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THE EFFECTS OF UTAUT AND USABILITY QUALITIES ON STUDENTS' USE OF LEARNING MANAGEMENT SYSTEMS IN SAUDI TERTIARY EDUCATION

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ABSTRACT

Aim/Purpose	This study proposes a theoretical framework that amalgamates Unified Theory of Acceptance and Use of Technology (UTAUT) variables with usability metrics to investigate the impact on students' intention and use of the Learning Management System (LMS) in Saudi higher education.
Background	There is a dearth of academic research on Saudi higher education to examine the effects of usability factors on students use of LMSs, so significant issues have not yet been examined.
Methodology	Based on survey data from 605 respondents, the Partial Least Squares Structural Equation Modelling (PLS-SEM) technique was employed to assess the model.
Contribution	The findings of the study may help colleges and universities to gain insights into the best way to promote e-learning system perceived usefulness and acceptance among students.
Findings	The results confirmed that the UTAUT parameters are valid and robust in the context of LMS in Saudi Arabia. The dimension of social influence emerged to significantly influence the students' intention and usage behaviour. The performance expectancy was affected by information quality and the system interactivity whereas the effort expectancy was influenced by system navigation, system learnability, and instructional assessment. The usability feature of

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	interactivity was also demonstrated to influence students' willingness to use the system.
Recommendations for Practitioners	University policymakers are expected to benefit from this research for e-learning system acceptance in an academic setting and eliminate any impediments to its implementation. University students will be able to identify the factors and motivations driving their adoption of the system. In particular, usability, social, and organisational factors that affect their use of an e-learning system would be better understood.
Recommendations for Researchers	The study should aid the research community in technology acceptance and usability studies to determine the students' perceptions and experiences towards e-learning usability, social, and organisational factors that influence their acceptance, specifically in a Saudi context where students have unique psychological and social characteristics. Administrators and designers could also better understand areas of improvement for usability issues and develop design solutions based on the findings of this study.
Impact on Society	The suggestions have been offered in order to accelerate and increase the use of e-learning services in Saudi higher education. System designers and administrators should have a better insight into the user interface design, considering system-independent metrics that could enhance user acceptance of e-learning systems.
Future Research	The study focused on the students' perspective, a natural progression of this work is to involve other e-learning stakeholders (teachers and administrators). This could enrich the research by providing a better understanding of undisclosed issues, offering different views about the implementation and use of an e-learning system in Saudi Arabia.

Keywords: UTAUT, technology acceptance, usability, e-learning systems, LMS, PLS-SEM, developing country

INTRODUCTION

The rapid improvement in information and communication technologies has shaped opportunities in many fields. While the progress of technological innovations is continuing, the transfer and integration of these advances into education has become a current topic of debate. The successful experience of e-services around the world has led to a redefinition of the role of educational institutions through the adoption of e-learning services and techniques. The goal is to create a lifelong learning environment through cost-efficient, flexible, and accessible education, regardless of geographic and time boundaries.

Since the ultimate goal of using an e-learning system is the improvement of effective learning, its benefits cannot be achieved if the students' adoption rate is low. Although higher education is investing heavily in e-learning system development, to stay competitive, educational officials have requested an assessment of the students' perceptions of e-learning systems and whether a system is effective and efficient in facilitating students' learning (Halawi & McCarthy, 2008). Thus, the focus of students' acceptance and utilization of LMSs has come to prominence.

The issue might be exacerbated when implementing a learning technology without an adequate understanding of the target audience. Various e-learning systems have been deployed in educational settings; some create a pleasurable and informative experience; others inflict frustration and unfavourable interaction. An LMS supports or hinders active engagement, easy communication, and formative feedback for all educational stakeholders (Rubin et al., 2010). If the e-learning system is difficult to use, the learners might find themselves disoriented, skip vital content, be reluctant to engage in the course, or be unwilling to communicate with a course coordinator and other peers using the e-learning system (Koohang & Paliszkiewicz, 2016). Thus, it becomes imperative to examine the students' experience of an e-learning system, with much emphasis on the factors that influence the use of these applications.

This is relevant to e-learning solutions in which further enhancements might be needed to suit individuals in unique settings such as the Saudi Arabian environment. In Saudi universities, the majority of students are still unwilling to use e-learning systems (Alenezi et al., 2011). Furthermore, recent studies have examined the use of e-learning systems in a Saudi higher institution and found that more than half of university students only use LMS either rarely or occasionally (Binyamin et al., 2016, 2017). Prior studies disclosed that there is a dearth of academic research on Saudi higher education to examine the effects of usability factors on students use of LMSs, so significant issues have not yet been examined (Al-Asmari & Khan, 2014; Al-Harbi, 2011a; Alshammari et al., 2016; Alshehri et al., 2019a; Salloum & Shaalan, 2019; Yamani, 2014). Issues associated with system technical support, self-efficacy and instructional design, perceived accessibility, perceived flexibility, and subjective norm have been examined in the acceptance and use of LMSs (Al-Harbi, 2011a; Alshammari et al., 2016). Yet, other system characteristics such as navigation, visual design, learnability, information quality, assessment, and interactivity are important usability qualities (Asarbakhsh & Sandars, 2013; Koohang & Paliszkiewicz, 2016; Zaharias & Poylymenakou, 2009). Thus, academic institutions would benefit more from these technologies if they could examine the factors that encourage effective use of LMS in Saudi Arabia (Alenezi et al., 2011; Binyamin et al., 2017).

In particular, organizational, technological and social barriers have been recognized as the main inhibitors for the utilization and adoption of an e-learning system in Saudi universities (Asiri et al., 2012). An integral step in filling this knowledge gap is to conduct a quantitative evaluation of the e-learning system and identify the drivers for effective utilization of the software (Decman, 2015; Koohang & Paliszkiewicz, 2016). Hence, this research fills the gap by determining empirically the effects of usability, social, and organizational factors on the use of LMS in Saudi university from students' standpoints. The researchers propose a theoretical framework by extending the Unified Theory of Acceptance and Use of Technology (UTAUT) model to include the system usability features such as navigation, learnability, visual design, information quality, instructional assessment, and interactivity for investigating students' perceptions towards the use of the LMS in Saudi tertiary education. The overall aim of this research is to identify the significant usability, social, and organisational factors that influence students' use of learning management systems in Saudi state universities.

The remainder of the paper is structured as follows: the next section provides a brief description of the UTAUT model. The third section explores the theoretical framework, the UTAUT variables, the usability dimensions and the research hypotheses. This is followed by the research methodology. The model testing results are provided in the next section and finally there is discussion, implication and conclusions.

THEORETICAL BACKGROUND

As a result of previous technology acceptance research, Venkatesh and colleagues (2003) developed a UTAUT model based on a comprehensive review of diverse theories for computer use prediction. The model unifies the theoretical models in information system studies and integrates human and social constructs to form a unique extensive model (Venkatesh et al., 2003). The model established a unique measure with four essential constructs of user behavioural intention and usage: Performance Expectancy (PE), Effort Expectancy (EE), Social Expectancy (SE), and Facilitating Condition (FC). All these elements are direct determinants of user intention and behaviour. Demographic characteristics such as age, experience, gender, and willingness to use are posited to moderate the influence of the four key constructs on behavioural intentions. The amalgamation of the core constructs and the moderating inputs has improved the predictive efficiency to 70% of the variance in behavioural intention to use technology (Venkatesh et al., 2003).

Furthermore, it is essential to identify the usability variables desired for a learning management system in the educational environment in Saudi higher education. It is often believed that choosing usability attributes is difficult, especially with the different variety of factors available (Hornbæk, 2006). It has thus been suggested to explore the current studies and check for measures that are relevant in an e-learning context (Hornbæk, 2006). Yet, the usability factors pertaining to e-learning-system evaluation have been diverse, and there is no consensus between scholars and experts about the dimensions and factors that should be utilised in the educational environments. Table 1 presents a summary of the relevant usability studies in the e-learning context and demonstrates the diverse usability attributes employed to evaluate different e-learning systems. This is supported by Orehovački et al. (2013), who claim that there is no agreement about the quality standards that reflect the e-learning system. Hence, there is abundant room for further progress in determining the significant and relevant usability factors in the e-learning system usability assessment.

In this research, the UTAUT theory was extended with six usability dimensions: System Navigation (SN), Visual Design (VD), System Learnability (SL), Information Quality (IQ), Instructional Assessment (IA), and the E-learning System Interactivity (ESI). There are four reasons why these six attributes have been specifically employed in the research's theoretical framework. The variables have already been validated extensively in prior studies of e-learning system evaluation (Alshehri et al., 2019b; Althobaiti & Mayhew, 2016; Binyamin et al., 2019; Reeves et al., 2002; Zaharias & Koutsabasis, 2011; Zaharias & Poylymenakou, 2009). The heuristics have been employed specifically in the design and evaluation of e-learning systems and were found to identify common areas of usability problems across web-based learning applications. Secondly, a study was carried out to identify the most important usability metrics in e-learning system evaluation from Saudi students' point of views (Alshehri et al., 2019b), and the six usability criteria were found to be important in the use of the e-learning system in Saudi higher education. Thirdly, the selected usability principles were tested in Saudi tertiary education, confirming the validity and reliability of the variables in a new context. As outlined previously by many experts (Althobaiti & Mayhew, 2016; Oztekin et al., 2010; Zaharias & Poylymenakou, 2009), considerably more work will need to be done to validate the usability attributes in diverse contexts, with different systems and users; hence this was another motivation to apply the variables in the Saudi Arabian educational context. Finally, the proposed model has been tested using PLS-SEM, a sophisticated multivariate analysis. This not only enhances the validity of the variables in Saudi Arabia using PLS-SEM but also adds to the novelty and originality to the current study.

