to the quality and quantity of content. For women, attention must be paid to other factors, including navigation, support and visual design.

In terms of theory, this study contributed to the applicability of the TAM in the acceptance of LMS within the context of Saudi higher education. Although Al-Aulamie (2013) extended the TAM with a gender moderating effect in Saudi LMS, our study is unique: the usual version of TAM (Davis, Bagozzi, & Warshaw, 1989), has been adapted to give it extra external variables and demographic characteristics (gender and age), which were used as moderators in the proposed model. Furthermore, this paper addressed the criticism concerning the lack of moderating variables in TAM. It has also provided evidence of the moderating effect of demographic characteristics.

8. Conclusion

To overcome the limitations addressed in the introduction section, this study extended the TAM with eight external variables (content quality, learning support, visual design, system navigation, ease of access, system interactivity, instructional assessment and system learnability) and two moderators (gender and age). This paper primarily examined the moderating effect of gender and age on the students' use of LMS in the context of Saudi public universities. This work should be of interest to researchers, academics, decision makers and LMS designers concerned about the students' acceptance, adoption or use of e-learning systems in universities.

This research examined the moderating effect of gender and age on 40 parameter relationships and determined that only one relationship was affected by gender (CQ → PEOU). This led us to conclude that demographic differences (gender and age) have very little effect on the use of LMS in Saudi public universities. Therefore, we suggest that Saudi universities should in general utilise similar policies to prompt students toward using LMS. However, in the case of women, consideration should be given to system organisation and navigation. On the other hand, content quality is more relevant to older students compared to younger students.

9. Limitations and future work

This study is not free of limitations. First, this study targeted students at Saudi public universities, and their perception might be different from students at Saudi private universities. For this reason, other studies could extend the scope to target students at both public and private universities in Saudi Arabia. In addition, our work investigated the moderating effect of gender and age, and future work could investigate other demographic moderators (e.g. experience) and/or cultural moderators (e.g. language). Finally, the present research examined only student perceptions. Later, further research

could be conducted to investigate the views of instructors and other employees in Saudi universities.

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ORCID

Sally Smith https://orcid.org/0000-0001-8208-3943

References

Abbasi, M. S. (2011). *Culture, demography and individuals' technology acceptance behaviour: A PLS based structural evaluation of an extended model of technology acceptance in South-Asian country context*. Doctoral dissertation, Brunel Business School, Brunel University, UK.

Abdel-Maksoud, N. F. (2018). The relationship between students' satisfaction in the LMS "Acadox" and their perceptions of its usefulness, and ease of use. *Journal of Education and Learning, 7*(2), 184–190.

Al Alhareth, Y. A., Al Dighrir, I., & Al Alhareth, Y. (2015). Review of women's higher education in Saudi Arabia. *American Journal of Educational Research, 3*(1), 10–15.

Al-Aulamie, A. (2013). *Enhanced technology acceptance model to explain and predict learners' behavioural intentions in learning management systems*. Doctoral dissertation, University of Bedfordshire, UK.

Al-Gahtani, S. S. (2008). Testing for the applicability of the TAM model in the Arabic context: Exploring an extended TAM with three moderating factors. *Information Resources Management Journal, 21*(4), 1–26.

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.

Al-Harbi, K. A. S. (2011). E-learning in the Saudi tertiary education: Potential and challenges. *Applied Computing and Informatics, 9*(1), 31–46.

Al-Mushasha, N. F. A. (2013). Determinants of e-learning acceptance in higher education environment based on extended technology acceptance model. In *Proceedings of the Fourth International Conference on e-Learning" Best Practices in Management, Design and Development of e-Courses: Standards of Excellence and Creativity"* (pp. 261–266). IEEE.

Al-Youssef, I. Y. (2015). *Student acceptance and use of internet-based distance education in Saudi Electronic University (SEU): A mixed method study*. Doctoral dissertation, The Patton College of Education, Ohio University, USA.

