The Effects of Gender and Age on Students' Use of a Learning Management System in Saudi Arabia

Ahmed Alshehri
Information Technology Department, Albaha University, Albaha, Saudi Arabia
Email: a.alyehyawi@bu.edu.sa

Malcolm J. Rutter and Sally Smith
Edinburgh Napier University, School of Computing, Edinburgh, United Kingdom
Email: {m.rutter, s.smith}@napier.ac.uk

***Abstract*—The success of an e-learning intervention relies, to a considerable extent, on the student's acceptance of the system. Still, the challenge for educational institutions is to determine the factors that influence the user's acceptance of a Learning Management System (LMS) particularly, the demographic variables of age and gender, which would allow for effective approaches to implementation. Therefore, this study aims to analyse the moderating effects of gender and age in the acceptance and use of an LMS. Furthermore, the study is located in a Saudi tertiary learning context where students have unique psychological and social characteristics and where LMS are being rolled out on a national level. To this end, the study utilised a UTAUT (Unified Theory of Acceptance and Use of Technology) model as a base model, with an additional six usability variables, to investigate empirically the variables that influence the students' use of an LMS in Saudi higher education. By using a quantitative research approach and a sample size of 605 students, data were collected from students in five Saudi universities. Partial Least Squares Structural Equation Modelling (PLS-SEM) in conjunction with multigroup analysis techniques were employed to assess the model. The findings revealed that both gender and age moderated a single association between the facilitating conditions and actual use where female and younger students exhibited higher perceptions of the association than did their counterparts. The research has several implications for decision-makers, administrators and designers of e-learning systems. In light of the study findings, the limitations and future research avenues were discussed.**

***Index Terms*—demographics, technology acceptance, UTAUT, LMS, E-learning system, Saudi Arabia**

I. Introduction

The implementation and use of LMS is a topic of intense interest germane to emerging nations such as Saudi Arabia. An educational LMS is a common e-delivery medium within academic institutions, possessing robust capabilities for delivering online courses in distance learning as well as augmenting on-campus courses in blended learning [1], [2]. Educational institutions implement LMSs such as Blackboard to administer their curricula with various types of functionalities, such as announcements, discussion boards, online assessment and document sharing. In Saudi Arabia, most universities are equipped with the Blackboard system as the main application for learning and teaching. A recent statistic indicated that the Blackboard system is by far the most prevalent LMS in Saudi higher education used by 90% of kingdom public universities [3]. Nonetheless, having access to an LMS does not necessarily mean that effective learning has occurred [4]. Despite the apparent usefulness, the issue of effective use of an LMS is an intriguing one [4]. The efficiency of LMSs will not be fully utilised if the students are not inclined to accept and use the system [5]. In fact, the decisions about the integration of LMS into universities are often at a higher management level. Yet, it is the individual adoption patterns that illustrate successful implementation [6]. Therefore, understanding the individuals' demographic differences can lead to a more favourable environment for greater adoption, as well as enhance the students' learning experience.

A survey of prior literature on moderators has not been addressed in existing works on e-learning in Saudi Arabia [7]–[9]. It is established that moderating factors have profound effects on user technology acceptance [10]. However, the influence of moderating effects on the LMS use might be different from the more developed nations such as the US and Europe. In the UTAUT model, the amalgamation of the core constructs and the moderating inputs have improved the predictive efficiency to 70% of the variance in behavioural intention to use technology [11]. Agarwal and Prasad [12] also explicitly criticized the absence of moderating influences in the Technology Acceptance Model (TAM). They called for more research that examines the moderating effect on the use and perception of an Information System (IS) [12]. As an illustration, when including gender as a moderating variable, the explanatory power of TAM increases to 52% compared to approximately 35% without moderators [10].

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Demographic variables such as age and gender have been reported as salient moderators in technology acceptance [13]. Therefore, the present research explores the effects of moderating effect: age and gender in the use of LMS in Saudi tertiary education.

Saudi Arabia has many valid motives to encourage the implementation and use of LMS as a means to create an effective learning environment. Saudi Arabia, among many developing countries, has been characterised by distinct cultural traditions that are different from the West [13]. As an illustration, Saudi Arabian education is gender-segregated, both in primary and higher education. Males usually have more chances to enrol in many more available educational areas than women. Engineering education for females is deficient in Saudi Arabia and the study is typically restricted to medical science, education, humanities, natural science and Islamic studies [14], [15].

Besides, the Saudi population growth must be addressed to understand the potential of investigating the influence of the age variable in online learning. The latest statistics disclosed that the population growth rate is high and has reached more than 33.4 million [16]. It is important to mention that young people constitute the overwhelming majority of the Saudi population. In fact, a recent statistical analysis shows that the Saudi population under 20 grew by 52.88% over the last ten years [16]. A surge in Saudi students has been observed in the latest statistics. In general, the effect of age has not been treated in much detail, particularly within technology acceptance models [10], [17]. Nonetheless, as can be observed, the factor of age is considered important, especially in Saudi higher education.