Table 1. Domain-Specific Usability Evaluation Studies

Study	Context	Methodology	Attributes	Validation
Koohang and Paliszkiewicz (2016)	e-learning system	Literature review	Developed a theoretical model of four interrelated components: Fundamental (simplicity, comfort, user friendly, control, navigability and load time) Appearance (recognition, visual appearance, consistency, and well-organized) Information presentation (understandability, relevancy, adequacy, and right to the point) Communication (technical communication, direction/instruction, feedback, visual models of all content,	A Likert-scale instrument was tested using a variance-based Structural Equation Modeling (SEM) package that uses Partial Least Square (PLS) in the USA

Study	Context	Methodology	Attributes	Validation
			provision of basic information via Q&A, and search/inquiry)	
Orfanou et al. (2015)	e-learning system	Literature review	System Usability Scale (SUS)	Inquiry-based method. They conducted eleven studies with 769 students.
Mtebe & Kissaka (2015)	LMS	Existing heuristics and studies	10 Nielsen's heuristics Instructional materials, collaborative learning, learner control, feedback and assessment, accessibility, motivation to learn	heuristics evaluation with five experts in Africa
Granić & Ćukušić (2011)	e-learning system	End users' assessment and expert inspection (quantitative and qualitative analysis)	Memorability: Memory test for System functions Attitude questionnaire: SUS Interview Usability criteria: accuracy of task completion, task completion time and satisfaction	Students, teachers and experts of several European countries
Davids et al. (2013)	e-learning system	Heuristics evaluation and user testing	10 Nielsen's heuristics Intuitive visual layout	Six inspectors to identify usability problems and end users are directly observed while using the application
Oztekin et al. (2010)	e-learning system	Existing heuristics in usability and quality-related checklist	Error prevention, visibility, flexibility, course management, interactivity, feedback and help, accessibility, consistency, assessment, memorability, completeness, aesthetics, reduce redundancy	Learner-based questionnaires, factor analysis and Structural Equational Modelling in the USA
Alsumait & Al-Osaimi (2009)	Child e-learning application	Guidelines and existing heuristics	10 Nielsen's heuristics Multimedia representations, attractive screen layout, appropriate hardware, challenge the child, evoke child mental imagery, support child curiosity, learning content design, assessment, motivation to learn, interactivity, accessible	Using four experts and user testing in Kuwait
Zaharias (2009)	e-learning application	Literature review	Learnability, accessibility, consistency, navigation, visual design, interactivity, content and resources, feedback, instructional assessment, media use, learner guidance and support, learning strategies design	None

Study	Context	Methodology	Attributes	Validation
Zaharias & Poylymenakou (2009)	e-learning application	Literature review	Content, learning support, visual design, navigation, accessibility, interactivity, self-assessment and learnability, motivation to learn	Two empirical studies of learner-based questionnaires and factor analysis in corporate settings
Ssemugabi & De Villiers (2007)	Web-based e-learning application	Existing heuristics, model and learning theories	10 Nielsen's heuristics Navigation, relevance of content, clarity of objectives, collaborative learning, learner control, support significant approaches to learning, cognitive error recognition, diagnosis and recovery, feedback, context meaningful to domain and learner motivation	Student-based questionnaires and focus groups in South Africa
Dringus & Cohen (2005)	e-learning system	Expanded existing heuristics	Visibility, functionality, aesthetics, feedback and help error prevention, memorability, course management, interactivity, flexibility, consistency, efficiency, reducing redundancy and accessibility	Faculty and students testing of online courses to produce an adaptable usability checklist

RESEARCH FRAMEWORK AND RESEARCH HYPOTHESES

The current study explores the UTAUT theory with the usability attributes on an LMS in Saudi Arabia. The model extends UTAUT to include navigation, learnability, visual design, information quality, instructional assessment, and interactivity for investigating students' perceptions towards the use of the LMS in Saudi tertiary education. The proposed research model is shown in Figure 1. The next sub-sections explain the model hypotheses.

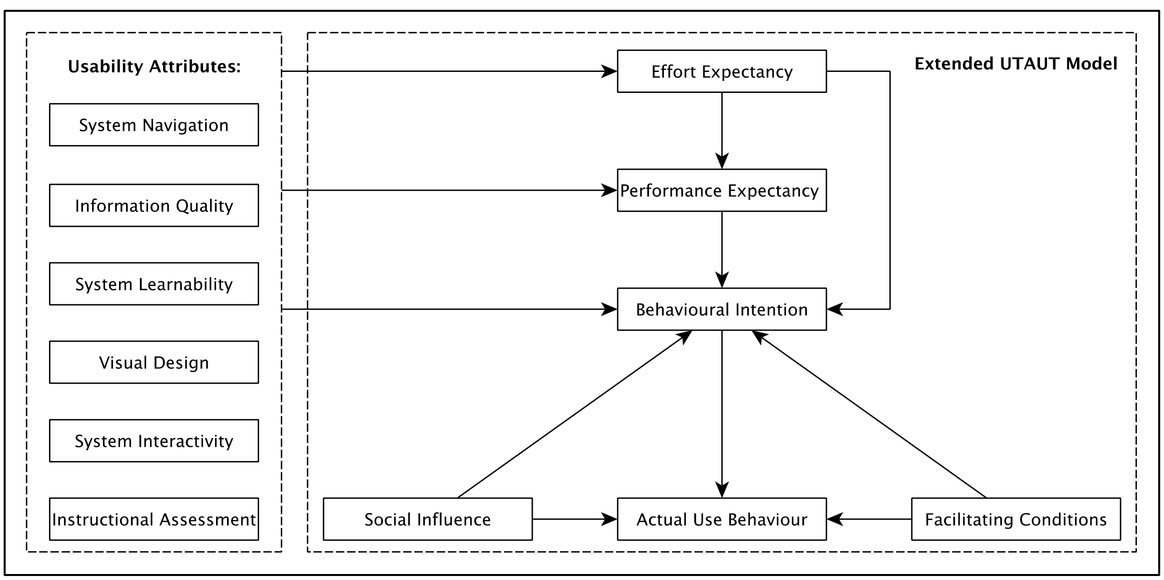

Figure 1. Research Theoretical Framework

UTAUT VARIABLES

The theoretical framework begins by discussing the base model (UTAUT) variables as follows:

Performance expectancy (PE)

Performance expectancy is concerned with individuals' beliefs that a system use will enhance their job performance to perform various tasks (Venkatesh et al., 2003). In this study, it is the extent to which students believe that using LMS will enhance the learning outcomes by accomplishing the learning activities. The presumption that learners form about the promising usefulness of the LMS, the more chances that they will use or continue to use the system in the future (Halawi & McCarthy, 2008). In the absence of this PE, the system might be not utilized even if it easy to use, easy to learn, and satisfying to use. Many studies have shown that PE is a significant determinant of behavioural intention (BI) to use an e-learning system (Alrawashdeh et al., 2012; Alshehri et al., 2019a; Bellaaj et al., 2015; Bouznif, 2018; Salloum & Shaalan, 2019; Usoro et al., 2013). Similarly, in the Saudi higher education context, the studies of Alshehri et al. (2019a) and Bellaaj et al. (2015) found that performance expectancy has a remarkably positive impact on the students' intention to use an LMS. Thus, these findings suggest that the students are driven to accept the e-learning system primarily on the basis of its usefulness. Based on the above discussion, it is hypothesized:

H1: *Performance expectancy has a direct positive influence on students' behavioural intention to use an LMS.*

Effort expectancy (EE)

Effort expectancy is defined as the degree of ease associated with the use of the system (Venkatesh et al., 2003). In this context, it is the students' perception of the LMS usage ease or difficulty (Chiu & Wang, 2008). Venkatesh et al. (2003) claim that the users' acceptance of an application is determined by users' perceived ease of use. Meta-analysis such as that conducted by Khechine et al. (2016) have shown that effort expectancy is a significant determinant of behavioural intention to use an LMS. Although data from several sources have identified a significant association between effort expectancy and behavioural intention to use learning technologies (Alrawashdeh et al., 2012; Bellaaj et al., 2015; Usoro et al., 2013), the claim was not the case in other studies (Alshehri et al., 2019a; Attuquayefio & Addo, 2014; Jong & Wang, 2009; Park, 2009; Salloum & Shaalan, 2019; Šumak et al., 2010). Thus, in order to further assess the relationship and confirm whether it is valid in the Saudi e-learning context, we propose that effort expectancy leads to improved performance and willingness to use, i.e., that effort expectancy has a positive effect on performance expectancy and behavioural intention to use LMS. This claim has been demonstrated by several empirical investigations e.g. Ameen et al. (2019) and Moreno et al. (2017). So, when students see that the LMS is free of effort, that will lead them to perceive it to be useful which further encourage them to use it. Therefore, it is hypothesized:

H2: *Effort expectancy has a direct positive influence on students' behavioural intention to use an LMS.*
H3: *Effort expectancy has a direct positive influence on performance expectancy.*

Social influence (SI)

This construct relates to whether important people (friends, colleagues, and family members) influence an individuals' intention to use the system (Venkatesh et al., 2003). In this study, it is the students' perceptions of the influence of university officials, lecturers, and peers on motivating students to use LMS. So, when students in the educational environment think they should adopt the system, they tend to conform to the opinions of others (e.g., university officials, lecturers, and peers) and adopt the system (specific behaviour) (Eckhardt et al., 2009). The construct has been recognized as fundamental to technology adoption as the influence of peers, change agents, organizational pressure, and societal norms are inevitable (Rogers, 1995; Venkatesh et al., 2003).

In the context of e-learning technologies, there has been a positive significant association between SI and behavioural intention to perform a focal behaviour with LMS (Chu & Chen, 2016; Khechine et al., 2014; North-Samardzic & Jiang, 2015; Salloum & Shaalan, 2019; Šumak et al., 2010; Williams et al., 2015). In recent studies, social influence was found to be an important factor for the individuals' intended behaviour towards usage of LMS in Saudi universities (Alshehri et al., 2019a; Soomro, 2018). Following the guidelines of UTAUT and since the e-learning system use is mandatory in the context of the study (i.e., students have to use the system to complete the course), this research will study the direct effect of SI on behavioural intention as well as on the system usage behaviour.

H4: *Social Influence has a direct positive influence on students' behavioural intention to use an LMS.*
H5: *Social Influence has a direct positive influence on students' actual usage behaviour.*

Facilitating conditions (FC)

This construct refers to the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system (Venkatesh et al., 2003). In this context, ensuring technological infrastructure is rich, reliable, and capable of providing the needed support for stakeholders is a critical element for e-learning success (Selim, 2007). It is also believed that the availability of environmental resources and organizational and technical infrastructures would help students to employ them in their learning activities, thereby promoting their use of the e-learning system (Venkatesh et al., 2003). Thus, some theoretical foundations acknowledge the effect of facilitating conditions on behavioural intention (Ajzen, 1991; Taylor & Todd, 1995), and this was supported by many empirical findings (Ain et al., 2015; Dwivedi et al., 2017; Eckhardt et al., 2009; Lewis et al., 2013; Venkatesh et al., 2012). These lines of evidence reinforced the association between FC and BI; in contrast to the original model (Dwivedi et al., 2017). Furthermore, many prior studies have demonstrated a significant positive influence between facilitating conditions and actual use of an e-learning system (Alshehri et al., 2019a; Buchanan et al., 2013; Deng et al., 2011; Khechine et al., 2014; Salloum & Shaalan, 2019; Šumak et al., 2010). Based on the prior literature, the following hypotheses are proposed:

H6: *Facilitating condition has a direct positive influence on students' behavioural intention to use an LMS.*
H7: *Facilitating condition has a direct positive influence on students' actual use of an LMS.*

Behavioural intention (BI)

BI is defined as the probability that individuals will perform the behaviour in question (Venkatesh et al., 2003). BI is proposed to be a direct antecedent of the actual behaviour (Ajzen, 1991), so the greater intention that an individual forms about a certain behaviour, the more likely that performance is to occur (Ajzen, 1991). There is a large volume of published studies confirming the relationship between BI and usage behaviour (Davis, 1989; Taylor & Todd, 1995; Venkatesh & Davis, 2000; Venkatesh et al., 2003). In the e-learning environment, the vast majority of studies on technology acceptance have proved that behavioural intention has a significant positive influence on LMS use (Ain et al., 2015; Alshehri et al., 2019a; Lewis et al., 2013; North-Samardzic & Jiang, 2015; Salloum & Shaalan, 2019; Šumak et al., 2010; Williams et al., 2015). Therefore, based on the findings in the literature, the following hypothesis is proposed:

H8: *Behavioural intention to use LMS has a direct positive influence on the actual usage behaviour.*

Usability Variables

The following describes the usability parameters of the framework:

System navigation

The LMS navigation quality concerns the visible navigational structure such as menus and links that grant learners many options over the system elements (Zaharias & Poylymenakou, 2009). The navigation is considered as a map that connects the components of a system and is expected to enable users to move within the system in a clear and easy way (Binyamin et al., 2019). If the navigation structure is complicated and contains broken links, users might become disorientated when navigating and experience heavy cognitive load.