Alenezi, A. R. (2012). E-learning acceptance: Technological key factors for successful students' engagement in e-learning system. In *Proceedings of the International Conference on e-Learning, e-Business, Enterprise Information Systems, and e-Government*. Retrieved from https://pdfs.semanticscholar.org/1659/6fda1b352a7d198e189dec6702299ce358d4.pdf

Alhabeeb, A., & Rowley, J. (2018). E-learning critical success factors: Comparing perspectives from academic staff and students. *Computers & Education, 127*, 1–12.

Aljaber, A. (2018). E-learning policy in Saudi Arabia: Challenges and successes. *Research in Comparative & International Education, 13*(1), 176–194.

Aljuhney, Y., & Murray, L. (2016). A comparison of the utilization of e-learning management systems in the Republic of Ireland and Kingdom of Saudi Arabia: A case study (2015). *International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC), 4*(2), 1–12.

Alkandari, B. (2015). *An investigation of the factors affecting students' acceptance and intention to use e-learning systems at Kuwait University: Developing a technology acceptance model in e-learning environments*. Doctoral dissertation, Cardiff School of Education, Cardiff Metropolitan University, UK.

Alkhasawneh, S., & Alanazy, S. (2015). Adopt ICT among academic staff in Aljouf University: Using UTAUT model. *Mediterranean Journal of Social Sciences, 6*(1), 490–494.

Almarashdeh, I., & Alsmadi, M. (2016). Investigating the acceptance of technology in distance learning program. In *Proceedings of the International Conference on Information Science and Communications Technologies (ICISCT)* (pp. 1–5). IEEE.

Alotaibi, S. J. (2017). ICT Classroom LMSs: Examining the various components affecting the acceptance of college students in the use of blackboard systems. In *Proceedings of the AHFE 2016 International Conference on Human Factors, Business Management and Society* (pp. 523–532). Cham: Springer.

Altawallbeh, M., Thiam, W., Alshourah, S., & Fong, S. F. (2015). The role of age and gender in the relationship between (attitude, subjective norm and perceived behavioural control) and adoption of e-learning at Jordanian universities. *Journal of Education and Practice, 6*(15), 44–54.

Ariffin, N. H. M., Alias, N. A., Abd Rahman, H., & Sardi, J. (2014). Assessment of the students' utilization of a learning management system in a Malaysian higher education. In *Proceedings of the IEEE Conference on e-Learning, e-Management and e-Services (IC3e)* (pp. 18–23). IEEE.

Aziz, N. S., & Kamaludin, A. (2014). Assessing website usability attributes using partial least squares. *International Journal of Information and Electronics Engineering, 4*(2), 137–144.

Back, D. A., Behringer, F., Haberstroh, N., Ehlers, J. P., Sostmann, K., & Peters, H. (2016). Learning management system and e-learning tools: an experience of medical students' usage and expectations. *International Journal of Medical Education, 7*, 267–273.

Baroud, F., & Abouchedid, K. (2010). E-learning in Lebanon: Patterns of e-learning development in Lebanon's mosaic educational context. In U. Demiray (Ed.), *E-Learning Practices* (pp. 409–424). Eskisehir, Turkey: Anadolu University.

Binyamin, S., Rutter, M., & Smith, S. (2017a). The students' acceptance of learning management systems in Saudi Arabia: A case study of King Abdulaziz University. In *Proceedings of the 11th Annual International Conference of Technology, Education and Development (INTED2017)* (pp. 9324–9333). Valencia, Spain: International Academy of Technology, Education and Development (IATED).

Binyamin, S., Rutter, M., & Smith, S. (2017b). Factors influencing the students' use of learning management systems: A case study of King Abdulaziz University. In *Proceedings of the 12th International Conference on e-Learning (ICEL2017)* (pp. 289–297). Orlando, FL: Academic Conferences International Limited.