As age and gender play a significant role in Saudi higher education, their moderating effects on the model relationships have been explored as main themes within this paper.

II. Theoretical Model

The UTAUT model has been extended with six usability attributes to measure students' behavioural intention and actual use of an LMS in Saudi higher education. The selection of the UTAUT framework was due to its comprehensiveness and powerful explanatory power [9]. Furthermore, the presence of demographics moderators in the UTAUT framework has added another significant value to the model. It is now well established from a variety of studies that usability attributes and user acceptance variables are essential to the uptake of a given technology [18], [19]. In this research, the UTAUT model was extended with six usability dimensions namely: system navigation, system learnability, visual design, information quality, instructional assessment and system interactivity. These six usability variables have been validated extensively in prior studies in the domain of usability, e-learning and educational technologies [20]–[22]. Along with that, the two moderators of students' gender and age were posited to influence all the model relationships. In this endeavour, the focus is on the influence of the moderating effect of student age and gender on the model relationships. The proposed model is depicted in Fig. 1.

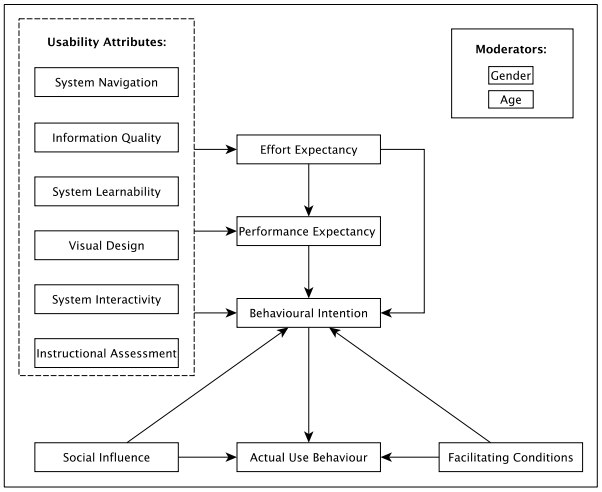

Figure 1. The proposed model

A. Gender Moderating Effect

Many researchers have acknowledged the role of gender in predicting the individual usage behaviour of technology [5], [11], [23]. Prior research has demonstrated that males and females are different in their decision-making processes, so their differences in perceptions of system usefulness and ease of use are evident in technology acceptance [24], [25]. For instance, it was found that men seem to utilize computers more than women [26]. A key study comparing male and female students' perceptions of information technology is that of He and Freeman [27], in which they found that females feel less confident with computers because they have learned less and practised less, and feel more anxious about using computers when compared with male counterparts. In the UTAUT model, gender significantly moderates the influence of the UTAUT independent variables on the behavioural intention to use technology [11]. The prior research on gender has shown that males tend to be more task-oriented than females [11], thus , placing more emphasis on work, accomplishment and rank whereas women seem to place more importance on the social influence, being more expressive, more aware of others' feelings, and more compliant compared with men [24]. As an illustration, performance expectancy is found to be significant in males as they are motivated by achievement needs whereas females are more concerned with effort expectancy aspects in the technology adoption and use [11]. Concerning social influence, females tend to be more sensitive to others' opinions, so the peer influence and affiliation needs are more salient to women in the study of technology adoption and use [11]. In fact, the explanatory power of the TAM model increased considerably at 52% when gender was included as a moderator [10], [11].

Gender differences also occur across cultures [10], [28]. This is evident in the Arab cultures as it was shown that women tend to be less powerful and less independent than men [29], and they are more reserved [30]. Women have fewer chances of obtaining a job, with historically less participation in the labour force, so the gender divide was expected to moderate in the Arab world [30]. There

are also variations between males and females in the use of technology. In an investigation into technology usage among Saudi Arabian undergraduate students, Alothman *et al*., [31] found that location and gender influences the duration of the use of technology: students in small towns spend less time on technology compared with their counterparts in the capital city. The study also revealed that the use of computers or laptops at university is considerably less than at home. Students spent only four hours per week using computers or laptops at university and some female colleges forbid their students' to bring and use laptops and smartphones [31]. Similarly, Al-Harbi [32] concluded that Saudi male students like to use an e-learning system more than female students. Still, the influence of gender role in technology acceptance is far from conclusive [27], [33], and even less in relation to e-learning systems [25] this study postulates that:

H1: Gender will moderate all relationships in the proposed model.