In the e-learning context, the navigational tools enable students to locate specific content items and instructional elements as well as to identify their position in the sequence of commands to enhance the amount of learners' control (Naveh et al., 2012). Furthermore, students' perceptions of usability formed the central focus of a study by Selim (2007) in which the author found navigation in an e-learning system impacted the decision to adopt and use the e-learning system. Similarly, in a Saudi higher education study, learners encountered difficulties navigating through the e-learning system content and other features in the menu (Alturki et al., 2016). Furthermore, Alelaiwi and Hossain (2015) found that the majority of Saudi university students reported inconsistency in the e-learning navigation format and even the results of clicking links might be confusing.

In a study which set out to determine the effects of usability attributes on the website acceptability in an e-commerce context, Y. Wu et al. (2009) reported that navigation is a key indicator that promotes the behavioural intention to use the system, and so did Green and Pearson (2011), in whose work navigability was found to be a significant predictor of perceived ease of use. In educational settings, Theng and Sin (2012) found that the navigation of LMS has a positive influence on the students' perceived ease of use. This also corroborates with the research of Tsai et al. (2017). As for antecedents to the learners' belief of ease of use and usefulness, the Cheng (2015) study revealed that e-learning system navigation has the greatest impact. In the Saudi universities, Binyamin et al. (2019) demonstrated the significant effect of LMS navigation on students' perceptions of ease of use, yet the effect of navigation on the students' perception of the system usefulness was not confirmed. This combination of findings provides some support for the premise that a relationship of e-learning navigation is evident. Hence, we hypothesise that:

H9: *System Navigation has a direct positive influence on performance expectancy.*
H10: *System Navigation has a direct positive influence on effort expectancy.*
H11: *System Navigation has a direct positive influence on students' behavioural intention to use an LMS.*

Visual design (VD)

This attribute focuses on the aesthetic aspects of the system through considering the effects of images, colours, fonts, and general layouts (Usability.gov, 2013). This includes the arrangement of the content: layouts, colours, icons, buttons, paragraph formats, and the line spacing as well as the websites' consistency (Graham et al., 2005). The structural design of the interface offers features and support whereby users can interact with the system components. A well-designed and user-friendly user interface for an e-learning system is the most significant driver for students' utilization (Shee & Wang, 2008). It is argued that the more simple and flexible the system user interface is, the less effort the students need to use the system, and that it promotes accessibility and adds further enhancement to the e-learning system's usefulness (Cho et al., 2009). That lessens the students' effort to access the functions and will help them to find information with ease and speed, and ultimately learn in an effective manner (Cho et al., 2009).

Visual design of e-learning systems is often overlooked and, in many cases, treated as a minor cosmetic detail (Horton, 2011; Reyna, 2013). Previously published studies on the effect of visual design on technology acceptance seem to be limited (Binyamin et al., 2019) and, in many cases, tend to be indeterminate. It was demonstrated that visual cues play a key role in the consumers' intention in an e-commerce context (Shaouf et al., 2016). In an empirical finding, the overall perception of visual interface design was determined to be a critical factor in the students' acceptance and use of the e-learning system (Cho et al., 2009). It was also found that the LMS interface design affected considerably the usefulness of the system (Cho et al., 2009; Khedr et al., 2011; Mouakket & Bettayeb, 2015). However, Binyamin et al. (2019) were unable to demonstrate the effect of visual interface design on the students' perception of the LMS ease of use and usefulness in the Saudi context while Al-Aulamie (2013) has proved the effect to be on the LMS ease of use, rather than usefulness. Using UTAUT, Almaiah and Alyoussef (2019) found visual design has a significant effect on performance expectancy as well as students' usage behaviour of LMS in a Saudi university. However, in other contexts, Theng and Sin (2012), Khedr et al. (2011), Cheng (2012) and Liu et al. (2010) have demonstrated the influence of interface design on the perceived ease of use. In this paper, it is assumed that LMS user interface design will enable students to accomplish their goals, affect the ease of use the system and subsequently influence their intention and use of the system. Hence, the following hypotheses are proposed:

H12: *Visual design has a direct positive influence on performance expectancy.*
H13: *Visual design has a direct positive influence on effort expectancy.*
H14: *Visual design has a direct positive influence on students' behavioural intention to use an LMS.*

System learnability (SL)

The learnability dimension is related to the ease of learning: the degree to which students can learn how to use the LMS without difficulty (Holden & Rada, 2011; Nielsen, 1993). There is a consensus among researchers that learnability is an essential component of usability (Dix et al., 2004; Nielsen, 1993; Shackel, 2009; Shneiderman et al., 2017). Most researchers acknowledge that learnability is particularly important in e-learning systems due the system complexity, intricate pedagogy, and the diversity of users (Junus et al., 2015). E-learning systems with high learnability enable learners to start using the system with a minimum of training, help, and orientation (Marzanah et al., 2013).

Few lines of evidence have investigated the impact of learnability on students' ease of use and usefulness. Using the Structural Equation Modelling technique, Scholtz et al. (2016) verified that learnability significantly influenced the Technology Acceptance Model (TAM) perceived usefulness and perceived ease of use which in turn increased the usage of the ERP system. Likewise, Aziz and Kamaludin (2014) revealed that the learnability of a Malaysian university website positively influenced students' perception of system ease of use and usefulness. Yet, in the study of Lin (2013), the correlation between learnability and perceived ease of use was not evident. In Saudi higher education, the effect of LMS learnability was demonstrated with the system ease of use but not for usefulness (Binyamin et al., 2019). Up to now, far little attention has been paid to the influence of the learnability variable on the students' intention and use of an e-learning system in the Saudi Arabian context. In this research, the concern is whether the learnability variable influences students' performance expectancy and effort expectancy as well as their intention to use the system. Thus, the following hypotheses are proposed:

H15: *System Learnability has a direct positive influence on performance expectancy.*
H16: *System Learnability has a direct positive influence on effort expectancy.*
H17: *System Learnability has a direct positive influence on students' behavioural intention to use an LMS.*

Information quality (IQ)

Information quality refers to the information and content that is provided by the e-learning system (Ameen et al., 2019; Aparicio et al., 2017). IQ is considered an important factor for measuring the effectiveness of an e-learning system because the students' materials for learning are contained in the system (Alsabawy et al., 2016; Aparicio et al., 2017). DeLone and McLean (2003) in their information systems' success model, asserted that information quality is a crucial variable that influences user satisfaction and intention. It is also an important measure for the system success (Freeze et al., 2010;

Petter et al., 2008), and among the most important qualities component in the evaluation of the e-learning system (Alla & Faryadi, 2013).

Empirical evidence has shown that information quality influences the effectiveness of computer-mediated learning (Ameen et al., 2019; Aparicio et al., 2017; Binyamin et al., 2019). Recently, researchers have shown that information quality has a significant effect on the intention to use an LMS in the Thai context (Thongsri et al., 2019). It was verified that students' high perceptions of the system information quality will lead to a higher level of perceived usefulness (Al-Fraihat et al., 2019; Alsabawy et al., 2016; Ameen et al., 2019; Aparicio et al., 2017; Lee et al., 2014; J.-H. Wu et al., 2010) and is positively correlated with learners' satisfaction (Al-Fraihat et al., 2019; Chiu et al., 2007; Mohammadi, 2015). Among the factors influencing the students' intention to use an e-learning system, the IQ factor had a remarkable positive effect in an Iranian context (Mohammadi, 2015). In an Arab context, it was confirmed that there is a positive relationship between information quality and the continued intention to use an e-learning system (Almahamid & Rub, 2011) and on students' perceived ease of use and on perceived usefulness (Alkandari, 2015; Salloum, 2018). Specifically, in Saudi higher education, it was empirically found that the IQ of an LMS is a determinant of students' perceived ease of use and usefulness (Binyamin et al., 2019). However, other researchers found different results. For instance, Al-Aulamie (2013) and Ameen et al. (2019) demonstrated the insignificance of the association between IQ and BI. To date few studies have examined the relationship between information quality and the willingness to use the system (Petter et al., 2008). Based on the previous discussion, the researchers consider that IQ will have an influence on the students' performance expectancy, effort expectancy, and their behavioural intention to use LMS. Therefore, the following hypotheses are proposed:

H18: *Information quality has a direct positive influence on performance expectancy.*
H19: *Information quality has a direct positive influence on effort expectancy.*
H20: *Information quality has a direct positive influence on students' behavioural intention to use an LMS.*

Instructional assessment (IA)

Instructional assessment is concerned with an e-learning system's provision of learning guidance through various assessment tools including test, quizzes, surveys, electronic submission of assignments, and the grade book (Zaharias & Poylymenakou, 2009). The construct also includes an evaluation of the effectiveness of e-learning system feedback facility to the online assessment. The e-learning assessment tool is an indispensable element in the students' learning process. The diversified evaluation methods within the e-learning systems stimulate students to interact with the assessment tools in order to gain better academic performance (Sun et al., 2008). Besides, the self-assessment tool can help students to understand the course educational materials (Kayler & Weller, 2007). This enables students to identify areas of difficulties and became more engaged with the course materials (Kayler & Weller, 2007).

Regarding the influence of IA on e-learning acceptance, one study conducted by Binyamin et al. (2019) examined the relationships of LMS instructional assessment on students' perception of LMS ease of use and usefulness. They found that both links were supported in Saudi higher education. Similarly, another recent research has revealed that course assessment has a significant positive effect on performance expectancy and the actual use of e-learning systems in a Saudi university (Almaiah & Alyoussef, 2019). To date, LMS system characteristics such as instructional assessment influence on UTAUT are far from conclusive, so the current research explored the role of assessment in students' intention as well as on performance expectancy and effort expectancy. Thus, we hypothesize the following:

H21: *Instructional assessment has a direct positive influence on performance expectancy.*
H22: *Instructional assessment has a direct positive influence on effort expectancy.*
H23: *Instructional assessment has a direct positive influence on students' behavioural intention to use an LMS.*

E-learning system interactivity (ESI)

Interactivity concerns the e-learning system's collaborative tools that facilitate the interaction among students and between students and instructors. This is evident in the LMS in which many collaborative functionalities such as announcements, mail, chat, and discussion are used, not only for student-student, student-instructor interaction but also as a convenience to communicate course matters and support instructional tasks (Junus et al., 2015). In an LMS, communication tools are fundamental and foster constructive and meaningful interaction among students and teachers (Rubin et al., 2010).

