Title: Enhanced technology acceptance model to explain and predict learners' behavioural intentions in learning management systems

Name: Abdullah Al-Aulamie

Enhanced Technology Acceptance Model to Explain and Predict Learners' Behavioural Intentions in Learning Management Systems

ABDULLAH AL-AULAMIE

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Enhanced Technology Acceptance Model to Explain and Predict Learners' Behavioural Intentions in Learning Management Systems

by

ABDULLAH AL-AULAMIE

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ABSTARCT

E-learning has become the new paradigm for modern teaching moreover, the technology allows to break the resurrection of time and place by enabling people to learn whenever and wherever they want. In information system research, learners' acceptance of e-learning can be predicted and explained using technology acceptance models. This research developed enhanced technology acceptance model to explain students' acceptance of learning management systems (LMSs) in Saudi Arabia. The research model aims to investigate the viability of TAM constructs in a non-western country. Moreover, due to the cultural impact of the Saudi Arabian culture towards genders, the research addresses the moderating effect of gender towards LMSs acceptance.

The developed model variables identification focuses on two motivation aspects, extrinsic and intrinsic. The developed model consisted of ten variables in total, which can be categorised into three groups. First, the extrinsic variables consisting of information quality, functionality, accessibility, and user interface design. Second, the intrinsic variables are consisting of computer playfulness, enjoyment, and learning goal orientation. Third, the TAM variables consisting of perceived usefulness, perceived ease of use and behavioural intention. Moreover, to validate and examine the developed model, a questionnaire tool was developed for data collection. Furthermore, the data was collected from electronically from three universities over six weeks. The research findings supported the developed model. Additionally, the identified variables were good critical in predicting and explaining students' acceptance of LMSs.

The research applied structural equation modelling for statistical analysis using IBM AMOS. The research results confirmed the applicability of the developed model to explain the Saudi students' acceptance of LMSs. The developed model explained high variance among the dependent variables outperforming the excising models. The research improved the explanatory power of the TAM model through the identified variables. Furthermore, the research results showed that the extrinsic variables were stronger predictors of students' perceived usefulness, perceived ease of use and behavioural intention. In addition, the results showed that males and females perception towards the LMS was significantly different. The male students' acceptance towards LMSs was higher than females. Moreover, enjoyment was the stronger determinant of females' behavioural intention.

Dedication

To my parents, my wife and to my lovely daughter (Danah) for their love, support and encouragement.

Acknowledgement

My sincere apperception goes to my director of studies Dr Ali Mansour who have supported, guided and encouraged me throughout all this time. I would like also to thank my former supervisory team members, Dr Osei Adjei and Dr Herbert Daly.

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List of Publications

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DECLARATION

I declare that this thesis is my own unaided work. It is being submitted for the degree of degree of Doctor of Philosophy at the University of Bedfordshire.

It has not been submitted before for any degree or examination in any other University.

Name of candidate: ABDULLAH AL AULAMIE Signature:

Date:7-05-2014

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Chapter One: Introduction

This chapter will present the research background of e-learning systems and the Technology Acceptance Model (TAM) developed by Davis, 1989 as both aspects form the basis of this research. The research background, will introduce the concept and benefits of e-learning systems, describe the purpose of TAM. Furthermore, the chapter will explain the research motivation, the research problem, then aims and objectives. Finally, the chapter will describe the research methodology, the scope and limitations, and detailed description of the thesis structure.

1.1 Background

E-learning has become the new paradigm for modern teaching and it can be defined as "a web-based system that makes information or knowledge available to users or learners and disregards time restrictions or geographic proximity" (Sun et al., 2008). The use of technology in learning emerged from the development and advancement in the information and communication technologies (Hsia, 2007). Today, many educational institutions, business organisations and are interested in e-learning, it is considered to be the fastest growing segment in today's global educational market with a worth value of $2.3T USD and is expected to grow to $69B USD by 2015 (Hezel Associates, 2005 cited in Wagner et al., 2008).

E-learning breaks the resurrection of time and place by enabling people to learn whenever and wherever they want. Moreover, e-learning can be divided into two main types: asynchronous and synchronous. In the asynchronous type, the e-learning system works as a supporting tool where students can use emails, discussion boards, online quizzes and assignments to help them study and to communicate with their instructor (e.g. Learning Management Systems, Blackboard, Moodle). The synchronous type is always used in distance learning where the class is given by the instructor live and online via the use of media such as live chat and videoconferencing enabling learners and teachers to communicate in real time (Hrastinski, 2008).

Today, educational institutions are shifting their learning paradigm from teacher-centred to learner-centred learning by offering new innovative online courses. These courses allow universities to expand their educational territories beyond time, space, and to enhance their traditional learning courses (Lee et al., 2009). The use of technology in learning will enhance the learning experience, and benefit by (Bouhnik and Marcus 2006):

- Allowing anytime and anyplace concepts; students will have access to the system in their own convenient time and place.

- Allowing group collaboration; students are able to communicate with each other and with their instructors using forums, chat rooms and video conferencing.

Moreover, in the information Systems (IS) domain learners' acceptance of e-learning can be predicted and explained to provide a better understanding of their motivation to use the system. The technology acceptance model (TAM) is of the main models used to investigate individuals' acceptance (i.e. intention to use) information technology (IT). The area of technology acceptance is constantly developing due to the rapid advancement in IT. Usage and acceptance are the two major disciplines contributed to the development of models and theories dealing with technology acceptance. The focus of the technology acceptance models differ from one field to another. For example, psychology and sociology studies focus on the acceptance behaviour of the individual. While information systems studies focus on the technology characteristics in relation to the individual acceptance.

The Technology Acceptance Model (TAM) developed by Davis (1989), is an intention-based model originated from the Theory of Reasoned Action (TRA) to explain and predcit users' acceptance of information technology. Moreover, TAM has been used in many empirical studies as theoretical base for users' technology acceptance (Ong et al., 2004; Sun and Zhang 2006). The theoretical model of TAM has helped in explaining and predicting user behaviour towards information technology (Park, 2009). TAM has a significant body of research and has wide acceptance in the IS domain and is proven to be an accurate predictor of users' intention and system actual usage (Tang and Chen, 2011).

1.2 Research Motivation

E-learning systems have become an essential tool to deliver learning courses via the Internet, for their ability to reach learners anywhere and anytime thus, opening new possibilities for learning. Educational institutions in the developing countries such as Saudi Arabia have started investing heavily in e-learning such as web-based learning systems like WebCT, Blackboard, and Moodle. These types of software enable the online collaboration and delivery of the training and educational courses. The Saudi Ministry of Higher Education new direction is to apply e-learning in the educational process, by integrating and supporting the use of Information and Communication Technologies in various universities (Alenezi et al., 2010).

The e-learning industry in Saudi Arabia is massive, the government investment is estimated to reach $125 million in 2008 and for the next five years it is expected to grow at a rate of 33% (The Saudi Gazette, 2008). The Saudi government has launched a national plan for the utilisation of IT in learning (Al-harbi, 2010). However, many educational institutions have failed in implementing

e-learning systems due to many reasons with one of the major reasons being the low adoption and usage from users of the e-learning systems (Tseng and Hsia 2008). According to Al-Jarf (2007) and Alenezi et al., (2010) the Saudi students' participation and willingness to use LMSs is low. However, little research has been done to investigate learners' acceptance of e-learning systems to point out the motivational variables for such systems (Park, 2009). Additionally, even though there is high investment of e-learning in Saudi Arabia, very few studies investigated students' acceptance of e-learning systems in higher education. With the increasing use of IT and the rapid reliance on e-learning systems, identifying motivational variables for e-learning acceptance is critical because these variables can initiate or increase the acceptance rate of e-learning systems (Yi and Hwang, 2003; Park, 2009). Therefore, the purpose of this research is to investigate students' acceptance of LMSs in Saudi Arabia by adapting the Technology Acceptance Model (TAM).

In Information Systems research, the Technology Acceptance Model (TAM) developed by Davis (1989) has been used to investigate users' acceptance of IT. The original model of TAM is able to predict users' acceptance of an IT by measuring their behavioural intention. User's behavioural intention is defined as *"a measure of the strength of one's intention to perform a specified behavior" (Davis et al., 1989).* Venkatesh and Bala (2008) pointed out that TAM is consistently able to explain about 40% of the variance in users' behavioural intentions in business organisations. However, TAM failed to reach 40% of the variance in students' behavioural intentions in educational environments (Jung et al., 2009; Tselios et al., 2011; Wong et al., 2013). This is due to e-learning being a relatively new topic where the existing TAM constructs alone (i.e. perceived usefulness and perceived ease of use) cannot fully explain a student's motivation to use an e-learning system (Hsia, 2007). The explained variance is defined as *"variance in the independent variable that can be accounted for by (statically associated with) variance in the independent variable(s)"* (Vogt and Johnson, 2011). Thus, based on the above, further development of TAM is required to improve the model's explanatory and predictive power in the e-learning environment.

In addition, even though some studies modified TAM in the e-learning context to investigate students' acceptance, most of these studies were either in the Far East, North America or Europe. Therefore, the applicability of these studies findings towards the Saudi students is questionable because according to Ticehurst and Veal (2000) and Saadė et al., (2008) culture can influence the research outcomes. Therefore, generalising research findings of one culture to another is questionable due to the culture differences between users. However, these research findings can

serve as an indication that needs to be examined and confirmed on the new users' group. This further encourages us to further investigate students' acceptance of LMSs in Saudi Arabia, as this will help to have better understanding of the potential variables that can affect the Saudi student's acceptance.

1.3 Research Problem

The research problem can be summarised from the motivation section as follow, recent literature showed that students' use of LMSs is low in Saudi Arabian universities (Al-Jarf, 2007; Alenezi et al., 2010). Moreover, the existing Technology Acceptance Model (TAM) failed to account for students' acceptance towards e-learning. Thus, this research will investigate the Saudi students' acceptance of LMSs by developing an enhanced technology acceptance model. Additionally, the developed model will identify external variables that believed will positively influence students' acceptance of LMSs. Finally, in Information Systems, a user's acceptance can be estimated by measuring their behavioural intention towards IT where behavioural intention can be defined as *"a measure of the strength of one's intention to perform a specified behavior"* (Davis et al., 1989).

1.4 Research Aims and Objectives

This research aims to develop an enhanced technology acceptance model that has the power to explain students' acceptance of LMSs in Saudi Arabian universities. From a theoretical perspective, the research will contribute to the current knowledge in technology acceptance by proposing an extension of the Technology Acceptance Model (TAM) to predict students' acceptance of LMSs. From a practical perspective, the research will enable practitioners to point out the potential variables that will help improve e-learning acceptance by focusing on the variables with the higher impact towards students' behavioural intentions. The research aim led to the development of five objectives as follow:

1. To review literature with regards to the development of the Technology Acceptance Model in Information Systems and e-learning: As part of this objective, a full review of the development of TAM in presented while reflecting on the models that were adapted by TAM, and outlining the advantages and disadvantages of each model. Moreover, a critical review the previous literature that used TAM to measure students' acceptance of e-learning systems is included as well.

2. To formulate a model of technology acceptance to explain students' acceptance of LMSs efficiently in Saudi Arabia: This research will propose an enhanced technology acceptance model that is able to measure students' acceptance of LMSs, and to improve the explained variance among all of TAM constructs i.e. perceived usefulness, perceived ease of use, and behavioural intention.

3. To investigate to what extent the intrinsic and extrinsic motivation variables can impact students' acceptance of LMSs: The research identified seven motivational variables that focuses on the system and personal characteristics. These variables are integrated in the proposed model moreover; the relationships between the model variables were governed by the research hypotheses.

4. To investigate the moderating effects of gender towards students' acceptance of LMSs: Due the impact of culture towards gender in Saudi Arabia, the research will investigate whether males and females have different perception towards e-learning that will influence the research model.

5. To validate the research model statistically, the research model will be examined for validity and reliability using confirmatory factor analysis and multiple regression analysis via structural equation modelling.

1.5 Research Methodology

The research methodology the research will follow to achieve its aim and objectives can be divided into five steps:

1. Literature review: The literature will review and summarise the previous work. Moreover, the review will involve a critical analysis of the existing technology acceptance models to bring forward the limitations and research problems.
2. Problem definition: The research will clearly define the research problem and how the research is planning to address this problem.
3. Model and Hypotheses development: The research will develop a new technology acceptance model to examine students' acceptance of e-learning systems. The research will explain the method and considerations for identifying the external variables for the research model. Moreover, research hypotheses will be proposed for each variable as they will govern the relationships among the external variables.

4. Data collection: Data will be collected to examine the research model; a data collection tool will be developed and examined for reliability.
5. Model testing and evaluation: The collected data will be used to examine the developed model.

1.6 Research Scope and Limitations

First, the focus of this research is to examine the Saudi students' acceptance of LMSs by measuring their behavioural intentions. The research will develop an enhanced technology acceptance model by adapting Davis's model. Davis et al., (1989) has theorised that there are two main beliefs that determinant users' acceptance of IT, perceived usefulness and perceived ease of use. Moreover, Davis et al., (1989) removed all of the psychological variables from TAM, such as attitude and subjective norms, because of their insignificance towards IT acceptance. Both of these two variables were part of the psychological model the Theory of Reasoned Action (TRA) in which Davis has adapted to develop TAM. Furthermore, Venkatesh and Davis (2000) and Venkatesh and Bala (2008) have confirmed the irrelevance of the psychological dimensions towards the TAM model in the information system field. As a result, the research did not account for psychological differences in the developed model.

Second, the research will focus on investigating the gender differences between students for the following reasons: First, recently in the technology acceptance research gender have become an important issue for researchers to understand users' acceptance of IT (Teo, 2010; Terzis and Economides, 2011; Padilla-Melėndez et al., 2013). Venkatesh and Bala (2008) pointed out that in the technology acceptance research gender can influence users' acceptance of information systems. Therefore, gender should be examined to clarify if differences do exist between genders in the environment being investigated. Secondly, Saudi Arabia is a conservative country. The segregation aspect between males and females in their daily life is common; it extends to cover schools, colleges, and universities. Usually, universities separate the two genders in terms of classes, colleges and facilitates; sometimes even subjects and majors can be available based on gender. Consequently, due to the importance of gender differences in the technology acceptance research and the Saudi culture's impact on students' life and learning style, this research will examine the moderating effect of gender on the developed model.

Third, a student's subject area will not be considered in this research for the following reasons. First, considering a subject as moderating variable will require different research design. For example, this research will use a voluntarily self-selection approach for data collection, where the collection process has no control over the participants or responses belonging to a particular

subject. As a result, carrying a multiple group analysis is not possible; because, there is no guarantee enough data will be collected from each subject. Therefore, researchers accounting for subject as a moderating variable should consider appropriate research design to ensure enough data is collected for each subject. Moreover, the selected research design should alien with the educational institutions regulations. Second, LMSs were designed as a shell to work with different type of subjects by offering customisation features to students and teachers. In addition, the research collected data showed that there is less chance for students' perception to be affected by subject differences. The most frequently used scale (i.e. median) between students to measure the developed model variables was the 4th scale "Agree" (see Appendix A). This indicates that students' perception towards the identified variables was similar regardless of their subject differences.

Fourth, the research target is undergraduate students within the universities of Saudi Arabia. This group is chosen because the majority population of the Saudi universities consist of undergraduate students. The number of the postgraduate students will make it difficult to carry statistical analysis on this segment. Therefore, the data collection will be targeted towards the undergraduate students for both genders, and will exclude postgraduate students. Finally, this research will focus on the blended learning approach because it is the main common approach used in the Saudi Arabia universities. Blended learning is a combination of face-to-face and online instructions. Graham (2006) defines it as *"the combination of instruction from two historically separate models of teaching and learning: traditional face-to-face learning systems and distributed learning systems"*. In Saudi Arabia universities, LMSs and face-to-face learning are used together as blended learning to deliver knowledge. Therefore, the research findings will be applicable to e-learning systems used in blended learning environment.

1.7 Thesis Structure

The thesis is divided into seven chapters as follow:

Chapter two investigates the historical development of the technology acceptance models by reviewing three main models: Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), and Technology Acceptance Model (TAM). The models are discussed in terms of their domain, strength and weakness. More emphasis is on TAM since it is the main model used in this research.

Chapter three consists of two parts. The first part is a literature review of the technology acceptance model (TAM) in the e-learning domain. The second part will present the developed

model, and the research hypotheses that will be used to establish the relationships between the model variables.

Chapter four addresses the research methodology which discusses the data collection instrument design and development. Also, it describes the sample description, sampling approach and ethical considerations. Finally, the chapter discusses the statistical tool and data analysis approach used to analyse the collected data.

Chapter five is devoted for the data analysis. The data analysis chapter can be divided into three sections. The first section examines the collected data for validity. The second section examines the model variables for validity and reliability using the confirmatory factor analysis. The third section examines the developed model and research hypotheses using the multiple regression analysis.

Chapter six is dedicated to discuss and evaluate the research findings. The first section discusses the developed model results based on the research hypotheses. The second section discusses and evaluates the developed model performance in term of the explained variance against the existing models in literature. The third section discusses the gender differences in their effect on the developed model.

Chapter seven addresses the research contribution, objectives achieved, research implications, limitations and future work.

Chapter Two: Theories of Technology Acceptance Models

This chapter will review the historical development of the technology acceptance models used in predicting and understanding people acceptance behaviour. Three main models will be investigated: the Theory of Reasoned Action, the Theory of Planned Behaviour, and Technology Acceptance Model. These technology acceptance models have been developed and evolved through rigorous validations and extensions over the years. The reason for covering the technology acceptance development even though the main focus of this research is the Technology Acceptance Model (TAM) is because of their interconnection, and to give a clear idea about the development of TAM.

2.1 Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (Ajzen and Fishbein, 1980) considers being one of the earliest models developed to explain technology acceptance in the field of Psychology. The theory was developed to predict and explain the individuals' volitional behaviour and to understand their psychological determinants. The theory assumes that individuals are rational in nature and they will act based on the information available with individuals' behavioural intentions being the main determinant for their actions (Ajzen and Fishbein, 1980). The theory considers intentions as the main predictor of an individual's behaviour and any external effect towards behaviour will be through his/her intentions. Intention is defined as *"the person's motivation in the sense of his or her conscious to extract effort to carry out a behaviour"* (Eagly et al., 2001).

According to TRA (Fishbein & Ajzen, 1975 cited in Yousafzai et al., 2010), there are two determinants for people intentions; personal influence and social influence. The personal influence represents *attitude* which refers to the positive or negative evaluations of the behaviour performed by the individual (Ajzen, 1985), while the social influence is *subjective norm* which can be defined as the degree to which a person believes that people who are important to him/her think that he/she should or should not perform the behaviour in matter (Ajzen, 1985). The weight of these two determinates will differ based on the person performing the behaviour and on the intention being investigated (see Figure 2-1). According to TRA, attitude is formed throughout the person's salient beliefs about a specific behaviour. These salient beliefs will connect the person's behaviour with the performance outcome.

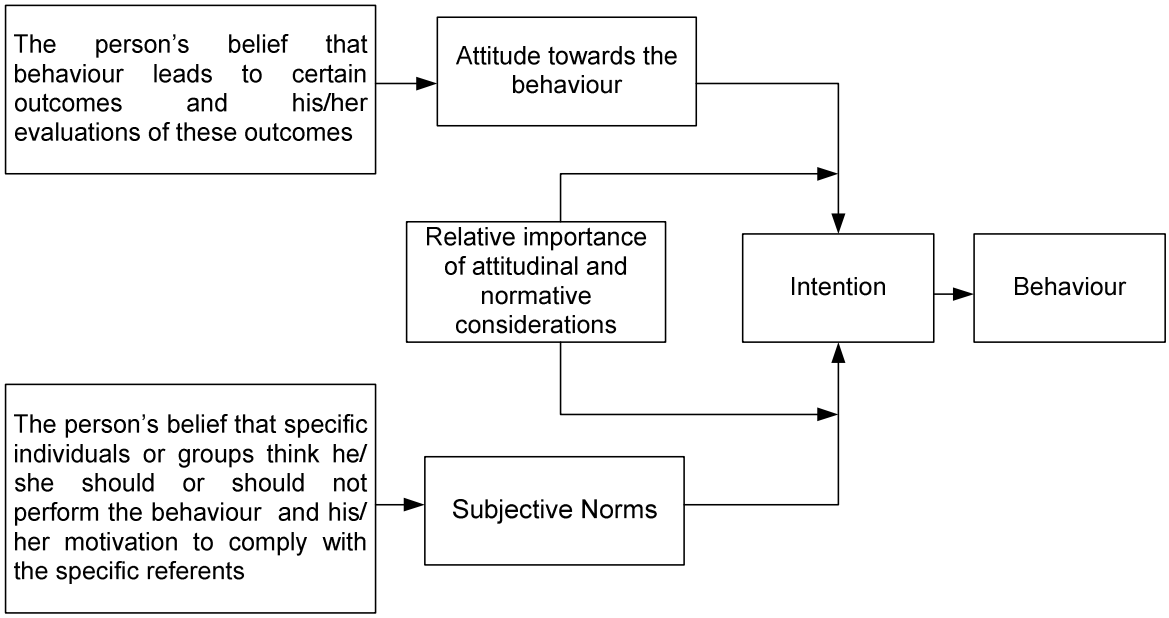


Figure 2-1: Theory of reasoned action (Ajzen and Fishbein, 1980)

Moreover, the individual evaluation of the outcome, will determine the effect of attitude towards behaviour. Therefore, an individual's attitude can be estimated by the salient beliefs and the evaluation of the situation outcome. Moreover, subjective norm is a function of belief where a person will perceive the social pressure from his/her group to perform the behaviour in question.

2.1.1 Limitations of the Theory of Reasoned Action

There are two main limitations of TRA: First, the theory suffers from what is called factors correspondence (Ajzen, 1985). Which means to predict an individual's behaviour, attitude and intention must be linked in action, context and time (Sheppard et al., 1988; Wright, 1998). Secondly, the theory only applies to behaviour that is volitional, a behaviour that is already been thought out in the person's conscious beforehand (Yousafzai et al., 2010). Therefore any behaviour involves irrational decisions, complex skills or social support cannot be explained by the TRA (Wright, 1998).

2.2 Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour is an extension of the Theory of Reasoned Action, developed by Ajzen (1985) to address the original model's limitations. The TPB introduced perceived behavioural control which will account for individuals' behaviour under non-volitional control. Perceived behavioural control defined as *"the amount of control individuals believe they have over performing a behavior"* (Hamilton and White, 2008).

In Figure 2-2 the broken line shows that in some cases perceived behavioural control has stronger impact towards behaviour (Ajzen, 1991). Nonetheless, both of intention and perceived behavioural control are important in predicting individuals' behaviour. According to the TPB, for a person to carry out a successful behaviour will depends on how much effort the person is willing to invest in the level of control e.g. knowledge, information and skills (Gist and Mitchell, 1992; Carr and Sequeira, 2007).

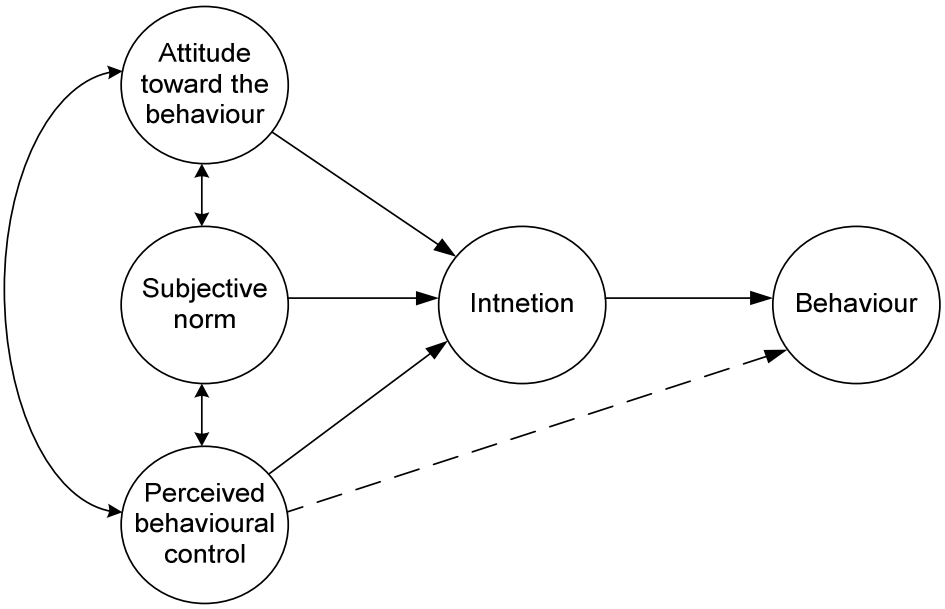


Figure 2-2: Theory of planned behaviour (Aizen, 1991)

2.2.1 Limitations of the Theory of Planned Behaviour

The TPB received many criticisms throughout the years even though it was developed to address the theory of reasoned action's volitional control limitation. First, both theories TRA and TPB, assume that individuals must be motivated to perform behaviour. This assumption may cause a problem for the consumer adoption behaviour because, there are external barriers that might prevent them from performing the behaviour e.g. price (Taylor and Todd, 1995). Second, Ajzen (1991) pointed out that the determinants of intention are not limited to the three suggested variables (i.e. attitude, subjective norms, perceived behavioural control). Moreover, empirical studies showed that TRA and TPB only explained 40% of the variance in individuals' behaviour. Furthermore, TPB was criticised for aggregating all the non-controllable variables affecting individuals' behaviour into one variable (Taylor and Todd, 1995).