Binyamin, S. S., Rutter, M. J., & Smith, S. (2018). The influence of computer self-efficacy and subjective norms on the students' use of learning management systems at King Abdulaziz University. *International Journal of Information and Education*

Technology, 8(10), 693–699.
Binyamin, S. S., Rutter, M., & Smith, S. (2019). Extending the technology acceptance model to understand students' use of learning management systems in Saudi higher education. *International Journal of Emerging Technologies in Learning, 14*(3), 4–21.
Binyamin, S., Smith, S., & Rutter, M. (2016). The utilization of system usability scale in learning management systems: a case study of Jeddah Community College. In *Proceedings of the 9th International Conference of Education, Research and Innovation (ICERI2016)* (pp. 5314–5323). Seville, Spain: International Academy of Technology, Education and Development (IATED).
Bousbahi, F., & Alrazgan, M. S. (2015). Investigating IT faculty resistance to learning management system adoption using latent variables in an acceptance technology model. *The Scientific World Journal, 2015*: 375651.
Brinson, S. W. (2016). *The moderating effect of gender on attitudes toward e-learning*. Doctoral dissertation, Capella University, USA.
Bryman, A. (2016). *Social research methods*. Oxford, UK: Oxford University Press.
Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern Methods for Business Research* (pp. 295–336). Mahwah, NJ: Lawrence Erlbaum Associates.
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.
Cidral, W. A., Oliveira, T., Di Felice, M., & Aparicio, M. (2017). E-learning success determinants: Brazilian empirical study. *Computers & Education, 122*, 273–290.
Cyr, D., Head, M., & Ivanov, A. (2006). Design aesthetics leading to m-loyalty in mobile commerce. *Information & Management, 43*(8), 950–963.
Dahlstrom, E., Brooks, D. C., & Bichsel, J. (2014). *The current ecosystem of learning management systems in higher education: Student, faculty, and IT perspectives*. EDUCAUSE.
Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information. *MIS Quarterly, 13*(3), 319–340.
Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982–1003.
de Rosario Uribe, M. (2014). *Online simulations for conceptual understanding of thermoelectric devices*. Doctoral dissertation, Purdue University, USA.
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.
DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research, 3*(1), 60–95.
Docebo. (2016). *eLearning market trends and forecast 2017-2021*. Docebo. Retrieved from https://www.docebo.com/elearning-market-trends-report-2017-2021/
Doleck, T., Bazelais, P., & Lemay, D. J. (2017). Examining the antecedents of Facebook acceptance via structural equation modeling: A case of CEGEP students. *Knowledge Management & E-Learning, 9*(1), 69–89.
Elmahadi, I., & Osman, Z. (2013). A study of the Sudanese students' use of collaborative tools within Moodle Learning Management System. In *Proceedings of the IST-Africa Conference and Exhibition* (pp. 1–8). IEEE.
Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). London, UK: SAGE.
Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with

unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50.

Garson, G. D. (2016). *Partial least squares: Regression and structural equation models*. Asheboro, NC: Statistical Associates Publishers.

González-Gómez, F., Guardiola, J., Rodríguez, Ó. M., & Alonso, M. Á. (2012). Gender differences in e-learning satisfaction. *Computers & Education, 58*(1), 283–290.

Goswami, A., & Dutta, S. (2016). Gender differences in technology usage - A literature review. *Open Journal of Business and Management, 4*(1), 51–59.

Green, D. T., & Pearson, J. M. (2011). Integrating website usability with the electronic commerce acceptance model. *Behaviour & Information Technology, 30*(2), 181–199.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). Los Angeles, CA: SAGE.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice, 19*(2), 139–152.

Hair, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review, 26*(2), 106–121.

Hair, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. (2018). *Advanced issues in partial least squares structural equation modeling*. Los Angeles, CA: SAGE.

Hair, J. F., Sarstedt, M., Ringle, C. M., & Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science, 40*(3), 414–433.