Several studies have demonstrated a direct relationship between system interactivity and perceived usefulness (Alkandari, 2015; Alrawashdeh et al., 2012; Baleghi-Zadeh et al., 2017; Binyamin et al., 2019; Cheng, 2012; Moreno et al., 2017; Pituch & Lee, 2006) and perceived ease of use Binyamin et al. (2019) and Cheng (2012) as well as the behavioural intention to use an e-learning system (Agudo-Peregrina et al., 2014; Uğur & Turan, 2018; Wrycza & Kuciapski, 2018). For instance, Pituch and Lee (2006) found that system interactivity had the greatest direct and total effect on perceived usefulness and e-learning system usage behaviour. A recent study in Iraq indicated that interactivity has a significant positive influence on students' perceived usefulness of an e-learning system (Moreno et al., 2017). Nonetheless, Abbad et al.'s (2009) analysis did not substantiate the effect of e-learning system interactivity on student's perception of usefulness and ease of use in a Jordanian university. In Saudi higher education, Alenezi (2012) indicated that interactivity constructs have a positive relationship with the perceived usefulness and perceived ease of use as well as the students' behavioural intention to use an e-learning system. Binyamin et al. (2019) performed a similar series of experiments and concluded that interactivity influenced the perceived usefulness and perceived ease of use of e-learning system in Saudi tertiary education. In tandem with that, Al-Harbi (2011b) found that perceived interactivity was a determinant for e-learning system usefulness in Saudi higher education.

More information on the influence of interactivity on the acceptance and use of LMS would help us to establish a greater degree of accuracy on this matter in Saudi higher education. Therefore, it is assumed that the higher the interactivity of the system, the stronger the students' belief about its usefulness and ease of use and accordingly, the more willingness to use the system. Thus, we hypothesize the following:

H24: *E-learning system interactivity has a direct positive influence on performance expectancy.*
H25: *E-learning system interactivity has a direct positive influence on effort expectancy*
H26: *E-learning system interactivity has a direct positive influence on students' behavioural intention to use an LMS.*

RESEARCH METHOD

POPULATION AND SAMPLE

The sample for this study was taken from students in Saudi higher education, targeting students in geographically dispersed universities. Due to the large sample frame of Saudi students, sampling techniques were necessary. This is a normal approach where it is difficult or infeasible to reach the total population due to geographical boundaries, time, and budget constraints (Saunders et al., 2012). Hence, the study approaches this concern using geographical cluster sampling of Saudi universities. Each cluster (university) represents a geographical province of Saudi Arabia based on cardinal directions; so five universities that have adopted LMS for student use were selected based on a simple random probability method. Within each of these universities, the researchers selected samples of students using a simple random probability technique. The sample design made provision for obtaining a suitable number of males and females who use or have used the LMS in their studies. This is particularly true when PLS-SEM is applied as large sample size increases the precision and consistency of the PLS-SEM estimation (Hair et al., 2017).

INSTRUMENT TESTING

The UTAUT items were used according to Venkatesh et al. (2003). The usability items were adapted from various studies in the usability evaluation of e-learning systems (Al-Aulamie, 2013; Alshehri et al., 2019b; Binyamin et al., 2019; Cheng, 2012; Cho et al., 2009; Gilani et al., 2016; Khedr et al., 2011; Oztekin et al., 2010; Pituch & Lee, 2006; Zaharias & Poylymenakou, 2009). The indicators were set into the context of the main web-based LMS in Saudi higher education, the Blackboard system. All survey items were translated into the Arabic version using the back-translation method by bilingual professors to ensure linguistic equivalence. As a check, the pre-test questionnaire was conducted with four experts in the field. The received insights and suggestions showed that the items' logical consistency, meaningfulness, clarity, ease of understanding, and relevancy were satisfactory and also that the meaning was consistent with the conceptual value of the construct. After the pre-test, a pilot study of the questionnaire was conducted with fifty-five students. The researcher ensured that the students had registered for at least one web-based course. The purpose was to gain additional comments regarding the understanding and the clarity of questionnaire content. Feedback about the survey layout and questions' ambiguity were taken into consideration. Also, minor modifications in wording were applied before issuing the survey to the students.

Quantitative research in the form of an online questionnaire-based survey was performed to test the hypotheses. The theoretical framework items used a five-point Likert scale which was considered suitable for this study, because its main purpose was to evaluate the perceived usability variable influence on the e-learning system acceptance from a student's perspective. The 5-point Likert scale was used in the questionnaire of the study with a scale of: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. The instrument was divided into three main sections. The first section included information about the respondents' characteristics. The second section was concerned with UTAUT constructs. This section comprised 25 positive statements, divided into six subscales using a five-point Likert scale about LMS use in higher education. The last part elicits students' perception of the six usability variables. It contained 31 positive statements (refer to the Appendix for the study's instrument).

DATA COLLECTION

Three thousand emails, providing a hyperlink to the Web-based survey, were distributed to students who had had some experience of blended learning or distance learning courses. 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 (more than 50% missing values). 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. Table 2 summarizes the distribution of respondent's characteristics. The results indicated that males represent 46.1% (279 participants) and females 53.9% (326 participants). The dominating age group ranges from 18 to 25 years old, representing 87.7% (531 respondents) of the total study sample. The remaining 12.3% corresponds to the more senior age groups, 26-36 years old.

Table 2. Demographic Analysis of Respondents

Characteristics	Frequency	Percentage
Gender		
Male	279	46.1
Female	326	53.9
Educational Level		
Undergraduate	573	94.7
Postgraduate	32	5.3

Characteristics	Frequency	Percentage
Blackboard Experience		
Less than 1 year	68	11.2
1 – 2 years	324	53.6
2 – 7 years	213	35.2
Blackboard enrolled Courses		
1-3 courses	246	40.7
4-5 Courses	194	32.1
More than 6 Courses	159	26.3
I do not Use Blackboard in any Course	6	1
Blackboard Training		
1-3 hours	263	43.5
4 -6 hours	36	6
More than 6 hours	17	2.8
None	289	47.8

DATA ANALYSIS AND RESULTS

The data was analysed using SPSS 24 and SmartPLS 3 Partial Least Squares Structural Equation Modelling PLS-SEM. The SPSS 24 package was employed to perform the preliminary examination including missing data, collinearity, outliers, normality, and unengaged responses. The SmartPLS 3 software was used to analyse and test the research proposed model. PLS-SEM is convenient when the primary objective of the research is to extend an existing theory or identify key drivers (Hair et al., 2017). Since the goal is to identify the key drivers for student's acceptance of an LMS by extending the UTAUT model to include usability variables, PLS-SEM was used.

The analysis was conducted in two phases. In phase one, the estimations of internal consistency, convergent validity, and discriminant validity were established to prove the validity and reliability of the constructs and the measurement items. The second phase involved the structural model analysis and hypothesis testing using PLS-SEM techniques. PLS-SEM examination of the structural model involved the criterion of the coefficients of determination (R^2 values), as well as the size and significance of the path coefficients (Hair et al., 2017).

ANALYSIS OF THE MEASUREMENT MODEL

Using the PLS algorithm with 5000 iterations, the researchers estimated the measurement model including outer loadings, composite reliability, Cronbach's alpha, Average Variance Extracted (AVE), convergent validity, and discriminant validity. As shown in Table 3, the reliability assessment of the measurement model ranges between 0.75 and 0.93 in which all variables were greater than the recommended benchmark value of 0.70 (Hair et al., 2014). Along with that, the composite reliability values demonstrate that all constructs have high levels of internal consistency reliability.

Convergent validity

Convergent validity evaluates the extent to which two measures of the same construct yield results that are highly correlated and whether the items can effectively reflect the corresponding constructs (Hair et al., 2014, 2017). In this study, the researcher began with evaluation of the convergent validity. To this end, the researcher estimated the factor loadings of the items and the Average Variance Extracted (AVE).

The assessment of items' factor loading was employed to examine the variability among correlated constructs. As illustrated in Table 3, most of the outer loadings of the reflective constructs are well above the threshold value of 0.70 (Hair et al., 2017). However, a few loadings estimate fall just below the 0.70 ideal standard. There are two indicators which are > 0.60 (e.g., FC3 (0.66), AU2 (0.61)) which were retained for further analysis in exploratory research. A number of researchers advised that values of 0.60 to 0.70 are acceptable in exploratory research, as is the case in this research (Hair et al., 2017). Besides, factor loadings less than 0.70 are anticipated in social science, especially when newly developed scales are utilized (Hair et al., 2017). Furthermore, these two were considered significant, and they were retained for further analysis on the basis of their contribution to construct content validity (Hair et al., 2014). In this research, all factors have an acceptable value which satisfies the requirement of the factor loadings (see Table 3).

Another common measure used to establish the convergent validity is the Average Variance Extracted (AVE) (Fornell & Larcker, 1981). The AVE calculates the amount of variance that each construct captures from its indicators relative to the variance contained in the measurement error. The measurement of the AVE for each construct should exceed the cut-off of 0.50 as recommended by Fornell and Larcker (1981). In this research, an AVE measure was estimated for each latent construct in a measurement model. The AVE values of the all constructs lie within the 0.54 to 0.81 range and are able to satisfy the explaining criteria of 50% of variance, as suggested by Fornell and Larcker (1981) (see Table 3). Thus, all measurement items converge highly on their own corresponding construct. Hence, adequate evidence of convergent validity is established.