2.3 The Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is an extension of TRA, proposed by Davis (1986, 1989) to predict the individual's adoption and use of information technology (see Figure 2-3). According to TAM, there are two beliefs that determine the individual's behavioural intention to use a technology; (1) perceived usefulness (PU) which is defined as *"the degree to which a person believes that using a particular system would enhance his or her job performance"*, and (2) perceived ease of use (PEOU) which is defined as *"the degree to which a person believes that using a particular system would be free of effort"* (Davis, 1989).

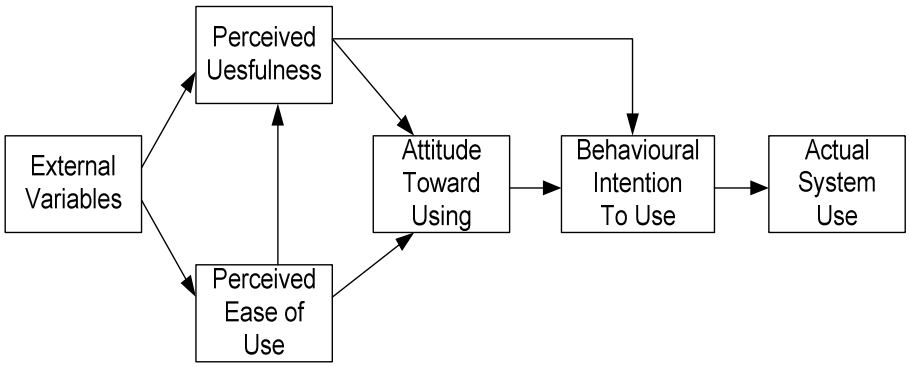


Figure 2-3: Technology Acceptance Model (TAM) (Davis et al., 1989)

The Technology Acceptance Model has been empirically validated, and supported over the last two decades (e.g., Mathieson, 1991; Taylor and Todd, 1995; Venkatesh, 2000; Moon and Kim, 2001; Hsia, 2007; Tseng and Hsia 2008; Liu et al., 2010). According to Venkatesh and Bala (2008), TAM is able to consistently explain 40% of the variance in individuals' intention. Moreover, TAM is concerned with the system characteristics that will influence individual acceptance. Figure 2-3 shows the original model of TAM however, attitude was excluded from the final model because (Davis et al., 1989):

1. The relationship between perceived usefulness and behavioural intention is more significant than the relationship between attitude and behavioural intention.
2. Attitude is not able to fully mediate the relationship between perceived ease of use and behavioural intention.

Davis and Venkatesh (1996) pointed out that the external variables, e.g. system design characteristics, computer self-efficacy, will affect the individual's behavioural intention through perceived ease of use and perceived usefulness. Overall, the development of TAM can be divided into three main phases, *adoption*, *validation* and *extension* (Han, 2003):

The adoption phase: The adoption phase dealt with the parsimonious of the Technology Acceptance Model. Davis and colleagues aimed at building a theoretical justified model that is able to predict and explain a user's behavioural intention in the IS context. During the development of TAM, the model has been applied over a variety of technologies. The results of these studies confirmed the applicability of TAM over the selected technologies in different information system contexts (see Table 2-1).

Table 2-1: Summary TAM studies in different information system contexts (Han, 2003)

Information Systems/Organisations	Example/Country	Author/s
Key office IS applications	• Spreadsheet Lotus 1-2-3 • WordPerfect • Word • Excel	(Mathieson,1991; Adams et al., 1992; Hendrickson et al., 1993; Segars and Grover, 1993; Taylor and Todd, 1995a; Taylor and Todd, 1995b; Chau, 1996; Venkatesh and Davis, 1996; Doll et al., 1998)
Communication technologies	• Email • Voice mail • Customer dial-up system • Fax	(Adams et al., 1992; Segars and Grover, 1993; Subramanian, 1994; Straub et al., 1995; Szjna, 1996; Venkatesh and Davis, 1996; Gefen and Straub, 1997)
Database systems	–	(Hendrickson et al., 1993; Szajan, 1994; Doll et al., 1998; Venkatesh et al., 2003)
Workstations	–	(Moore and Benasat, 1991; Lucas and Spitler, 1999)
Microcomputers	–	(Igbria et al., 1995; Igbaria et al., 1996; Agarwal and Prasad, 1999)
Telemedicine technology for physicians	–	(Hu et al., 1999; Chau and Hu, 2001; Chau and Hu, 2002)
Internet-related IS applications	• WWW • WWW information services • Online services • Virtual workplace systems • Digital libraries	(Venkatesh and Moriis, 2000; Agarwal and Prasad, 1998; Parthasarathy and Bhattacherjee, 1998, Venkatesh, 1999; Chau and Hu, 2001)
B2C	• Web-based bookstores • Online services firm	(Koufaris 2002; Gefen et al., 2003)
Financial institution	• America	(Straub et al, 1995)
Integrated steel company	• Canada	(Montazemi et al., 1996)
Public tertiary hospitals	• Hong Kong	(Hu et al.,1999)
Universities	• University of Michigan • Boston University • Minnesota University • Open University of Hong Kong	(Davis et al., 1989; Davis, 1989; Venkatesh and Davis, 1996; Hong et al., 2001)

The validation phase: This phase can be divided into two main parts. The *first* is to prove the psychometric characteristics of TAM's main constructs, perceived usefulness (PU) and perceived ease of use (PEOU). To measure the two constructs, Davis (1989) created a set of items for each construct. Table 2-2 shows some examples of the measures used to measure perceived usefulness and perceived ease of use (Han, 2003).

Table 2-2: Examples perceived usefulness and perceived ease of use measures (Han, 2003)

Construct	Measures
Perceived Usefulness (PU)	The system would improve individual's Job performance
	The system would increase the individual's productivity
	The system would enhance individual effectiveness on the job
	The system would enhance the individual to accomplish tasks more quickly
	The system would make it easier to do the job
Perceived Ease of Use (PEOU)	learning to operate the system would be easy for me
	I would find it easy to get the system to do what I want to do
	I would be easy for me to become skilful at using the system
	I would find the system easy to use

The number of items used in measuring perceived usefulness and perceived ease of use varies from one study to another. Most of TAM's constructs measures have been empirically tested and validated in many studies. For example, Davis et al, (1989) assessed TAM using WriteOne, a word processing program, by gathering the data from 107 MBA students at Michigan Business School. The study used four measures for each constructs (i.e. perceived usefulness and perceived ease of use), the results show high level of convergent and discriminate validity for the selected measures. Furthermore, Adam et al. (1992) focused on the psychometric properties of TAM's scales. Adam and colleagues replicated Davis's work (1989) to test the validity of PU and PEOU for different technologies in two studies. The first study used Electronic Mail and Voice Mail while the second utilised Word Processing, Spreadsheets and Graphics. Both studies confirmed the reliability and validity of PU and PEOU scales with good convergent and discriminate properties. Moreover, Chin and Todd (1995) showed that TAM's usefulness construct had an acceptable psychometric property.

The *second part* of the *Validation* phase is to validate the casual links between TAM's constructs and any external variables affecting perceived usefulness and perceived ease of use. There are four casual links between TAM's constructs:

- Perceived Usefulness → Behavioural Intention
- Perceived Ease of Use → Behavioural Intention

- Perceived Ease of Use → Perceived Usefulness
- Behavioural Intention → Actual Use

Most of these casual links have been tested and showed a consentient results with the original model of TAM, except the causal link between perceived ease of use towards behavioural intention. The relationship has been inconsistent which requires further investigation (Surbamanian, 1994; Venkatesh and Morris, 2000; Saadé et al., 2009).

The extension phase: Studies have been extending TAM over the years by adding external variables or moderating variables. Firstly, there are two well-known extensions of TAM proposed by Venkatesh and Davis (2000) and Venkatesh and Bala (2008). The first extension of TAM main focus was to identify determinants of perceived usefulness (i.e. TAM 2). Venkatesh and Davis (2000) added five variables subjective norm, image, relevance, output quality, and result demonstrability. The authors examined the extended model over four business organisations. The results showed that perceived usefulness was the strongest determinant of behavioural intention. The second extension main focus was to propose determinants of perceived ease of use (TAM 3). The proposed variables by Venkatesh and Bala (2008) were computer self-efficacy, perception of external control, computer anxiety, computer playfulness, perceived enjoyment and objective usability. Combining the determinants of the second and third model together added more richness and understanding to the extended model (Venkatesh and Bala 2008). However, the TAM model performed better than TAM 2 and TAM 3 in respect to the explained variance in behavioural intention (Tang and Chen, 2011). Moreover, the moderating variables function is to explain the model's inconsistencies by identifying the situational differences (Sun and Zhang, 2006). Venkatesh et al. (2003) examined eight models and their results revealed that six of eight models had their predictive validity increased significantly after the inclusion of moderating variables. Moreover, Chin et al. (2003) confirmed the significance effect of moderating variables on technology acceptance models. Venkatesh et al. (2003) identified four moderators (i.e. age, gender, computer experience and voluntariness) as the commonly used in the technology acceptance research.

2.3.1 The External Variables Identification

In the technology acceptance research, the main consideration for identifying external variables is to address the research unique context (Musa, 2006). This requires better understanding of the potential variables that can influences IT acceptance, such variables can be used to extend TAM model and address the unique characteristics of the research. The early extensions of TAM were carried out in business organisations therefore; the external variables were primarily addressing

this environment. For example, Venkatesh and Davis (2000) identified external variables such as image, job relevance, and output quality to extend TAM in business setting. Since the development of TAM model, many studies attempted to examine employees' acceptance of information technologies by identifying external variables that are more related to the business domain, some of these variables are, tenure in work force, role with regards to technology, task technology fit, and argument of change (Agarwal and Prasad, 1997, 1999; Jackson et al., 1997; Dishaw and Strong, 1999).

According to Venkatesh and Davis (2000) the main procedural method to identify the external variables is from literature, because literature will help to develop a theoretical rationale for the causal relationships between the model variables leading to the research hypotheses formulation. The hypotheses are needed because they will establish the relationships between the model variables. Additionally, each hypothesis will be supported from literature to determine the relationships between the model variables. The hypotheses will enable to examine the prediction path from the independent variable towards the dependent variable (i.e. regression analysis). Furthermore, Venkatesh and Davis (2000) pointed out that the relationship between the model variables must be hypothesised to measure the external variables effect towards TAM constructs (i.e. perceived usefulness, perceived ease of use, and behavioural intention).

This method of identifying the external variables has been the standard for the technology acceptance research (e.g. Davis et al., 1989; Venkatesh and Davis, 1996, 2000; Agarwal and Prasad, 1997, 1999; Igbaria et al., 1997; Jackson et al., 1997; Dishwa and Strong, 1999; Karahanna et al., 1999; Brown, 2002; Lee et al., 2003; Yi and Hwang, 2003; Hu et al., 2003; Ong et al., 2004; Wagner and Flannery, 2004; Saadė and Bahli, 2005; Lee et al., 2005; Roca et al., 2006; Pituch and Lee, 2006; Liaw et al., 2007; Ngai et al., 2007; Zhang et al., 2008; Lee, 2008; Chiu and Wang, 2008; Van Raaij and Schepers, 2008; Padilla-Melėndez et al., 2008; Roca and Gagne, 2008; Liaw, 2008; Wang and Wang, 2009; Teo, 2009; Sorebo et al., 2009; Teo et al., 2009; Liu et al., 2009' Sànchez-Franco et al., 2009; Bourgonjon et al., 2010; Sànchez-Franco and Hueros, 2010; Lee 2010, Liu et al., 2010; Lee et al., 2011; Karaali et al., 2011; Pynoo et al., 2011; Bahry et al., 2012; Padilla-Melėndez et al., 2013).

2.3.2 Limitations of the Technology Acceptance Model

First, many researchers used students to examine their technology acceptance models which limit their ability to generalise their results (Lee et al., 2003). The argument against using students as participants for business organisations studies is because students and employees have different motivations. The drivers for accepting an information technology from the point of view of

students and employees might differ. Therefore, researchers should choose users that fit their study environment (Legris et al., 2003; Lee et al., 2003; Yousafzai et al., 2003).

Second, the explanatory power of TAM model is low. The model is consistently explaining 40% of the variance in behavioural intention (Davis et al., 1989; Taylor and Todd, 1995; Venkatesh and Davis, 2000; Sun and Zhang, 2005). The model explanatory power is affected by many variables such as the participant type, study environment (Sun and Zhang, 2005). Moreover, the explanatory power of TAM can be improved by the addition of external variables.

Third, the main relationships between TAM constructs are inconsistent. For example, the relationship between perceived ease of use and behavioural intention was reported statistically significant in some studies (e.g. Davis et al., 1989; Davis and Venkatesh, 1996; Venkatesh, 2000; Venkatesh and Davis 2000, Gefen et al., 2003; Heijden, 2004). Still, some studies showed that perceived ease of use was not significant towards behavioural intention (e.g., Davis et al., 1992; Chau, 1996; Szajna, 1996; Straub et al., 1997; Chau and Hu, 2001; Park, 2009). The inconsistency of perceived ease of use can be due to three variables, system complexity, user experience, or gender (Surbamanian, 1994; Venkatesh and Morris 2000).

2.4 Summary

This chapter reviewed the development of three models, the Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB) and the Technology Acceptance Model (TAM). This research focuses on the Technology Acceptance Model developed by Davis (1989) to explain students' acceptance of e-learning systems. The chapter explained the three development stages of TAM, adoption, validation and extension. Moreover, the chapter pointed out the methodology and consideration used by the previous research to identify the external variables. Finally, the chapter addressed the limitations of TAM model. The next chapter will present the literature review concerning the Technology Acceptance Model in the e-learning studies. The chapter also will explain the development of the research model and hypotheses.

Chapter Three: The Developed Model and Research Hypotheses

This chapter will present the literature review of studies that applied the Technology Acceptance Model (TAM) to explain students' acceptance of e-learning systems. The first section will discuss the research that applied the original model of TAM without any further development. The second section will discuss the research that applied TAM with further modification or extensions. The third section will introduce and discuss the external variables, the proposed hypotheses and the developed model.

3.1 The Technology Acceptance Model in the E-learning Setting

There is an increased usage in higher education for e-learning systems to provide learners with online courses and teaching materials (Concannon et al., 2005; Lee et al., 2009). However, the integration of information technology in higher education is facing many barriers and difficulties to be successful such as, technology infrastructure, faculty effort, and low acceptance of e-learning (Tseng and Hsia, 2008). Moreover, Hsia (2007) pointed out that, universities and colleges are still struggling with the utilisation of e-learning systems. Yet, little research has been done to investigate the motivations behind students' acceptance of e-learning systems (Park, 2009). Therefore, to improve e-learning effectiveness, developers and instructors need to understand the drivers behind students' acceptance. The recent studies that applied TAM in the e-learning context can be divided into two groups: The first group applied TAM without extension, while the second group extended TAM with external variables.

3.1.1 The Technology Acceptance Model without Extension

Yih (2009) investigated students' acceptance of writing web logs system in Malaysia. The study applied TAM without any extension to verify its suitability for such a system. The sample was divided into two groups; the first group was administrated before experiencing the web log system, and the second group which was administrated after experiencing the system. The results for both groups showed that TAM constructs were significant moreover, perceived usefulness was the strongest determinant for students' behavioural intention. Moreover, Tselios et al., (2011) used TAM to compare students' acceptance between blended and distance learning, and to investigate the variation of students' perception before and after the actual use of the learning management system (i.e. Moodle). The results showed that students' acceptance of the learning management system in blended and distance learning were similar. Furthermore, TAM constructs were all significant for the post-use group only. The author pointed out that students' perception of the system usefulness increased after their actual use of the system.

Jung et al., (2008) applied TAM to examine students' acceptance of a learning management system (i.e. Fronter) in Sweden. The authors included attitude in the model even though Davis et al., (1989) and Venkatesh and Bala (2008) recommended the variable to be removed. The study collected a total number of 120 responses from undergraduate students who have experienced the system before. The results showed that perceived usefulness and perceived ease of use were significant in predicting students' behavioural intention. Moreover, Wong et al., (2013) investigated the integration of IT in teaching and learning within Malaysian student teachers. Again the authors included attitude in the model to mediate the relationships from perceived usefulness and perceived ease of use towards behavioural intention. The results supported the significance of TAM constructs. The use of TAM original model without extensions cannot fully reflect and explain students' acceptance of e-learning systems (Hsia, 2007). Table 3-1 shows the explained variance reported by the above studies; the explained variance was low indicating that more than 60% of the variance was left unexplained. This confirms that TAM alone cannot explain enough variance in students' behavioural intention. Therefore, there is to identify external variables relevant to e-learning context to improve the explanatory power of TAM model (Jung et al., 2009; Wong et al., 2013).

Table 3-1: The variance explained in the three studies

Study	Variance Explained (R^2) in Behavioural Intention
(Jung et al., 2009)	31%
(Tselios et al., 2011)	39%
(Wong et al., 2013)	37.3%

3.1.2 The Extension of the Technology Acceptance Model

The second group extended TAM by either integrating the model with other information system models or by identifying external variables support the learning process. Motivation is considered as an important factor in determining individuals' behaviour. For a human to perform a specific behaviour he or she must be motivated (Lin, 2007). Motivation can be classified into extrinsic and intrinsic. Extrinsic motivation refers to *"the performance of an activity because it leads to instrumental rewards"* (Saade et al., 2009), while Intrinsic motivation refers to the *"engagement motivated by pleasure or enjoyment"* (Henderlong and Lepper, 2002). In literature the focus of TAM extensions was either on the extrinsic or intrinsic variables.

First, studies that focused on the extrinsic variables to understand students' behavioural intention. Park (2009) proposed an integrated theoretical framework for university students to predict their

behavioural intention in South Korea. The author introduced three variables; computer self-efficacy, subjective norm, and accessibility. Moreover, the relationships between the three variables and TAM constructs (i.e. perceived usefulness, perceived ease of use, and behavioural intention) were governed by study hypotheses. The result showed that computer self-efficacy was the strongest predicator of behavioural intention. Furthermore, the study showed unusual results because; perceived usefulness and perceived ease of use were not significant towards behavioural intention. This is possibly because attitude was meditating the relationships between the three variables. Davis et al., (1989) advised to remove attitude from TAM, the reasons were further explained in section 2.3.

Hsia (2007) used computer self-efficacy and perceived control to examine TAM applicability to explain employees' acceptance of an e-learning system. The study hypothesised that perceived usefulness, perceived ease of use, and perceived control will have a direct positive effect towards behavioural intention. The results showed that all of the three hypotheses were accepted however, perceived control was the strongest determinant of behavioural intention. In addition, the model explanatory power was low; it was only able to explain 33% of the variance in the employees' behavioural intention.

Liao and Lu (2008) considered e-learning as an information technology innovation. They used the perceptions of innovation characteristics (PCI) to predict learners' acceptance of a web-based learning system. Innovation is *"the situationally new development and introduction of knowledge-derived tools, artefacts, and devices by which people extend and interact with their environment"* (Tornatzky and Fleischer, 1990). The seven attributes of innovation characteristics are ease of use, compatibility, relative advantage, trialability, results demonstrability, visibility and image (Rogers, 1982; Moore and Benbasat, 1991). The results showed that from the seven attributes, only compatibility and relative advantage were significant towards learners' acceptance. However, the study results are difficult to generalise due to the sampling approach (i.e. convenience sampling) and sample size.

Jong (2009) utilised the Unified Theory of Acceptance and Use of Technology (UTAUT) with some modification to examine students' acceptance of a learning management system (LMS) in Taiwan. The UTAUT was developed by Venkatesh et al., (2003) based on the Technology Acceptance Model (TAM). The author modified UTAUT by including attitude, anxiety, and self-efficacy. The results were not consistent with TAM as the strongest determinant of behavioural intention was attitude. Besides, the model explained only 40% of the variance in students' behavioural intention. In a similar study, Šumak et al., (2010) used UTAUT to measure students

acceptance of Moodle (Moodle.org). The results showed that performance expectancy was the strongest predictor of students' behavioural intention. Nevertheless, the UTAUT model explained only 26% of the variance in students' behavioural intention. Therefore, further investigation is required to confirm the applicability of UTAUT to explain students' acceptance of e-learning systems.

Liu et al., (2010) extended TAM to investigate the willingness of high school students to use an online learning community. Four variables were proposed; online course design, user interface design, previous online learning experience, and perceived interaction. The proposed variables explained 70% and 59% of the variance in perceived ease of use and perceived usefulness respectively. The results also showed that perceived usefulness was the strongest determinant of behavioural intention. In addition, the developed model explained 76% of the variance in the students' behavioural intention. However, using a high school student will limit the ability to generalise the study finding. Because, the high school students perception is different than the perception of university students or business employees.

Lee (2010) investigated the continued intention (i.e. the frequent and regular use of the system in the future) of e-learning systems. The author synthesised four models the expectation-confirmation model (ECM), the theory of planned behaviour (TPB), the technology acceptance model (TAM), and the flow theory. The developed model included two factors from the original model of TAM perceived usefulness and perceived ease of use. Overall, the results showed that satisfaction came first in predicting students' continued intention, while perceived usefulness came in second. The author pointed out that satisfaction plays an important role in determining users' continuance intention however; perceived usefulness is strongly associated with users' acceptance (i.e. behavioural intention). Furthermore, Liaw (2008) supported the above statement. The author investigated the effect of satisfaction and perceived usefulness towards students' acceptance of the Blackboard (Blackboard.com). The results indicated that perceived usefulness was stronger than perceived satisfaction in determining students' acceptance.

Due to the increase attention of Information Technology within the educational institutes in Saudi Arabia, Al-Harbi (2011) examined the Saudi students' acceptance of e-learning systems in higher education. The author extended TAM with eight variables that can be categorised as follow social influence, institutional influence, system characteristics, and individual characteristics. The research findings showed that perceived usefulness and perceived ease of use were consistent with the TAM original model. The developed model accounted for 43% of the variance in Saudi students' behavioural intention, which is still low compared with the existing models in literature.

Second, studies that focused on the intrinsic variables to understand students' behavioural intention. Lee et al., (2005) pointed out that extrinsic motivation is the main emphasis of the TAM model, and lacked to consider important aspects such as the intrinsic motivation aspect. The role of intrinsic motivation has been investigated recently in the information system field to provide a better understanding of students' acceptance (Saadé et al., 2008; Saadé et al., 2009). Lee et al., (2009) developed a model based on TAM to investigate students' behavioural intention to use an e-learning supporting tool in South Korea. The authors introduced four variables to TAM, instructor characteristics, teaching materials, design of learning contents, and playfulness. The results confirmed perceived usefulness as the strongest determinant of behavioural intention with standardised coefficient ($\beta = 0.679$) followed by playfulness with ($\beta = 0.586$). This indicates that beside usefulness, embedding amusement and entertainment into the e-learning system can play important role in students' acceptance.

Moreover, Roca and Gagné (2008), focused on examining the effect of motivational variables on TAM constructs to understand e-learning continuance intention. The authors proposed an extension of TAM based on the self-determination theory (SDT) by adding four variables, perceived playfulness, perceived autonomy, perceived competence, and perceived relatedness. The findings showed that perceived playfulness was critical in determining perceived usefulness, perceived ease of use, and e-learning continuance intention. However, perceived usefulness was the strongest determinant of continence intention. Moreover, Saadé et al., (2008) investigated the role of intrinsic motivation on students' intention to a web-based learning system (WBL) in China and Canada. The authors hypothesised that enjoyment will have a direct effect towards behavioural intention. The results showed that enjoyment was significant towards behavioural intention for both countries. However, the Chinese students perceived usefulness as the strongest determinant of their behavioural intention, while enjoyment was the strongest determinant of the Canadian behavioural intention. Sheng et al., (2008) applied the same model developed by Saadė et al., (2008) to examine the Chinese students' acceptance of a web-based learning system. The results were similar from both studies.

On the other hand, Saadé et al., (2009) further investigated the effect of enjoyment towards TAM constructs by proposing additional modifications to the previous developed model. In the latest model, enjoyment was hypothesised to affect all of TAM constructs, perceived usefulness, perceived ease of use and behavioural intention. The data analysis gave different results compared to the 2008 study. For example, enjoyment was not significant towards behavioural intention for the Chinese and Canadian students. Furthermore, perceived usefulness was not significant towards behavioural intention for the Canadian students. The authors pointed out that

student reaction can change by time or environment (e.g. classroom location, time of course). Therefore, a longitudinal approach can be used to better capture the change in students' behavioural intention. Additionally, Alenezi et al., (2010) investigated the effect of the intrinsic variable towards the Saudi students' acceptance of learning management system. The authors extended TAM using five variables, attitude, enjoyment, computer anxiety, computer self-efficacy, and Internet experience, and they were hypothesised to directly affect behavioural intention. The results confirmed enjoyment as the strongest determinant of students' behavioural intention.

Finally, Sánchez-Franco et al., (2009) focused on investigating the perception between the European Nordic countries (Finland, Norway, Sweden and Denmark) and European Mediterranean countries (Portugal, Spain and Greece), using a web-based learning system. The authors extended TAM by introducing one intrinsic variable, and model results were different between Nordic and Mediterranean users. For example, the intrinsic variable affect towards behavioural intention was only significant for the Nordic users. Moreover, their perception towards perceived usefulness was strongly affected by ease of use (β = 0.645) compared to the Mediterranean users (β = 0.387). Overall, both cultures perceived usefulness as the strongest determinant of their behavioural intention. Sánchez-Franco et al., (2009) stated that *"Cultural differences have a significant impact on attitudes and behaviours towards using Web-based applications"*. Therefore, caution is needed when generalising a study result based on one culture to another.