Hussein, H. B. (2011). Attitudes of Saudi universities faculty members towards using learning management system (JUSUR). *Turkish Online Journal of Educational Technology (TOJET), 10*(2), 43–53.

Iacobucci, D., Posavac, S. S., Karde, F. R., Schneider, M. J., & Popovich, D. L. (2015). Toward a more nuanced understanding of the statistical properties of a median split. *Journal of Consumer Psychology, 25*(4), 652–665.

Ilie, V., Slyke, C. V., Green, G., & Hao, L. (2005). Gender differences in perceptions and use of communication technologies: A diffusion of innovation approach. *Information Resources Management Journal, 18*(3), 13–31.

Isa, S. M., & Wong, K.-Y. (2015). Age differences in behavioral intention to use internet marketing: A comparative study between Malaysian and Taiwanese. *International Journal of Business and Society, 16*(3), 386–396.

Islam, A. K. M. N. (2013). Investigating e-learning system usage outcomes in the university context. *Computers & Education, 69*, 387–399.

Jaradat, M. R., Imlawi, J., & Mashaqba, A. (2012). Investigating the moderating effects of self-efficacy, age and gender in the context of nursing mobile decision support systems adoption: A developing country perspective. *International Journal of Interactive Mobile Technologies (iJIM), 12*(2), 113–129.

Junus, I. S., Santoso, H. B., Isal, R. Y., & Utomo, A. Y. (2015). Usability evaluation of the student centered e-learning environment. *The International Review of Research in Open and Distributed Learning, 16*(4), 62–82.

Kabassi, K., Dragonas, I., Ntouzevits, A., Pomonis, T., Papastathopoulos, G., & Vozaitis, Y. (2016). Evaluating a learning management system for blended learning in Greek higher education. *SpringerPlus, 5*: 101.

Kanwal, F., & Rehman, M. (2017). Factors affecting e-learning adoption in developing countries–Empirical evidence from Pakistan's Higher Education Sector. *IEEE Access, 5*, 10968–10978.

Kayler, M., & Weller, K. (2007). Pedagogy, self-assessment, and online discussion groups. *Educational Technology & Society, 10*(1), 136–147.

Khan, A., & Qutab, S. (2016). Understanding research students' behavioural intention in

the adoption of digital libraries: A Pakistani perspective. *Library Review, 65*(4/5), 295–319.

Khechine, H., Lakhal, S., Pascot, D., & Bytha, A. (2014). UTAUT model for blended learning: The role of gender and age in the intention to use webinars. *Interdisciplinary Journal of E-Learning and Learning Objects, 10*(1), 33–52.

Khedr, A. E., Hana, M. A., & Shollar, D. Z. (2012). Investigating learners' acceptance of e-learning courses using adopted technology acceptance model. In *Proceedings of the International Conference on e-Learning, e-Business, Enterprise Information Systems, and e-Government*. IEEE.

Lee, Y.-C. (2008). The role of perceived resources in online learning adoption. *Computers & Education, 50*(4), 1423–1438.

Lin, C.-C. (2013). Exploring the relationship between technology acceptance model and usability test. *Information Technology and Management, 14*(3), 243–255.

Lin, S.-C., Persada, S. F., & Nadlifatin, R. (2014). A study of student behavior in accepting the blackboard learning system: A technology acceptance model (TAM) approach. In *Proceedings of the 18th International Conference on Computer Supported Cooperative Work in Design* (pp. 457–462). IEEE.

Maricutoiu, L. P. (2014). A meta-analysis on the antecedents and consequences of computer anxiety. *Procedia-Social and Behavioral Sciences, 127*, 311–315.

Matthews, L. (2017). Applying multigroup analysis in PLS-SEM: A step-by-step process. In H. Latan & R. Noonan (Eds.), *Partial Least Squares Path Modeling* (pp. 219–243). Heidelberg: Springer.

