Modelling E-Learning Adoption: The Influence of Learning Style and Universal Learning Theories

by

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Declaration of Authorship

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged. I also certify that it has not been published or submitted elsewhere, except where otherwise mentioned.

Candidate Signature

Ahmed Habeeb Said Al-Azawei	**Date**

This research is dedicated to the memory of my parents who passed away, but never forgotten

May their soul rest in the paradise

Abstract

E-learning faces a high failure rate, particularly in developing nations due to a lack of public acceptance. One of the most commonly adopted theories for investigating this is the Technology Acceptance Model (TAM). However, TAM fails to consider the effect of individual and cultural differences, and environmental variables on users' technology acceptance. The present research therefore sought to address TAM's limitations in the e-learning context, by considering individual differences adopting the Felder and Silverman Learning Styles Model (FSLSM) and environmental learning factors using the Universal Design for Learning (UDL) framework. It also attempts to identify any barriers to effective e-learning implementation in Iraq.

A survey research design comprising analytical and descriptive methods was consequently adopted. Two experiments were conducted in Iraq to validate the proposed research framework from the perspective of undergraduate students. A third experiment was dedicated to in-depth understanding the hindrances to e-learning application in Iraq's public-sector universities, from the standpoint of undergraduates and academic staff.

The findings suggest that the explanatory power of TAM can be improved by integrating learning styles as moderators, although this psychological trait has limited ability to predict e-learning acceptance and learners' perceptions as well as it is uncorrelated with academic performance. However, combining the UDL model with TAM enhances its power to predict e-learning acceptance and learners' perceptions. Furthermore, the qualitative outcomes identify many barriers to e-learning implementation in Iraq, supporting the quantitative analysis and highlighting other factors that could influence e-learning acceptance.

This study should provide valuable information for scholars, leadership, e-learning providers and instructors, while also contributing to TAM, learning styles and universal learning theories. It is the first of its kind to examine e-learning acceptance in Iraq, in terms of the integrated factors. This research is also the first to compare the influence of learning styles and universal learning theories on e-learning experience. Accordingly, it extends the existing literature and fills a research gap in the Iraqi context, with empirical implications being discussed for further research.

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List of Publications

Journal Papers

1) Al-Azawei, A., & Badii, A. (2014). State of the art of learning styles-based adaptive educational hypermedia systems (LS-BAEHSs). *International Journal of Computer Science & Information Technology*, *6*(3), 1-19.

2) Al-Azawei, A., & Lundqvist, K. (2015). Learner differences in perceived satisfaction of an online learning: An extension to the technology acceptance model in an Arabic sample. *Electronic Journal of e-Learning*,*13*(5), 408-426.

3) Al-Azawei, A., Al-Bermani, A., & Lundqvist, K. (2016). Evaluating the effect of Arabic engineering students' learning styles in blended programming courses. *Journal of Information Technology Education: Research, 15*, 109–130.

4) Al-Azawei, A., Serenelli, F., & Lundqvist, K. (2016). Universal Design for Learning (UDL): A content analysis of peer reviewed journal papers from 2012 to 2015. *Journal of the Scholarship of Teaching and Learning, 16*(3), 39-56.

5) Al-Azawei, A., Parslow, P. & Lundqvist, K. (2016). Barriers and opportunities of e-learning implementation in Iraq: A case of public universities. *International Review of Research in Open and Distributed Learning, 17*(5), 126-146.

6) Al-Azawei, A., Parslow, P., & Lundqvist, K. (2017). Investigating the effect of learning styles in a blended e-learning system: An extension of the technology acceptance model (TAM). *Australasian Journal of Educational Technology, 33*(2), 1-23. https://doi.org/10.14742/ajet.2758.

7) Al-Azawei, A., Parslow, P. & Lundqvist, K. (currently in press). The effect of Universal Design for Learning (UDL) application on e-learning acceptance: A structural equation model. *International Review of Research in Open and Distributed Learning*.

Conference Papers

8) Al-Azawei, A., & Lundqvist, K. (2014, November). The impacts of learning styles, learning patterns and demographic factors on learners' performance in a blended learning environment. In *Information Society (i-Society), 2014 International Conference* (pp. 105-111). IEEE, London, UK.