3.2 Identifying the External Variables

Based on the technology acceptance research considerations discussed in section 3.2. For this research there are two main considerations to identify the external variables. First, the external variables will address the e-learning unique context. Second, the external variables must have the potential to predict and explain students' acceptance of e-learning. The research performed critical analysis on the existing work of technology acceptance research; based on the critical analysis the external variables were identified. The external variables were chosen based on their potential from literature to predict and explain students' acceptance of LMSs. Therefore, whether or not these external variables are critical towards students' acceptance, this is the question this research is aiming to investigate and proof. (Venkatesh and Davis 2000; Venkatesh and Bala, 2008).

The importance of the identified external variables towards e-learning can be explained as follow. The research critical analysis indicated that accounting for the extrinsic and intrinsic variables can

critically improve a model performance to explain students' acceptance of LMSs. Previous studies have mainly focused on examining extrinsic variables and neglected the significance of the intrinsic variables. This is possibly because the original model of TAM main focus was on the extrinsic variables. Furthermore, Hsia, (2007), Saadé et al., (2008) and Sánchez-Franco et al., (2008) pointed out that research models that does not consider the extrinsic variables are not able to capture the full motivation aspects behind users' acceptance. Recent studies showed that intrinsic variables can have direct and indirect influence on students' acceptance of e-learning. However, the results were not consistent between cultures and genders.

Therefore, this research aims to identify important extrinsic and intrinsic variables relevant to the e-learning environment to investigate which aspect is more important towards students' acceptance of LMSs the extrinsic or intrinsic variables; as this question has not been clearly addressed in the technology acceptance research. Moreover, the extrinsic and intrinsic dimensions can be further categorised to incorporate two important aspects, system and user's characteristics. Literature has indicated that system and user's characteristics can predict and explain TAM constructs (i.e. perceived usefulness, perceived ease of use and behavioural intention) in information system research.

First, system characteristics have a significant role to determine users' acceptance in different information system domains (e.g. Venkatesh and Davis, 1996; Ruth, 2000). Moreover, Davis et al., (1989) posited that system characteristics can directly impact user's behavioural intention. Yet, the impact of system characteristics on students' acceptance of e-learning has not been fully examined (Pituch and Lee, 2006; Šumak et al., 2011). Crowther et al., 2004 argued that the impact of a system characteristic such as having a system with poor interface design is more serious for education than business environment. Because, having a poor interface design can impairs learners' motivation and learning performance. Additionally, a number of studies examined some system characteristics variables indicating their significance to predict and explain an e-learning system acceptance (Pituch and Lee, 2006; Cho et al., 2009; Park, 2009; Park et al., 2009; Liu et al., 2010).

Second, user's characteristics have shown to influence students' acceptance of e-learning systems (Pituch and Lee, 2006). Furthermore, Heinich et al., (1996) pointed out that user's characteristics can enhance students' use of instructional technology (Heinich et al., 1996). Therefore, accounting for user's characteristics in identifying the external variables might improve students' perception towards LMSs acceptance. The common used user's characteristics in literature are Internet experience and computer self-efficacy. The issue with these two characteristics is both of

them are not domain specific, and they are mainly used to address business studies. Therefore, part of this research aim is to identify user's characteristics more relevant to the e-learning environment to account for students' perception (Šumak et al., 2011).

Based on the points discussed above this research will identify external variables to account for the following. First, the extrinsic and intrinsic variables to examine which group are more prominent towards students' acceptance of LMSs. Second, the research will classify the extrinsic and intrinsic variables into system and user's characteristics due to their potential importance in and to address the literature limitations regarding the two characteristics. Thirdly, the research hypotheses will be proposed for each external variable supported by literature to govern the relationships between the identified variables (Venkatesh and Davis 2000; Venkatesh and Bala, 2008). Finally, the research identified seven external variables beside TAM three constructs (i.e. perceived usefulness, perceived ease of use and behavioural intention), (see Table 3-2). Additionally, the theoretical rationale for each external variable was formed based on literature to propose the research hypotheses

Table 3-2: The developed model variables

Dimension	Variable	Group	Type
Extrinsic	Information Quality	System Characteristic	Independent
	Functionality	System Characteristic	Independent
	Accessibility	System Characteristic	Independent
	User Interface Design	System Characteristic	Independent
Intrinsic	Computer Playfulness	System Characteristic	Independent
	Enjoyment	System Characteristic	Independent
	Learning Goal Orientation	User Characteristic	Independent
TAM	Perceived Usefulness	TAM	Dependent/Independent
	Perceived Ease of Use	TAM	Dependent/Independent
	Behavioural Intention	TAM	Dependent

3.3 The Research Hypotheses

In the technology acceptance research, hypotheses are required to govern the relationships between the model variables (Venkatesh and Davis, 2000; Lee et al., 2005; Cho et al., 2009; Park, 2009; Liu et al., 2010; Sànchez and Hueros, 2010; Al-Harbi, 2011; Lee et al., 2011; Udo et al., 2012; Padilla-Meléndez et al., 2013). The combined hypotheses will from the relationships in the developed model by governing the direction of each relationship between variables. In addition, the research hypotheses will enable to examine every single relationship between variables in terms of the probability value (i.e. significance level) and standardised coefficient (i.e. prediction value). This approach is common in dedicative research, where the research hypotheses are proposed first then tested. The following sections will justify the research hypotheses for each identified variable.

3.3.1 Information Quality (IQ)

Information quality can be defined as "users' perception of the quality of information presented on a Web site" (Mckinny et al., 2002) or "the extent to which complete, accurate, and timely information is provided for the customer in the electronic service interface" (Liu, 2010). Delone and McLean (1992) emphasised the importance of information relevance, timeliness and accuracy for information systems success. Moreover, Information quality has proved to be an important variable in determining user's satisfaction (Katerattankul and Siau, 1999; McKinny et al., 2002; Lee, 2006). Hughes et al., (2004) pointed out that websites content and function are considered to be the main reasons for students to like a website. Their results indicated students valued the website content and functionality up to 58%, followed by ease of use and appearance with 26% and 10% respectively. Furthermore, Yanjun et al., (2010) examined students' willingness to use an online open resource. The results showed the strongest predictor for students' usage was information quality, stronger than perceived usefulness. However, Liu (2010) found out that even though information quality was significant, perceived usefulness remained as the strongest determinant of purchase intention. Also, Zheng (2011) investigated users' acceptance of sponsored links using TAM and the study findings supported the results above, where perceived usefulness was the strongest determinant followed by information quality. This supports the importance of information quality towards behavioural intention.

However, the relationship between information quality and behavioural intention showed inconsistent results. For example, McGill and Hobbs (2003) found information quality to be insignificant towards users' intentions to perceive information system success; similar results were reached by Iivari (2005). Petter (2008) pointed out there is insufficient literature that

addressed the inconsistency of information quality towards behavioural intention. Therefore, more research is required to investigative the relationship between information quality and behavioural intention in different information system domains. Additionally, little research has been done to examine the importance of information quality in the e-learning context.

An e-learning system with a good content will allow learners to perceive the value of a system (Tseng, et al., 2008). If the information provided by an information system is ambiguous, incomplete, or inaccurate, might reduce users' chance of accepting the system (Liao et al., 2006). LMSs can offer a variety of content for learners; however, whether information quality can influence learners' acceptance requires further investigation. Therefore, this research will investigate information quality importance towards the Saudi students' acceptance of LMSs by hypothesising two hypotheses. Hypothesis (H1a): investigate information quality direct effect towards perceived usefulness. Hypothesis (H2b): investigate information quality direct effect towards behavioural intention, by bypassing perceived usefulness.

Hypothesis (H1a): Information quality has a positive effect on the students' perceived usefulness of the LMS.

Hypothesis (H1b): Information quality has a positive effect on the students' behavioural intentions to use the LMS.

3.3.2 Functionality (FL)

Functionality can be defined as "the functions provided by an information system, i.e., an e-learning system in this study that enable the user/e-learner to effectively achieve their goals" (Cho et al., 2009). System characteristics have posited to have a direct effect on users' acceptance of IT (Hong et al., 2005). In addition, Davis (1989) stated that functionality would improve users' perceived usefulness, because functionality will enable them to use the system effectively. Hong et al., (2005) supported the previous statement by extending TAM to investigate the effect of system characteristics and user characteristics on students' intentions to use a supplementary learning tool. The system characteristics incorporated functionality, interactivity and response, while user characteristics included self-efficacy and Internet experience. The hypotheses testing results showed that functionality was the strongest determinant of perceived usefulness. Similar results were reached by Cho et al., (2009), where the study investigated the continuance usage intention of a self-paced e-learning tool and functionality remained as the strongest determinant towards perceived usefulness.

On the other hand, the results reached by Pituch and Lee (2006) were quite the opposite. They examined the influence of system characteristics on e-learning as a supplementary learning tool in Taiwan. They have surveyed 259 Taiwanese students from one university; the results showed the effect of functionality has shifted towards behavioural intentions instead of perceived usefulness. Overall, a functional LMS should offer a flexible learning environment, functional features that can contribute to learning process by offering a variety of instructional and assessment mediums such as online course content, turn in assignments online, online quizzes and tests. However, the effect of functionality towards perceived usefulness and behavioural intention was inconsistent. In addition, few studies have investigated the effect of functionality towards students' acceptance of e-learning systems especially LMSs. Therefore, the question this research is aiming to investigate is whether the functionality aspects of LMSs have an effect on students' acceptance or perceived usefulness. Therefore, the research hypothesises two hypotheses to investigate the effect of functionality.

Hypothesis (H2a): Functionality has a positive effect on the students' perceived usefulness of the LMS.

Hypothesis (H2b): Functionality has a positive effect on the students' behavioural intentions to use the LMS.

3.3.3 Accessibility (A)

Accessibility can be defined as "the ease with which information can be accessed or extracted from the system" (Wixom and Todd 2005). In Addition, Park et al., (2009) referred to accessibility as "the degree of convenience with which an individual accesses an information system" (Park et al., 2009). In the research area of digital library Thong et al., (2002) utilised TAM to understand users' acceptance of digital libraries by identifying nine variables that were hypothesised to affect perceived usefulness and ease of use. The results showed that accessibility was the strongest determinant towards perceived ease of use while the variable was not significant towards perceived usefulness. On the contrary, Teo et al., (2003) found out that accessibility was significantly affecting both of perceived usefulness and ease of use for online learning communities. Accessibility significance towards perceived usefulness, perceived ease of use and behavioural intention has not been consistent between countries. For example, Park et al., (2009) investigated users' acceptance of digital libraries in five developing countries (i.e. Gana, Malawi, Kenya, Nigeria and Tanzania) and users' perception towards accessibility was different in term of the variable effect towards perceived usefulness and perceived ease of use.

Moreover, Park (2009) investigated students' behavioural intentions to use an e-learning system in South Korea. The author hypothesised that accessibility will have significant effect with perceived usefulness, perceived ease of use, and behavioural intention. However, the results showed that functionality was only significant towards perceived ease of use. Park pointed out explained that functionality was not a dominating variable towards TAM constructs, because South Korea has a developed IT and internet infrastructure. Therefore, in developing countries where the IT and internet infrastructure development is slow, accessibility will be perceived as critical variable towards systems acceptance. Finally, Fan et al., (2012) pointed out that accessibility is fundamental to information system usage. An information system with poor accessibility can negatively affect users' perception to accept an information system (Thong et al., 2002; Fan et al., 2012). Additionally, the IT and internet infrastructure in Saudi Arabia is still developing; therefore, this research is examining whether or not accessibility will be critical variable for LMSs acceptance in Saudi Arabia. Furthermore, the inconsistency between accessibility and TAM constructs (i.e. perceived usefulness, perceived ease of use and behavioural intention) urges for further investigation the relationships between these variables. Based on the above this research hypothesises the following:

Hypothesis (H3a): Accessibility has a positive effect on the students' perceived usefulness of the LMS.

Hypothesis (H3b): Accessibility has a positive effect on the students' perceived ease of use of the LMS.

Hypothesis (H3c): Accessibility has a positive effect on the students' behavioural intention to use the LMS.

3.3.4 User Interface Design (UID)

User interface design is defined as *"the structural design of an interface that presents the features and instructional support of an information system"* (Cho et al., 2009). The interface is the communication channel between the user and the system. The aspects of User interface design area critical as they need to be addressed in systems development stage (Saadé and Otrakji, 2007). Te'eni and Sani-Kuperberg (2005) pointed out users' perception towards user interface design can be more important than functionality (Te'eni and Sani-Kuperberg, 2005). According to Liu et al., (2006) having an interactive interface design for e-learning systems, should allow learners to learn effectively. A good interface design can reduce the disorientation and users' cognitive overload (Saadé and Otrakji, 2007; Liu et al., 2010). Disorientation is defined as *"the*

user's tendency to lose their sense of location while using the system interface" (Saadé and Otrakji, 2007), while cognitive overload i "*the amount of mental effort needed to perform various tasks*" (Rose et al., 2009).

Cho et al., (2009) hypothesised that user interface design will have a positive effect towards perceived usefulness and perceived ease of use for a self-paced e-learning tool. The results showed the relationship between user interface design and perceived usefulness was not significant; because, functionality effect towards perceived usefulness was stronger. However, when functionality was removed, the user interface design was significantly affecting perceived usefulness. In both cases, user interface design remained significant towards perceived ease of use. In addition, Liu et al., (2010) pointed out that for online learning communities, having a good interface design is critical for high school students to perceive the system ease of use.

However, generalising the results of Cho et al., (2009) and Liu et al., (2010) studies is difficult for two reasons. First, both studies were different in term of the research goal and the examined e-learning system. Second, the second study used high school students which make it impossible to generalise the study on different samples such as university students or business employees. Therefore, further investigation is required to confirm the significance of user interface design towards perceived usefulness and perceived ease of use using LMSs. Consequently, this research will examine whether or not user interface design is critical towards students perception of perceived usefulness and perceived ease of use.

Hypothesis (H4a): Perceived user-interface design has a positive effect on the students' perceived usefulness of the LMS.

Hypothesis (H4b): Perceived user-interface design has a positive effect on the students' perceived ease of use of the LMS.

3.3.5 Computer Playfulness (CP)

Playfulness can be defined as *"the degree of cognitive spontaneity un microcomputer interaction"* (Webster and Martocchio, 1992). The word playfulness includes terms like exploration, discovery, curiosity and challenge (Venkatesh, 2000). Playfulness represents the intrinsic motivation aspect that associate with a new system (Venkatesh and Bala, 2008). According to Venkatesh (2000) individual's playfulness is critical in the early stages of system acceptance. Venkatesh and Bala (2008) examined the perception of playfulness towards

perceived ease of use among three groups in business organisations. The results showed playfulness remained significant towards perceived ease of use over the three groups.

On the other hand, Tsao and Yang (2010) investigated the effect of towards users' behavioural intentions to use an online keyword searching website. The results supported the significance of playfulness towards behavioural intention with standardised coefficient of (β = 12) however, perceived usefulness remained as the strongest determinant of behavioural intentions. Moreover, Bahry et al., (2012), proposed an extension of TAM to predict the use of web portal system. Their model included four variables (i.e. perceived usefulness, perceived playfulness, perceived attractiveness, and physic cost perception) in which they were hypothesised to have a direct affect towards behavioural intentions. The results showed both of perceived playfulness and perceived usefulness were significant towards behavioural intention with equal standardised coefficient (β = 27).

In the e-learning context, the relationship between playfulness and behavioural intention has shown inconsistent results between different users. For example, Davis and Wong (2007) focused on measuring learners' acceptance of an e-learning system. The authors proposed three main variables towards behavioural intention; the original constructs of TAM (i.e. perceived usefulness, and ease of use), and playfulness. The results showed that among the three suggested variables, playfulness was the strongest determinant of behavioural intention. On the other hand, Lee et al., (2009) results showed perceived usefulness as the strongest determinant of behavioural intention while playfulness came second for the South Korean learners. Furthermore, Padilla-Meléndez et al., (2013) found out that even though learners' overall perception towards playfulness measured variables were high; playfulness did not post any significance towards behavioural intention. However, playfulness led learners' perception to perceive the system as easy to use. The insignificance of playfulness towards behavioural intention was caused by learners' strong perception towards perceived usefulness and perceived ease of use. Authors argue that students' perception towards e-learning systems can be improved by incorporating the sense of amusement in the system design.

The intrinsic variables have rarely been investigated towards Saudi students' acceptance of e-learning systems. From literature there are evidence showing that playfulness does have the potential to improve users' perception to use an information system. However, the current studies have shown inconsistent results which make it difficult to draw general conclusion. Moreover, there are indications that users' nationality or culture can easily influence their perception towards the intrinsic variables (Saadė et al., 2008; Saadė et al., 2009; Sànchez-Franco et al.,

2009). Therefore, the inclusion of playfulness in the research model was for the following reasons. First, is to investigate whether or not playfulness can improve the Saudi students' acceptance of LMSs. Second, is to confirm whether or not playfulness has a direct relationship with behavioural intentions and perceived ease of use. Based on the points discussed above this research hypothesises the following:

Hypothesis (H5a): Computer playfulness has a positive effect on the students' perceived ease of use of the LMS.

Hypothesis (H5b): Computer playfulness has a positive effect on the students' behavioural intentions to use the LMS.

3.3.6 Enjoyment (E)

Enjoyment is defined as "the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use" (Venkatesh, 2000). Enjoyment has been attracting many researchers in the technology acceptance research, because users' perception can be positively influenced by the intrinsic variables (Venkatesh and Bala, 2008). The enjoyment feeling while using a new system can reduce the perception of effort being performed by a user (Saadė et al., 2008). In the e-learning research, enjoyment has shown to be capable of influencing learners to accept e-learning systems directly via behavioural intention, and indirectly via perceived ease of use depending on the examined nationality (Saadė et al., 2008; Saadė et al., 2009). The literature review in section 3.1.2 pointed out the differences in results between enjoyment and the two constructs of TAM (i.e. behavioural intention and perceived ease of use). Saadė (2007) pointed out There is a need to have a complete view of the intrinsic and extrinsic motivation aspects to have a better understanding of users' technology acceptance. In addition, there are not enough studies to generalise the significance of enjoyment on research the population of this research i.e. university students in Saudi Arabia. Moreover, the intrinsic variables have shown to be affected by the users' culture being investigated. The impact of enjoyment towards behavioural intention and perceived ease of use was not consistent from one country to another. Therefore, this research will examine whether or not the perception of enjoyment can improve the Saudi students acceptance of LMSs.

Hypothesis (H6a): Enjoyment has a positive effect on the students' perceived ease of use of the LMS.

Hypothesis (H6b): Enjoyment has a positive effect on the students' behavioural intentions to use the LMS.

3.3.7 Learning Goal Orientation (LGO)

Learning goal orientation is an intrinsic motivation that refers to the *"motivation to constantly improve one's competencies"* (Runhaar et al., 2010). Learning goal orientation means that people will take on challenging tasks to enhance their knowledge and skills. Therefore, any difficulty the people face during their learning process will be considered as part of their education (Yi and Hwang, 2003). Learning goal orientation is considered as a user characteristic that has been rarely discussed in the technology acceptance domain. Some studies pointed out the significance of this variable on users' acceptance. For example, Yi and Hwang (2003) extended TAM to predict the use of a web-based information system. The results showed learning goal orientation to play an important role toward users' acceptance via perceived ease of use. Moreover, Zheng et al., (2010) supported the importance of learning goal orientation towards behavioural intention; the authors investigated employees' intentions to use IT in China. The study findings showed that learning goal orientation had a significant direct effect towards users' behavioural intentions to use IT.

Empirical evidence has shown learning goal orientation to relate positively towards the learning context (Runhaar et al., 2010). This research assumes that students with a learning goal orientation are more likely to accept the e-learning system by perceiving the system as easy to use. Because, students with a learning goal motive are more willing to overcome the system challenges and design hurdles to gain knowledge, skills and learn. Therefore, this research will adapt the learning goal orientation variable in the research model to investigate its effect towards the Saudi students' acceptance of LMSs. The investigation will examine the possible relationships from learning goal orientation towards behavioural intention and perceived ease of use. Investigation such an aspect will give a better understanding on how to approach e-learning systems design. For example, if the highly motivated students are willing to use the difficult system features to learn, then knowing this might give more opportunities for designers to innovate in the e-learning systems design. Based on the points discussed above this research hypothesise the following:

Hypothesis (H7a): Learning goal orientation has a positive effect on the students' perceived ease of use of the LMS.

Hypothesis (H7b): Learning goal orientation has a positive effect on the students' behavioural intentions to use the LMS.

3.3.8 Perceived Usefulness (PU) and Perceived Ease of Use (PEOU)

Perceived usefulness and ease of use are the two main constructs of TAM model, the importance of these two variables have been already justified (Davis, 1989, Venkatesh, 2000, Venkatesh and Bala, 2008). Perceived usefulness is defined as *"the degree to which a person believes that using a particular system would enhance his or her job performance"* (Davis, 1989). Perceived ease of use is defined as *"the degree to which a person believes that using a particular system would be free of effort"* (Davis, 1989).

The following literature points out the significance of the two factors towards behavioural intention in different Information Systems' domains. In the e-commerce domain, Liu et al., (2010) found out that perceived usefulness was an important factor for customers' purchase intentions. Moreover in the health field, Lai and li (2010) examined the factors affecting the acceptance of a computer assistance orthopaedic surgery system in hospitals. The study revealed that perceived ease of use and perceived usefulness had a significant impact towards users' intentions to use the system. Similar results were supported by Mohamed et al., (2011) when they investigated the acceptance of the e-health services in the United Kingdom and United Arab Emirates. Furthermore, Tian et al., (2010) investigated the drivers of mobile office services by identifying determinant for perceived usefulness and perceived ease of use; again both factors showed to be significant towards users' behavioural intentions. In the e-learning context, perceived usefulness has shown to be as an important factor in determining learners' behavioural intentions to use e-learning (e.g. Raaij and Schepers, 2006; Liaw, 2007; Lee, 2009; Lee et al., 2009; Liu et al., 2009). Moreover, many empirical researches has supported the significant relationship of perceived ease of use towards perceived usefulness and behavioural intention (e.g. Hsia, 2007; Lee et al., 2009; Yih, 2009; Liu et al., 2010; Sánchez & Hueros, 2010; Teslios et al., 2011). However, the inconsistent relationship between perceived ease of use and behavioural intention surfaced also in the e-learning studies (e.g. Saadé et al., 2009).

Hypothesis (H8a): Perceived ease of use has a positive effect on the students' perceived usefulness of the LMS.

Hypothesis (H8b): Perceived ease of use has a positive effect on the students' behavioural intentions to use the LMS.

Hypothesis H9a: Perceived usefulness has a positive effect on the students' behavioural intentions to use the LMS.

3.3.9 Gender Differences

In the technology acceptance research, gender has become concern for researchers (Teo, 2010). The previous researchers have found mixed results between genders in regard to the acceptance of e-learning (Terzis and Economides, 2011). Some researchers found that males perception is significantly higher than females towards e-learning systems use (e.g. Enoch and Soker, 2006; Zhou and Xu, 2007). On the other hand other researchers found that there is no significant different between genders perception to use e-learning (e.g. Zhang, 2005; Davis and Davis, 2007; Cuadrado-García et al., 2010; Hung et al., 2010). For example, Sun and Zhang (2006) found that males are more motivated by perceived usefulness, while Ong and Lai (2006) showed that perceived ease of use is being influenced more by females than males. Terzis and Economides (2011) study revealed that gender was moderating two relationships of TAM; perceived usefulness towards behavioural intention and perceived ease of use towards behavioural intention.

Moreover, the effect of gender towards external variables such as computer anxiety, computer self-efficacy and social influence, has showed mixed results as well (e.g. Kesici et al., 2009; Wang et al., 2009). Furthermore, Padilla-Meléndez et al., (2013) used TAM and perceived playfulness to examine the gender difference in accepting e-learning. The results showed that for perceived playfulness there was no significant different between males and females. Overall, gender did not moderate the proposed model except for the relationship from perceived ease of use towards perceived usefulness. Moreover, the study showed that males' perception towards e-learning was higher than females; the explained variance in behavioural intention for males and females was 68.2% and 37.7% respectively. Based on the finding of the previous studies, this research attempts to highlight the effect of gender towards students' acceptance of LMSs in Saudi Arabia. Therefore, this research will examine whether or not gender has a moderating effect towards the research model.

3.4 The Developed Model

Based on the extensive literature review in the area of technology acceptance, the research developed an enhanced technology acceptance model consisting of ten variables, variables, information quality, functionality, accessibility, user interface design, computer playfulness, enjoyment, learning goal orientation, perceived usefulness, perceived ease of use and behavioural intention. Moreover, the relationships between model's variables are governed by the proposed hypotheses. Based on the proposed hypotheses the developed model relationships were structured (see Figure 3-1).