B. Age Moderating Effect

Literature has shown that age is an important factor in technology and acceptance research [5], [11], [17]. The age has exhibited a moderating effect on behavioural intention and use of a technology [11], [26]. In the UTAUT model, Venkatesh *et al*., [11] reported that age showed a substantial moderation in the relationship between performance expectancy, facilitating conditions and behavioural intention. As an illustration, younger age groups appear to be more willing to adopt and use the system than older groups. In contrast, increased age was associated with difficulties in processing complex tasks and allocating attention to content [11]. Likewise, the relationship between effort expectancy, social influence and the behavioural intention was stronger for older employees in technology acceptance and use [11]. In England, age was found to moderate the relationship between perceived ease of use, perceived usefulness, self-efficacy and behavioural intention [5]. However, no differences were detected in terms of social influence on behavioural intention to use an LMS [5]. Khechine et al., [34] conducted a UTAUT study of the effects of moderators gender and age, on the acceptance of a Webinar system in a blended learning course. They found that age had a salient moderating influence on intention while gender did not. In a similar line of evidence, Chawla & Joshi [35] discovered that students aged 25 and under have a more favourable perception of e-learning systems than those over 25. However, the study of Julie, Becker, & Newton [36] has been unable to demonstrate the effect of age on users' intention and satisfaction with an e-learning system in an Australian organisational context. In Saudi higher education, the age variable was demonstrated to influence the utilization of the Jusur LMS [37]. Nonetheless, research on the subject has been mostly restricted to limited contexts other than Saudi Arabia. Overall, there remain questions as to whether the age variable has an influence on the students' use of LMS in Saudi higher education. Hence, it is hypothesised

H2: age will moderate all relationships in the proposed model.

III. Methodology

The target sample for this study was taken from students in Saudi higher education. The researcher targeted students in Saudi higher education from geographically dispersed universities. Due to the large sample frame of Saudi students, a sampling technique was necessary. Hence, the study approaches this concern using a multi-stage cluster sampling technique as suggested by [38].

Quantitative research in the form of an online questionnaire-based survey was performed to test the hypotheses. The instrument was divided into three main sections. The first section included information about the respondents' characteristics. In this section, the students select their gender identity and insert their age. In consideration of the cultural context of Saudi Arabia, the decision was taken to offer only a binary male/ female response for the gender question. The second section is concerned with UTAUT constructs. This section comprises 25 positive statements divided into six subscales using a five-point Likert scale, based on LMS use in higher education. The last part elicits students' perception of the six usability variables, containing 31 positive statements.

Three thousand emails, providing a hyperlink the Web-based survey, were distributed to students in five public universities. Specifically, the online survey was employed to reach the wider population of the female colleges as female students study in gender-segregated campuses. A total of 861 (28%) were returned and 256 (30%) questionnaires were incomplete and considered unusable due to the excessive missing data. Those instances had to be discarded before the process of data analysis. After the preliminary examination for outliers, normality and unengaged responses, 605 responses (20% response rate) were used for data analysis. The results indicated that males represent 46.1% (279 participants) and females 53.9% (326 participants).

IV. Data Analysis

This study employed the Partial Least Squares Structural Equation Modelling (PLS-SEM) approach to test the measurement and structural model using SmartPLS 3 [39]. The multigroup analysis (MGA) technique was used to test the moderating effects. Many researchers emphasise the importance of using multigroup analysis using PLS-SEM technique, to analyse the effects of moderation across multiple relationships rather than standard moderation [40]–[42].

A. Measurement Model Assessment

1) Gender moderator

The gender moderator was examined based on a nominal scale. Therefore the refinement strategies were not required [43]. The first step was to assess the measurement model for male and female groups. In this study, males represent 46.1% (279 participants) and females 53.9% (326 participants). The researcher began with the measurement model and structural model analyses.

Table I provides the summary statistics of the measurement model for male and female subpopulations. The analysis of male and female groups indicate that all constructs achieved composite reliability values of .7 and higher. Moreover, all Average Variance Extracted (AVE) values exceeded the recommended value of 0.50. In terms of factors loadings, all indicators exhibit loading above 0.70 except the AU2 for both male (0.554) and female (0.602) subsamples. However, Hair *et al.* [44] recommended that items with factor loadings between 0.4 to 0.7 should be removed only when removal leads to an increase in the composite reliability or in the average variance extracted above the cut-off value [44]. Also it is suggested to retain item loadings above .5 in exploratory research [43]. Hence, these items were retained for further multigroup analysis.

Regarding the convergent validity for each group, the AVE values for each construct, presented in Table I, exceeded the cut-off of 0.50 as recommended by Fornell and Larcker [45]. The results confirm that all loadings of the measurement model are highly significant as required for convergent validity (see Table I). Hence, adequate evidence of convergent validity is established.