9) Al-Azawei, A., & Lundqvist, K. (2015, September). Development of a universal design for learning-based teaching collaborative system (UDL-BTCS) to support accessible learning. In *Computer Science and Electronic Engineering Conference (CEEC), 2015 7th* (pp. 129-134). IEEE, Colchester, UK.

Posters

10) Deducing and Evolving Models of Learning Styles to Support Adaptive E-Learning Systems. This poster was presented in the University of Reading Conference (2014), Reading, UK.

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List of Abbreviations

ATU	Attitude Towards Use
AVE	Average Variance Extracted
CAST	Center for Applied Special Technology
CEART	Centre of Excellence for Applied Research and Training
CR	Composite Reliability
CSS	Cascading Style Sheet
E-learning	Electronic Learning
ELSE	E-Learning Self-Efficacy
F2F	Face-to-Face
FSLSM	Felder and Silverman Learning Styles Model
HTML	Hypertext Markup Language
ICTs	Information and Communication Technologies
ILS	Index of Learning Styles
ISs	Information Systems
ITs	Information Technologies
ITU	Intention to Use
LMSs	Learning Management Systems
M	Mean
MHESR-I	Iraqi Ministry of Higher Education and Scientific Research
MMAE	Multiple Means of Action and Expression
MME	Multiple Means of Engagement
MMR	Multiple Means of Representations
Moodle	Modular Object Oriented Dynamic Learning Environment
P value	Probability Value
PEOU	Perceived Ease of Use
PLS-SEM	Partial Least Squares Structural Equation Modelling
PU	Perceived Usefulness
SPSS	Statistical Package for Social Science
SD	Standard Deviations
TAM	Technology Acceptance Model
TAM2	Technology Acceptance Model2
TAM3	Technology Acceptance Model3
TEL	Technology Enhanced Learning
TOE	Technology-Organisation-Environment
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UAE	United Arab Emirates
UDI	Universal Design of Instruction
UDL	Universal Design for Learning
UID	Universal Instructional Design
UTAUT	Unified Theory of Acceptance and Use of Technology
VIF	Variance Inflation Factors

Chapter 1: Introduction

1.1 Overview

This Chapter presents some general background on the use of e-learning, particularly in Iraq. It also discusses the research gaps in one of the most dominant technology acceptance theories, out of which the research aims for the present study are derived, together with the study questions and objectives. In addition, the survey design and methods are briefly mentioned as a general guide for the reader. This Chapter subsequently highlights the research scope, as well as its original contribution to knowledge. It is concluded by a summary of the thesis structure and its thematic content.

1.2 Background

The rapid growth of information and communication technologies (ICTs) over recent decades has radically altered teaching and learning in higher education (Sife, Lwoga & Sanga, 2007). Indeed, it may be observed that e-learning is becoming ubiquitous in developed nations. Yet, still there is a significant reluctance to take up new technology and innovation (Marangunic & Granic, 2015). Over the last three decades, a body of theoretical and empirical research has examined the 'diffusion' and 'acceptance' of information systems (ISs). In this context, many studies have been conducted to identify why the application of e-learning systems faces a high rate of failure (Al-Sabawy, 2013). In regard to developing nations, this work is less advanced due to greater challenges in comparison to developed countries (Tarhini, 2013). Hence, this thesis aims to contribute to the problem of understanding the obstacles to diffusion and acceptance of e-learning in developing countries. It takes Iraq as the particular object of study.

Higher education in Iraq has been deprived of modern learning technology for a period of many years. As reported by Nour (2002), from 1996 to 2001, no information was available on the use of mobile phones or the Internet in Iraq, because the Baath authorities forbade public Internet usage. Moreover, mobile telephones were not in use there until mid-2003.

What further compounds the situation is the fact that, up until 2010, researchers failed to identify the status of e-learning application in Iraq (Matar, Hunaiti, Halling & Matar, 2010). Machado and Demiray (2012) report that by 2012 only a few Iraqi universities had implemented e-learning and that in general the prospects are not optimistic. Following the second Gulf war in 2003, the Iraqi Ministry of Higher Education and Scientific Research (MHESR-I) greatly encouraged the use of e-learning in public-sector universities.

However, there are few academic studies on e-learning acceptance and implementation in Iraq. A more detailed profile of the e-learning situation in this context is provided in Chapter Two, Section 2.9.