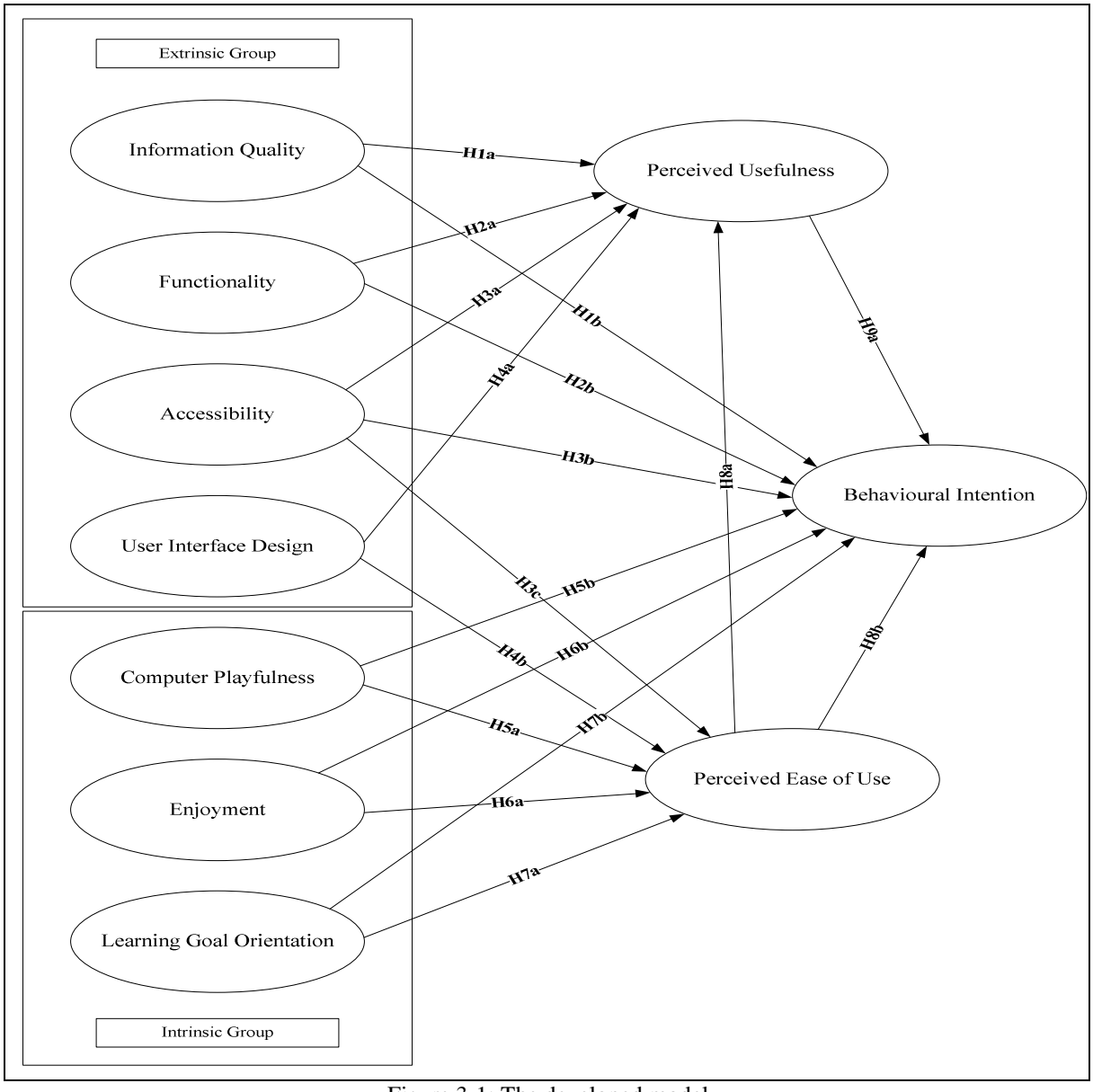


Figure 3-1: The developed model

3.5 Summary

This chapter provided extensive literatures review about studies that have used TAM to explain students' acceptance of e-learning systems. The chapter divided the literature review into two sections, the first section was about discussed the work of TAM without any further development while the second section discussed the work of TAM that have applied extension or modification on the model. Furthermore, the chapter explained the method used to identify the external variables and the potential importance of them presented in the external variables and the research hypotheses sections.

The research model consisted of ten variables (seven external variables and three TAM variables) and their relationships where supported and governed by the proposed hypotheses. The research proposed a total of eighteen hypotheses along with their justifications. Moreover, the research model has focused on two main categorises, extrinsic and intrinsic groups, followed by two sub categories, systems and user's characteristics. Based on the two main categorise, there are four extrinsic variables (i.e. information quality, accessibility, functionality, and user interface design) and three extrinsic variables (i.e. computer playfulness, enjoyment, and learning goal orientation). Due to the potential that theses external variables have toward students' acceptance in the e-learning context, they were integrated as part of the developed model to be examined. .

The next chapter will discuss the research methodology through the research process, the research design, population and sample, and data collection. The research process will describe the logical steps the research followed in details to achieve the research objectives. The research design will discuss the nature of the research by applying five parameters. The population and sample section will discuss the research population and the sampling method used to sample the research population. Finally, the data collection section will describe the tool development process and how the data were collected.

Chapter Four: The Research Methodology

There are a variety of research approaches that can be used to achieve a research objectives successfully, e.g. descriptive, analytical, applied, quantitative, qualitative, inductive, deductive, expletory, and confirmatory (Hussey and Hussey 1997; Fitzgerald and Howcroft, 1998). In this research, a technology acceptance model was developed to investigate students' acceptance of Learning Management Systems (LMSs) in Saudi Arabia. This chapter will discuss the research process, research design, population, sampling approach, data collection and data analysis.

4.1 The Research Process

In research, there are two processes for reasoning inductive and deductive. *Inductive* is *"a process where we observe certain phenomena and on this basis arrive at conclusions"* (Sekaran, 2003). Inductive research begins the investigation by observing a phenomenon then try to explain this phenomenon through the development of a theory or a hypothesis (Crowther and Lancaster, 2008). The inductive approach observes the phenomena to better understand the nature of the problem, based on these observations theories or hypotheses can be formulised to explain the phenomena (Saunders et al., 2012). Donnelly and Trochim (2005) summarised the inductive research process in the following steps: First, the research begins detecting patterns and regularities in the environment via observations. Second, theories and hypotheses can be formulated based on the observed patterns. Moreover, inductive approach is suited to use and interpret qualitative data (Crowther and Lancaster, 2008). Moreover, Teddlie and Tashakkori (2003) pointed out that qualitative research is predominantly related to inductive research, whereas quantitative research for hypothesis testing is related to deductive research.

Deductive refers to *"a set of techniques for applying theories in the real world in order to test and assess their validity"* (Lancaster, 2005). Deductive research is a top-down approach where the developed theories and hypotheses can be either accepted or rejected through empirical observation (Lancaster, 2005). Saunders et al., (2012) pointed out that the process of deductive research is *"the development of a theory that is subjected to a rigorous test"*. This research follows a deductive research approach, because the research aim is to develop technology acceptance model to explain students' acceptance of LMSs. Additionally, the developed model will be validated and examined empirically through rigorous tests. Lancaster (2005) suggested four main steps that should be included in any deductive research:

1. Theory/hypothesis formulation: The first step is to formulate theories or hypotheses based on the researcher ideas, pervious experience, literature review or the desire to solve a specific problem. All of this gained knowledge can be integrated together in a

logical manner to address the research problem. For this research extensive literature review will be conducted to investigate the current work in the technology acceptance research.

2. Operationlisation: All of the concepts used in theories or hypotheses should be defined precisely thus they can be measured empirically. This process is essential to eliminate any confusion in term of what is to be measured and how these measurements will be carried out (Burns, 2000). This research will develop a technology acceptance model to explain students' acceptance of LMSs. The model consists of ten variables, and their relationships were governed by eighteen hypotheses. Furthermore, all the variables will be defined along with their measurement items.

3. Theory testing/empirical observation: This stage is concerned with the research methodology and research design such as sampling process, instrument development, data collection, methods of analysis, and results interpretation. The nature of the research will derive the research methodology and design. For this research a quantitative approach was chosen to validate and examine the developed model.

4. Accepting or rejecting the theory: Based on the results the research theory or hypothesis can be either rejected or accepted. This research will use Structural Equation Modelling (SEM) via IBM AMOS to perform confirmatory factor analysis and multiple regression analysis. The analysis results will be for the developed model and proposed hypotheses will be discussed and evaluated.

4.2 The Research Design

The research can be design to be qualitative or quantitative based on the research nature. Qualitative research *"is a process of inquiry that seeks to understand phenomena in real-world settings where the researcher does not attempt to manipulate the phenomenon of interest"* (Armour and Macdonald, 2012). Qualitative research takes a naturalistic approach towards the research subjects, because the research focus is on the people experiences and the world they live in (Denzin and Lincoln, 2005). Moreover, Armour and Macdonald, (2012) pointed out that all qualitative research has similar key characteristics. First, the researcher is the main tool for data collection and analysis. Second, the researcher is usually involved in the fieldwork, where he or she meets people in their site of work in order to collect the data via observation of interviews.

Third, qualitative research follows inductive research strategies, where the research aims to build abstractions, concepts, or theories. In qualitative research, researchers and participants have to employ expressive language and voice to present the description and findings. Moreover, the qualitative approach suffers from subjectivity issues because the researchers are the primary tool for collection the data (Armour and Macdonald, 2012).

Quantitative research is *"attempts to gather data by objective methods in order to provide information about relations, comparison and predictions, without 'contamination' by the investigator"* (Armour and Macdonald, 2012). Quantitative research is usually associated with the philosophy of positivism and deductive research (Saunders et al., 2012). In addition, positivism follows three assumptions (Weber, 2004). First, reality and the researcher are two separate things; they do not interact with each other during the data collection process. Second, the knowledge or the theory of knowledge exists beyond the human mind, where knowledge is built through human experiences. Third, the research objects qualities exist independently of the researcher (i.e. independent reality); where the researcher is not the tool measuring the object qualities. These three assumptions are basically the opposite of qualitative research characteristics mentioned above. There are two common types of quantitative research, experiments and questionnaires. Moreover, Weber (2004) divides these types into three methods field experiments, laboratory experiments, and questionnaires. Experiments allow researchers to control the testing environment; therefore, they will be able to link the cause and effect. On the other hand, questionnaires allow reaching wider base of the research population and providing a cross-sectional status of the population at a given time (Armour and Macdonald, 2012).

This research follows a quantitative approach through the use of questionnaires as the main instruments to collect the data for the following reasons. First, questionnaires allow reaching wider sample size of the research population, since the minimum sample size for this research is relatively large (i.e. 450 participants). Third, questionnaires allow collecting data from participants' anonymously and without interference, as requested by the universities participating in the research. Finally, Sekaran (2003) suggested the following guidelines for a research design, which further confirms the applicability of questionnaire to this research:

1. **The Purpose of the Study:** The purpose of a study can be exploratory or confirmatory. Firstly, exploratory approach is undertaken when a little is known about the phenomenon, because the approach will allow for better understanding of the research problem. The exploratory approach strategy is the process of mutual adjustment, where theories and concepts should be adjusted to reflect the results at hand (Gerring, 2001). Exploratory

approach can be considered as inductive research that offers flexibility in hypotheses formulation, because these hypotheses just require the obtained data to be supported. Moreover, exploratory approach commonly uses qualitative methods for data collection such as interviews and observation. Secondly, confirmatory approach is undertaken when a research is seeking to test the proposed hypothesis or relationship. The strategy for this approach is to empirically examine the theoretical aspects of the research thus, researchers can decide whether to accept or reject these aspects. Furthermore, the confirmatory research is mainly deductive research and relies on the statistical means to answer research questions (Meyers et al., 2005). This research uses a confirmatory research approach as the research aims to confirm the statistical significance of the developed model and hypotheses in the e-learning environment using a quantitative approach.

2. **The Study Setting and the Extent of Researcher Interference:** The setting of a study can be casual or correlational. In causal study *"the researcher wants to delineate the cause of one or more problems"* (Sekaran, 2003), while in correlational study *"the researcher is interested in delineating the important variables associated with the problem"* (Sekaran, 2003). The setting of this research is correlational, because the research is investigating the association between the ten external variables and students' acceptance of LMSs. In addition, researcher interference is also influenced by the study setting. In causal study, researchers tend to have excessive interference with the work flow of the experiment to identify the cause and effect relationship. On the other hand, correlational study allows for minimal interference, for example the use of questionnaires does not cause disruption to the people in working environment (Sekaran, 2003).
3. **The Unit of Analysis and the Time Horizon:** The unit of analysis refers to the *"level of aggregation of the data collected during the subsequent data analysis stage"* (Sekaran, 2003). In the technology acceptance research the unit of analysis is on the individual level. In this research the data will be collected individually from each participant via questionnaires then the collected responses will be grouped in one table of data. Moreover, questionnaires enable to perform cross-sectional study where the data is collected once over a period of time (days, weeks or months). This research follows cross-sectional approach, where the data will be collected from university students over six weeks.

4.3 Population

The population refers to *"the entire group of people, events, or things of interest that the researcher wishes to investigate"* (Sekaran, 2003). The population of this research can be defined as the Saudi male and female, undergraduate students studying in the universities of Saudi Arabia who are familiar with LMSs. Based on the Ministry of Higher Education (2013), the total number of population whom fits the research description is around 600,000 students. However, due to the population large size and difficulty to obtain a sampling frame, a self-selected sampling was used to sample the research population (Saunders et al., 2012).

Hair et al., (2010) pointed out for structural equation modelling i.e. multiple regression analysis and confirmatory factor analysis; the minimum sample size required the ratio of 20:1 (i.e. 20 responses for each independent variable). However, Hair et al., (2010) recommended the ratio of 50:1 for better results. The developed model for this research is consisted of 9 independent variables, information quality, functionality, accessibility, user interface design, enjoyment, learning goal orientation, computer playfulness, perceived usefulness and perceived ease of use. The ratio 50:1 indicates the minimum required sample size 450 responses. The total number of completed response obtained for the statistical analysis was 766 responses which is a sufficient number. Moreover, all of the 766 responses will be used for the research statistical analysis without exception. The confirmatory factor analysis will use the 766 responses to validate the developed model through unidimensionality, goodness of fit measures and constructs' validity. The multiple regression analysis will use the 766 responses to examine the research hypotheses and explained variance for the developed model (Janssens et al., 2008; Hair et al., 2010).

Furthermore, accepting or rejecting the research hypotheses will be performed by the multiple regression analysis using the 766 collected responses. The multiple regression analysis calculates the probability value (i.e. significance level) and standardised coefficient (i.e. predication value) for each hypothesis in one statistical test. The analysis will provide two importance values for each hypothesis, the probability value (i.e. significance level) and the standardised coefficient (i.e. prediction value). Moreover, the hypothesis is accepted only if its probability value is below (0.05), or else the hypothesis is rejected. The analysis will provide the standardised coefficient for all the research hypotheses regardless of their probability values, as standardised coefficient must be reported for the accepted and rejected hypotheses. The multiple regression analysis will use the 766 responses to provide the explained variance for the dependent variables (i.e. perceived usefulness, perceived ease of use and behavioural intention), based on the accepted hypotheses.

4.4 Sampling

Sampling is *"the process of selecting a sufficient number of elements from the population"* (Sekaran, 2003). Sampling is very useful technique especially when it is difficult or infeasible to survey the whole research population due to geographical boundaries, survey expenses, or time limits (Saunders et al., 2009). There are two main sampling approaches used to sample the research population, probability sampling and non-probability. Probability sampling assumes every element or individual in the population has an equal chance of being selected to participate in the research (Sekaran, 2003). The most important aspect of probability sampling is to obtain the sampling frame. The sampling frame is a list that contains all of the population that need to be sampled (Sekaran, 2003). However, in cases where the sampling frame is not available or difficult to obtain then probability sampling is not feasible and non-probability sampling needs to be considered (Saunders et al., 2009).

Non-probability sampling offers a range of techniques to enable researchers sampling their study population without sampling frame. This research will use non-probability sampling to identify the research participants for the following reasons. First, it is impractical to survey the whole research population, because of population size. Second, it is difficult to obtain the sampling frame due to universities regulations in Saudi Arabia. Among the non-probability sampling techniques self-selection from the volunteer group was the most suited technique for this research. This sampling technique allows individuals to participate in the research voluntarily without the researcher interference through two steps (Saunders et al., 2009). First, the researcher needs to publicise his or her needs for participants via an appropriate media. Second, collect the data from the participated individuals.

The self-selection criteria for the data collection were as follow: First, the availability of a LMS (e.g. Moodle, Blackboard, WebCT) in the university, the most common used LMS in Saudi universities is Blackboard. Second, the university must promote and support the use of LMS for teaching and learning. This will help students to be more engaged and familiar with the system. Finally, the university must allow the data collection process to be conducted on their students. Three universities have given their approval to participate in this research. These universities are King Faisal University, Dammam University and King Fahd University of Petroleum and Minerals. The ICT department in each university has notified all students by emails to participate in the research, a copy of the questionnaire hyperlink was provided in the email.

4.5 Data collection

Data collection is an important part of research design which involves choosing an appropriate method for the data collection process (Saunders et al., 2009). The research design section explained the suitability of questionnaires as an instrument for data collection. The following section will point out in detail the instrument development stages. The term questionnaire refers to "*all methods of data collection in which each person is asked to respond to the same set of questions in a predetermined order*" (Saunders et al., 2009). The use of questionnaire in general is inexpensive, quick, geographically dispersed, and allows participants to answer without any restraints (Bryman and Bell, 2007; Saunders et al., 2009). Furthermore, there are two main types of questionnaires, self-completed and interviewer-completed. Saunders et al., (2009) suggested five criteria to select an appropriate approach: respondent's characteristics, respondent's importance, distorting respondents, sample size, sample type and number of questions. Based on the above criteria self-completed questionnaire was selected, because the research subject is students, the required sample size is large, type of questions used is Likert-scale and number of questions is relatively high. In addition, the self-completed questionnaire is commonly used as the main method for collecting data in technology acceptance domain (e.g. Ong et al., 2004; Raaij and Schpeers, 2006; Liaw, 2008; Hsia, 2007; Roca and Gagné, 2008; Jong, 2009; Lee, 2009; Park, 2009; Sánchez and Hueros, 2010; Šumak et al., 2010).

4.5.1 Questionnaire Development

Questionnaire design is crucial to the data collection process; because, the design can affects data respond rate, data internal validity and reliability (Saunders et al., 2009). In terms of validity and reliability, Foddy (1993) stated that *"the question must be understood by the respondent in the way intended by the researcher and the answer given by the respondent must be understood by the researcher in the way intended by the respondent"*. For this research, the questionnaire development has gone through many development stages to ensure its validity and reliability. *The first stage* is to identify the measurement items (i.e. measured variables) to measure the developed model variables. The measurement items for each external variable was identified and adapted from literature. Hair et al., (2010) pointed out that for confirmatory research there should be at least two measurement items for each variable in the model. The research identified thirty four measurement items aimed to measure the developed model variables. The adapted measurement items were modified to fit this research context. *The second stage* is to select an appropriate question type. In the technology acceptance research the direct question type to measure users' perception is Likert-scale. In this type of scale *"the respondent is asked how strongly she or he agrees or disagrees with a statement or series of statements, usually on a four,*

five, six or seven-point rating scale" (Saunders et al., 2009). This research uses a five-point Likert-scale with strongly disagree as the lowest scale and strongly agree as the highest scale. Moreover, questions are typed in an agreement statement where users will choose whether they strongly agree or strongly disagree with the statement using five scale points. *The third stage* is concerned with the design of questionnaire layout. Dilman (2007) pointed out the importance of questionnaire layout such as general appearance, clear instructions and questions order. Because having a good layout design can reduce errors and non-response rates. Therefore, the self-completed questionnaires layout design should enable users to read and answer questions easily. In addition, having an attractive layout design will encourage users to complete the questionnaire (Saunders et al., 2009). This research uses an online survey tool (surveymonkey.com) to design the questionnaire layout. Furthermore, Dilman (2007) relates between good cover page and response rate. The developed questionnaire cover page explained and clarified the purpose of the research, the voluntarily participation and the confidentiality aspects of the collected data. *The fourth stage* is concerned with pre-testing the developed questionnaire for validity, reliability, errors and mistakes (Dilman, 2007; Saunders et al., 2009). The developed questionnaire has gone through three pre-testing phases:

- First, a draft of the questionnaire was reviewed by three PhD researchers and two senior lecturers. This will help to elicit suggestions from reviewers based on their knowledge and experience (Dilman, 2007). The overall feedback was positive and some comments were made in regard the questionnaire layout design and questions wording. Based on these comments the questionnaire was improved accordingly.
- Second, the questionnaire was tested in pilot study to emulate the actual data collection procedures. The pilot study was conducted using undergraduate students from Saudi Arabia and United Kingdom. Moreover, a total number of 130 responses were collected; however, due to missing data in 18 responses only 112 responses were used to test the questionnaire. Dilman (2007) suggested for a pilot study a sample size of 100 to 200 is acceptable. The pilot study gave acceptable results of the measurement items through Cronbach's alpha test.
- Thirdly, a final check to the questionnaire was carried out using a new group of PhD researchers to increase the probability of detecting obvious problems (Dilman, 2007). The reviewers completed the questionnaire without any problems. After this step the questionnaire was completed and ready to be used.

4.5.2 Questionnaire Administration and Ethical Consideration

The questionnaire was administrated in three universities, King Faisal University, King Fahd University of Petroleum and Minerals and University of Dammam. Moreover, a copy of the questionnaire was given to each university to get their approval. The three universities approved the questionnaire then an email was sent to all of the undergraduate students through the university email directory. The email included a message requesting students' participation in the study. Moreover, the message included information about the research aim, the research needs for volunteers, and the questionnaire hyperlink created by surveymonkey.com. The data collection process was conducted over six weeks, after the sixth week the questionnaire hyperlink was closed. This research followed the Research Ethical Code in the University of Bedfordshire. The Research Ethical form has been signed and submitted to the Research Graduate School to confirm the research complies with the University research ethical. The data were collected from participants anonymously and personal information such as name, phone number, and email, was not requested. The participation was voluntary and participants were informed that completing the questionnaire constitute their consent to participate. Finally, all of the information provided by the participants were treated confidentially and was used for the purpose of this research only.

4.6 Data Analysis

The Structural Equation Modelling (SEM) technique was used to analyse the research data. SEM is an extension of several multivariate techniques e.g. multiple regression, confirmatory factor analysis, multivariate analysis of variance, that allow *"to simultaneously examine a series of interrelated dependence relationships among the measured variables and latent constructs (variates) as well as between several latent constructs"* (Hair et al., 2010). SEM foundation lies in two multivariate techniques, factor analysis and multiple regression analysis; however, structural equation models can be distinguished by four characteristics (Hair et al., 2010). First, estimate multiple and interrelated dependence relationships. Second, represent the unobserved variables. Third, account for the measurement error. Finally, define a model to explain the set of relationships.

Furthermore, SEM is very useful to test theories that have involved dependence relationships (e.g. A→B→C) (Hair et al., 2010). There are two well-known statistical software packages that enable SEM, Linear Structural Relations (LISREL) and Analysis of Moment Structures (AMOS). This research uses AMOS to conduct the confirmatory factors analysis and multiple regression analysis. The software use graphical shapes to represent variables and regression paths are drawn between the independent and dependent variable. This research will use two SEM techniques

confirmatory factor analysis and multiple regression analysis. First, the confirmatory factor analysis is to measure how good the representation of the measured variables towards their variables. Moreover, the analysis will provide a variety of measures to assess the model goodness of fit in which the theoretical model can be accepted or rejected (Hair et al., 2010). Second, the multiple regression analysis will explain the variance in students' acceptance through perceived usefulness, perceived ease of use and behavioural intention, based on the developed model structure. In addition, the analysis will test the research hypotheses to examine the external variables effect towards students' acceptance. Furthermore, the Statistical Package for the Social Sciences (SPSS) was used for data screening screen (e.g. missing data), before applying the SEM.

4.7 Summary

The chapter presented the research methodology in detail by explaining the research process and design based. The research process explained the two reasoning approaches inductive and deductive. Moreover, this research follows the deductive reasoning approach (i.e. top-down approach) to develop the research model and hypotheses. The acceptance or rejection of the research model and hypotheses will be decided through testing. The research design described both of the qualitative and quantitative approaches, and gave the reasons for choosing a quantitative approach for this research. Moreover, the chapter defined the research population by pointing out the minimum sample size required and how the collected data will be used to confirm or reject a hypothesis. The chapter discussed the appropriate sampling approach to be used for data collection. This research uses the Non-probability sampling known as self-selection strategy to interact with the research participants via questionnaires. Finally, the chapter gives detailed information about the development of the research instrument (i.e. questionnaire) and the statistical analysis techniques that will be used on the data. The next chapter is dedicated for the data analysis. The chapter will be divided into four sections, data screening to ensure the validity of the collected data, assessing the developed model validity by examining the goodness of fit measures, examining the developed model and hypotheses, and investigating the moderating effect of gender.

Chapter Five: Data Analysis

This chapter focuses on the data analysis for the developed model and proposed hypotheses. The research statistical analysis was performed using the Analysis of Moment Structures (AMOS) and the Statistical Package for the Social Sciences (SPSS). The statistical analysis can be divided into three steps. The first step is data screening to ensure the collected data is clean, useful, and valid for testing. In data screening stage, issues like missing data, outliers, normality, linearity and multicollinearity are examined. The second step is to assess the developed model measurements using the confirmatory factor analysis (CFA). The developed model measurements specifies the relationship between the observed variables (i.e. measurement items), and the developed model variables. The confirmatory factor analysis allows the developed model measurements to be checked for goodness of fit, and constructs' validity. The third step is to examine the developed model and research hypotheses via the multiple regression analysis. The developed model specifies the relationships between the variables as they were proposed by the research hypotheses. The multiple regression analysis will calculate the explained variance for the developed model and identify the accepted or rejected hypotheses.

5.1 Data Screening

Raw data might suffer from problems such as missing data, outliers, linearity or normality problems. Therefore, the collected data will be examined to ensure their validity.