Table 3. Results of Measurement Model

Construct	Indicator	Factor Loading (>0.5)*	Composite Reliability (>0.7)*	Cronbach Alpha (0.7)*	Average Variance Extracted (>0.5)*
Performance Expectancy (PE)	PE1	0.84	0.89	0.84	0.67
	PE2	0.86			
	PE3	0.88			
	PE4	0.70			
Effort Expectancy (EE)	EE1	0.85	0.93	0.9	0.76
	EE2	0.90			
	EE3	0.87			
	EE4	0.88			
Social Influence (SI)	SI1	0.76	0.86	0.77	0.60
	SI2	0.84			
	SI3	0.77			
	SI4	0.72			
Facilitating Conditions (FC)	FC1	0.72	0.85	0.79	0.54
	FC2	0.76			
	FC3	0.66			
	FC4	0.73			
	FC5	0.79			
Behavioural Intention (BI)	BI1	0.90	0.95	0.92	0.81
	BI2	0.92			
	BI3	0.88			
	BI4	0.91			
Actual Use (AU)	AU1	0.75	0.84	0.75	0.57
	AU2	0.61			
	AU3	0.88			
	AU4	0.77			
System Navigation (SN)	SN1	0.84	0.90	0.85	0.63
	SN2	0.78			
	SN3	0.83			
	SN4	0.75			
	SN5	0.77			

Construct	Indicator	Factor Loading (>0.5)*	Composite Reliability (>0.7)*	Cronbach Alpha (0.7)*	Average Variance Extracted (>0.5)*
System Learnability (SL)	SL1	0.84	0.91	0.88	0.67
	SL2	0.81			
	SL3	0.87			
	SL4	0.81			
	SL5	0.76			
Visual Design (VD)	VD1	0.73	0.93	0.91	0.70
	VD2	0.77			
	VD3	0.88			
	VD4	0.90			
	VD5	0.86			
	VD6	0.88			
Information Quality (IQ)	IQ1	0.87	0.95	0.93	0.77
	IQ2	0.90			
	IQ3	0.89			
	IQ4	0.88			
	IQ5	0.86			
Instructional Assessment (IA)	IA1	0.79	0.93	0.91	0.69
	IA2	0.85			
	IA3	0.88			
	IA4	0.86			
	IA5	0.79			
	IA6	0.80			
E-learning System Interactivity (ESI)	ESI1	0.84	0.91	0.88	0.73
	ESI2	0.87			
	ESI3	0.84			
	ESI4	0.86			

* indicates the threshold level of reliability and validity.

Discriminant validity

Discriminant validity measures whether the items of the same construct are statistically different from other similar concepts (Anderson & Gerbing, 1988; Kline, 2016). In this research, the measure can be evaluated using two approaches, Fornell-Larcker criterion and Heterotrait-Monotrait Ratio (HTMT), as suggested by Hair et al. (2017). The Fornell-Larcker criterion assessment compares the square root of the AVE values with the latent variable correlation (Chin, 1998; Hair et al., 2017). A successful evaluation of discriminant validity can be verified by comparing the correlation variances between any pair of variables with AVE square root in which the value of AVE square root should exceed the correlation coefficients among any pair of latent constructs (Fornell & Larcker, 1981). The elements in the matrix diagonals, presented in Table 4, indicate the square roots of the average variance extracted. The diagonal bold values confirmed that all the AVEs are higher than any other correlation. Therefore, the discriminant validity of the constructs is established.

Table 4. The Fornell-Larcker Criterion Result

	AU	BI	EE	FC	IQ	IA	ESI	SL	SN	PE	SI	VD
Actual Use	**0.76**											
Behavioural Intention	0.57	**0.90**										
Effort Expectancy	0.49	0.58	**0.87**									
Facilitating Conditions	0.55	0.56	0.62	**0.73**								
Information Quality	0.47	0.54	0.53	0.58	**0.88**							
Instructional Assessment	0.50	0.52	0.54	0.62	0.67	**0.83**						
E-learning System Interactivity	0.40	0.54	0.42	0.52	0.58	0.69	**0.85**					
System Learnability	0.55	0.59	0.75	0.65	0.69	0.66	0.57	**0.82**				
System Navigation	0.51	0.54	0.63	0.66	0.62	0.64	0.60	0.70	**0.79**			
Performance Expectancy	0.55	0.78	0.57	0.57	0.62	0.57	0.56	0.60	0.55	**0.82**		
Social Influence	0.58	0.51	0.40	0.51	0.50	0.48	0.40	0.49	0.43	0.55	**0.77**	
Visual Design	0.44	0.43	0.48	0.54	0.63	0.62	0.56	0.67	0.70	0.45	0.41	**0.84**

Henseler et al. (2015) proposed an alternative approach: the heterotrait-monotrait ratio (HTMT) assessment of correlations in variance-based SEM. The technique achieves high specificity and sensitivity rates across all simulations compared with the Fornell-Larcker criterion (Henseler et al., 2015). Specifically, the technique measures the average correlations of indicators across constructs, measuring different phenomena relative to the average of the correlations of indicators within the same construct (Henseler et al., 2015). An HTMT value close to 1 indicates a lack of discriminant validity. In this research, a more conservative threshold value of 0.85 was used (Hair et al., 2017; Henseler et al., 2015). It can be seen from the data in Table 5 that all the values are below the threshold of HTMT 0.85, hence, the discernment validity is established. Overall, based on the assessment of the Fornell-Larcker criterion and Heterotrait-Monotrait Ratio (HTMT), the discriminant validity of the constructs was established.

Table 5. The HTMT Results

	AU	BI	EE	FC	IQ	IA	ESI	SL	SN	PE	SI
AU											
BI	0.683										
EE	0.593	0.637									
FC	0.668	0.614	0.678								
IQ	0.557	0.577	0.575	0.666							
IA	0.604	0.567	0.597	0.721	0.723						
ESI	0.468	0.559	0.447	0.62	0.617	0.762					
SL	0.678	0.648	0.845	0.827	0.767	0.739	0.641				
SN	0.636	0.604	0.710	0.786	0.693	0.728	0.675	0.795			
PE	0.684	0.771	0.638	0.660	0.703	0.652	0.624	0.694	0.638		
SI	0.753	0.597	0.481	0.642	0.586	0.566	0.474	0.593	0.532	0.671	
VD	0.537	0.460	0.529	0.643	0.686	0.684	0.608	0.751	0.793	0.519	0.491

Structural Model Estimation

Hypotheses testing results

In running the PLS-SEM algorithm, the hypothesized relationships among variables will be estimated. To this end, the researcher ran a bootstrapping technique, a non-parametric statistical approach that draws many sub-samples from the sample data and examines models for each sub-sample. 5000 bootstrap sub-samples were set as recommended by Hair et al. (2017). The critical t value should be above 1.96 with p value of 0.05 as the cut-off for significance (Hair et al., 2017). Table 6 illustrates all the study hypotheses, the path coefficients, t values, and p values. Among the factors influencing behavioural intention, performance expectancy (β = 0.571) exhibited the highest positive effect on students' intention towards using the LMS, followed by effort expectancy (β = 159), interactivity (β = 0.112), social influence (β = 0.081) and supporting, H1, H2, H4 and H26. It can be observed that all t values for these relationships are above the threshold of 1.96 with the significance level less than 0.05 (see Table 6). The other hypotheses that were proposed to have a direct influence on behavioural intention did not prove to be a significant determinant of the construct, hence H6, H11, H14, H17, H20 and H23 are not supported ($P > 0.05$) (see Figure 2).

Moving to the students' actual use of the e-learning system. as it can be seen from Table 6, the findings also reveal that usage behaviour is influenced positively by social influence at (β = 0.340) followed by behavioural intention (β = 0.266) and facilitating conditions (β = 0.229). These results provide support for hypotheses H5, H7 and H8 at 5% significance level.

Regarding the dependent variable of performance expectancy, the variable information quality displayed the primary positive correlation with the usefulness of the LMS (β = 0.309), followed by effort expectancy (β = 0.245) and interactivity (β = 0.228) with the t value greater than 1.96 and the p value less than 0.05. Hence, H18, H3 and H24 were supported. Since there was negative evidence of the relationship between visual design and performance expectancy (β = -0.102, $p < 0.05$), the findings leave H12 unproven. In line with that, H9, H15 and H21 hypotheses were not supported because of the p-value > 0.05.

Table 6. The Result of Path Analysis

Hypothesis number	Path	Path Coefficient β	T Value	P Values	Study Results
H1	PE -> BI	0.571***	13.574	0.001	Supported
H2	EE -> BI	0.159***	3.718	0.001	Supported
H3	EE -> PE	0.245***	5.021	0.001	Supported
H4	SI -> BI	0.081**	2.524	0.012	Supported
H5	SI -> AU	0.340***	8.312	0.001	Supported
H6	FC -> BI	0.065	1.814	0.07	Not Supported
H7	FC -> AU	0.229***	6.21	0.001	Supported
H8	BI -> AU	0.266***	6.414	0.001	Supported
H9	SN -> PE	0.05	0.895	0.371	Not Supported
H10	SN -> EE	0.157**	3.127	0.002	supported
H11	SN -> BI	0.037	0.792	0.428	Not Supported
H12	VD -> PE	-0.102**	2.153	0.031	Not Supported
H13	VD -> EE	-0.111**	2.24	0.025	Not Supported
H14	VD -> BI	-0.033	0.832	0.406	Not Supported
H15	SL -> PE	0.056	0.874	0.382	Not Supported
H16	SL -> EE	0.673***	13.376	0.001	Supported
H17	SL -> BI	0.009	0.155	0.877	Not Supported

Hypothesis number	Path	Path Coefficient β	T Value	P Values	Study Results
H18	IQ -> PE	0.309***	5.852	0.001	Supported
H19	IQ -> EE	0.003	0.071	0.944	Not Supported
H20	IQ -> BI	-0.029	0.673	0.501	Not Supported
H21	IA -> PE	0.068	1.295	0.196	Not Supported
H22	IA -> EE	0.129**	2.749	0.006	Supported
H23	IA -> BI	-0.034	0.788	0.431	Not Supported
H24	ESI -> PE	0.228***	5.225	0.001	Supported
H25	ESI -> EE	-0.092**	2.187	0.029	Not Supported
H26	ESI -> BI	0.112**	2.375	0.018	Supported
*P <0.1, **p<0.05, ***P<0.001					

Coefficient of determination (R squared).

The coefficient of determination R^2 is a common measure to assess the structural model. R^2 is the proportion of the variance in the outcome variable that is predictable from the independent variables (Hair et al., 2014, 2017). Hair et al. (2017) proposed that R^2 value of 0.75, 0.50, or 0.25 for dependent variables can be respectively described as substantial, moderate, and weak. In this research, the adjusted coefficient of determination is used to avoid the bias toward a complex model as recommended by Hair et al. (2017) and Hair et al. (2014). The adjusted R^2 deals with a number of independent variables relative to the sample size, removing the need to include several independent variables that were nonsignificant in the regression equation to merely increase the R^2 (Hair et al., 2014). Following a Hair et al.'s (2017) recommendation, the adjusted R^2 values of actual use (0.48), effort expectancy (0.58), performance expectancy (0.51), and behavioural intention (0.65), can be considered moderate (Table 7, Figure 2). Overall, 48% of the variance in actual use is predictable from behavioural intention, facilitating conditions, and social influence. Also, students' intention to use is demonstrated to be well predicted by its independent variables which account for 65% of the variance in student behavioural intention to use an e-learning system in Saudi higher education.