TABLE I. THE MEASUREMENT MODEL ASSESSMENT FOR GENDER GROUPS

	Female Group			**Male Group**		
Construct	**CA > 0.7**	**CR > 0.7**	**AVE > 0.5**	**CA > 0.7**	**CR > 0.7**	**AVE > 0.5**
Actual Use (AU)	0.758	0.848	0.587	0.728	0.829	0.554
E-learning System Interactivity (ESI)	0.897	0.949	0.822	0.855	0.898	0.689
Behavioural Intention (BI)	0.928	0.949	0.822	0.918	0.942	0.803
Effort Expectancy (EE)	0.913	0.939	0.793	0.878	0.916	0.732
Facilitating Conditions (FC)	0.813	0.868	0.570	0.771	0.833	0.502
Instructional Assessment (IA)	0.917	0.935	0.707	0.897	0.921	0.662
Information Quality (IQ)	0.940	0.954	0.807	0.909	0.932	0.732
System Learnability (SL)	0.870	0.906	0.659	0.882	0.914	0.681
System Navigation (SN)	0.861	0.899	0.642	0.846	0.891	0.621
Performance Expectancy (PE)	0.85	0.899	0.692	0.821	0.882	0.654
Social Influence (SI)	0.776	0.855	0.597	0.772	0.854	0.595
Visual Design (VD)	0.921	0.939	0.72	0.905	0.928	0.682

CA: Cronbach's alpha, CR: composite reliability, AVE: average variance extracted

2) Age moderator

In this research, age was coded as a continuous variable, in compliance with previous studies [11], [24]. It has been suggested that when a metrically scaled variable is used, it should be transformed into a categorical variable ("high" and "low") [42]. The transfer can be created using median splits based on simulation studies as suggested in [46]. Other researchers also recommended using median splits on the variable measured on a continuous scale to create groups for comparison of the moderator's effects [42], [47]. Hence, using the median-split procedures (median = 21), the data were divided into two age groups; younger age (281) and senior age (324) groups. The younger age group is undergraduates aged between 17 and 21 years old. The senior age group is the students whose age is 21 and over. It has been stated that the validity of variables, including, construct reliability, construct validity and indicator loadings remain a requirement for all group estimations [48]. In this study, the researcher ran the PLS algorithm for both younger and senior age groups and found all the item ranges were acceptable except one item (AU2 "I have been using Blackboard regularly in the past" = 0.35) in the younger group, which did not conform to the standard factor reliability cut-off of .7 and above. That also affected the actual use's Cronbach's Alpha and the researcher had to delete the AU2 indictor for all groups and re-estimate the model. Similarly, the assessment of compositional invariance was conducted using a permutation test. Results of MICOM represented a problem in the analysis that the visual design score was significantly different from one which did not support the partial measurement invariance. In short, measurement invariance (measurement equivalence) refers to whether measurement operations yield measures of the same attribute. Since visual design composites differ regarding their composition across the groups, the researcher eliminated the construct that did not achieve compositional invariance from both groups as suggested by Hair e*t al*. [40] and Henseler *et al*. [48].

The PLS algorithm and permutation test were repeated for both age groups. Table II illustrates the measurement model results for senior and younger age groups. As can be seen from the Table II, the results indicated that all Cronbach's Alpha, composite reliability and average variance extracted for the models of both groups were satisfactory.

In recent years, there has been an increasing amount of literature on IS which used only the criterion of Fornell-Larcker for reporting the discriminant validity [49]. Thus, the constructs' discriminant validity for both male and female groups was assessed using the Fornell-Larcker criterion [45]. The elements in the matrix diagonals, presented in Table III indicate that for all the constructs, AVE is greater than its squared correlation with other constructs. Hence, discriminant validity is established for

male and female subpopulations. Overall, these results provide clear support for the measures' reliability, and discriminant and convergent validity of the constructs.

Similarly, Table IV showed that the levels of square root of the AVE for each construct is greater than the correlation involving the constructs for young and senior age groups [44]. Hence discriminant validity has been established for both groups. Based on these results, the construct validity, evidenced by convergent and discriminant validity, have been established.

TABLE II. THE MEASUREMENT MODEL ASSESSMENT FOR AGE GROUPS

	Senior Age Group			**Young Age Group**		
Construct	**CA > 0.7**	**CR > 0.7**	**AVE >0.5**	**CA > 0.7**	**CR >0.7**	**AVE >0.5**
Actual Use (AU)	0.777	0.871	0.693	0.744	0.854	0.662
E-learning System Interactivity (ESI)	0.893	0.924	0.753	0.863	0.904	0.703
Behavioural Intention (BI)	0.925	0.947	0.817	0.920	0.944	0.807
Effort Expectancy (EE)	0.880	0.918	0.736	0.907	0.935	0.783
Facilitating Conditions (FC)	0.813	0.867	0.566	0.776	0.843	0.520
Instructional Assessment (IA)	0.918	0.936	0.710	0.897	0.921	0.661
Information Quality (IQ)	0.926	0.944	0.773	0.928	0.945	0.776
System Learnability (SL)	0.889	0.919	0.693	0.864	0.902	0.650
System Navigation (SN)	0.862	0.895	0.63	0.853	0.895	0.631
Performance Expectancy (PE)	0.820	0.881	0.651	0.852	0.900	0.693
Social Influence (SI)	0.757	0.846	0.580	0.788	0.862	0.609