5.1.1 Missing Data

Missing data occurred when one respondent fail to answer one or more questions in the questionnaire (Hair et al., 2010). The process of sorting the collected data showed that from the 843 collected responses there were 77 uncompleted responses. These 77 responses have suffered from 70% of missing data, meaning that 77 participants fail to answer half of the questionnaire questions. According to Hair et al., (2010) if one response fails to answer 50% of the questionnaires questions, then the response should be deleted. Therefore, the 77 uncompleted responses were deleted to avoid creating any artificial relationship between the model variables.

5.1.2 Descriptive Statistics

The total completed responses after removing the missing data were 766 responses. All of the completed 766 responses were used for the statistical analysis. Table 5-1 and Table 5-2 show the descriptive statistics of the 766 collected data. Table 5-2 summarises the mean for the 34 measured variables measuring the model variables (see Appendix B).

Table 5-1: Descriptive statistics

Gender	Frequency	Percentage
Male	529	69.1
Female	237	30.9
Total	766	100.0

Table 5-2: The measured variables mean

Measured variables (Appendix B)	*Mean*
Information Quality (IQ)	
IQ1	3.77
IQ2	3.93
IQ3	3.80
Functionality (FL)	
FL1	3.45
FL2	3.40
FL3	3.60
FL4	3.56
Accessibility (A)	
A1	3.77
A2	3.81
A3	3.87
User Interface Design (UID)	
UID1	3.63
UID2	3.59
UID3	3.31
UID4	3.50
Enjoyment (E)	
E1	3.27
E2	3.10
E3	3.28
Computer Playfulness (CP)	
CP1	3.27
CP2	3.05
CP3	2.88
Learning Goal Orientation (LGO)	
LGO1	3.87
LGO2	4.17
LGO3	3.62
LGO4	3.90
LGO5	3.85
Perceived Usefulness (PU)	
PU1	3.80
PU2	3.71
PU3	3.88
Perceived ease of use (PEOU)	
PEOU1	4.08
PEOU2	4.00
PEOU3	3.94
Behavioural Intention (BI)	
BI1	3.59
BI2	3.81
BI3	3.90

$$\boldsymbol{Mean} = \frac{\sum M}{N}$$

M = the sum of the variables

N = the variables number

5.1.3 Normality

Normality refers to the *"degree to which the distribution of the sample data corresponds to a normal distribution"* (Hair et al., 2010). The data can be assessed for normality statistically using Skewness and Kurtosis. Skewness (SI) is measuring the symmetry of the data distribution (Tabachnick and Fidell, 2007). While Kurtosis (KI) describes the shape of data distribution i.e. peaked or flattened, compared to the normal distribution (Hair et al., 2010). Hair et al., (2010) pointed out that a large sample size (i.e. 200 responses) reduces the detrimental effect of non-normality. In addition, the SI and KI values for each measured variables were calculated using SPSS. The results showed (see Table 5-3) that every measured variable was within the acceptable range of the cut-off points (SI < 3) and (KI < 10) recommended by Kline (2011).

$$\boldsymbol{Skewness} = \frac{n}{(n-1)\,(n-2)} \sum_{i=1}^{n} \left(\frac{x_i - \bar{x}}{s}\right)^3$$

x = observation number in the sample
$\hat{X}$ = average numbers in the sample
n = sample size
s = the sample standard deviation

$$\boldsymbol{Kurtosis} = \frac{n-1}{(n-2)\,(n-3)}\,[(n+1)g_2 + 6]$$

n = sample size
$g_2 = \frac{m_4}{m_2^2}$
m_r = Sample moments

Table 5-3: Skewness and Kurtosis results

Variable	Numbering	Measured variable	Skewness	Kurtosis
Information Quality	1	IQ1	-0.8	0.26
	2	IQ2	-0.94	0.87
	3	IQ3	-0.78	0.43
Functionality	4	FL1	-0.49	-0.49
	5	FL2	-0.64	-0.02
	6	FL3	-0.5	-0.58
	7	FL4	-0.7	0.16
Accessibility	8	A1	-0.98	0.77
	9	A2	-0.82	0.97
	10	A3	-1.01	1.39
User-Interface Design	11	UID1	-0.81	0.09
	12	UID2	-0.69	0.17
	13	UID3	-0.58	-0.63
	14	UID4	-0.86	0.13
Computer playfulness	15	CP1	-0.12	-0.73
	16	CP2	0.02	-0.72
	17	CP3	-0.41	0.13
Enjoyment	18	E1	-0.39	-0.49
	19	E2	-0.2	-0.67
	20	E3	-0.43	-0.49
Learning Goal Orientation	21	LGO1	-0.69	0.56
	22	LGO2	-0.59	-0.18
	23	LGO3	-0.98	1.95
	24	LGO4	-0.79	0.54
	25	LGO5	-0.89	0.49
Perceived Usefulness	26	PU1	-0.96	1.21
	27	PU2	-0.78	0.42
	28	PU3	-1	1.19
Perceived Ease of Use	29	PEOU1	-1.21	1.88
	30	PEOU2	-1.19	1.68
	31	PEOU3	-0.95	0.93
Behavioural intention	32	BI1	-0.6	-0.14
	33	BI2	-0.98	0.89
	34	BI3	-1.06	1.01

5.1.4 Univariate and Multivariate Outliers

An outlier is *"observation that is substantially different from the other observations (i.e. has an extreme value) on one or more characteristics (variables)"* (Hair et al., 2010). The data will be examined for two types of outliers, univariate and multivariate. First, univariate outlier is the extreme values in the collected data for each measured variables. There are 34 measured variables measuring the developed model variables, each measured variable will be examined for univariate outliers using SPSS. Identifying univariate outliers can be done by calculating the standardised value (z) for the measured variables. In addition, there are two recommended cut off values to examine univariate outliers. First, cut off value of $z \leq \pm 3.2$ recommended by Tabachnick and Fidell, (2007). Second, cut off value of $z \leq \pm 4$ is recommended by Hair et al., (2010) to studies with large sample size. Thus, the z value recommended by Hair was used due to the research large sample, and the results indicated that all of the measured variables had a z value below ±4.

Second, multivariate outlier analysis is used to identify the extreme values between three variables or more at the same time (Cramer and Howitt, 2004). A multivariate outlier can be calculated by the Mahalanobis distance D^2 (i.e. multivariate assessment measure). However, an observation can be qualified as a multivariate outlier only if $\left({}^{D^2}/_{df}\right) > 4$ where D^2 is the Mahalanobis distance and *df* is the degree of freedom (i.e. number of the measured variables) (Hair et al., 2010). The Mahalanobis distance D^2 was calculated using AMOS and then divided by the number of measured variables *df* =34, and the results showed that none of the observed values qualified as a multivariate outlier. In addition, Table 5-4 shows that the four highest observations value are below the recommended value of 4.

$$\textbf{Mahalanobis Distance} = (x - m)^{T} C^{-1} (x - m)$$

x = data vector
m = independent variables vector of mean
C^{-1}= independent variables inverse covariance matrix
T= transposed vector

Table 5-4: Multivariate outlier results for the four highest observations

Observation number	(D^2/df)
420	3.66
416	3.65
709	3.49
632	3.24

5.1.5 Linearity

Linearity is an implicit assumption of the multivariate methods such as logistic regression, factor analysis and structural equation modelling (Hair et al., 2010). The *linearity* and *deviation from linearity tests* were used to assess the relationship between the independent and dependent variables. The *linearity* and *deviation from linearity tests* were calculated using the compared means of ANOVA. Moreover, to achieve the linearity assumption the *linearity test* result have to be significant (probability value $\leq$ 0.05), while *deviation from linearity test* have to be insignificant (probability value > 0.05). The results showed that all of the relationships between the independent and dependent variables achieved the linearity assumption except for three relationships, perceived ease of use → behavioural intention, perceived ease of use → perceived usefulness, and computer playfulness → perceived ease of use. Even though, these three relationships results were significant towards the *linearity test*, they were also significant towards the *deviation from linearity* test. In this case Gaskin (2012) suggested using the ordinary least squares linear regression to examine such relationships. The three relationships were examined using the squares linear regression. Moreover, the results confirmed the significance of above relationships as their probability values were below the recommended value (p-value $\leq$ 0.05). Consequently, this confirms the linearity of the three relationships.

5.1.6 Conllinearity and Multicollinearity

First, conllinearity occurs when two measured variables for different external variables are highly correlated (Kline, 2011). Moreover, the correlation between the 34 measured variables should be high only between the measured variables measuring the same external variable. For example, the 3 measured variables measuring information quality should not be highly correlated with 3 measured variables measuring accessibility. Hair et al., (2010) pointed out if the correlation between two measured variables belonging to two different external variables is above 0.90, then they are highly correlated. Additionally, Pearson correlation was calculated between the 34 measured variables and 0.65 was the highest correlation value between two different measured variables.

Second, multicollinearity occurs when one independent variable has a high correlation with another set of independent variables (Hair et al., 2010). Multiconllinearity can be assessed by measuring the tolerance for each independent variables, information quality, functionality, accessibility, user interface design, learning goal orientation, computer playfulness and enjoyment. Tolerance is *"the amount of variability of the selected independent variable not explained by the other independent variables"* (Hair et al., 2010). The tolerance calculated by subtracting the R^2 (coefficient of determination) by 1, where the tolerance for an independent variable has to be greater than 0.25 (Menard, 1995). For example, information quality will be regressed by rest of the independent variables to determine the R^2 then subtracted by 1 to calculate the tolerance. This process will be repeated for the entire independent variable at a time. Furthermore, Table 5-6 presents the tolerance calculated for each independent variable indicating no mulicollinearity problem between the independent variables.

Table 5-6: Tolerance results

Variable	Tolerance
Learning Goal orientation	0.94
Information Quality	0.61
Functionality	0.57
Accessibility	0.54
User Interface Design	0.56
Enjoyment	0.62
Computer Playfulness	0.32

5.2 Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis is *"a way of testing how well the measured variables represent a smaller number of constructs"* (Hair et al., 2010). The confirmatory factor analysis assesses the validity of the developed model by examining the 34 measurement variables that were assigned for the model variables (see Appendix B). Confirmatory factor analysis measures how truly the assigned measured variables measure the model variables. Moreover, the confirmatory factor analysis deals with the measurement version of the developed model which is known as the measurement model. In the measurement model the structural relationships between the model variables as proposed by the research are replaced by correlational relationships (i.e. covariance). Figure 5-1 shows the measurement model representation in IBM AMOS connecting the developed model variables, behavioural intention (BI), perceived usefulness (PU) and perceived ease of use (PEOU), information quality (IQ), accessibility (A), functionality (FL) and user interface design (UID), learning goal orientation (LGO), computer playfulness (CP) and enjoyment (E). The confirmatory factor analysis will validate the developed model through three measures unidimensionality, goodness of fit measures and constructs validity. Furthermore, IBM AMOS (Version 19) was used for the confirmatory factor analysis.

Confirmatory Factor Analysis $\tilde{\sum} = \wedge\ \Phi\ \wedge^{T} + \Psi$

$\tilde{\sum}$ = covariance matrix
$\wedge$ = factor loading matrix
Cov (F) = Φ
Cov (ε) = Ψ
Cov (X) = $\sum$
X = centred observed variables
ε = specific factors
F= common factors

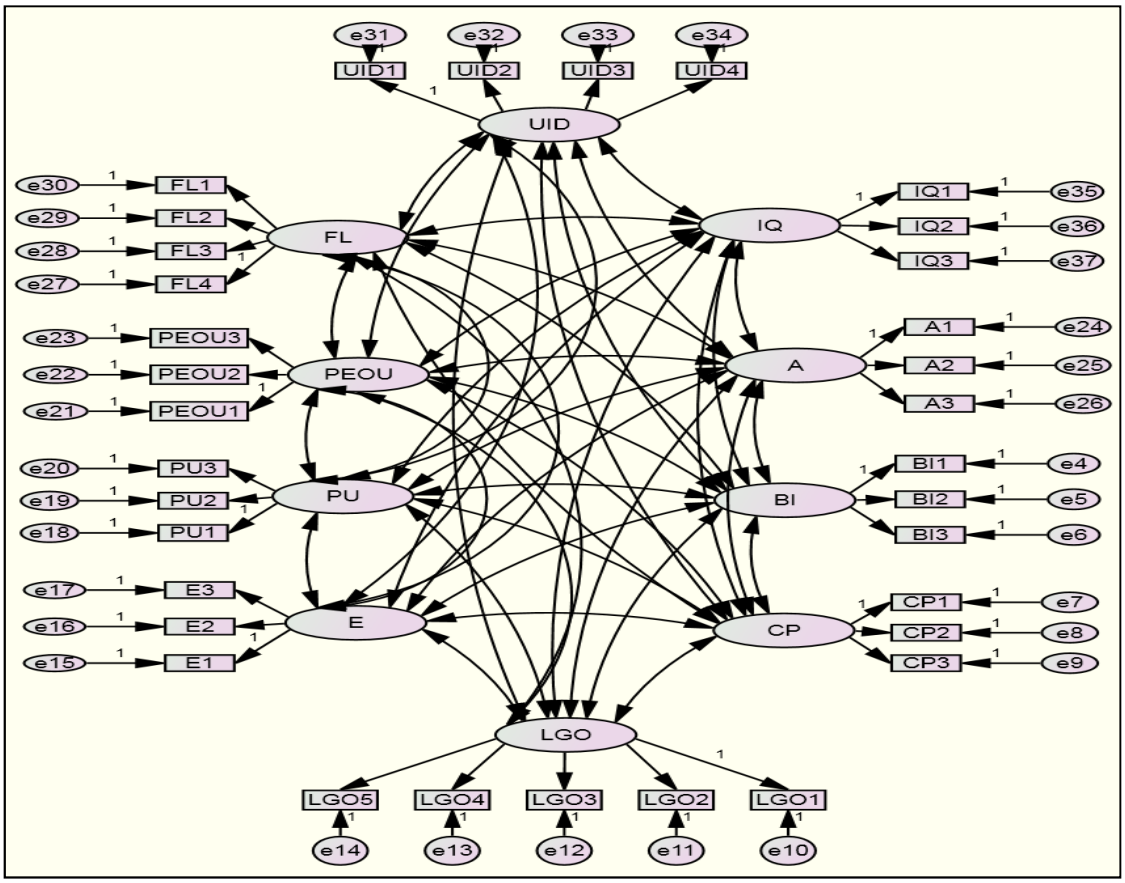


Figure 5-1: The measurement model in IBM AMOS

5.2.1 Unidimensionality

Unidimensionality assumes the measured variables have one underlying dimension (i.e. model variables) (Janssens et al., 2008). Figure 5-1 shows the 34 measured variable and the 10 model variables, each of the ten variables have an assigned number of measured variables. For example, learning goal orientation (LGO) variable has 5 measured variables (i.e. 5 questions), LGO1, LGO2, LGO3, LGO4, LGO5. Additionally, to ensure every measured variables have a unidimensional relationship with their main variables there are two conditions. First, the measured variable factor loading must be higher than 0.50. Second, the factor loading must be significant (t-value > 1.96) (Janssens et al., 2008). The factor loading results based on the confirmatory factor analysis confirmed the unidimensionality for all the measured variables except for one measured variable (see Table 5-7). The measured variable LGO4 measuring learning goal orientation could not achieve the minimum recommend factor loading value. Therefore, this measured variable becomes a candidate for deletion to improve the model validity (Hair et al., 2010).

Table 5-7: The factor loading for the measured variables

Variable	Measured Variable	Observed Variable Loading	t-value
Behavioural Intention	BI1	0.796	***
	BI2	0.910	27.074
	BI3	0.738	20.971
Perceived Usefulness	PU1	0.807	***
	PU2	0.854	26.794
	PU3	0.788	22.063
Perceived Ease of Use	PEOU1	0.823	***
	PEOU2	0.876	27.058
	PEOU3	0.785	23.644
Information Quality	IQ1	0.811	***
	IQ2	0.837	24.045
	IQ3	0.768	21.578
Accessibility	A1	0.758	***
	A2	0.879	24.483
	A3	0.871	24.591
Functionality	FL4	0.731	***
	FL3	0.732	18.381
	FL2	0.753	18.445
	FL1	0.571	14.118
User Interface Design	UID1	0.783	***
	UID2	0.689	19.28
	UID3	0.792	21.136
	UID4	0.770	20.256
Learning Goal Orientation	LGO1	0.681	***
	LGO2	0.543	12.036
	LGO3	0.687	14.07
	LGO4	0.499	10.878
	LGO5	0.573	11.895
Computer Playfulness	CP1	0.715	***
	CP2	0.831	19.797
	CP3	0.728	17.784
Enjoyment	E1	0.846	***
	E2	0.904	32.739
	E3	0.869	30.205

*** = t-value > 1.96 (i.e. the factors loading is significant > 1.96)

5.2.2 Goodness of Fit measures (GOF)

Goodness of Fit measures indicates *"how well the specified model reproduces the observed covariance matrix among the indicator items"* (Hair et al., 2010). The research selected five measures to assess the developed model validity, goodness of fit index, root mean square error of approximation, standardised root mean residual, comparative fit index and Tucker-Lewis index. The five selected measures are the most recognised and commonly used in information system research (Hair et al., 2010). Furthermore, the significance (probability value) of chi-square x^2 and normed chi-square (NC) will not be used as a measure of GOF because of the following reasons: First, the significant of chi-square can be misleading because; chi-square is sensitive to large sample size (Schumacker and Lomax, 2004; Hair et al., 2010). For example, Hair et al., (2010) pointed out that a model with a sample size over 250 a nd m variables more than 12 is always expected to have a significant chi-square even if the model is fit (a fit model should have a non-significant chi-square). Second, Hair et al., (2010) indicates that the cut-off value (3:1) suggested for NC might not be applicable to models with large sample size (larger than 750). Moreover, Kline (2011) states that *"because there is little statistical or logical foundation for NC, it should have no role in model fit assessment"*. More details about the five selected goodness of fit measures as follow:

A. Goodness of Fit Index (GFI): This measure value range is between 0 and 1. Moreover, the minimum acceptable value is greater than 0.90 (Janssens et al., 2008; Hair et al., 2010). According to Hair et al., (2010) there is a decline in GFI usage because it is being sensitive to the sample size. In addition, the Adjusted Goodness of Fit Index (AGFI) takes into account the different aspects if model complexity and the recommended cut-off value is AGFI > 0.80 (Janssens et al., 2008).

$$\mathbf{GFI} = 1 - \frac{\hat{F}}{\hat{F}_b}$$

$\hat{F}$ = minimum value of the discrepancy function
$\hat{F}_b = \sum^{(g)} = 0,\ g = 1,2,\ldots,G.$

B. Root Mean Square Error of Approximation (RMSEA): One of the most widely used measures of GOF. A value of RMSEA between 0.05 and 0.08 is acceptable (Janssens et al., 2008; Hair et al., 2010).

$$\textbf{RMSEA} = \sqrt{\frac{\hat{F}_0}{d}}$$

$\hat{F}$ = minimum value of the discrepancy function
d = degree of freedom

C. Standardised Root Mean Residual (SRMR): The average standardised residual and the recommended cute-off value for SRMR is to be lower than 0.08 (Janssens et al., 2008).

$$\boldsymbol{SRMR} = \sqrt{\frac{2}{k(k+1+2\delta)}\left[\sum_i^K \sum_j^i \frac{(c_{ij} - \hat{\sigma}_{ij})^2}{c_{ii}c_{jj}} + \delta \sum_i^k \frac{(\bar{\chi}_i - \hat{\mu}_i)^2}{c_{ii}}\right]}$$

K = the number of identified variables
C = correlation matrix
$\bar{\chi}_i$ = the sample means of the p-vector
$\hat{\mu}_i$= the mean vector predicted
$\hat{\sigma}_{ij}$= the correlation matrix predicted
δ = the structures mean

D. Comparatives Fit Index (CFI): One of the common used GOF measure, because it is less sensitive to model complexity (Hair et al., 2010). CFI value above 0.90 indicates that the model has a good fit (Janssens et al., 2008; Hair et al., 2010).

$$\textbf{CFI} = 1 - \frac{\max(\hat{C} - d, 0)}{\max(\hat{C}_b - d_{b,0})}$$

$(\hat{C} - d, 0)$= the non-centrality, degree of freedom and discrepancy parameters for the model being evaluated.
$(\hat{C}_b - d_{b,0})$ = the non-centrality, degree of freedom and discrepancy parameters for the baseline model.

E. *Tucker-Lewis Index (TLI):* The value can fall below 0 and above 1. A TLI value close to 1 indicates a good model fit (Hair et al., 2010). A recommended cut-off value for TLI is greater than 0.90 (Janssens et al., 2008).

$$\mathbf{TLI} = \frac{\frac{\hat{C}_b}{d_b}}{\frac{\hat{C}_b}{d_b}} - \frac{\frac{\hat{C}}{d}}{1}$$

$\hat{C}$ = the discrepancy of the model being evaluated.
d = the degree of freedom of the mode the model being evaluated
$\hat{C}_b$= the discrepancy of the baseline model.
d_b= the degree of freedom of the baseline model.

The confirmatory factor analysis calculated the five goodness of fit measures for the 766 completed collected data. The results confirmed the validity of the developed model over five measures AGFI, RMESA, SRMR, CFI and TLI (see Table 5-8). However, model achieved only 0.90 in the GFI measure, where the recommended value should be over 0.90. Additionally, there are two methods to improve the developed model result over the GFI measure.

1. The Squared Multiple Correlations (SMCs) (i.e. communalities): The developed model validity can be improved by removing any measured variable with a low communality value (lower than 0.5) (Hair et al., 2010). The SMCs results are calculated as part of the confirmatory factor analysis. The analysis results identified five measured variables with a communality value less than the recommended value. These five measured variables are user interface design 2 (UID2), functionality 1 (FL1), and learning goal orientation 2, 4, 5 (LGO2) (LGO4) (LGO5) (see Table 5-9).

2. Factor loadings (i.e. standardised regression weights): The factor loadings for the measured variables have to be at least 0.5 or the variable becomes a candidate for removal (Hair et al., 2010). The factor loadings for the measured variables were calculated via confirmatory factor analysis (see Table 5-7). The results showed one measured variable with low factor loading, learning goal orientation 4 (LGO4 $\leq$ 0.5).

Based on the Squared Multiple correction and factor loading results, the five identified measured variable will be removed to improve the developed model validity over the GFI measure. The goodness of fit of measures was calculated again for the developed model after the five measured variable were removed. The developed model gave better results over all of the goodness of fit measures when the five measured variables were removed (see Table 5-10).

Table 5-8: The research model fit summary

GOF	x^2	df	**GFI**	**AGFI**	**RMSEA**	**SRMR**	**CFI**	**TLI**
The Research Model	1387.561	482	0.900	0.876	0.050	0.043	0.939	0.929

Table 5-9: Squared Multiple Correlations

Variable	Extraction Value
UID2	0.475
FL1	0.326
LGO2	0.295
LGO4	0.249
LGO5	0.328

Table 5-10: Refined model fit summary comparison

The developed model	x^2	df	**GFI**	**AGFI**	**RMSEA**	**SRMR**	**CFI**	**TLI**
Before removing the 5 measured variables	1387.561	482	0.900	0.876	0.050	0.044	0.939	0.929
After removing the 5 measured variables	1068.540	332	0.909	0.881	0.050	0.045	0.946	0.933

5.2.3 Constructs Validity

Construct validity can be defined as *"the extent to which a measure assesses the construct that it is intended or supposed to measure"* (Cramer and Howitt, 2004). The constructs' validity of the developed model will be assessed by the following two components: Firstly, convergent validity which refers to *"the extent to which a measure is related to other measures which have been designed to assess the same construct"* (Cramer and Howitt, 2004). Convergent validity can be assessed by using the average variance extracted (AVE). The average variance extracted value can be calculated by dividing the total of all squared standardised factors loading on the number of measured variables. Moreover, the average variance extracted (AVE) values will be compared to the maximum square variance (MSV) to examine the measured variables discriminat validity. Discriminat validity refers to the extent in which a variable is very distinctive from other variables (Hair et al., 2010). According to Hair et al., (2010) the average variance extracted value must be above 0.5 to ensure convergent validity and the average variance extracted has to be higher than maximum square variance to ensure discriminat validity. Table 5-11 confirms the convergent validity and discriminat validity for each variable in the developed model.

$$\textbf{Average variance extracted} = \frac{\sum_{i=1}^{n} \lambda_i^2}{n}$$

N = the number of measurements for one variable
λ_i^2 = the sum of the squared factors loading

Secondly, reliability which measures the consistency of the measured variables will be assessed by Cronbach's Alpha. Hair et al., (2010) recommended a value of 0.7 or higher for good reliability. However, reliability between 0.6 and 0.7 is still acceptable only if the variable has passed the convergent and discriminant validity tests. The results showed that all of the variables have achieved a good reliability except for learning goal orientation which had a value of 0.65 (see Table 5-11). The value of learning goal orientation is still acceptable, because the variable has met the two conditions of convergent and discriminant validity (Hair et al., 2010).

$$\textbf{Cronbach's Alpha } \alpha = \frac{N.\bar{C}}{\bar{V} + (N-1).\bar{C}}$$

N = the number of measurements for one variable
$\bar{C}$ = inter-item covariance among measurements
$\bar{V}$ = the average variance

Table 5-11: Constructs' validity

Variable	Cronbach's Alpha (α)	Average variance extracted	Maximum square variance
Accessibility (A)	0.869	0.702	0.436
Information Quality (IQ)	0.844	0.649	0.542
Functionality (FL)	0.787	0.552	0.542
User Interface Design (UID)	0.831	0.631	0.404
Learning Goal Orientation (LGO)	0.648	0.504	0.061
Computer Playfulness (CP)	0.796	0.578	0.429
Enjoyment (E)	0.905	0.763	0.429
Perceived Ease of Use (PEOU)	0.866	0.687	0.387
Perceived Usefulness (PU)	0.854	0.667	0.507
Behavioural Intention (BI)	0.844	0.669	0.507

5.3 Structural Equations Modelling (SEM)

Structural equation modelling is a *"Multivariate technique combining aspects of factor analysis and multiple regressions that enables the researcher to simultaneously examine a series of interrelated dependence relationships among the measured variables and the latent constructs"* (Hair et al., 2010). Structural equation modelling will use multiple regression analysis (γ) to examine the developed model and research hypotheses. The structural equation modelling was performed using IBM Analysis of Moment Structures (AMOS), which allow examining the developed model fit, explained variance and the research hypotheses. Figure 5-2A shows the developed model and Figure 5-2B shows the developed model representation in IBM AMOS. Moreover, in Figure 5-2B the large oval shapes represent the model ten variables, the square shapes represent the measurement variables, and the small oval shapes represent the error term for each measurement variable.