Ministry of Education. (2017). *Higher education statistics*. Ministry of Education, Saudi Arabia. Retrieved from https://departments.moe.gov.sa/PlanningDevelopment/RelatedDepartments/Educationstatisticscenter/EducationDetailedReports/Pages/default.aspx

Morris, M. G., & Venkatesh, V. (2000). Age differences in technology adoption decisions: Implications for a changing work force. *Personnel Psychology, 53*(2), 375–403.

Morris, M. G., Venkatesh, V., & Ackerman, P. L. (2005). Gender and age differences in employee decisions about new technology: an extension to the theory of planned behavior. *IEEE Transactions on Engineering Management, 52*(1), 69–84.

Mtebe, J. S., & Kissaka, M. M. (2015). Heuristics for evaluating usability of learning management systems in Africa. In *Proceedings of the IST-Africa Conference* (pp. 1–13). IEEE.

Muniasamy, V., Eljailani, I. M., & Anandhavalli, M. (2014). Prediction of learner perception and acceptance of e-learning system for learning with TAM (Technology Acceptance Model) in King Khalid University, Kingdom of Saudi Arabia. *International Journal of Emerging Technology and Advanced Engineering, 4*(9), 94–99.

Naveh, G., Tubin, D., & Pliskin, N. (2012). Student satisfaction with learning management systems: A lens of critical success factors. *Technology, Pedagogy and Education, 21*(3), 337–350.

Ng, P. L., & Tan, A. K. G. (2017). Determinants of e-resource usage by open distance learning university students. *Malaysian Journal of Library & Information Science, 22*(1), 29–44.

Nicholas-Omoregbe, O. S., Azeta, A. A., Chiazor, I. A., & Omoregbe, N. (2017). Predicting the adoption of e-learning management system: A case of selected private universities in Nigeria. *Turkish Online Journal of Distance Education-TOJDE, 18*(2), 106–121.

Nielsen, J. (1993). *Usability engineering*. London, UK: Aademic Press.

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). E-research: Ethics, security, design, and control in psychological research on the Internet. *Journal of Social Issues, 58*(1), 161–176.

Ong, C.-S., & Lai, J.-Y. (2006). Gender differences in perceptions and relationships among dominants of e-learning acceptance. *Computers in Human Behavior, 22*(5), 816–829.

Padilla-MeléNdez, A., Aguila-Obra, A. R., & Garrido-Moreno, A. (2013). Perceived playfulness, gender differences and technology acceptance model in a blended learning scenario. *Computers & Education, 63*, 306–317.

Rahman, A. L. A., Jamaludin, A., & Mahmud, Z. (2011). Intention to use digital library based on modified UTAUT model: Perspectives of Malaysian postgraduate students. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 5*(3), 270–276.

Raman, A., Don, Y., Khalid, R., & Rizuan, M. (2014). Usage of learning management system (Moodle) among postgraduate students: UTAUT model. *Asian Social Science, 10*(14), 186–192.

Ramírez-Correa, P. E., Arenas-Gaitán, J., & Rondán-Cataluña, F. J. (2015). Gender and acceptance of e-learning: A multi-group analysis based on a structural equation model among college students in Chile and Spain. *PLoS One, 10*(10), e0140460.

Research and Markets. (2017). *Middle East Online Education & E Learning Market Size, Demand, Opportunity & Growth Outlook 2023*. Research and Markets. Retrieved from https://www.researchandmarkets.com/research/htqzrl/middle_east

Ringle, C. M., Wende, S., & Becker, J.-M. (2015). *SmartPLS 3*. SmartPLS GmbH, Boenningstedt.

Saba, T. (2012). Implications of e-learning systems and self-efficiency on students outcomes: A model approach. *Human-Centric Computing and Information Sciences, 2*: 6.

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.

Sarstedt, M., Henseler, J., & Ringle, C. M. (2011). Multigroup analysis in partial least squares (PLS) path modeling: Alternative methods and empirical results. In M. Sarstedt, M. Schwaiger, & C. R. Taylor (Eds.), *Measurement and Research Methods in International Marketing* (pp. 195–218). Emerald.