CA: Cronbach's alpha, CR: composite reliability, AVE: average variance extracted

TABLE III. THE FORNELL-LARCKER CRITERION FOR MALE AND FEMALE

Male Students												
	AU	**BI**	**EE**	**FC**	**IQ**	**IA**	**ESI**	**SL**	**SN**	**PE**	**SI**	**VD**
AU	**0.744**											
BI	0.573	**0.896**										
EE	0.404	0.541	**0.855**									
FC	0.494	0.532	0.593	**0.709**								
IQ	0.452	0.546	0.543	0.554	**0.856**							
IA	0.429	0.549	0.531	0.575	0.623	**0.814**						
ESI	0.380	0.59	0.423	0.485	0.572	0.695	**0.830**					
SL	0.511	0.574	0.733	0.666	0.703	0.643	0.550	**0.825**				
SN	0.449	0.548	0.620	0.599	0.617	0.637	0.607	0.762	**0.788**			
PE	0.528	0.756	0.507	0.51	0.599	0.56	0.559	0.570	0.541	**0.809**		
SI	0.560	0.486	0.359	0.502	0.444	0.424	0.418	0.466	0.466	0.536	**0.772**	
VD	0.428	0.463	0.500	0.505	0.671	0.638	0.549	0.655	0.698	0.473	0.459	**0.826**
Female Students												
	AU	**BI**	**EE**	**FC**	**IQ**	**IA**	**ESI**	**SL**	**SN**	**PE**	**SI**	**VD**
AU	**0.766**											
BI	0.568	**0.907**										
EE	0.551	0.619	**0.890**									
FC	0.610	0.594	0.647	**0.755**								
IQ	0.479	0.533	0.518	0.595	**0.899**							
IA	0.561	0.506	0.557	0.656	0.697	**0.841**						
ESI	0.416	0.491	0.409	0.547	0.58	0.671	**0.873**					
SL	0.594	0.605	0.779	0.718	0.684	0.678	0.59	**0.812**				
SN	0.561	0.535	0.645	0.711	0.618	0.647	0.585	0.763	**0.801**			
PE	0.568	0.792	0.609	0.611	0.64	0.578	0.564	0.631	0.551	**0.832**		
SI	0.628	0.536	0.447	0.527	0.54	0.531	0.395	0.52	0.421	0.553	**0.772**	
VD	0.464	0.401	0.468	0.576	0.607	0.609	0.558	0.68	0.701	0.442	0.386	**0.849**

TABLE IV. THE FORNELL-LARCKER DISCRIMINANT VALIDITY FOR AGE GROUPS

Young Age											
	AU	**BI**	**EE**	**FC**	**IQ**	**IA**	**ESI**	**SL**	**SN**	**PE**	**SI**
AU	**0.814**										
BI	0.558	**0.898**									
EE	0.503	0.590	**0.885**								
FC	0.610	0.618	0.611	**0.721**							
IQ	0.410	0.570	0.532	0.541	**0.881**						
IA	0.504	0.570	0.555	0.635	0.641	**0.813**					
ESI	0.370	0.568	0.408	0.523	0.573	0.667	**0.839**				
SL	0.516	0.626	0.775	0.624	0.661	0.659	0.563	**0.806**			
SN	0.470	0.585	0.636	0.676	0.593	0.641	0.592	0.772	**0.794**		
PE	0.567	0.815	0.594	0.625	0.644	0.604	0.590	0.629	0.576	**0.833**	
SI	0.617	0.529	0.404	0.515	0.469	0.479	0.387	0.472	0.378	0.564	**0.781**
Senior Age											
	AU	**BI**	**EE**	**FC**	**IQ**	**IA**	**ESI**	**SL**	**SN**	**PE**	**SI**
AU	**0.830**										
BI	0.580	**0.900**									
EE	0.460	0.560	**0.860**								
FC	0.500	0.520	0.640	**0.750**							
IQ	0.520	0.510	0.530	0.620	**0.880**						
IA	0.490	0.490	0.540	0.610	0.690	**0.840**					
ESI	0.420	0.500	0.420	0.520	0.580	0.700	**0.870**				
SL	0.560	0.550	0.740	0.690	0.720	0.660	0.570	**0.830**			
SN	0.520	0.480	0.630	0.650	0.640	0.650	0.590	0.680	**0.790**		
PE	0.550	0.710	0.520	0.510	0.600	0.540	0.530	0.570	0.510	**0.810**	
SI	0.620	0.530	0.420	0.530	0.530	0.480	0.430	0.520	0.520	0.550	**0.760**