Multiple regression analysis $\gamma = b_0 + b_1V_1 + b_2V_2 + \cdots + b_nV_n + e$

b_0 = constant number, $\gamma -$ intecept
b_1= the coefficient of the first predictor variable
b_2 = the coefficient of the second predictor variable
V_1= the first predictor variable
V_2 = the second predictor variable
e = the prediction error (residual)

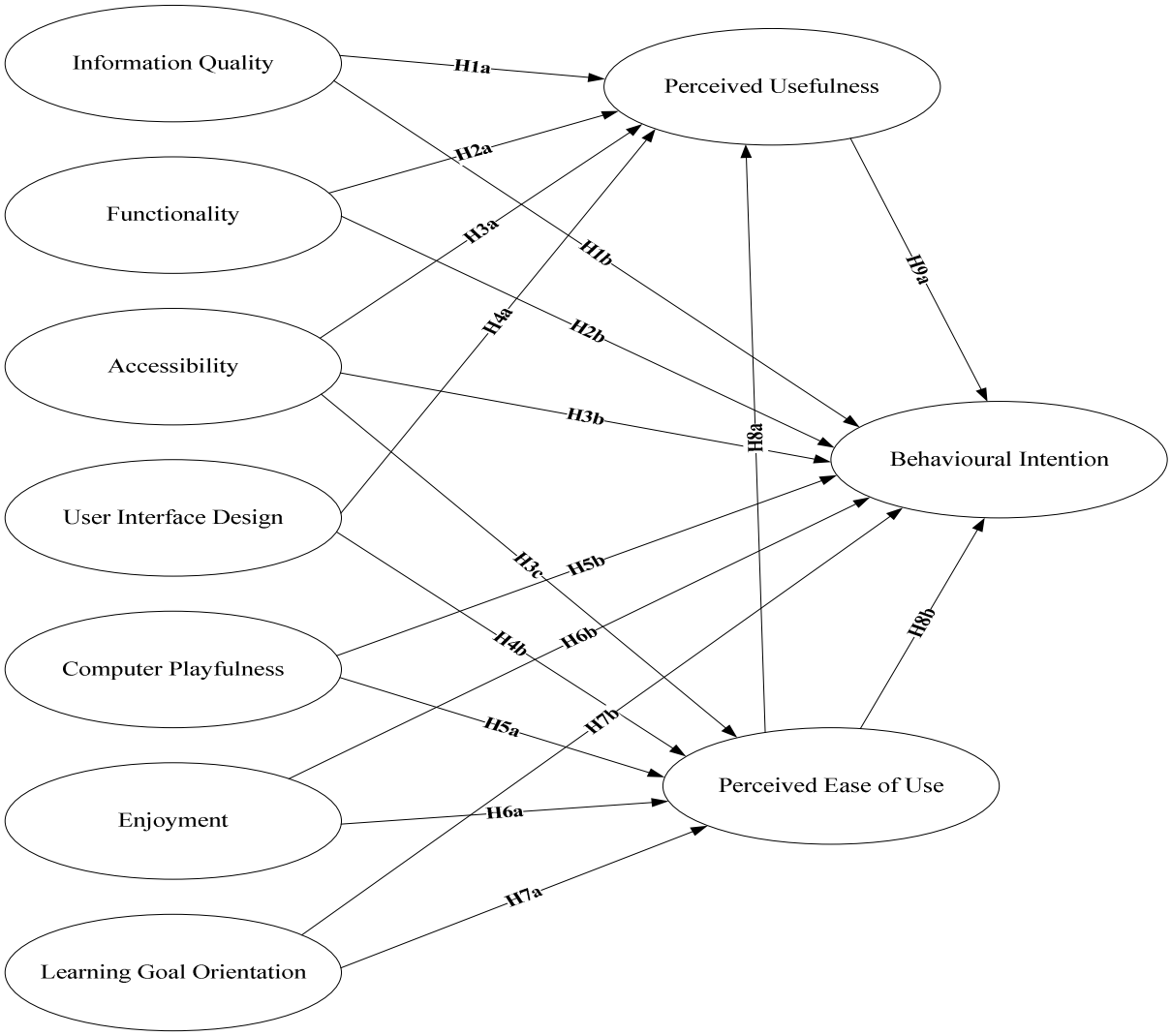


Figure 5-2A: The developed model

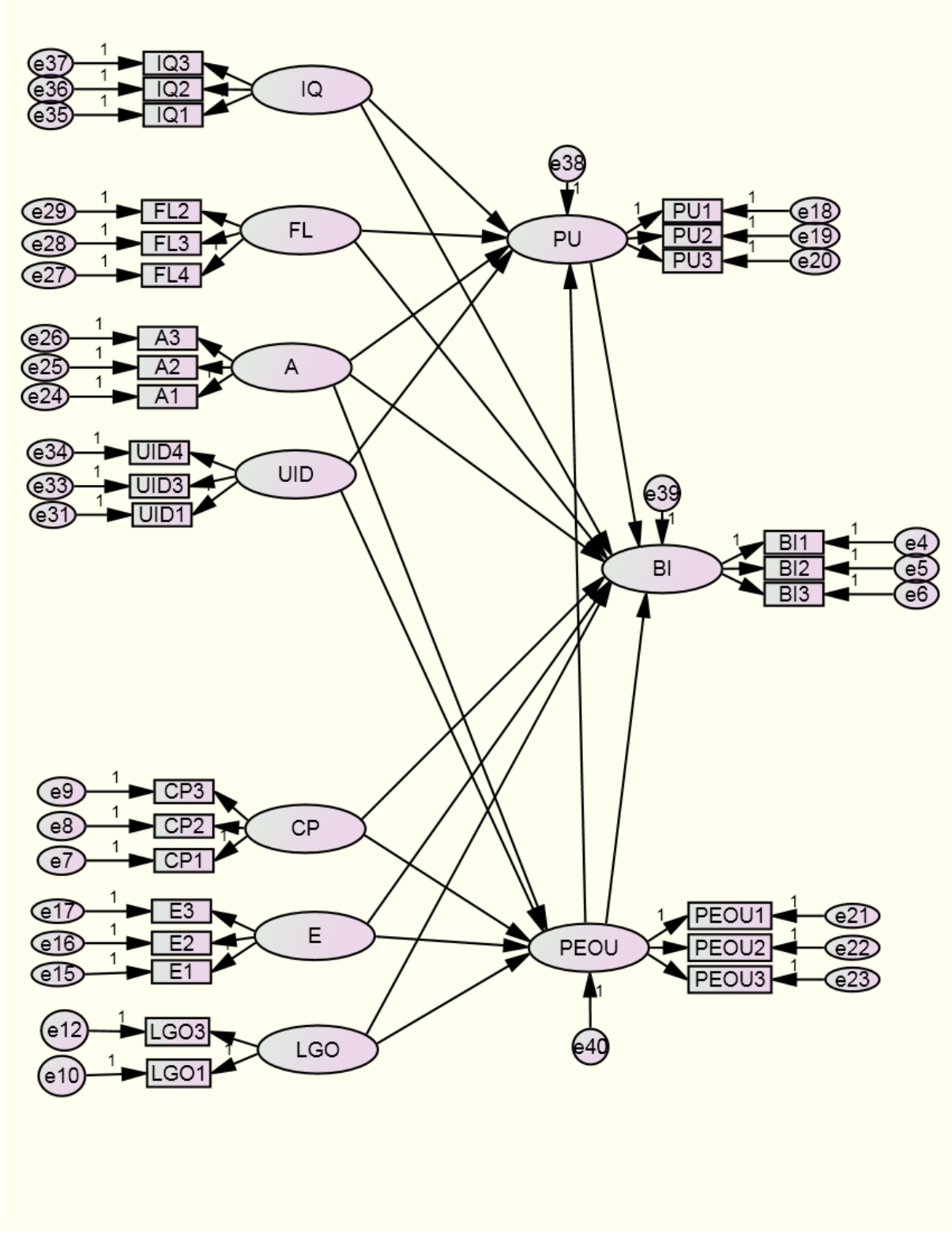


Figure 5-2B: The developed model representation in IBM AMOS.

5.3.1 The Fit of the Developed Model

The developed model goodness of fit was measured by using five measures, Goodness of Fit Index (GFI), Root Mean Square Error of Approximation (RMSEA), Standardised Root Mean Residual (SRMR), Comparatives Fit Index (CFI), and Tucker-Lewis Index (TLI). All of these measures were explained in section 5.2.2. Moreover, the results confirmed developed model goodness of fit over the fives measures (see Table 15-12).

Table 5-12: The research model fit results

GOF	x^2	df	**GFI**	**AGFI**	**RMSEA**	**SRMR**	**CFI**	**TLI**
The Research Model	1164.887	338	0.901	0.873	0.057	0.053	0.939	0.927

5.3.2 The Developed Model Results

The multiple regression analysis examined the developed model in term of the explained variance and research hypotheses. The results confirmed the significance of the developed model, the model performed better than the existing models in explaining students' acceptance of LMSs through behavioural intention, perceived usefulness and behavioural intention. Moreover, the results confirmed that six out of seven identified variables are critical to predict students' acceptance of LMSs in Saudi Arabia. These variables are information quality, functionality, accessibility, user interface design, enjoyment, enjoyment and learning goal orientation. The six variables were good predictors of students' perceived usefulness, perceived ease of use and behavioural intention. Furthermore, the six variables explained a high percentage of variance in between the dependent variables. Figure 5-3 shows the six variables with their standardised coefficient (i.e. prediction value) and significance level represented in straight and dotted arrow; the explained variance value is represented inside perceived usefulness, perceived ease of use and behavioural intention.

Moreover, the multiple regression analysis tested the research hypotheses using the probability value (i.e. significance level) and standardised coefficient (i.e. prediction value). First, the probability value is defined as *"the probability that a statistic would occur by sampling error-if the null hypothesis is true"* (Vogt and Johnson, 2011). The required probability value (P-value) to accept the research hypothesis is where (P-value ≤ 0.05), a probability value where (P-value $>$ 0.05) will cause to the hypothesis to be rejected (Hair et al., 2010). Second, the standardised coefficient (β) is *"A statistic that provides a way to compare the relative importance of different variables in a multiple regression analysis"* (Vogt and Johnson, 2011). The standardised

coefficient will point out the prediction value for the independent variable towards the dependent variable. The statistical analyses showed from the 18 proposed hypotheses, 12 hypotheses were accepted and 6 hypotheses were rejected. Figure 5-3 shows the 12 accepted hypotheses represented with a straight arrow line and the 6 rejected hypotheses with a dotted arrow line. Moreover, the value above the arrow lines represents the standardised coefficient for the accepted and rejected hypotheses. Additionally, Table 5-13 gives detailed information about the hypotheses testing results.

Figure 5-2A and Figure 5-3 represent the same developed model. Figure 5-2A shows the developed model before the statistical analysis where the relationships between the model variables represent the hypotheses. While, Figure 5-3 shows the developed model after the statistical analysis, the probability value and standardised coefficient for each hypothesis is presented. As a result, the predictions and hypotheses proposed in chapter 3 (section 3.3) for the developed model Fig 5-2A are also elaborated in Fig 5-3. Moreover, Figure 5-2B shows the developed model structural representation in IBM AMOS. However, IBM AMOS does not represent the significance level of a hypothesis on the model figure. Therefore, Figure 5-3 was redrawn with MS Visio to make the results apparent and readable. The hypotheses probability value (i.e. significance level) in Figure 5-3 was represented with an arrow line. The accepted hypothesis was presented with straight, while the rejected hypothesis was presented with dotted line. Furthermore, the developed model results presented in Figure 5-3 can be explained as follow.

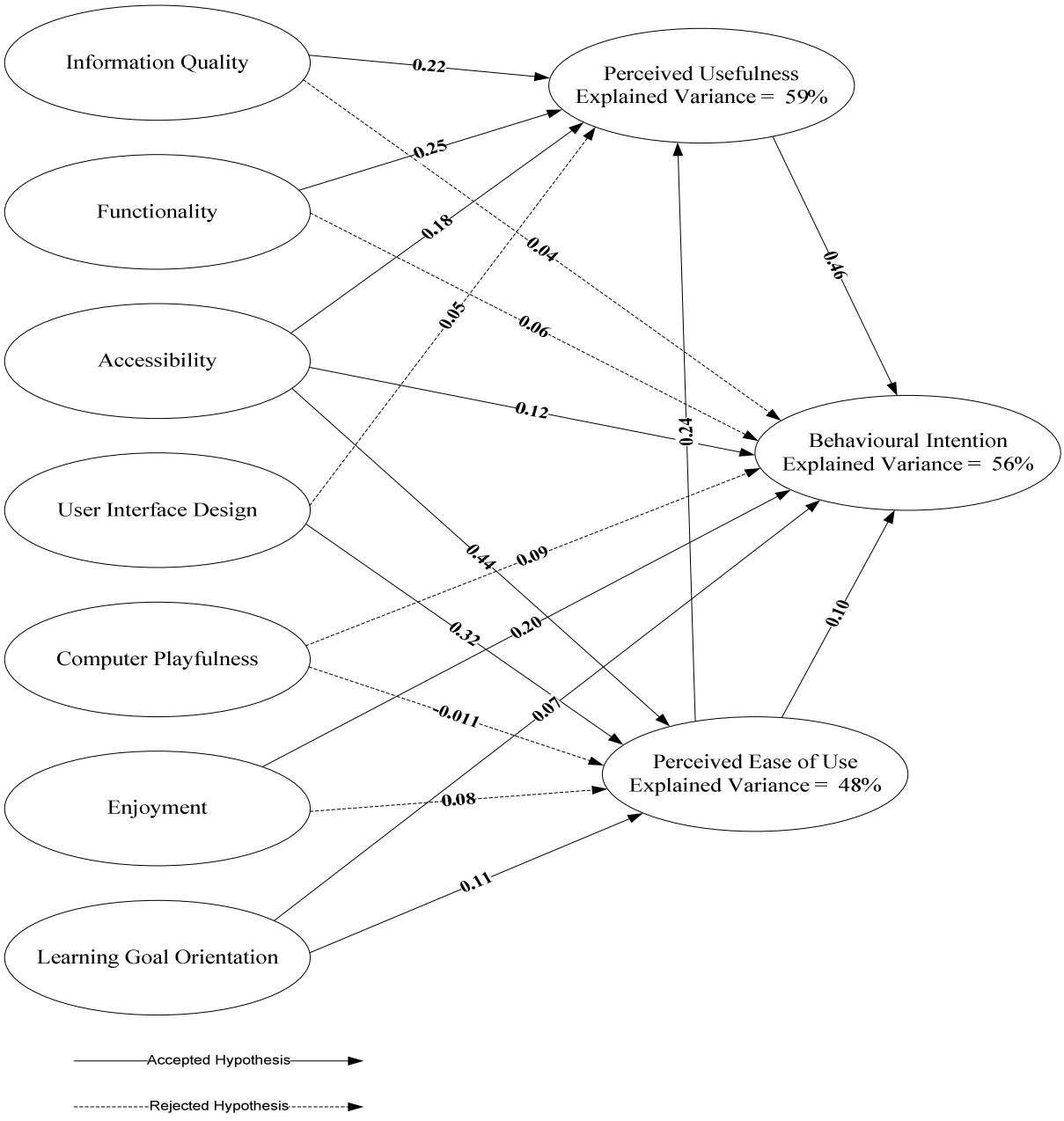
First, perceived usefulness (H9a) was the strongest determinate of behavioural intention (β = 0.458, P-value $\leq$ 0.01). Second, perceived ease of use had a positive affect towards perceived usefulness (H8a) and behavioural intention (H8b) with (β = 0.237, P-value $\leq$ 0.01) and (β = 0.100, P-value $\leq$ 0.01) respectively. The results showed that perceived ease of use was the third strongest determinants of behavioural intention, subsequent to perceived usefulness and enjoyment. TAM constructs were functional and significant in predicting students' behavioural intention. Third, information quality was hypothesised to have a positive effect on students' perceived usefulness (H1a) and behavioural intentions (H1b). The first hypothesis was accepted with standardised coefficient of (β = 0.215) and probability value of (P-value < 0.01). The significance of (H1a) hypothesis was consistent with the previous research (e.g. Yanjun et al., 2010; Cheng, 2011). On the other hand, the second hypothesis (H1b) testing information quality towards behavioural intention was rejected, because the probably value was higher than (0.05). The insignificance of (H1b) is possibly due to the mediating effect of perceived usefulness. The

meditating effect of perceived usefulness can be examined by calculating the probability value of the following relationship information quality → perceived usefulness → behavioural intention. The results showed the probability value of information quality towards behavioural intention through perceived usefulness was significant (P-value = 0.03 ≤ 0.05). This means that perceived usefulness is fully mediating the relationship between information quality and behavioural intention; therefore, hypothesis (H1b) was insignificant. Fourth, functionality was hypothesised to have a positive effect towards perceived usefulness (H2a) and behavioural intention (H2b). The first hypothesis (H2a) was accepted with (β = 0.252, P-value ≤ 0.01), the effect of functionality towards perceived usefulness was stronger than information quality. The second hypothesis (H2b) was rejected, because the relationship between functionality and behavioural intention is fully mediated by perceived usefulness.

Fifth, accessibility was hypothesised to positively affect three variables, perceived usefulness (H3a), perceived ease of use (H3b), and behavioural intention (H3c). All of the three hypotheses were accepted however, accessibility strongest effect was towards perceived ease of use with standardised coefficient and probability value of (β = 0.441, P-value ≤ 0.01). The standardised coefficient and probability value towards perceived usefulness and behavioural intention were (β = 0.177, P-value ≤ 0.01) and (β = 0.120, P-value ≤ 0.05) respectively. Park (2009) pointed out that for e-learning systems accessibility becomes important in environments with low IT and Internet infrastructure. This possibly explains the significant impact of accessibility towards students' perceived usefulness, perceived ease of use, and behavioural intentions. Sixth, user interface design was proposed to have a positive affect towards, perceived usefulness (H4a), perceived ease of use (H4b). Based on the results, user interface design (H4b) was the second strongest determinant of perceived ease of use, after accessibility with (β = 0.320, P-value ≤ 0.01). However, user interface design did not influence students' perception of the system usefulness due to the insignificance relationship between user interface design and perceived usefulness (P-value = 0.13 ≥ 0.05).

Seventh, computer playfulness hypotheses (H5a) and (H5b) were both rejected. The two hypotheses (H5a) and (H5b) had a probability value higher than the recommended threshold (0.05). The insignificance of computer playfulness towards perceived ease of use and behavioural intention is possibly because students perceived the extrinsic variables as more important towards their acceptance of LMSs. Furthermore, enjoyment was hypothesised to have a positive effect towards perceived ease of use (H6a) and behavioural intention (H6b). The first Hypothesis (H6a) was rejected with (β = 0.078, P-value ≥ 0.05), and the second hypothesis (H6b) was accepted

with (β = 0.199, P-value ≤ 0.05). Enjoyment was the second strongest determinant of students' behavioural intention. Finally, learning goal orientation hypotheses (H7a) and (H7b) were both accepted. Learning goal orientation influential effect was mainly towards perceived ease of use with a standardised coefficient (β = 0.108). Moreover, even though the effect of learning goal orientation towards behavioural intention was significant, the standardised coefficient was low (β = 0.07).



The numbers represent the standardised coefficient

Figure 5-3: The developed model results

Table 5-13: Hypotheses testing results

Hypothesis	Paths			Standardised coefficient *(β)*	Probability value $(P - value \leq 0.05)$	Hypothesis result based on the probability value
H1a	IQ	→	PU	0.215	***	Accepted
H1b	IQ	→	BI	0.037	0.239	Rejected
H2a	FL	→	PU	0.252	***	Accepted
H2b	FL	→	BI	0.061	0.305	Rejected
H3a	A	→	PU	0.177	***	Accepted
H3b	A	→	PEOU	0.441	***	Accepted
H3c	A	→	BI	0.120	**	Accepted
H4a	UID	→	PU	0.049	0.126	Rejected
H4b	UID	→	PEOU	0.320	***	Accepted
H5a	CP	→	PEOU	-0.107	0.135	Rejected
H5b	CP	→	BI	0.094	0.124	Rejected
H6a	E	→	PEOU	0.078	0.221	Rejected
H6b	E	→	BI	0.199	**	Accepted
H7a	LGO	→	PEOU	0.108	***	Accepted
H7b	LGO	→	BI	0.071	**	Accepted
H8a	PEOU	→	PU	0.237	***	Accepted
H8b	PEOU	→	BI	0.100	***	Accepted
H9a	PU	→	BI	0.458	***	Accepted

*** = P – value ≤ 0.01, ** = P-value ≤ 0.05

5.4 The Moderating Effect of Gender

The importance of gender has been pointed out in sections 1.5 and 3.2.2.9. The research model will be examined from two prospective, the measurement and structural. In the measurement model, the research model will examined for the differences between genders in term of the measured variables. In the structural model, the research model will be examined for the differences between genders in term of the hypotheses. The multi group analysis in AMOS categorise the data based on the grouping value (i.e. gender), and the group analyse will be performed simultaneously between genders (Byrne, 2010).

Moreover, the difference in chi-square Δx^2 will be used to examine if there significant different between genders on the measurement and structural models level. Chi-square is *"statistical measure of difference used to compare and estimated covariance matrices"* (Hair et al., 2010). The chi-square x^2 will be calculated for the measurement model via the confirmatory factor analysis, and for the structural model via the structural equation modelling. The difference in chi-square Δx^2 can be computed by calculating the chi-square x^2 for the targeted model twice; first without weight constrains and second with weight constrains (Byrne, 2010). If the difference in chi-square Δx^2 is significant then the model is not equivalent over genders.

The measurement model test: The chi-square for the measurement model was calculated before and after applying the weight constrains to the measured variables. The results showed that there is no significant different (chi-square $\Delta x^2 = 24.378$ and $\Delta \text{df} = 19$), which means that the perception of males and females towards the measured variables is the same (see Table 5-14). The difference in chi-square Δx^2 result significance can be decided using Chi-Square Distribution Table which is commonly used in statistics.

Table 5-14: The chi-square Δx^2 for the measurement model

Measurement Model	x^2	df (degree of freedom)
Unconstrained Model	1527.750	664
Constrained Model	1552.128	683
The difference in chi-square Δx^2	24.378	19

The structural model test: The chi-square for the structural model was calculated before and after applying the weight constrains to the research hypotheses. The results showed that there is a significant difference between males and females in between the research hypotheses (see Table 5-15). After proving that there is a significant difference between males and females towards the research hypotheses; the next step will be to identify the hypotheses that are causing these

differences. The identification of these hypotheses will be by repeating the weight constrains method on each hypothesis individually and calculate the difference in chi-square Δx^2 again. There research model contains of 18 hypotheses thus, the difference in chi-square Δx^2 was calculated 18 times for each hypothesis.

The analysis showed that there are five hypotheses that are significant different between genders (see Table 5-16). Among the variables that were hypothesised to affect perceived ease of use, learning goal orientation was the only variable that males and females had different perception toward it. Where hypothesis H7a (learning goal orientation) was accepted for males and rejected for females. Moreover, the hypotheses for information quality (H1a) and functionality (H2a) toward perceived usefulness were significantly different between genders. Finally, the differences between genders toward behavioural intention were between two variables computer playfulness (H5b) and enjoyment (H6b). Furthermore, the structural model test showed that the explained variance (i.e. the variance in the dependent variable that was accounted for by the independent variables) towards the dependent variables, perceived usefulness, perceived ease of use and behavioural intention, was different between the two genders (see Table 5-17).