Scholtz, B., Mandela, N., Mahmud, I., & Ramayah, T. (2016). Does usability matter? An analysis of the impact of usability on technology acceptance in ERP settings. *Interdisciplinary Journal of Information, Knowledge, and Management, 11*, 309–330.

Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill-building approach* (6th ed.). Chichester, UK: Wiley & Sons Ltd.

Shaouf, A., & Altaqqi, O. (2018). The impact of gender differences on adoption of information technology and related responses: A review. *International Journal of Management and Applied Research, 5*(1), 22–41.

Sheerah, H., & Goodwyn, A. (2016). Blended learning in Saudi Universities: Challenges and aspirations. *International Journal of Research in Humanities and Social Studies, 3*(10), 6–13.

Smeda, A. (2017). *Factors influencing the acceptance of e-book among mathematics and statistics students at universities in Libya*. Doctoral disseration, Murdoch University, Australia.

Smeda, A. M., Shiratuddin, M. F., & Wong, K. W. (2017). Measuring the moderating influence of gender on the acceptance of e-book amongst mathematics and statistics students at universities in Libya. *Knowledge Management & E-Learning, 9*(2), 177–199.

Sun, H., & Zhang, P. (2006). The role of moderating factors in user technology acceptance. *International Journal of Human-Computer Studies, 64*(2), 53–78.

Tarhini, A. (2013). *The effects of individual-level culture and demographic characteristics on e-learning acceptance in Lebanon and England: A structural equation modelling approach*. Doctoral dissertation, Brunel University, UK.

Tarhini, A., Hone, K., & Liu, X. (2014a). Measuring the moderating effect of gender and age on e-learning acceptance in England: A structural equation modeling approach for an extended technology acceptance model. *Journal of Educational Computing Research, 51*(2), 163–184.

Tarhini, A., Hone, K., & Liu, X. (2014b). The effects of individual differences on e-learning users' behaviour in developing countries: A structural equation model. *Computers in Human Behavior, 41*, 153–163.

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, 25*(3), 306–328.

Teo, T. (2016). Modelling Facebook usage among university students in Thailand: The role of emotional attachment in an extended technology acceptance model. *Interactive Learning Environments, 24*(4), 745–757.

Theng, Y.-L., & Sin, J. (2012). Evaluating usability and efficaciousness of an e-learning system: A quantitative, model-driven approach. In *Proceedings of the IEEE 12th International Conference on Advanced Learning Technologies (ICALT)* (pp. 303–307). IEEE.

Tran, K. N. N. (2016). The adoption of blended e-learning technology in Vietnam using a revision of the technology acceptance model. *Journal of Information Technology Education: Research, 15*, 253–282.

Venkatesh, V., & Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly, 24*(1), 115–139.

Venkatesh, V., Morris, M. G., & Ackerman, P. L. (2000). A longitudinal field investigation of gender differences in individual technology adoption decision-making processes. *Organizational Behavior and Human Decision Process, 83*(1), 33–60.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478.

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

Vision 2030. (2016). *KSA vision 2030*. Saudi Vision 2030. Retrieved from https://vision2030.gov.sa/en

Wang, M. (2018). Effects of individual and social learning support on employees' acceptance of performance-oriented e-learning. In M. Wang (Ed.), *E-Learning in the Workplace: A Performance-Oriented Approach Beyond Technology* (pp. 141–159). Cham: Springer.

Wang, T.-H. (2014). Developing an assessment-centered e-learning system for improving student learning effectiveness. *Computers & Education, 73*, 189–203.

Wang, Y.-S., Wu, M.-C., & Wang, H.-Y. (2009). Investigating the determinants and age and gender differences in the acceptance of mobile learning. *British Journal of Educational Technology, 40*(1), 92–118.