B. Structural Model Assessment

1) Gender moderator

TABLE V. THE MODERATING EFFECT FOR GENDER

Paths	**Female**		**Male**		**Test**
	β	**R^2**	**β**	**R^2**	**p-Values**
BI -> AU	0.191	0.519	0.336	0.442	0.083
FC -> AU	0.302		0.154		0.044
SI -> AU	0.368		0.32		0.565
EE -> BI	0.168	0.662	0.134	0.626	0.693
IA-> BI	-0.069		-0.01		0.501
ESI -> BI	0.053		0.192		0.159
FC -> BI	0.08		0.069		0.872
IQ -> BI	-0.044		-0.014		0.745
SL -> BI	-0.001		0.024		0.835
SN -> BI	0.05		0.015		0.705
PE -> BI	0.605		0.528		0.38
SI -> BI	0.113		0.044		0.309
VD -> BI	-0.03		-0.024		0.938
VD-> PE	-0.11	0.545	-0.078	0.457	0.745
EE -> PE	0.329		0.143		0.057
IQ -> PE	0.335		0.287		0.678
IA-> PE	0.021		0.113		0.39
SN -> PE	0.012		0.078		0.58
SL -> PE	0.055		0.064		0.94
ESI -> PE	0.243		0.217		0.768
SN -> EE	0.139	0.624	0.154	0.542	0.89
SL -> EE	0.77		0.589		0.076
IA-> EE	0.137		0.108		0.762
IQ -> EE	-0.03		0.038		0.488
ESI -> EE	-0.116		-0.061		0.535
VD -> EE	-0.154		-0.056		0.326

Since the results support partial measurement invariance, the standardized path coefficients differences across both groups can be computed with confidence using a multigroup analysis [40], [48]. Since the permutation test is non-parametric, two-tailed, more conservative, and recommended by researchers [40], [50], the researcher employed them in the analysis. The results obtained from the permutation test, summarised in Table V show the path coefficient for male and female, followed by the coefficient of determination (R squared) and the final column represent the permutation p-value. It can be seen from the data that most structural model relationships do not differ between male and female subsamples. The only exception is the correlation between the facilitating conditions and actual use which showed a statistical difference between the two groups at 0.05 significance level. This is evident by the permutation p-value of 0.04. Females exhibited higher perceptions (β = 0.302) of facilitating conditions to use the e-learning system than did their male counterparts (β = 0.154).

In Table V, the R^2 values were communicated. For the males group, the R^2 values of AU, BI, EE, PE were 0.442 (44%), 0.626 (62%), 0.542 (54%) and 0.457 (46%) respectively. For the females group, the R^2 values for AU, BI, EE, PE were 0.519 (52%), 0.662 (62%), 0.624 (62%) and 0. 0.545 (55%) respectively. There is a clear indication that females explain more variance compared to their male counterparts.

2) Age moderator

Having established configural and compositional invariance, it is important to compare the path coefficients of young and senior groups using a permutation technique. In Table VI, the results of path coefficients of both groups were presented. As it can be seen, most structural model relationships were insignificant, as most of the p values are considerably larger than 0.05 with a single exception: the relationship between facilitating conditions and actual use behaviour of the LMS, which differ significantly on p.value < 0.05. The relationship between facilitating conditions and the actual use is significantly different among young students ($\beta^{(1)} = 0.319$) versus those who are senior ($\beta^{(2)} = 0.139$).

It can be concluded that the freshman and sophomores have more tendency to use LMS if the universities provide proper support to use the system more than the senior students.

In Table VI, the R^2 values were presented. For the young group, the R^2 values of AU, BI, EE, PE were 0.508 (51%), 0.704 (70%), 0.606 (61%) and 0.550 (55%) respectively. For the senior group, the R^2 values for AU, BI, EE, PE were 0.477 (48%), 0.572 (57%), 0.553 (55%) and 0. 0.437 (44%) respectively. As can be seen, the young students' explained variances of the outcomes outperformed the senior students and the R^2 values for the young students' model appeared to range between medium and high.