Table 7. R^2 for the Dependent Variable

Constructs	R Square Adjusted
Actual Use	0.48
Behavioural Intention	0.65
Effort Expectancy	0.58
Performance Expectancy	0.51

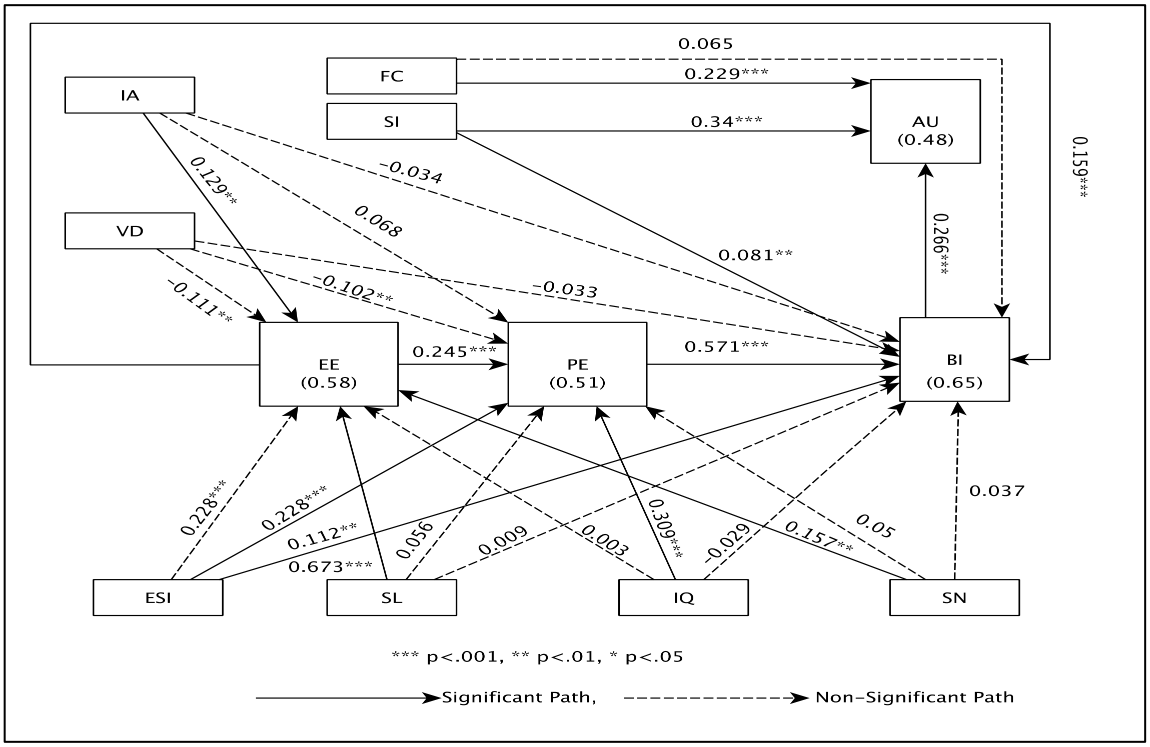

Figure 2. The Results of Path Analysis and R^2

DISCUSSION AND IMPLICATION

This section aims to interpret and describe the significance of the posed hypotheses and explain any insights that emerged from the analysis. Therefore, the results of the analysis of the UTAUT and usability model relationships, predictors, and outcomes will be discussed. It can be observed from the results that half of the proposed hypotheses were supported (see Figure 2). Specifically, the UTAUT variable (PE, EE, SI, FC, BI and AU) relationships were supported in Saudi higher education in accordance with the original results conducted by Venkatesh et al. (2003). However, the findings of the usability dimensions were mixed; around a third of the proposed hypotheses were supported. Below is a brief discussion of each proposed relationship.

PERFORMANCE EXPECTANCY (PE)

The first hypothesis (**H1**) postulated that PE will have a direct effect on the students' behavioural intention to use an e-learning system. The findings demonstrated that PE displayed a robust effect on the students' intention to use an LMS. The construct has the highest predictor ($\beta = 0.571$, $P < 0.05$) on students' behavioural intention to use the e-learning system in the Saudi universities in the study, explaining more than half of the variance in the student's behavioural intention to use e-learning system. In tandem with our findings, the Chiu and Wang (2008), Raman et al. (2014), Decman (2015) and Thongsri et al. (2019) studies of an LMS acceptance revealed that PE exhibited the maximum weight on the students' intention to use the system. Besides, in a number of meta-analysis investigations, the PE was the only construct in the complete list of analysed cases that showed substantial influence on BI among all relationships of the UTAUT model (Dwivedi et al., 2011; Khechine et al., 2016; Taiwo & Downe, 2013). In the Saudi higher education context, the studies of Alshehri et al. (2019a) and Bellaaj et al. (2015) found that performance expectancy has a remarkably positive impact on the students' intention to use an LMS. This finding suggests that the students are driven to accept the e-learning system primarily on the basis of its usefulness. In this respect, lecturers, course designers, system administrators, and students should work together to enhance the usefulness of the system, seeking to influence learners' perceptions. As an illustration, more detailed e-learning context and content, including course content, assessments, and delivery activity, could be planned and clearly presented in the e-learning system for the target students. That would help students to better realize the advantages of an e-learning system and increase the perception that using the system can enhance their learning performance and productivity.

EFFORT EXPECTANCY (EE)

The second and third hypothesized relationships were the paths of effort expectancy with behavioural intention **H2** and performance expectancy **H3** respectively. The current study found the link between EE and BI was significant ($\beta = 0.159$, $P < 0.05$) and supported by the research findings (**H2**) (refer to Table 6). The results indicated that the relationship EE->PE is statistically significant thus, **H3** was supported. In this respect, the predictive strength of EE-> PE ($\beta = 0.245$, $P < 0.05$) is stronger compared with the EE-> BI but weaker compared to that of performance expectancy in the previous discussion. This finding is in line with IS adoption studies (Islam, 2013; Venkatesh & Davis, 2000).

Several studies have demonstrated a positive effect of effort expectancy on performance expectancy. These results reflect those of Chiu and Wang (2008), who also found effort expectancy had a direct effect on performance expectancy. Similarly, Al-Gahtani (2016), whose EE was called PEOU (Effort expectancy pertains to perceived ease of use in TAM), found that the PEOU has a significant positive influence on students' perceived usefulness of an e-learning system in Saudi higher education. This is also consistent with many studies in the prior literature (Ameen et al., 2019; Binyamin et al., 2019; Davis, 1989; Davis et al., 1989; Moreno et al., 2017; Teo, 2009). Besides, many studies support the direct impact of effort expectancy on behavioural intention (Alrawashdeh et al., 2012; Usoro et al., 2013). In Saudi higher education, Bellaaj et al. (2015) reported a substantial positive impact of effort expectancy on the intention to use LMS. Prior research has indicated that effort expectancy is more salient for females (Venkatesh et al., 2003; Wang, 2016). Thus, since more than half of the participants were female in this study, this phenomenon explains why effort expectancy revealed a more noticeable effect on the students' behavioural intention. Overall, if a system is relatively easy to use, students will be more likely to have a perception of usefulness and be willing to learn about the e-learning system features and use them in their studies, and that leads them to form a positive intention to use it which influences their actual usage behaviour. Thus, the challenges facing developers and system administrators would become clearer: to improve the system's ease of use, clarity, and understanding (i.e., 'ease of understanding') to make the students' learning experience more efficient and effective.

SOCIAL INFLUENCE (SI)

This study hypothesized that social influence would have an influence on the behavioural intention **(H4)** and on the actual use behaviour of an e-learning system **(H5)**. Regarding the path of SI->BI, the findings illustrated that the social influence factor had a small but significant impact on behavioural intention ($\beta = 0.081$, $P < 0.05$) hence, H4 was supported. Similar to the study findings, the weights of social influence were classified as small on the intention to use the system (Chen, 2011; Taiwo & Downe, 2013). These results match those observed in earlier studies that social factors significantly affect the students' intention to adopt LMSs (Alrawashdeh et al., 2012; Chu & Chen, 2016; Khechine et al., 2014; North-Samardzic & Jiang, 2015; Raman et al., 2014; Salloum & Shaalan, 2019; Šumak et al., 2010; Thongsri et al., 2019). In Saudi tertiary education, social influence was found to be an important factor for students' willingness to use an LMS (Soomro, 2018).

In this research, the association of social influence with e-learning system actual usage behaviour was examined (**H5**). Remarkably, the construct had a significant positive effect on the student's actual usage behaviour ($\beta = 0.340$, $P < 0.05$). The relationship appeared to significantly influence the variance in the student's usage of the e-learning system (due to the direct relationship (0.34)). Our findings also showed that the explanatory power of the theoretical model improved significantly when social influence is explicitly theorized (i.e., from 40% of variance in usage behaviour without social influence to 48% of variance in usage behaviour explained with the construct in the model). However, very little was found in the literature that examined the association between SI and use behaviour (Eckhardt et al., 2009). Jong & Wang (2009) found that social influence had a significant impact on the students' system usage. In accordance with the present results, El-Masri and Tarhini (2017) in their comparative studies between Qatar and the US showed that the social influence association with the e-learning system use behaviour tended to be more influential in a non-western context, the Qatari sample, more than the US sample. The findings also corroborate the ideas of Al-Gahtani et al. (2007), who suggested that a low individualism culture such as Saudi Arabia might exhibit a significant relationship between social construct and the use of web-based technology. One plausible explanation could be that those living in a high collectivistic culture structure (e.g., Saudi Arabia) tend to regard social influence as a significant element in the usage behaviour towards technology (Al-Gahtani et al., 2007; Ameen et al., 2019). Therefore, the referents, e.g., university officials and teachers, should encourage the students in the use of the e-learning system. More importantly, they should develop initiatives to encourage awareness about the efficiency and the effectiveness of the e-learning system for teaching and learning, e.g., through social media such as the university official social networking site's Facebook, Twitter, and newspapers that might arouse young peoples' interest.

FACILITATING CONDITION (FC)

To examine how the perceived organizational support influences students' intentions and usage behaviour, two hypotheses were proposed: **H6:** FC -> BI and **H7:** FC -> AU. In the FC -> BI path, the current study did find a significant link between FC and BI ($\beta = 0.065$, $P > 0.05$), leaving **H6** unproven. This matches with the study conducted by Hsu (2013), Ain et al. (2015) and Alshehri et al. (2019a). These results reported an insignificant relationship between facilitating conditions and students' behavioural intention to use the e-learning system. However, Venkatesh et al. (2003) anticipated that when performance expectancy and effort expectancy factors are present, the facilitating conditions construct becomes nonsignificant in predicting an intention to use technologies. Thus, the presence of performance expectancy and effort expectancy in our proposed model might explain the reason for this hypothesis to be unsupported, as confirmed by Venkatesh et al. (2003).

Nevertheless, our study reported that facilitating condition was found to be a strong predictor of the e-learning system's actual use ($\beta = 0.229$, $T= 6.21$, $P < 0.05$), indicating a support for **H7**. The facilitating condition has in the past been found to be the most significant factor for predicting the students' use of an LMS (Buchanan et al., 2013; Deng et al., 2011). The empirical evidence has supported the impact of the perceived organizational resources on the individuals actual utilization of the e-learning system (Buchanan et al., 2013; Deng et al., 2011; North-Samardzic & Jiang, 2015; Šumak et al., 2010). A plausible explanation for this could be that as students have experienced the e-learning system, they might become more familiar with the available organizational resources and they are more willing to find support to facilitate the actual use of the system. Thus, universities should encourage learners to take advantage of e-learning services by providing the necessary resources and support (e.g., enhance the ICT infrastructure, give timely, appropriate technical support, and deliver training by a qualified individual).