Table 5-15: The chi-square Δx^2 for the structural model

Structural Model	x^2	df (degree of freedom)
Unconstrained Model	1619.886	676
Constrained Model	1662.095	694
The difference in chi-square Δx^2	42.209	18

Table 5-16: The significantly different hypotheses over genders

Hypothesis	Paths			Male		Female	
				Standardised coefficient	Probability value ($P - value \leq 0.05$)	Standardised coefficient	Probability value ($P - value \leq 0.05$)
H7a	LGO	→	PEOU	0.137	***	0.067	0.203
H1a	IQ	→	PU	0.366	***	0.120	0.181
H2a	FL	→	PU	0.100	0.141	0.602	***
H5b	CP	→	BI	0.208	***	0.412	0.145
H6b	E	→	BI	0.112	0.134	0.702	**

*** = P – value ≤ 0.01= Accepted, ** = P-value ≤ 0.05 = Accepted

Table 5-17: The explained variance for the dependent variables between genders

Gender	Perceived Usefulness	Perceived Ease of Use	Behavioural Intention
Male	61%	52%	63%
Female	66%	48%	47%

5.5 Summary

This chapter presented the data analysis for the developed model and research hypotheses. This chapter can be divided into four main sections based on the statistical analysis, data screening, confirmatory factor analysis, multiple regression analysis and multiple group analysis. In data screening the collected data was examined for missing data, normality, linearity, outliers and multicollinearty. In confirmatory factor analysis the developed model was examined for unidimensionality, goodness of fit and constructs validity. First, unidimensionality to ensure the measured variables are loading into one underlying variable. All of the measured variables have achieved the unidimensionality condition by having factor loading above (0.50), except for one measured variable (LGO4). Second, the developed model goodness of fit was measured using five measures, GFI, AGFI, RMSEA, SRMR, CFI and TLI. The developed model has passed the goodness of fit measure among the five measures. Moreover, the model goodness of fit was further improved by removing five measured variables that have not achieved the squared multiple correlations and factor loadings conditions.

Third, the multiple regression analysis was used to examine the developed model and research hypothesis. The results confirmed the model ability to explain better variance among the dependent variables. Moreover, the research hypothesis supported the importance of six variables to predict students' acceptance of LMSs. Finally, the multiple group analysis examined the gender differences effect on the developed model. The results showed that both genders have different perception towards the model variables. The next chapter will discuss the data results and findings in details. The chapter will discuss the results in term of the model variables. Moreover, the variable will be also discussed based on their dimension, intrinsic or extrinsic. Furthermore, the chapter will evaluate the developed model performance by comparing its results with the existing models results. Finally, the chapter will discuss the gender differences effect towards the developed model.

Chapter Six: Discussion

This chapter will discuss the data analysis results in term of the research model variables, hypotheses, and performance. The significance of each variable will be explained individually and as a group depending whether they belong to the extrinsic or intrinsic group. The research model performance will be measured by the explain variance in the dependent variables which are perceived usefulness, perceived ease of use, and behavioural intention. The research model performance results will be compared against similar models used in the e-learning context. Finally, the moderating effect of gender will be discussed by pointing out the differences in males and females perception.

6.1 Results Discussion

The goal of the research was to develop an enhanced technology acceptance model to explain students' acceptance of LMSs in Saudi Arabia. Moreover, the research explored the influence of the intrinsic and extrinsic variables in the learning environment. The intrinsic and extrinsic variables were operational in the research model through perceived usefulness, perceived ease of use and behavioural intention. The developed model consisted of ten variables categorised into three groups: The first group focuses on the extrinsic motivation aspects: information quality (IQ), accessibility (A), functionality (FL) and user interface design (UID). The second group focuses on the intrinsic motivation aspects: enjoyment (E), computer playfulness (CP) and learning goal orientation (LGO). The third group is TAM model constructs: perceived usefulness (PU), perceived ease of use (PEOU), and behavioural intention (BI). The identified variables have shown to be critical towards students' acceptance of LMSs.

First, information quality was positively affecting perceived usefulness, because the learning management system provided up to date, relevant and accurate information. Information quality has shown to be imperative for students to perceive the system usefulness. In addition the insignificant relationship between information quality and behavioural intention was caused by the full meditation effect of perceived usefulness. Petter (2008) pointed out that there is insufficient literature addressed the inconsistency between information quality and behavioural intention therefore, further investigation is necessary. Second, functionality was the strongest determinant of perceived usefulness, because having a system with functional features (e.g. online assessment, quizzes, and learning forums) will help students to accomplish their learning objectives. According to Cho et al., (2009) a functional system would enable students to learn effectively and would enhance their perception towards the system usefulness. Therefore, students' perception towards the system usefulness can be improved by providing learning

functionalities to address students needs (Cho et al., 2009). On the other hand, functionality was insignificant towards behavioural intention, because perceived usefulness was fully meditating the relationship between them.

Third, accessibility has shown critical towards the Saudi students' acceptance. The variable was positively affecting all of TAM constructs, perceived usefulness, perceived ease of use and behavioural intention. This is because in developing countries the significance of accessibility increases due to the difficulties a user faces to access information (Park et al., 2009). This explains students' high perception towards accessibility. As a result, accessibility has a direct effect to influence all of TAM constructs. Moreover, accessibility strong influence is usually towards perceived ease of use due to the design aspects that can enable information access (Thong et al., 2002; Park, 2009; Park et al., 2009). Fourth, user interface design was the second strongest determinant of perceived ease of use. A well-organised and designed interface can stimulate students' motivation enabling them to use the system easily (Cho et al., 2009). Consequently, an easy to use interface will encourage students' use and accept the system. The Saudi students' perception towards user interface design was caused by the good interface design they have experienced with the LMS. Cho et al., (2009) pointed out that an e-learning system with a good user interface design will create comfortable atmosphere for users, because they will perceive the system as easy to use.

Fifth, enjoyment was the second strongest determinant of students' behavioural intentions, after perceived usefulness. This confirms Davis et al., (1992) point, that enjoyment as an intrinsic motivation is critical towards user's intention to use information systems. The Saudi students' sense of enjoyment is possibly because of the system interface design and functionalities. Cyr et al., (2006) pointed out that interface design is the central in determining the system enjoyment level (Cyr et al., 2006). As a result, students' acceptance of LMS will increase when they experience enjoyment (Saadė et al., 2008). Moreover, the relationship between enjoyment and perceived ease of use was insignificant. This is because the strong effect of functionality and user interface design on perceived ease of use has diminished the relationship between enjoyment and perceived ease of use. Deci (1975) pointed out that the extrinsic variables can diminish the effect of the intrinsic variables. The same effect happened to computer playfulness. The strong effect of the extrinsic motivation variables has affected the significance of computer playfulness towards behavioural intention and perceived ease of use.

Sixth, learning goal orientation was positivity affecting behavioural intention and perceived ease of use. The effect of learning goal orientation towards behavioural intention was significant

(probability value ≤ 0.05) however, the standardised coefficient was very low (β = 0.07). This indicates that having a learning goal orientation motive is not enough for LMSs acceptance. On the other hand, the direct effect of learning goal orientation towards perceived ease of use was accepted with (probability value ≤ 0.05) and standardised coefficient (β = 0.11). This indicates that students with a learning goal orientation motive will perceive the system as easy to use; because, they believe using the system will help them to improve and learn new skills. Therefore, students are more likely to disregard any of the system design hurdles in exchange of learning and gaining knowledge.

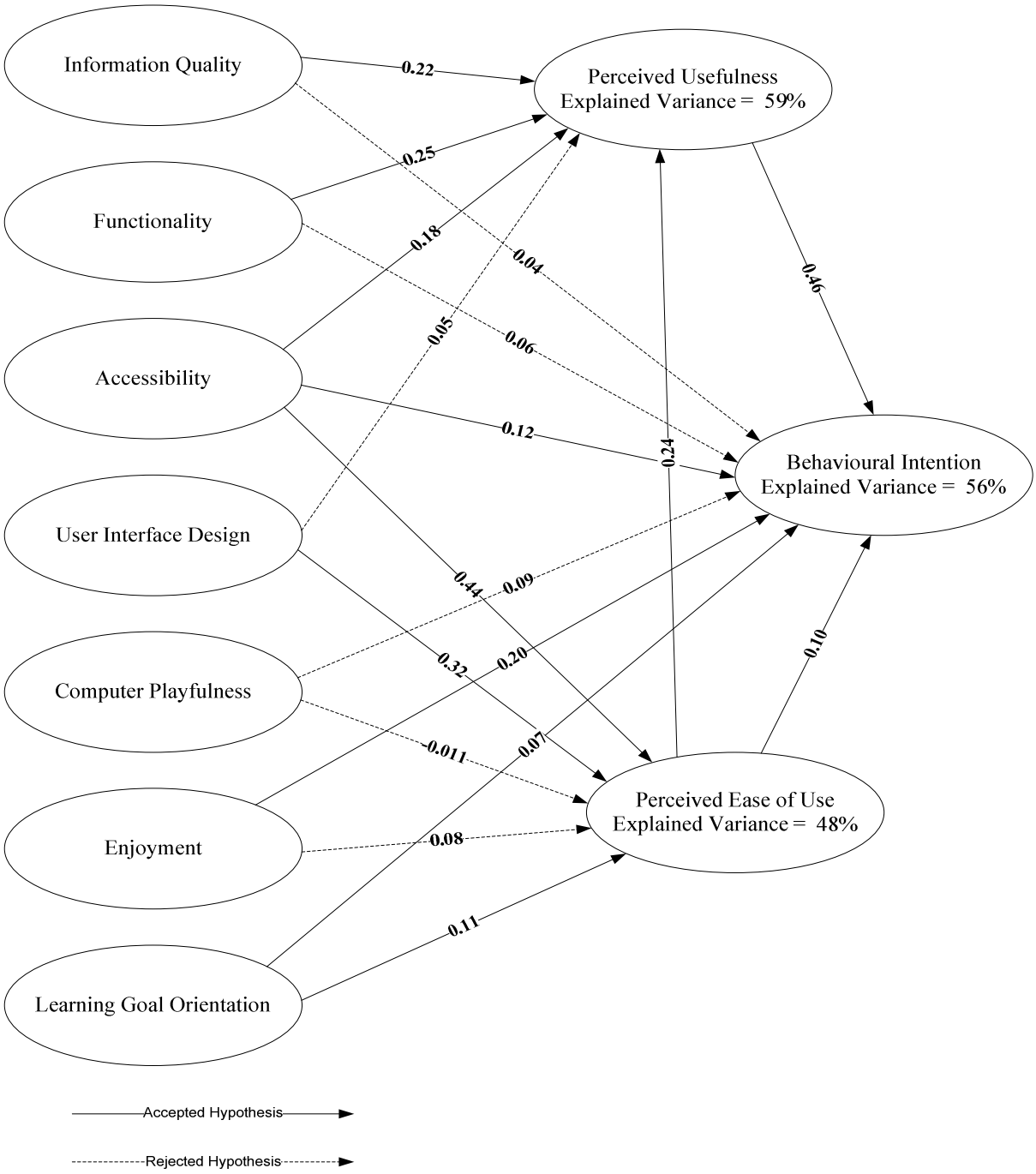
Seventh, perceived usefulness was the most important antecedent of student's behavioural intention. This is because students have a tendency to use an e-learning system to achieve their learning objectives, where these objectives can be achieved by performing basic level of tasks such downloading study materials, teaching schedules, online chat, or discussion forums (Raaij and Schepers, 2008). Achieving these objectives will allow students to perceive the system usefulness leading them towards the system acceptance. Moreover, the results showed that information quality, functionality and accessibility have strong influence towards perceived usefulness. Therefore, students' perception of usefulness can be further improved by focusing on these three aspects in the system design. In addition, previous studies have pointed out the significance of perceived usefulness to drive e-learning systems acceptance (Ong et al., 2004; Roca and Gagné, 2008; Raaij and Schepers, 2008; Liaw, 2008; Lee et al., 2009; Liu et al., 2010). Finally, the Saudi students' perception towards ease of use was important towards their behavioural intention and to perceive the system usefulness. These results confirm the causal relationships between TAM constructs, perceived usefulness, perceived ease o use and behavioural intention.

6.2 The Developed Model Performance

Although a number of research studies have investigated students' acceptance of e-learning systems. Few of those studies accounted for the extrinsic and intrinsic motivation variables together. This research identified four extrinsic and three intrinsic variables to investigate student's acceptance of LMSs in Saudi Arabia. The relationship between the identified variables and TAM constructs were governed by the research hypotheses. The research model performance can be measured by the explained variance in the dependent variables, perceived usefulness, perceived ease of use, and behavioural intention. The explained variance (R^2) is calculated as part of the multiple regression analysis and can be defined as *"variance in the independent variable that can be accounted for by (statically associated with) variance in the independent variable(s)"* (Vogt and Johnson, 2011).

The research model was able to explain high variance in the dependent variables, behavioural intention, perceived usefulness and perceived ease of use. The total explained variance (R^2) results in behavioural intentions, perceived usefulness, and perceived ease of use are 56%, 59%, and 48% respectively. The developed model explained variance results are considered as one of the research main contributions as they have outperformed existing models investigated students' acceptance of LMSs (see Table 6-1). Moreover, the explained variance among the three dependent variables was with less variation between them, unlike the existing model models where a high (R^2) in one dependent variable is faced with a significantly lower (R^2) in another dependent variable.

These results suggest that the identified variables are critical predictors towards students' acceptance of LMSs. This confirms the developed model applicability to explain the students' acceptance in Saudi Arabia. Moreover, the research findings confirmed students' acceptance to use LMSs in Saudi Arabia, and which aspects of the system they are more attracting to them. The extrinsic variables have shown to be more critical towards the Saudi students' acceptance. Table 6-1 shows the selected studies based on their involvement with the Technology Acceptance Model to examine students' acceptance of e-learning systems.



The numbers represent the standardised coefficient

Figure 6-1: The developed model results

Table 6-1: The explained variance comparison among perceived usefulness (PU), perceived ease of use (PEOU) and behavioural intention (BI)

Study	Country	Sample Size	Key Factors				Variance Explained R^2		
			Intrinsic	Effect Direction Towards	Extrinsic	Effect Direction Towards	BI	PU	PEOU
(Ong et al., 2004)	Taiwan	140	–	–	Perceived Credibility	BI	44%	50%	30%
					Computer Self-Efficacy	PU & PEOU			
(Lee et al., 2005)	China	544	Enjoyment	BI	–	–	35%	None	None
(Hsia, 2007)	Taiwan	206	–	–	Computer Self-Efficacy	PU & PEOU	33%	28%	7%
(Liaw, 2008)	Taiwan	424	–	–	Computer Self-Efficacy	PU	58.00%	48%	None
					Interactive learning activities				
					Multimedia Instruction				
					System Quality				
(Jong, 2009)	Taiwan	606	–	–	Facilitating Conditions	BI	40.10%	None	None
					Computer Self-Efficacy				
					Social Influence				
					Anxiety				
(Sánchez-Franco et al., 2009)	Nordic/Mediterranean	304/376	Playfulness	BI	–	–	37%/38%	42%/15%	None
(Lee et al., 2009)	South Korea	214	Playfulness	BI	Instructor Characteristics	PU	66%	51%	30%
					Teaching Materials	PU			
					Design of Learning Contents	PEOU			
(Alenezi et al., 2010)	Saudi Arabia	480	Enjoyment	BI	Computer Anxiety	BI	61%	None	None
					Computer Self-Efficacy				
					Internet experience				
This Research	Saudi Arabia	766	Enjoyment	BI	Information Quality	PU	56%	59%	48%
			Computer Playfulness	Insignificant	Accessibility	BI, PU & PEOU			
			Learning Goal Orientation	BI & PEOU	Functionality	PU			
					User Interface Design	PEOU			

(−) = not applicable, the research model results were added twice in the table for clarity.

Table 6-1: The explained variance comparison among perceived usefulness (PU), perceived ease of use (PEOU) and behavioural intention (BI) (Continued)

Study	Country	Sample Size	Key Factors				Variance Explained R^2		
			Intrinsic	Effect Direction Towards BI	Extrinsic	Effect Direction Towards BI	BI	PU	PEOU
(Al-Harbi, 2011)	Saudi Arabia	531	–	–	Accessibility	BI	43%	56%	23%
					Computer Self-Efficacy				
					University Support				
					Interactivity	PU			
					Flexibility	PU			
					Internet Experience	PU & PEOU			
(Tselios et al., 2011)	Greece	102	–	–	–	–	39%	37%	None
This Research	Saudi Arabia	766	Enjoyment	BI	Information Quality	PU	56%	59%	48%
			Computer Playfulness	Insignificant	Accessibility	BI, PU & PEOU			
			Learning Goal Orientation	BI & PEOU	Functionality	PU			
					User Interface Design	PU			

(–) = not applicable, the research model results were added twice in the table for clarity.

6.3 The Extrinsic and Intrinsic Variables

One of the research objectives is to investigate which groups of variables are important towards students' acceptance; the extrinsic or intrinsic variables (see Table 6-2). Hypotheses testing results showed the extrinsic variables as better predictors of students' acceptance of LMSs. Among the extrinsic variables perceived usefulness remained as the strongest predictor of students' behavioural intentions. Moreover, the four extrinsic variables, information quality, functionality, accessibility, and user interface design, were good predictors of students' behavioural intentions directly or indirectly via perceived usefulness and ease of use. This indicates that the tangible design aspects of extrinsic variables are more important towards students' acceptance than the intrinsic aspects. Moreover, enjoyment was the second strongest predictor of behavioural intention, indicating that enjoyment does play a direct role towards students' acceptance. Therefore, the aspect of enjoyment should also be considered towards the design of e-learning systems.

Table 6-2: The research variables dimensions

Extrinsic Variables	Intrinsic Variables
• Information quality • Functionality • Accessibility • User interface design	• Enjoyment • Computer playfulness • Learning goal orientation

6.4 The Moderating Effect of Gender

This section will discuss the moderating effect of gender on the developed model. The data analysis showed males and females are significantly among five hypotheses. The first section will discuss the gender differences towards TAM constructs, perceived usefulness, and perceived ease of use and behavioural intention. The second will discuss the gender differences towards the external variables.

6.4.1 Gender Differences and TAM Constructs

The data analysis showed that gender did not moderate the relationship between perceived usefulness perceived ease of use, and behavioural intention. This is possibly because the daily use of e-learning systems has narrowed down the differences between males and females perception (Wong et al., 2012). The research results showed that the standardised coefficient and probability value among perceived ease of use, perceived usefulness and behavioural intention were almost the same between males and females. Table 6-4 shows the three hypotheses governing the

relationships between perceived usefulness, perceived ease of use and behavioural intention. The table contains the standardised coefficient and probability value for the three relationships.

Table 6-3: The direct and indirect effect of perceived usefulness and perceived ease of use

Hypothesis	Path			Standardised Coefficient Male		Standardised Coefficient Female	
				Direct effect	Indirect effect via PU	Direct effect	Indirect effect via PU
H8a	PEOU	→	PU	0.23***	-	0.31***	-
H8b	PEOU	→	BI	0.17***	0.11***	0.01 ns	0.16**
H9a	PU	→	BI	0.47***	-	0.44***	-

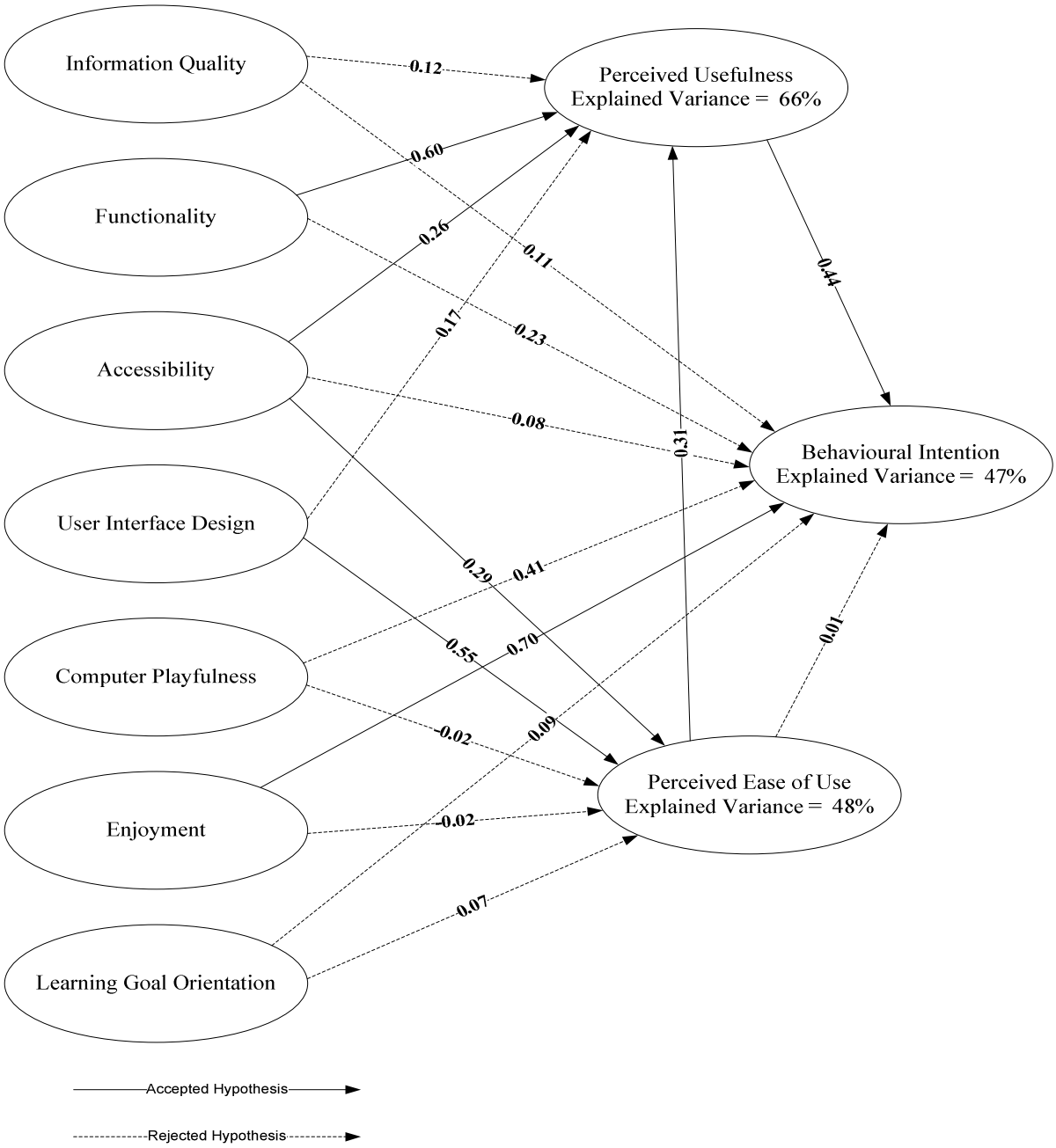
*** = P-value ≤ 0.01, ** = P-value ≤ 0.05, ns = not significant, (-) = not applicable

The results in Table 6-3 shows that perceived usefulness effect towards behavioural intention was slightly stronger for males than females; similar results were reported by previous studies (Yuen and Ma, 2002; Carr, 2005; Ong and Lai, 2006). This is possibly because males tend to concentrate on the usefulness aspects of the system as they are more performance and goal oriented than females (Ong and Lai 2006; Kim 2010). This explains the high standardised coefficient from perceived usefulness towards behavioural intention (see Figure 6-2). Moreover, the results also showed that for females the effect of perceived ease of use towards behavioural intention was insignificant because the relationship was full mediated by perceived usefulness. This means that perceived ease of use is affecting behavioural intentions indirectly through perceived usefulness due to the dominant effect of perceived usefulness towards behavioural intentions (see Figure 6-3).

Furthermore, the only noticeable different between males and females was the explained variance (R^2) in behavioural intention (see Figure 6-2 and Figure 6-3). The explained variance for males' behavioural intentions was higher than females, 63% and 47% respectively. Moreover, Zarrett and Malanchuk (2005) pointed out that males are more confident to use an information system leading them to have a higher acceptance than females; this possibly explains the low acceptance rate for the Saudi female students. In addition, previous studies showed similar results, where usually males had a higher explained variance towards behavioural intention than females (e.g. Al-Harbi, 2011; Terzis and Economides, 2011; Padilla-Meléndez et al., 2013).

The numbers represent the standardised coefficient

Figure 6-2: The developed model results for **males**



The numbers represent the standardised coefficient

Figure 6-3: The developed model results for **females**

6.4.2 Gender Differences and the External Variables

The data analysis results showed that from the eighteen proposed hypotheses, thirteen hypotheses were perceived the same between genders and five hypotheses were perceived significantly different between males and females (see Table 6-4). These hypotheses are H1a, H2a, H5b, H6b, and H7a. Most of the differences occurred between the intrinsic variables, computer playfulness, enjoyment, and learning goal orientation. For example, females perceived enjoyment as the strongest determinant of behavioural intentions, while the same relationship was insignificant for males. On the other hand, computer playfulness effect towards behavioural intentions was significant for males only. Sánchez-Franco (2006), pointed out there is inconsistency in gender perception towards the intrinsic variables. These inconsistency can caused a user culture or gender (Saadé et al., 2008; Saadé et al., 2009; Sánchez-Franco et al., 2009; Terzis and Economides 2011; Padilla-Meléndez et al., 2013). Moreover, females usually have a higher perception towards the intrinsic aspects of the system (Sánchez-Franco, 2006; Terzis and Economides, 2011; Padilla-Meléndez et al., 2013). This possibly explains the strong impact of enjoyment towards females' behavioural intentions.

Moreover, among the five significantly different hypotheses there are two hypotheses belong to the extrinsic variables. These two hypotheses are H1a and H2a representing the effect of information quality and functionality towards perceived usefulness. The multiple regression analysis showed information quality as the strongest determinant of perceived usefulness for males, while functionality was the strongest determinant of perceived usefulness for females. This is possibly because males are more concerned with information quality especially the verbal information (e.g. information accuracy, format, up to date), unlike females who finds non-verbal information more engaging (Cyr et al., 2007). In addition, females' perception of functionality towards behavioural intentions was significant, because females assign greater emphasis on the learning process through planning and participation (Gonzàlez-Gómez et al., 2012).