TABLE VI. THE MODERATING EFFECT FOR AGE

Paths	(Young_Age)		(Senior_Age)		Test
	β	R2	β	R2	p.value
BI -> AU	0.167	0.508	0.308	0.477	0.097
FC -> AU	0.319		0.139		0.016
SI -> AU	0.365		0.379		0.871
EE -> BI	0.082	0.704	0.231	0.572	0.094
PE -> BI	0.632		0.474		0.068
SI -> BI	0.062		0.149		0.187
FC -> BI	0.067		0.054		0.870
IQ -> BI	-0.038		-0.026		0.901
ESI -> BI	0.086		0.135		0.609
SL -> BI	0.028		0.013		0.904
IA-> BI	-0.024		-0.038		0.865
SN -> BI	0.066		-0.067		0.144
ESI -> EE	-0.117	0.606	-0.084	0.553	0.711
IA-> EE	0.106		0.14		0.718
SL -> EE	0.681		0.642		0.696
IQ -> EE	0.023		-0.061		0.405
SN -> EE	0.097		0.123		0.799
SN -> PE	0.023	0.550	-0.02	0.437	0.693
SL -> PE	0.041		0.06		0.889
IQ -> PE	0.278		0.308		0.790
EE -> PE	0.257		0.210		0.653
IA-> PE	0.088		0.039		0.635
ESI -> PE	0.231		0.211		0.827

V. DISCUSSION

A. Gender Moderator

The standardized path coefficient differences between males and females show that most structural model relationships do not differ between male and female subsamples with one exception: the facilitating conditions effect on actual use. It is somewhat surprising that in this research no other significant relationships were noted in Saudi higher education, as females are separate in terms of education and location. The results overlap with several e-learning studies in which male and female students are equally motivated to use an LMS [25], [51]–[54].

The results indicate, however, that gender moderated the FC->AU path and is significant for male and female sub-groups. The female group exhibited a stronger effect (β = 0.302) than did their male counterpart (β = 0.154). In line with this, the Alshehri *et al*. [55] study (using a different data set) found that facilitating condition was the highest path coefficient that affected the LMS use in Saudi higher education (β = 0.511). In tandem with our results, the gender differences were found to have an impact on technology acceptance where women place more emphasis on facilitating conditions, which was more pronounced with increasing age [56]. Besides, Kibelloh & Bao [57] focused on the female perceptions of e-learning system and revealed key concerns regarding the poor and costly internet connectivity in developing countries. This outcome is compatible with that of Ameen [30] who found that gender was insignificant in moderating the effect of FC on AU to use a mobile phone in three Arabian countries, Iraq, Jordan and United Araba Emirates (UAE). This can be interpreted by the cultural influence of gender segregation; where females' segregated colleges are more demanding of organisational resources (e.g. technological support and technical ICT infrastructure) to support the use of LMS in Saudi higher education. Females have dispersed campuses and the availability of support might be limited. In the context of the study, some universities might not have the appropriate ICT infrastructure, especially those who were recently established, so female students might find limited avenues for help and support at the universities' campuses.

Regarding the explained variance for gender, the female group model accounted for 52% of the variance in actual use behaviour, and 62% for behavioural intention compared with 44% for usage behaviour and 62% for the behavioural intention to use. Similarly, in the female sub-sample, 62% of the variability in the effort expectancy variable is explained the predictors and 55% of the variability in the performance expectancy construct is explained by the predictors (refer to Table V). There is a clear indication that females explain more variance compared to their male counterparts. Thus, females exhibited more variance in the dependent variables than males. This is in line with the study of [23], [51] in which the female group explained more variance than males in the acceptance of mobile learning.

In this regard, universities should create strategies for ongoing enhancement of their LMS organizational and technical infrastructure to support the learners' use of the system, especially for female colleges. Services such as online support, response time, training provided and resource availability have been suggested as fundamental to successful e-learning implementation [58], [59].

B. Age Moderator

As it can be seen in Table VI, the age moderating variable did not affect the young and senior population except for one path: facilitating conditions on actual use. The moderating factor of age did not moderate most of the relationships in the model. This is consistent with the Ameen *et al*. [53] study in the Iraqi context. Similarly, the age moderating effect did not play an important role in the relationships between the psychological constructs of the UTAUT model and the intention to use a technology in Saudi Arabia higher education [60]. Likewise, Altawallbeh, Thiam, Alshourah, & Fong [61] demonstrated that age does not moderate the students' acceptance and use in Jordanian universities. Similar results were concluded by Baker *et al*. [13] where age and

gender were non-significant in the IT adoption in their Saudi Arabian sample. Overall and considering the single moderating effect, the results could be attributed to an increasing awareness of LMS among students, no matter their age group.

FC->AU is the only path coefficient where the p.value is less than 0.05. The influence of FC on AU is significant for both groups. However, the relationship is significantly different among young students ($\beta^{(1)}$ = 0.319) versus those who are senior ($\beta^{(2)}$ = 0.139). Considering the system usage behaviour, the age attribute was more significant for older workers with more experience [11], [24]. Nonetheless and unlike our results, age moderated all of the key relationships in the Venkatesh's UTAUT model [11]. Age was shown to affect the willingness of students to use an LMS [34]. In this research and similar to the gender moderator, it is evident that young students are more focused on the available IT support and infrastructure (FC) than older students. A possible explanation for these results may be the lack of adequate support and poor Internet access, especially in the newly established universities, as confirmed in the previous studies in Saudi education [62], [63]. As most of the respondents are undergraduates, young students may require more IT support and available Internet access based on higher expectations, especially in the recently established universities. Furthermore, it seems possible that these results are due to the lack of training on LMS platforms. The descriptive statistics showed that the majority of students had no previous training in the use of LMS (47.8%). Thus young students might be more in need of LMS training at the universities campuses.