BEHAVIOURAL INTENTION (BI)

As the theoretical foundation of TAM and UTAUT postulated that behavioural intention is a direct determinant of actual usage behaviour (Davis, 1989; Venkatesh et al., 2003), the study under discussion here also hypothesized the direct influence of BI on AU (**H8**). Our findings indicate that behavioural intention demonstrated a positive effect on the e-learning usage of students ($\beta = 0.266$, $T= 6.414$, $P < 0.05$), supporting **H8**. The vast majority of studies on technology acceptance have proved that behavioural intention has a significant positive influence on LMS use (Ain et al., 2015; Binyamin et al., 2019; Lewis et al., 2013; North-Samardzic & Jiang, 2015; Salloum & Shaalan, 2019; Šumak et al., 2010). Weight analysis of the relationship between BI and AU was found to be positively correlated in 82% of studies, qualifying for the best predictor category of usage behaviour (Williams et al., 2015). Also, the use of LMS is mandatory for students in Saudi higher education so it is logical to consider the connection between the two dependent variables.

System Navigation (SN)

In this study, it was hypothesized that SN has a direct positive influence on students' PE and EE and BI of the LMS use, representing **H9**, **H10**, and **H11** respectively. Regarding the path of SN->PE, the analysis revealed that the SN factor had an insignificant effect on performance expectancy ($\beta = 0.05$, $P > 0.05$) hence, **H9** was not supported. This result was unexpected and is contrary to prior research findings, e.g., Khan and Qutab (2016) in which the system navigation significantly predicted the users' perceived usefulness. Nonetheless, in an e-library system, navigation was found to have an insignificant influence on the perceived usefulness (Jeong, 2011). Similarly, Binyamin et al. (2019) in Saudi Arabian universities demonstrated that SN is not a significant predictor of the students' perception of usefulness in the context of an e-learning environment. This result might be attributed to a lack of awareness of e-learning system features such as navigational structure. This might explain the inadequate exploitation of e-learning system tools in Saudi higher education as outlined by Alotaibi (2019).

In the current study, it was also hypothesized that SN has a direct positive influence on students' effort expectancy of LMS. The results confirmed that SN had a significant positive effect on the students' perception of effort expectancy ($\beta = 0.157$, $P < 0.05$). Thus, **H10** was supported. The findings are in parallel with previous investigations of Cheng (2015), Binyamin et al., (2019), and Theng and Sin (2012) who established a significant influence between e-learning interface navigation and the students' perceived ease of use. A possible explanation for this might be that the ease of navigational structure between the course content along with the operating links might encourage students to consider the LMS system easy to use, and ultimately to use it. In general, therefore, it seems that the ease in finding the information, correctness of navigation buttons, menu, site map, and links are significant elements for the students' perception of ease of use of an e-learning system.

The last hypothesized relationship in the construct is SN->BI. The findings indicated that navigation had no effect on student's behavioural intention ($\beta = 0.037$, $P > 0.05$) to use LMS, leaving **H11** unproven. There is a dearth of research into the causal impacts between the navigation factor and the intention and usage behaviour, especially in e-learning settings (Binyamin et al., 2019). Therefore, more research is needed to investigate the SN->BI especially in Saudi higher education.

Visual Design (VD)

The SEM results in Table 6 provided empirical evidence that the path VD->PE was insignificant ($\beta = -0.102$, $p < 0.05$), and accordingly **H12** was rejected. Even though it is a weak correlation, this indicates an inverse relationship. Contrary to the conceptualized path model, the students' perception of the system visual design is negatively associated with the students' perception of the system usefulness. This observation is similar to the findings of Binyamin et al, (2019) and Al-Aulamie (2013) in a Saudi educational context while other researchers evidenced otherwise (Cho et al., 2009; Khedr et al., 2011; Mouakket & Bettayeb, 2015). Contrary to the previous research, the effect of VD on EE was found to be insignificant ($\beta = -0.111$, $p < 0.05$), failing to support **H13**. These results also corroborate the findings of a Binyamin et al. (2019) in a Saudi context. However, this result disagrees with Al-Aulamie (2013) Khedr et al. (2011), Cheng (2012), Liu et al. (2010), and Cho et al. (2009) in which the e-learning system interface design was confirmed to be an important determinant that affects perceived ease of use. A possible explanation for the unsupported relation of VD on PE and EE can be attributed to the fact that 89% of the respondents acknowledged moderate and advanced levels of e-learning system experience. Thus, the students' familiarity with the system and their high exposure to it might minimize the effect of the interface's visual appearance.

Regarding VD -> BI, it was hypothesized that BI is directly affected by VD of LMS. The results in Table 6 showed empirical evidence that hypothesis **H14** was not proven ($\beta = -0.033$, $P > 0.05$). This also accords with the study of Shaouf et al. (2016), which did not find a direct effect between visual design and users' behavioural intention to use an e-commerce system. Even though this not in an educational context, the overall pattern of the findings failed to demonstrate the support of the visual aesthetics in system acceptance and use. Therefore, in Saudi tertiary education, the aesthetics aspects of the system stimuli such as colours, images, shapes, font style, and graphical information as well as screen design consistency across pages, appeared to be less attention-grabbing and are not congruent with the student's beliefs of usefulness or ease of use as well as their willingness to use the system.

SYSTEM LEARNABILITY (SL)

In the proposed model, it was hypothesized that the system learnability construct would have a significant positive influence on performance expectancy (**H15**), effort expectancy (**H16**), and the students' behavioural intention to use the system (**H17**). Regarding SL -> PE, it was thought that PE would be directly influenced by the SL of the LMS. However, the observed p value of the relationship between SL and PE in this study was not significant, ($\beta = 0.056$, $P > 0.05$) and thus, **H15** was rejected. This result concurs with the result published by Binyamin et al. (2019) in which the system's ease of learning, in time or effort, does not play a significant role in the students' decisions of the LMS usefulness in Saudi higher education. In contrast to earlier findings (Aziz & Kamaludin, 2014; Gul, 2017; Scholtz et al., 2016), evidence of a positive and significant relationship between SL and system usefulness was detected. It is worth mentioning that the above studies were conducted in different contexts with different systems, e.g., an ERP system.

The results of the model testing in Table 6 supported the positive and significant relationship between SL -> EE ($\beta = 0.673$, $P < 0.05$), indicating an acceptance for **H16**. The findings demonstrated that SL showed the strongest effect on the conceptual model. The construct also had the highest predictor on the students' perception of the LMS ease of use in Saudi tertiary education. This result is aligned with the result found by Binyamin et al. (2019), and Scholtz et al. (2016). The rationale behind the significant association between SL and EE could be that the effort expectancy of the system can be explained by learnability. In this respect, the system designers have a significant role in making the LMS easy to learn: the clarity of wording, the familiarity and predictability of commands and buttons, the availability of on-line help manuals, the site maps availability with a reasonable hierarchy. Incorporating these into an LMS design not only facilitates the students' learning but also maximises the speed of the learning process.

The last hypothesized relationship between SL and BI was not supported ($\beta = 0.009$, $P > 0.05$), leaving **H17** unproven. The result is consistent with a previous study in which lack of ease of learning did not correlate with usage behaviour (Mendoza et al., 2010). Therefore, it can be concluded that the study findings reject the direct influence of SL on students' intention to use LMS in Saudi higher Arabia.

INFORMATION QUALITY (IQ):

In this study, it was hypothesized that IQ has a direct positive influence on students' PE and EE and BI of the LMS use, representing **H18**, **H19** and **H20** respectively. The results revealed that IQ has a significant influence on performance expectancy ($\beta = 0.309$, $p < 0.05$), indicating a support for **H18**. Across the significant factors, IQ->PE exhibited one of the strongest effects in the proposed framework. Comparison of the findings with those of other studies confirms that the path IQ->PE has been demonstrated in an e-learning context (Alkandari, 2015; Ameen et al., 2019; Binyamin et al., 2019; Cheng, 2012; Lee et al., 2014; Mohammadi, 2015; Shah et al., 2013), and IQ was found to be an important predictor of the system usefulness in an e-commerce context (Green & Pearson, 2011). Thus, the quality of information provided by the e-learning system, being understandable, useful, clear, relevant, sufficient, and up-to-date, is a significant determinant of whether the students perceive the system to be useful. A plausible explanation for this is that students seem to enjoy multiple learning resources and materials in different forms such as books, lecture slides, online quizzes, and discussion, that enhance their education. These resources appeared to be useful, sufficient, and appropriate for the student learning in which they can access materials anytime and from everywhere.

The results of the structural model assessment unexpectedly disclosed the lack of a direct positive influence of information quality on effort expectancy ($\beta = 0.003$, $p > 0.05$), leaving **H19** unconfirmed. This outcome is contrary to those of Shah et al. (2013), Lee et al. (2014), Alkandari (2015), and Binyamin et al. (2019) who found that the quality of e-learning information directly affected students' perceived ease of use. This rather contradictory result may be because that students consider the e-learning system to be more convenient and less complex nowadays, especially with recent technological advances and the greater sophistication of information technology products.

The SEM results showed no statistical influence between IQ and BI ($\beta = -0.029$, $P > 0.05$), leaving **H20** unproven. The insignificant findings between the IQ and the student's intention to use the e-learning system are in accordance with those studies of Al-Aulamie (2013), Ameen et al. (2019), and Terzis & Economides (2011). That said, the correlation between IQ and intention and use behaviour is lacking, so more research is needed to investigate the association between information quality and behavioural intention in an e-learning system context (Terzis & Economides, 2011).

Instructional Assessment (IA)

In the current study, it was thought that IA would have a significant positive influence on performance expectancy **H21**, effort expectancy **H22**, and the behavioural intention **H23** to use the LMS. The parameter estimates for these hypothesized relationships are ($\beta = 0.068$, $P > 0.05$), ($\beta = 0.129$, $P < 0.05$), and ($\beta = -0.034$, $P > 0.05$), respectively. These results indicate that hypotheses **H21** and **H23** were rejected, whereas only hypothesis **H22** with this construct was supported.

The current study found that the LMS assessment tools seem to influence only the ease of use, whereas no influence was found regarding usefulness and the willingness to use. So once students are provided with effective assessment tools, they are more likely to perceive the LMS as being easy to use. In Saudi higher education, supporting the IA->EE path accords with that of Binyamin et al. (2019) whereas the IA->PE relationship contradicts the finding of Binyamin et al. (2019). However, the literature seems to be limited in investigating such associations. The most likely explanation for this surprising result is the students may differ in the awareness and utilization of the assessment tools. There might be a lack of maturity among students regarding the use of the diversity of assessment features that are offered by the LMS (e.g., test, quizzes, and surveys feedback facilities). So, students might be not aware of the complete assessment and feedback functionalities in the LMS. In Saudi universities, the system tends to be used mainly for assignment submission. The other e-learning system features such as test, quizzes, surveys, and given feedback are practically unused in the students' learning process, which also might be a plausible explanation for this discrepancy. This finding is unexpected and suggests that the matter should be explored further in future research.