The moderating effect of gender has received a considerable interest in the technology acceptance domain; however, most of the previous studies investigated genders towards technology acceptance have given inconsistent results (Padilla-Meléndez et al., 2013). Sun and Zhang (2006) stated that *"It is noteworthy that the major function of moderating factors is explaining the inconsistencies by identifying the situational differences"*. The research findings showed that gender can moderate some aspects of the developed model; moreover, few studies investigated the Saudi students' acceptance in terms of genders differences. Therefore; further investigation is required to confirm gender differences between the Saudi students.

Table 6-4: List of the significant and insignificant paths between genders

Hypothesis	Paths			Male		Female	
				Standardised coefficient	$(P-value \leq 0.05)$	Standardised coefficient	$(P-value \leq 0.05)$
H1a	IQ	→	PU	0.366	***	0.120	0.181
H2a	FL	→	PU	0.100	0.141	0.602	***
H5b	CP	→	BI	0.208	***	0.412	0.145
H6b	E	→	BI	0.112	0.134	0.702	**
H7a	LGO	→	PEOU	0.137	***	0.067	0.203
H1b	IQ	→	BI	0.122	0.127	0.112	0.193
H2b	FL	→	BI	0.041	0.311	0.226	0.284
H3a	A	→	PU	0.149	***	0.257	***
H3b	A	→	PEOU	0.450	***	0.293	***
H3c	A	→	BI	0.099	0.057	0.08	0.256
H4a	UID	→	PU	0.09	0.053	0.166	0.103
H4b	UID	→	PEOU	0.282	***	0.550	***
H5a	CP	→	PEOU	-0.064	0.269	-0.022	0.464
H6a	E	→	PEOU	0.103	0.168	-0.023	0.468
H7b	LGO	→	BI	0.077	0.065	0.093	0.16
H8a	PEOU	→	PU	0.23	***	0.31	***
H8b	PEOU	→	BI	0.17	***	0.01	0.12
H9a	PU	→	BI	047	***	0.44	***

***= P-value ≤ 0.001, ** = P-value ≤ 0.05, Gray colour= hypotheses that are significantly different between gender.

6.5 Summary

This chapter focused on discussing the data analysis results. The first section discussed the research model variables, the significance of each variable were examined based on their hypotheses results. The second section examined the importance of the extrinsic and intrinsic groups toward students' acceptance of learning management systems, and the results showed that extrinsic variables had more important role than intrinsic variables to explain students' acceptance. Moreover, the chapter assessed the research model performance in term of the explained variance in perceived usefulness, perceived ease of use and behavioural intention. The findings indicated that the research model outperformed the existing extensions models to explain the variance in above three variables. Finally, the chapter discussed the moderating effect of gender. The results indicated that differences do exist between males and females acceptance of learning management systems. The research model was different between the two genders among five hypotheses only. The next chapter will summarise the research findings, review the research objectives, and how these objectives were met. Moreover, contributions will be highlighted, followed by the research limitations, implications for future work, and finally the conclusion.

Chapter Seven: Conclusion

This work aims to address the gap in the technology acceptance research by developing an enhanced technology acceptance model able to explain students' acceptance of learning management systems (LMSs) in Saudi Arabia. The developed model consisted of ten variables in which they can be divided into seven external variables and TAM three constructs. In addition, the research focused on examining the effect extrinsic and intrinsic variables have on students' acceptance of LMSs. One of the research main objectives was to identify external variables have the potential to explain student's acceptance by accounting for the extrinsic and intrinsic variables in the developed model. Additionally, the developed model consisted of seven external variables, four extrinsic variables and three intrinsic variables.

On the first hand, the results showed the significance of the extrinsic variables towards students' acceptance of LMSs. Among the four extrinsic variables, information quality and functionality were perceived as important determinant of the system usefulness. Moreover, the two variables had an indirect effect on behavioural intention via perceived usefulness. In addition, user interface design was influencing the system ease of use directly thus, becoming the second strongest determinant towards perceived ease of use. Finally, accessibility was the only variable to have a direct consequence on all of the TAM constructs perceived usefulness, perceived ease of use, and behavioural intention. Among these three relationships, accessibility strongest influence was towards perceived ease of use.

On the other hand, the intrinsic variables group included computer playfulness, enjoyment and learning goal orientation. Among the three variables, enjoyment and learning goal orientation were the only ones to influence perceived ease of use and behavioural intention. Moreover, enjoyment was playing a significant role in predicting behavioural intention; the variable was the second strongest determinant of behavioural intention. This indicates that incorporating the enjoyment aspects in an LMS will directly motivate students to accept the system. In addition, data analysis showed that students with a learning goal orientation motive are more likely to perceive the system as easy to use, meaning that students are willing to overcome the system design challenges to learn and gain experience.

The main research novelty is the developed model as the model succeeded in explaining high percentage of the explained variance for perceived usefulness, perceived ease of use and behavioural intention among the Saudi students. The explained variance among the three variables was with less variation between them. Therefore, developed model results confirmed the importance of the external variables (i.e. information quality, functionality, accessibility, user

interface design, enjoyment and learning goal orientation) to predict and explain students' acceptance of learning management systems in Saudi Arabia. Finally, the multi group analysis revealed that gender differences do exist in the developed model. The gender differences were mainly between the external variables towards TAM constructs.

7.1 Research Objectives

The research aimed to develop an enhanced technology acceptance model to explain students' acceptance of LMSs in Saudi Arabian universities. Consequently, the research proposed five objectives to address the research aims. This section will explain and summarise each objective and how they were achieved.

1. **To review literature in regard to the development of the Technology Acceptance Model (TAM) in information system domain**: The research literature review can be divided into two sections. The first section reviewed the historical development of the TAM model in Information Systems. This included the development of the Theory of Reasoned Action and Theory of Planned Behaviour models, as they formed the base for developing the TAM model. Then, more details on TAM development were given in terms of the adoption, validation, and extension. The adoption stage mainly dealt with the applicability (i.e. parsimonious) of TAM to explain a variety of information technologies. The validation phase focused on two aspects, to validate the psychometric characteristics (i.e. measured variables) of perceived usefulness and ease of use, and of the causal relationships between TAM constructs. The extension phase dealt with researchers' effort to improve the explanatory power of TAM by adding external variables to the model.

   The second section discussed the literature applied the technology acceptance models to explain students' acceptance of e-learning systems. The literature review showed two main trends in applying TAM to explain e-learning systems acceptance: First, studies that applied TAM without any extensions have showed poor results to explain students' acceptance, in terms of the explain variance (R^2). Second, studies that extended TAM with external variables to account for students' acceptance towards e-learning systems, the explain variance (R^2) for these studies improved after the addition of the external variables. The literature review showed few studies focused on identifying external variables associated with the learning environment. The research addressed this point by identifying external variables, where the results confirmed their significance towards students' acceptance.

2. **To formulate a model of technology acceptance to explain students' acceptance of Learning Management Systems efficiently in Saudi Arabia**: The research proposed an enhanced technology acceptance model consisting of ten variables. The ten variables can be divided into two groups, external variables and TAM constructs. First, there are seven external variables which are information quality, functionality, accessibility, user interface design, computer playfulness, enjoyment, and learning goal orientation. Second, TAM constructs, perceived usefulness, perceived ease of use, and behavioural intention. The main consideration was to identify extrinsic and intrinsic variables to examine their potential to influence students' acceptance of LMSs. Moreover, the research focused on the system and user's characteristics aspects in identifying the extrinsic and intrinsic variables. After the external variables identification process was completed, the research hypotheses were proposed to govern the relationships between the model variables. The proposed hypotheses were justified for each variable, based on the literature review. The results confirmed the importance of the external variables and the developed model performance.

3. **To investigate to what extent the intrinsic and extrinsic motivation variables can impact students' acceptance of Learning Management Systems:** To achieve this objective, the research identified seven external variables based on their relevance e-learning context. These seven external can be divided into four extrinsic variables (information quality, functionality, accessibility, and user interface design) and three intrinsic variables (computer playfulness, enjoyment, and learning goal orientation). All of the extrinsic variables were significantly affecting behavioural intention directly or indirectly. Moreover, the results showed that the extrinsic variables are better predictors of students' acceptance of LMSs

   On the other hand, the most important intrinsic variable towards students' acceptance was enjoyment. Enjoyment was the second strongest predictor of behavioural intention after perceived usefulness. This indicates that enjoyment can play a critical part in students' acceptance of LMSs. Furthermore, the results showed that students with a learning goal orientation motive are more likely to perceive the system as easy to use, leading them to use the system regardless the design hurdles.

4. **To investigate the moderating effects of gender toward students' acceptance of Learning Management Systems:** Pervious studies have shown that gender can moderate model relationships. The Saudi Arabian cultural has a strong influence on the males and females

students. This research will investigate whether males and females have different perception to accept LMSs in Saudi Arabia. The moderating effect of gender was measured by performing a multi group analysis using IBM Analysis of Moment Structures (AMOS) software. The multi group analysis will group the data based on gender then will perform a multiple regression analysis for males and females separately. Moreover, Figure 6-2 and 6-3 show the developed model results for males and females.

On the first hand, the multi group analysis terms of the measured variables i.e. the questions used to measure the external variables, were perceived equally by both genders, which means that males and females understood the questionnaire questions in the same manner. On the second hand, the multi group analysis in terms of the model relationships has shown significant different between genders. The differences were between five hypotheses, H7a, H1a, H2a, H5b, and H6b. The overall results indicated that males have a higher acceptance towards LMSs, while females' acceptance was mainly affected by enjoyment then perceived usefulness.

5. **To validate the research model statistically:** The statistical analysis can be divided into three steps. The first step was to ensure the validity of the collected data. The research used questionnaires as the main tool used to collect data. The questionnaire had gone through several development stages which can be summarised as follow. First, the questionnaire questions were identified and adapted from literature to measure the model variables then modified to fit the research context. Second, the developed questionnaire was reviewed by five reviewers, based on their feedback the questionnaire was revised. Third, the questionnaire was examined with a pilot study to emulate the actual data collection procedure. Fourth, the questionnaire was reviewed again by another group of reviewers. Finally, the collected data were screened for normality, linearity, outliers, and multicollinearity.

   The second step was to use confirmatory factor analysis to examine the validity of the developed model through the measured variables. The developed model validity was evaluated using unidimensionality, goodness of fit measures and constructs validity. First, unidimensionality to ensure the measured variables are loading into one underlying variable. Second, goodness of fit measure was used to evaluate the developed model validity via five measures. Goodness of Fit Index (GFI), Root Mean Square Error of Approximation (REMSA), Standardised Root Mean Residual (SRMR), Comparative Fit Index (CFI), and

Tucker-Lewis Index (TLI). The results confirmed the validity of the developed model among the five measures. Third, constructs validity was measured using cronbach's alpha and average variance extracted.

The third step, the multiple regression analysis was performed to examine the developed model and the research hypotheses. The analysis will examine the developed model in terms of the explained variance, and the research hypotheses in terms of the standardised coefficient and probability value. The explained variance was calculated for the dependent variables in the developed model, perceived usefulness, perceived ease of use and behavioural intention. Additionally, the developed model explained a high percentage of the variance among the dependent variables with less variation, outperforming most of the existing models. Moreover, the standardised coefficient and probability value were calculated for each hypothesis. The results showed that from the eighteen proposed hypotheses, six hypotheses were rejected and twelve hypotheses were accepted (see Figure 5-3 and Table 5-13).

7.2 The Research Contributions

This research has several contributions to the body of knowledge in the information system domain. First, the research developed a novel technology acceptance model to explain students' acceptance of LMSs. The developed model accounted for the the extrinsic and intrinsic variables to predict and explain students' acceptance. The results indicated the significance of the identified variables in the e-learning environment. Moreover, the developed model was able to explain a high percentage of the variance in the dependent variables, behavioural intention, perceived usefulness and perceived ease of use. The achieved explained variance has outperformed the explained variance of the existing models (see Table 6-1). In addition, the developed model explained the variance in behavioural intention, perceived usefulness, and perceived ease of use with less variation between them, 56%, 59%, and 48% respectively.

Second, the developed model was empirically validated by utilising the structural equation modelling via IBM AMOS, which allowed for an adequate assessment of the model. The structural equation modelling allowed the validation and examination of the developed model through confirmatory factor analysis and multiple regression analysis respectively. The results of the confirmatory factor analysis confirmed the developed model validity through three statistical analysis, unidimensionality goodness of fit measures and constructs validity. Furthermore, the multiple regression analysis enabled to examine the developed model in terms of the explained variance and the research hypotheses in terms of the probability value and standardised coefficient. The multiple regression analysis pointed out the external variables collective effect to

explain the variance in perceived usefulness, perceived ease of use and behavioural intention. While, the probability value and standardised coefficient pointed out the significance level and prediction value of each hypothesis.

Third, the research applied multi group analysis to examine the gender differences. The multi group analysis is an advanced technique that uses the difference in chi-square $\Delta\chi^2$ to compare groups. Through IBM AMOS the multi group analysis between males and females was performed for the measurement and developed models (see Table 5-14 and Table 5-15). The multi group analysis for the measurement model will identify if males and females have perceived the measured variables (i.e. questionnaire questions) differently, while for the developed model will identify if males and females have perceived the research hypotheses differently. The multi group analysis showed that gender differences do exist in the developed model over five hypotheses (H7a, H1a, H2a, H5b, and H6b) (see Table 5-16).

Fourth, the research contributed to the development of questionnaire to measure the extrinsic and intrinsic variables at the individual level. The questionnaire questions were developed and validated for each variable in the model. These questions were adapted from literature and modified to fit the context of this research. In addition, the questionnaire has gone through rigorous examinations to ensure its validity and reliability. Moreover, the validated questionnaire can be adapted and replicated in future technology acceptance research (see Appendix A and B). The final contribution was applying the developed model to explain the Saudi students' acceptance of LMSs. The model succeeded in explaining students' acceptance of LMSs in Saudi Arabia in blended learning environment.

7.3 Results' Implications

The results showed that information quality was important variable to perceive the usefulness of LMSs. The main implication for stakeholders is to maintain information quality by providing updated, rich, relevant and easy to understand information in the system, as this will encourage current and potential students to perceive the system usefulness. Moreover, functionality was directly affecting perceived usefulness, which gives three implications based the measured variables of functionality. First, e-learning systems should provide university students with learning features to enable them achieve their learning goals (e.g. online assessment, quizzes, and learning forums). Additionally, designers interact with university students to identify further required functionalities. Second, designers must ensure systems learning features are functional and suitable for the intended purpose. Finally, the implementation of LMSs should be

accompanied with training and technical supports by the educational institutes directed towards students.

Furthermore, accessibility has shown to positively affect perceived usefulness, perceived ease of use, and behavioural intention. In developing countries, users' perception towards accessibility increases, because of the low Internet access, and the deficiency of technical and organisational support. As a result, educational institutes should provide the following to ensure an easy access to the LMSs: infrastructural support (e.g. hardware support, network availability, application monitoring, and power supply), software support (e.g. software and content quality, and system stability), and organisational support (Fan et al., 2012). Thong et al., (2002) pointed out that organisational support can determine the success of e-learning systems by providing an easy access to these systems. For example, a university can allow students to access the e-learning system from any computer on the campus by increasing the number of computers and providing a hyperlink access to the e-learning system from the university home page (Fan et al., 2012).

Moreover, the results showed that user interface design was the second strongest determinant of perceived ease of use. Because, a good user inter face design will reduce students' disorientation and cognitive load allowing them to use the system easily. The implication for designers is to design a user-friendly interface and reflect student characteristics in the system design. For example, a system with personalisation feature will add more emphasis on students' preferences, interests and browsing behaviour (Cho et al., 2009). Furthermore, student's needs and perceptions change over time therefore, designers should be aware of these changes to address them in the system design. Moreover, enjoyment was the second strongest determinant of behavioural intention. This indicates that aside from the perception of usefulness and ease of use, enjoyment directly influence students' acceptance of LMSs. The implication for researchers is to identify more intrinsic variables and examine their influence towards students' acceptance, as the findings confirmed their significance in the e-learning research. The implication for designers is to supplement learning management systems with features (e.g. animation, and attractive appearance) that can intrinsically motivate students. Finally, learning goal orientation has a positive impact on perceived ease of use. This means that students will discount design hurdles to use the e-learning system. Therefore, designers should provide an e-learning environment that encourages challenging goals and making errors, as part of the skill acquisition process (Yi and Hwang, 2003; Runhaar et al., 2010).

7.4 Summary of the Research Findings

The following points are summary of the research findings:

1. Perceived usefulness, ease of use, enjoyment, accessibility, and learning goal orientation were the only variables to affect behavioural intention directly.
2. Perceived usefulness was the strongest determinant of behavioural intention, followed by enjoyment and perceived ease of use.
3. Perceived ease of use remained significant towards perceived usefulness and behavioural intention.
4. Information quality and functionality were only significant variables towards perceived usefulness.
5. Perceived usefulness was fully mediating the relationships of Information quality and functionality towards behavioural intention.
6. Accessibility was significant towards all of TAM constructs, perceived usefulness, perceived ease of use and behavioural intention.
7. User interface design was significant towards perceived ease of use.
8. Perceived ease of use was fully mediating the relationship between user interface design and behavioural intention.
9. Students with learning goal motivation perceived the system as easy to use.
10. Computer playfulness was insignificant towards perceived usefulness and behavioural intention.
11. Males and females perception towards the developed model was significantly different between five hypotheses.
12. Males' behavioural intention to use LMSs was stronger than females.
13. Females' perception towards intrinsic variables was stronger than males.

7.5 Limitations and Future Research

The research presented interesting findings to explain students' acceptance of LMSs however, the research does have certain limitations. First, the research findings may be limited to the research population, type of technology examined, or the e-learning context. Hence, caution when generalising the research findings beyond the above aspects. Second, the research population was the undergraduate student in Saudi Arabian universities, there was no inclusion for postgraduate students because of their insignificant size number. Moreover, future research can further refine the developed model to explain more variance in students' behavioural intentions, perceived usefulness, and perceived ease of use. In addition, researchers can examine the developed model performance to explain different online behaviour in the information system field. Furthermore,

researchers should give more attention to intrinsic variables in the technology acceptance research, as they have the potential to directly influence users' acceptance of an information technology. Additionally, researchers can investigate moderating variables that have theoretical and practical implications to the research area. For example, this research selected gender as a moderating variable due to the Saudi Arabian culture differences between genders.

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Appendix A - Research Questionnaire

Please Read

Dear Sir/Madam

I am a PhD research student at University of Bedfordshire conducting a study to investigate learners' behaviour with respect to e-learning. One of the research objectives is to identify the factors that affect learners' behavioural intention towards Learning Management System for undergraduate students in Saudi Arabia.

If you use Learning Management Systems such as Blackboard, WebCt, Moodle, I would be very grateful if you fill out this questionnaire.

Your participation is voluntary. If you do not wish to participate, simply close the questionnaire page. Responses will be completely anonymous; your name will not appear anywhere on the survey. Completing the questionnaire constitutes your consent to participate. All of the information you kindly provide will be treated as completely confidential and it will not be possible for anyone to identify the information you supply.

The questionnaire will only take 10-15 minutes of your time to fill out. Your corporation is highly appreciated and will contribute to the success of this study.

If you have any questions or concerns, please contact me Abdullah.Al-Aulamie@beds.ac.uk.

Thank you

Abdullah Al Aulamie

Demographic profile

(Please answer the question or tick the appropriate answer)

1. Which University do you study in?

2. Gender:

- ◯ Male
- ◯ Female

Information Quality

Please indicate your level of disagreement/agreement with the following:

***3. The LMS provides up-to-date information for my study:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

***4. The LMS provides useful information for my study:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

***5. The LMS provides easy to understand information for my study:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

Functionality

Please indicate your level of disagreement/agreement with the following:

***6. The LMS responds fast enough:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

***7. The LMS provides enough features that I need:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

***8. The features of the LMS enable me to access the content that I need:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

***9. As a whole, the features of the LMS enable me to achieve my learning goals:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

Accessibility

Please indicate your level of disagreement/agreement with the following:

***10. The LMS allows quick access to the information:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

***11. The LMS makes the information very accessible:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

***12. The LMS makes the information easy to access:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

User Interface Design

Please indicate your level of disagreement/agreement with the following:

***13. The design of the LMS interface is user-friendly:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

***14. The instructions provided by the LMS is clear:**

◯ Strongly disagree ◯ Disagree ◯ Neither agree nor disagree ◯ Agree ◯ Strongly agree

***15. The design of the LMS is good:**

○ Strongly disagree ○ Disagree ○ Neither agree nor disagree ○ Agree ○ Strongly agree

***16. Overall, the interface design of the LMS is satisfactory:**

○ Strongly disagree ○ Disagree ○ Neither agree nor disagree ○ Agree ○ Strongly agree

Enjoyment

Please indicate your level of disagreement/agreement with the following:

***17. The actual process of using the LMS is enjoyable:**

○ Strongly disagree ○ Disagree ○ Neither agree nor disagree ○ Agree ○ Strongly agree

***18. I have fun using the LMS:**

○ Strongly disagree ○ Disagree ○ Neither agree nor disagree ○ Agree ○ Strongly agree

***19. I find using the LMS to be interesting:**

○ Strongly disagree ○ Disagree ○ Neither agree nor disagree ○ Agree ○ Strongly agree

Computer Playfulness

Please indicate your level of disagreement/agreement with the following:

***20. when I use the LMS I feel spontaneous:**

○ Strongly disagree ○ Disagree ○ Neither agree nor disagree ○ Agree ○ Strongly agree

***21. when I use the LMS I feel creative:**

○ Strongly disagree ○ Disagree ○ Neither agree nor disagree ○ Agree ○ Strongly agree

***22. when I use the LMS I feel playful:**

○ Strongly disagree ○ Disagree ○ Neither agree nor disagree ○ Agree ○ Strongly agree

Learning Goal Orientation

Please indicate your level of disagreement/agreement with the following:

***23. I am willing to select a challenging learning task that I can learn a lot from:**

○ Strongly disagree ○ Disagree ○ Neither agree nor disagree ○ Agree ○ Strongly agree

***24. I often look for opportunities to develop new skills and knowledge:**

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

***25. I enjoy the challenging and difficult learning tasks:**

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

***26. For me, developing my learning ability is important enough to take risks:**

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

***27. I prefer to learn in situations that require a high level of ability and talent:**

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

Usefulness

Please indicate your level of disagreement/agreement with the following:

***28. Using the LMS can improve my learning performance:**

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

***29. Using the LMS makes my learning more effective:**

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

***30. I find the LMS useful to me:**

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

Ease of Use

Please indicate your level of disagreement/agreement with the following:

***31. Learning how to use the LMS is easy for me:**

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

***32. I find the LMS easy to use:**

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

***33. It is easy to become skilful at using the LMS:**

Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree

Intention to Use

Please indicate your level of disagreement/agreement with the following:

***34. I intend to increase my use of the LMS in the future:**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

***35. I intend to use the LMS in the future:**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

***36. For future studies I would use the LMS:**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

Appendix B – Measured Variables

Variable	Numbering	Symbol	Measured variables i.e. variable's questions	Adapted From
Information Quality	1	IQ1	The LMS provides up-to-date information for my study	(Cho et al., 2009)
	2	IQ2	The LMS provides useful information for my study	
	3	IQ3	The LMS provides ease to understand information for my study	
Funcationality	4	FL1	The LMS responds fast enough	(Cho et al., 2009)
	5	FL2	The LMS provides sufficient features that I need	
	6	FL3	The LMS enables me to access the content that I need	
	7	FL4	As a whole, the features of the LMS enable me to achieve my learning goals	
Accessibility	8	A1	The LMS allows quick access to the information	(Wixom et al., 2005)
	9	A2	The LMS makes the information very accessible	
	10	A3	The LMS makes the information easy to access	
User Interface Design	11	UID1	The design of the LMS interface is user-friendly	(Cho et al., 2009)
	12	UID2	The instructions provided by the LMS is clear	
	13	UID3	The design of the LMS is good	
	14	UID4	Overall, the interface design of the LMS is satisfactory	
Computer Playfulness	15	CP1	When I used the LMS I feel spontaneous	(Venkatesh and Bala, 2008; Lee et al. ,2009)
	16	CP2	When I used the LMS I feel creative	
	17	CP3	When I use the LMS I feel playful	
Enjoyment	18	E1	The actual process of using the LMS is enjoyable	(Moon and Kim, 2001)
	19	E2	I have fun using the LLMS	
	20	E3	I find using the LMS to be interesting	
Learning Goal Orientation	21	LGO1	I am willing to select a challenging learning task that I can learn a lot from	(Brett and VandeWalle, 1999)
	22	LGO2	I often look for opportunities to develop new skills and knowledge	
	23	LGO3	I enjoy the challenging and difficult learning tasks	
	24	LGO4	For me, developing my learning ability is important enough to take risks	
	25	LGO4	I prefer to learn in situations that require a high level of ability and talent	

Perceived Usefulness	26	PU1	Using the LMS can improve my learning performance	(Roca et al., 2008)
	27	PU2	Using the LMS makes my learning more effective	
	28	PU3	I find the LMS useful to me	
Perceived Ease of Use	29	PEOU1	Learning how to use the LMS is easy for me	(Roca et al., 2008)
	30	PEOU2	I find the LMS easy to use	
	31	PEOU3	It is easy to become skilful at using the LMS	
Behavioural Intention	32	BI1	I intend to increase my use of the LMS in the future	(Liao and Lu, 2008)
	33	BI2	I intend to use the LMS in the future	
	34	BI3	For future studies I would use the LMS	