Regarding the explained variances' differences, the R^2 values of the young group AU, BI, EE, PE was (51%), (70%), (61%) and (55%) respectively. The percentages of 48%, 57%, 55%, 44% accounted for AU, BI, EE, PE in the senior group respectively. Thus, the young students outperformed the senior group, meaning a better model fit for younger students in the dependent variables AU, BI, EE and PE. Similar conclusion was reached by Chawla & Joshi [35].

The impact of social influence on intention was significant for older students, which is consistent with previous research [11], [24]. This implies that senior Saudi students place more importance on the opinion of others in the use of LMS, in which social influences change over time. This indicates its important role in driving behaviour in Saudi education. Overall, the senior model has more statistically significant relationships in the model, indicating the LMS implementation might have more significance for mature students (refer to Table VI).

VI. Conclusion

The present study was designed to determine the effects of gender and age on the students' acceptance and use of LMS in Saudi universities. The results have shown that both gender and age moderating variables affected only one path: the facilitating conditions on actual use. These findings suggest that in general, the gender and age, that have been reported to be significant in other cultural settings e.g. [11], were found to be less significant in the Saudi Arabian sample. It might be that the recent fast changes associated with the vision 2030 [64], has created a more LMS-friendly environment in Saudi universities. In light of the evident need to focus on education, the effect of vision 2030 on the equality of access to education has begun to materialise. The initiative emphasised that the demand and focus on the quality of education should be set out to ensure that all students, with different age and gender, would be equipped with the required skills and knowledge to compete in the globalised society [64].

These findings have significant implications for the universities' management regarding future LMS policy. System designers and administrators may now have a better understanding of the age and gender-related differences on students' use of LMS, specifically in a Saudi context where students have unique psychological and social characteristics. Possibly, a key policy priority should therefore be to enhance the strategic plan for e-learning system implementation at universities, considering the effect of age and gender on the students' use of LMS. Whilst this study did confirm only a single moderation (FC->AU), it did partially substantiate the students' demographic differences regarding path significance and intensity. There is a clear indication that the predictors have more effect on the female and senior subsample's outcomes, as evidenced by the more statistically significant relationships in the female and senior groups. This means that LMS implementation and use might have more significance for female and mature students.

The generalisability of these results is subject to certain limitations. The scope of this study was limited in terms of using a quantitative methodological approach. The study was grounded on the inquiry-based survey to collect data from the target population. Even though the survey method is the most common approach used in technology acceptance and usability research, more information derived from qualitative methods (e.g. interviews and focus groups) would also help to establish an in-depth understanding of the research problems and the surrounding issues towards students' attitudes and perceptions. Likewise, this study focused on the students' perspective, a natural progression of this work would be to involve other e-learning stakeholders (teachers and administrators). This could enrich the research by providing a better understanding of other issues, offering different views about the implementation and use of an e-learning system in Saudi Arabia.

There are two suggested directions for further studies: firstly, to increase the scope and cover data from a larger student population (e.g. private institutions), with different demographic characteristics such as income, cultural aspects and level of education. A second direction might be to consider other technological attributes such as other system functionalities, service qualities e.g. privacy, to investigate their effects on the

students' use of LMSs. This is expected to add valuable insights to inform decision-making processes at university higher management and administrative level.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

All authors have contributed to this work. Alshehri conducted the research; Malcolm and Sally have proofread the paper and provided valuable feedback. All authors had approved the final version.

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Ahmed Alshehri is a lecturer within the School of Computer Science and Information Technology at Albaha University, Saudi Arabia. He is also a research student at Edinburgh Napier University. He has over 7 years of experience in project management, business continuity for IT services as well as various responsibilities in academia. Mr Alshehri graduated with a master's degree in Information Technology from the University of Western Australia (2011) and a bachelor's degree in Education, majoring Computer Science from King Khalid University (2007). His primary research interests include issues related to IS/IT adoption and implementation, human computer interaction, usability and e-learning systems.

Dr. 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.

Prof. Sally Smith has an MA in mathematics from Aberdeen University, an MSc in computer science from City University, London and a DBA from Edinburgh Napier University. She is the dean of Computing at Edinburgh Napier University and project director of e-placement, Scotland. Prior to joining academia in 1992, she was a software engineer in the telecoms industry. She is also the director of the Computing Education Research Centre and her research interests are digital skills development and graduate employability. Prof. Smith is a Fellow of the British Computer Society and a Principal Fellow of the Higher Education Academy.