E-learning System Interactivity (ESI)

The theoretical model hypothesized that perceived LMS interactivity would have a significant positive effect on performance expectancy (**H24**), effort expectancy (**H25**), and student's behavioural intention (**H26**) to use the LMS.

The hypotheses testing results showed that ESI->PE ($\beta = 0.228$, $P < 0.05$) path was significant, hence **H24** was supported. In accordance with the present results, previous studies have demonstrated that system interactivity has a significant positive influence on the students' performance expectancy (Alkandari, 2015; Alrawashdeh et al., 2012; Baleghi-Zadeh et al., 2017; Binyamin et al., 2019; Cheng, 2012; Moreno et al., 2017; Pituch & Lee, 2006). The interactivity feature had the most significant direct effect in the e-learning context (Pituch & Lee, 2006). Thus, the higher the student's perception of system interactivity is, the stronger they believe the LMS to be useful as a means to assist them to achieve their educational objectives. This can be interpreted to mean that the students have experienced using a wide spectrum of features in the LMS (email, discussion board, chat room) that increase their performance.

Among all antecedents examined in this study, ESI exhibited a small negative direct impact on EE ($\beta = -0.092$, $P < 0.05$) and thus, **H25** is rejected. This study supports evidence from previous observations, e.g., Pituch and Lee (2006), Abbad et al. (2009), Baleghi-Zadeh et al. (2017), and Uğur and Turan (2018). Nonetheless, other scholars, e.g., Binyamin et al. (2019) and Cheng (2012), demonstrated a positive significant relationship between system interactivity and perceived ease of use. Thus, and contrary to expectation, Saudi students tend to not perceive that the LMS communication tools' effectiveness has an impact on their effort to use the system. This may be caused in part by a lack of training and support. In our study, nearly 50% of the students have not received any training in the use of an e-learning system. This concurs with the research conducted by Alenezi (2018) that inadequate training was among the main challenges of LMSs adoption in Saudi Arabian universities.

As expected, the significant and positive influence of the system interactivity on the student's behavioural intention ($\beta = 0.112$, $P < 0.05$) **H26** was supported. Even the previous literature is limited on interactivity (J. Sun & Hsu, 2013) , few have demonstrated such an effect, e.g., Uğur & Turan (2018) and more significant direct impact, e.g., Wrycza and Kuciapski (2018) while others revealed indirect influence in an e-learning context, e.g., Alrawashdeh et al. (2012). Some also found no influence, e.g., Abbad et al. (2009). This result indicated that students' willingness to use the LMS is affected by their perception of the interaction between students and the interaction between lecturers and students as well as the effectiveness of the system's communication tools. A possible explanation for this is that previous and current research has demonstrated that the social influence construct appeared to be important in the students' use of the e-learning system (Alshehri et al., 2019a). Hence the social communication between the learners themselves and also between learners and their teachers tended to be more effective and more engaging, contributing to efficiency in learning. Thus, system designers should ensure that a system's components are highly interactive and intuitive to use, so students are involved and willing to learn. Instructors should also motivate the collaboration between students and facilitate better communication with the help of activity streams.

CONCLUSION

The use of an LMS has become important in education to provide recipients with information content and instruction resources. In fact, the incorporation of technology in the learning and teaching environment is no longer an option, but a necessity. However, assessment of learner's perceptions and adoption of LMSs are becoming an essential element in improving educational inputs and outcomes. This research has attempted to amalgamate the unified acceptance model, UTAUT, with six usability factors to investigate empirically the influence on students' intentions and usage behaviour for an LMS in Saudi tertiary education. The UTAUT model was extended with six usability features (navigation, visual design, learnability, information quality, instructional assessment, and interactivity) to formulate a new theoretical framework of LMS acceptance. Using the PLS-SEM technique, the results confirmed that the UTAUT parameters are valid and robust in the context of LMS in Saudi Arabia. In particular, the empirical results concluded that social influence is fundamental in determining the students' acceptance as well as the usage behaviour of LMS in Saudi Arabia. While the findings of this research show that effort expectancy was influenced directly by system navigation, system learnability, and instructional assessment, the performance expectancy was affected by information quality and system interactivity. The usability feature of interactivity was also shown to influence students' willingness to use the system.

These findings provide a new theoretical basis with empirical support to further understand the individuals' intention and usage behaviour. Based on this interpretation, developers and practitioners can determine how to improve the learners' intention and usage of LMS to their full potential. The refinement strategies must not only focus on UTAUT inputs but also consider the important usability design characteristics in technology adoption and usage behaviour. The validated research model can not only be applied to examine the student's acceptance of LMS but can also serve as a diagnostic measure for further enhancements and improvements to the system. This is an important finding for future research in which usability testing or expert evaluation can be conducted to further improve the existing design of LMS and maximize its effective utilization. This is expected to add valuable insights to inform the decision-making processes at the university higher management and administrative level.

Before drawing definitive conclusions from these results, it is important to consider the study's limitations. To begin with, this cross-sectional study analysed data at a specific point of time. Several lines of evidence suggest that longitudinal research is recommended in which the same students are observed over the study period (Roca et al., 2006; Venkatesh et al., 2003). Secondly, since the study was limited to five regions of Saudi universities, it was not feasible to include another educational institution within the allocated region, considering the study time and resource constraints. In fact, there are 30 public universities distributed throughout the Saudi area where various cultures, nationalities, and backgrounds might be significant. Thus, the validity and reliability of the developed model might improve if different universities were surveyed, especially those more recently founded. Apart from the intra-cultural context limitations, the scope of this study was limited to higher education in Saudi Arabia, so the generalisation at a cross-cultural level is undetermined. Thus, it is desirable to include geographically distributed universities around the Gulf region which might improve the generalizability of our research outcomes.

There are three suggested directions for further studies. Firstly, 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. Finally, since the study focused on the students' perspective, a natural progression of this work is to involve other e-learning stakeholders (teachers and administrators). This could enrich the research by providing a better understanding of undisclosed issues, offering different views about the implementation and use of an e-learning system in Saudi Arabia.

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APPENDIX: QUESTIONNAIRE (ENGLISH)

Part 1: Demographic Details:

1. Gender : □ Male □ Female
2. Age: [ ] Years
3. University: □ King Khalid University □ Saudi Electronic University
   □ Al Jouf University □ King Abdelaziz University
   □ Imam Abdulrahman Bin Faisal University
4. Education level: □ Undergraduate □ Graduate
5. Blackboard Experience: □ Less than a Year □ 1-2 years □ More than 2 years
6. Blackboard Usage Frequency: □ Daily □ Weekly □ Monthly □ Almost never
7. Blackboard Taught Courses: □ 1-3 courses □ 4-5 Courses □ More than 6 Courses
   □ I do not use Blackboard in any course.
8. Blackboard Training: □ None □ 1-3 hours □ 4-6 hours □ More than 6 hours

Part 2: Perceptions of UTAUT variables towards Blackboard:

Performance Expectancy (PE)

1. I find Blackboard useful in my courses.
2. Using Blackboard enables me to accomplish tasks more quickly.
3. Using Blackboard increases my academic productivity.
4. If I use Blackboard, I will increase my chances of getting high grades.

Effort Expectancy (EE)

5. I find Blackboard clear and understandable.
6. It would be easy for me to become skilful at using Blackboard.
7. Learning to operate Blackboard is easy for me.
8. Overall, I find Blackboard easy to use.

Social Influence (SI)

9. People who influence my behaviour think that I should use Blackboard.
10. My classmates and friends think that I should use Blackboard.
11. My instructors encourage the use of Blackboard.
12. In general, the university encourages students to use of Blackboard.

Facilitating conditions (FC)

13. I have the resources necessary to use Blackboard.
14. I have the knowledge necessary to use Blackboard.
15. The e-learning support staff are available when I face any problem with Blackboard.
16. Training and manuals for Blackboard is available.
17. The management would provide the necessary help for using Blackboard.

Behavioural Intention (BI)

18. I intend to continue using Blackboard in the future.
19. I would prefer my instructors use Blackboard more frequently.
20. I would like to use Blackboard in all future courses.
21. I would recommend using Blackboard to others.

Actual Use (AU)

22. I have used Blackboard this semester.
23. I have been using Blackboard regularly in the past.
24. I have used Blackboard frequently in my studies.
25. I usually use Blackboard for my learning activities.

Part 3: Perceptions of Usability variables towards Blackboard:

System Navigation (SN)

26. The navigational structure of Blackboard is easy for me.
27. Hyperlinks in Blackboard are working satisfactorily.
28. Navigation options are visible in each page.
29. Learners always know where they are in the course.
30. I can leave Blackboard at any time and easily return.

System Learnability (SL)

31. Learning how to perform tasks using Blackboard is easy.
32. I can predict the general result of clicking on each button or link.
33. The Blackboard system provides clarity of wording for easy learning.
34. I can learn how to use Blackboard without a long introduction.
35. There is sufficient on-line help to support the learning process.

Visual Design (VD)

36. Texts, fonts and colours are easy to read.
37. The most important information on the screen is placed in the areas most likely to attract attention.
38. Blackboard layout follows a good structure.
39. Terminology, symbols, and icons are used consistently throughout Blackboard.
40. Blackboard operates consistently throughout my courses.
41. Blackboard visual design is attractive and appealing to the learner's senses.

Information Quality (IQ)

42. Blackboard provides easy to understand information for my study.
43. Blackboard provides complete information for my study.
44. Blackboard provides sufficient information for my study.
45. Blackboard provides accurate, free form error information for my study.
46. Blackboard provides up-to-date information for my study.

Instructional Assessment (IA)

47. Blackboard contains self-assessment tools (i.e. exams, quizzes, case studies… etc.) that advance my achievement.
48. It is easy for me to use the self-assessment tools in Blackboard.
49. Assessment features in Blackboard are effective to help understanding the material.
50. The self-assessment tools in Blackboard measure my achievements of learning objectives.
51. Blackboard provides learners with opportunities to access extended feedback from instructors, experts, peers, or others.
52. Blackboard provides informative feedback to online assessments.

E-learning System Interactivity (ESI)

53. The communicational tools in Blackboard (email, discussion board, chat room, etc.) are effective.
54. Blackboard enables interactive communication between instructor and student.
55. Blackboard enables interactive communication among students.
56. Blackboard makes my learning process more engaging.

BIOGRAPHIES

Ahmed Alshehri is a lecturer within the School of Computer Science and Information Technology at Albaha University, Saudi Arabia. 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.