The formulation of the research problem, presented below, and its component questions take the general body of research on diffusion and acceptance. The present study, however, is based on an ISs theory, a psychological learning theory and a pedagogical learning theory as a point of departure:

- ISs theory: Technology Acceptance Model (Davis, 1986).
- Psychological learning theory: Felder and Silverman Learning Styles Model (FSLSM) (Felder & Silverman, 1988).
- Pedagogical learning theory: Universal Design for Learning (UDL) framework (Rose & Meyer, 2002).

It is conjectured that they can be combined to reflect the situation of e-learning acceptance in Iraq and thereby contribute to a better understanding of e-learning in developing countries.

1.3 The Research Problem

The apparent failure of ISs implementation has attracted researchers from different disciplines to identify the factors that could improve this experience, anticipated to yield many different advantages (Somers & Nelson, 2001). ISs failure has in fact affected a whole range of sectors, such as e-business, e-banking, e-health and e-learning (Dwivedi et al., 2014). Diffusion and technology acceptance theories investigate what can influence users' willingness to accept a technology. One of the most dominant technology acceptance theories is the Technology Acceptance Model (TAM) (Bagozzi, 2007; Marangunic & Granic, 2015; Taylor & Todd, 1995a). However, the explanatory power of TAM has been criticised, because it ignores the influence of individual and cultural differences, as well as environmental variables, on technology acceptance (Bagozzi, 2007; Marangunic & Granic, 2015).

This thesis therefore highlights a number of gaps in e-learning acceptance research. First, according to the literature, research into the influence of individual differences in terms of learning styles on technology adoption remains scarce (Brown et al., 2009; Huang, 2015; Ursavaş & Reisoglu, 2017), especially when one considers that learning styles are directly

associated with cultural differences (Dunn et al., 1990; Oxford & Anderson, 1995). Furthermore, previous research confirms the significant effect of UDL applied to e-learning as an indicator of addressing environmental learning limitations (Bryans Bongey, Cizadlo & Kalnbach, 2010). To the best of the researcher's knowledge, however, the influence of this framework on e-learning acceptance has not been examined in the literature so far. It is also negligible whether existing research in this area has really compared the influence of learning styles with the UDL framework concerning e-learning acceptance. Finally, there is a scarcity of research investigating e-learning acceptance and barriers to its use in Iraq.

1.4 Research Aims

There are three key aims in this research:

1) The primitive aim is to enhance the explanatory power of TAM in the e-learning context by considering the role of learning styles and the UDL principles.
2) The second aim is to investigate e-learning acceptance in Iraq based on the proposed research framework.
3) Another aim is to filling the gap in academic research with regard to barriers that hinder effective implementation of e-learning in Iraq.

1.5 Research Approach, Questions and Objectives

The research approach is a survey research design. Based on this approach, three research questions are framed in order to satisfy the research aims:

Research Question 1: *What impact does Learning Styles Theory have on:*

i. E-learning acceptance? and

ii. Learners' experience?

This question is to be answered through an analytical survey research design where a model is first constructed, here as an extension of TAM, and then validated by investigating the cause and effect relationship between its variables. The validation process adopted depends upon performing surveys involving the target subjects in Iraq. This involves the following objectives:

1) Extending TAM by integrating the four dimensions of the Felder and Silverman model (processing, perception, input and understanding).

2) Investigating and validating the extended framework, in order to test the cause and effect relationships between its factors and the improvement in the explanatory power of TAM.
3) Analysing the moderating effect of active/reflective and sequential/global learning style dimensions on the strength of the path between the proposed model variables.
4) Understanding the differences in learners' perceptions, behavioural intention and academic achievement, based on learning style groups.

Research Question 2: *Can applying the principles of the UDL model enhance:*

i. E-learning acceptance? and

ii. Learners' perceptions?

This question is also to be answered through an analytical survey research design where a model is constructed and then validated. The aim is to achieve the following objectives:

1) Extending TAM by integrating the principles of the UDL framework (multiple means of representation, multiple means of action and expression and multiple means of engagement).
2) Investigating and validating the extended framework in Iraq, in order to test the cause and effect relationships between its factors and the improvement in the explanatory power of TAM.