Wong, K.-T., Teo, T., & Russo, S. (2012). Influence of gender and computer teaching efficacy on computer acceptance among Malaysian student teachers: An extended

technology acceptance model. *Australasian Journal of Educational Technology, 28*(7), 1190–1207.

Zaharias, P. (2009). Usability in the context of e-learning: A framework augmenting 'traditional' usability constructs with instructional design and motivation to learn. *International Journal of Technology and Human Interaction, 5*(4), 37–59.

Zaharias, P., & Poylymenakou, A. (2009). Developing a usability evaluation method for e-learning applications: Beyond functional usability. *International Journal of Human-Computer Interaction, 25*(1), 75–98.

Zanjani, N., Edwards, S. L., Nykvist, S., & Geva, S. (2017). The important elements of LMS design that affect user engagement with e-learning tools within LMSs in the higher education sector. *Australasian Journal of Educational Technology, 33*(1), 19–31.

Appendix I

Content Quality:
10. The vocabularies used in Blackboard are appropriate for me (e.g. discussion board, content, assignments… etc.).
11. Overall, the content of Blackboard is up-to-date.
12. Overall, the content is organised in an appropriate sequence.
13. Overall, there is sufficient content to support my learning.

Learning Support:
14. Blackboard provides tools that support my learning.
15. Blackboard supports individual and group learning.
16. The online help of Blackboard is always available.
17. The Blackboard manual is written clearly.
18. The Blackboard manual provides the information I need.

Visual Design:
19. Text, colours, and layout used in Blackboard are consistent.
20. The interface design of Blackboard is attractive to me.
21. Text and graphics of Blackboard are readable.
22. Important information is placed in areas most likely to attract my attention.

System Navigation:
23. I always know where I am in Blackboard.
24. The navigational structure of Blackboard is convenient for me.
25. It is easy for me to find the information I need in Blackboard.
26. Links in Blackboard are working satisfactorily.
27. I can leave Blackboard at any time and easily return.

Ease of Access:
28. It is easy for me to login to Blackboard.
29. I can access Blackboard from different browsers.
30. The pages and other elements of Blackboard download quickly.
31. Blackboard is free from technical problems.

System Interactivity:
32. In general, Blackboard provides me with good synchronous and asynchronous communication tools (e.g. email, chat, forum).
33. Blackboard promotes my communication with teachers.
34. Blackboard facilitates my communication with students.
35. Blackboard helps me engage more with my learning.

Instructional Assessment:
36. Blackboard provides good self-assessment tools (e.g. exams, quizzes, case studies).
37. It is easy for me to use the self-assessment tools in Blackboard.
38. The self-assessment tools in Blackboard help me to understand the content of course.
39. The self-assessment tools in Blackboard measure my achievements of learning objectives.

System Learnability:
40. It is easy for me to learn how to use Blackboard.
41. The results of clicking on buttons are predictable.

42. I do not need to read a lot to learn how to use Blackboard.
43. I can start using Blackboard with only online help.

Perceived Ease of Use:
44. I find Blackboard flexible to interact with.
45. It is easy for me to get Blackboard to do what I want it to do.
46. It is easy for me to become skilful at using Blackboard.
47. Overall, Blackboard is easy to use.

Perceived Usefulness:
48. Blackboard enables me to achieve tasks more quickly.
49. Blackboard improves my learning performance.
50. Blackboard helps me to learn effectively.
51. Blackboard makes it easier for me to learn course content.
52. Overall, Blackboard is useful in my learning.

Behavioural Intention to Use:
53. I would like to use Blackboard in all future courses.
54. I would recommend using Blackboard to others.
55. I would encourage my teachers to use Blackboard in courses.
56. I will continue using Blackboard in the future.

Actual Use:
57. I use Blackboard frequently.
58. I tend to use Blackboard for as long as is necessary.
59. I have been using Blackboard regularly.
60. I usually get involved with Blackboard.