Research Question 3: *In the context of public-sector universities in Iraq, what barriers to the use of e-learning are reported by academic staff and students?*

This question is to be answered through a descriptive survey research design approach intended to support the third aim mentioned above. This research question will assist in meeting the following objectives:

1) Supporting the quantitative analysis of the proposed research framework.
2) Highlighting variables that may affect e-learning acceptance, other than those investigated in the proposed research model.

1.6 Overview of the Survey Research Design and Methods

A survey research design is adopted in this thesis, whereby both analytical and descriptive survey methods are used. The analytical survey method was deemed convenient for answering the first and second research questions, because this method seeks to explain the

relationship between the research constructs and causality association (Oppenheim, 1992). The descriptive survey method was then selected as appropriate for answering the third research question. The main underlying rationale for this method is, for example, to understand how many members (or what proportion) of the whole population have a particular view or opinion about a certain phenomenon (Oppenheim, 1992).

With regard to the sampling techniques applied, this study adopts non-probabilistic, convenience and purposive approaches. The convenience sampling technique was used to recruit the majority of the research participants. This is justified on the basis of the researchers needing to select subjects according to their availability, as well as based on the researcher's criteria (Tarhini, Hone & Liu, 2015b). On the other hand, the selection of the lecturers participating in the semi-structured interviews was based on a purposive sampling technique. This is more appropriate when a researcher seeks to obtain rich information about a particular phenomenon (Leedy & Ormrod, 2005).

The research data were collected using quantitative and qualitative approaches. Structured questionnaires were adopted to collect quantitative data and test the relationship between the proposed model constructs. This method enables a researcher to access large populations in different regions, thus saving time and money (costs) (Wright, 2006). To answer the third research question and gain an in-depth understanding of the existing barriers to e-learning use in Iraq, the qualitative data were gathered using two open-ended questions, focus groups and semi-structured interviews.

1.7 The Research Scope

Three experiments were conducted in Iraq to cover the boundaries of the research problem discussed in Section 1.3, meet its aims reported in Section 1.4 and answer the questions presented in Section 1.5. Regardless of the significant theoretical and practical findings of this thesis, it is subject to a limited scope, which could in turn invite further academic research. The scope of the present study is highlighted as follows:

1) Many factors, such as subjective norms, family support, institutional support and computer anxiety could be included when promoting the explanatory power of TAM. However, the present research aims to understand the role of learning styles and universal learning theories in this process. Thus, the first constraint consists of predicting e-learning acceptance and learners' perceptions based on the original TAM variables and the factors of these two theories.

2) All samples used to validate the proposed model were drawn from amongst undergraduate Computer Science students attending the same college and so these may be considered as homogeneous samples, whereas examining a heterogeneous group could have rendered the research findings more reliable. Moreover, the perceptions and attitudes of academic staff regarding e-learning acceptance have not been tested; their perspectives have purely been considered in relation to identifying barriers to e-learning implementation.

3) The study scope solely comprises learning management systems (LMSs), whereas the adoption of other e-learning technologies, or barriers that could hinder their successful application was not examined.

4) The scope of this research is also limited to the use of LMSs in higher education, so the application of such systems in other sectors has not been investigated.

5) Finally, this research is open to the subjective experience of Iraqi students and teaching staff. Therefore, its results may not be applicable to other cultures and regions, especially when the conflict and unstable situation in Iraq is considered.

1.8 Resulting Research Contributions

This thesis examines the empirical effect of learning styles and the UDL framework on e-learning acceptance. It also sheds some light on the barriers behind the slow uptake of e-learning in Iraq. Accordingly, the present study makes many theoretical and practical contributions to the body of e-learning research:

1) It contributes to and extends the existing literature on Technology Acceptance Theory in a region that remains largely unexplored in the literature. As a result, it fills a gap in academic research in the Iraqi context.

2) By considering the influence of individual differences in terms of learning styles and environmental limitations regarding the UDL framework for e-learning acceptance, the research assists in addressing TAM limitations in the e-learning context.

3) This study is one of a few investigations that have incorporated three well-defined and frequently adopted theories relating to technology acceptance and educational practice. Accordingly, this study is not only the first to examine learners' perceptions in accordance with the identified constructs in Iraq; it is also the first of its kind to integrate psychological, pedagogical and IS models. The relevant literature has not previously examined or compared the impact of learning styles or UDL on e-learning

acceptance and learners' perceptions and so the present study bridges this research gap.

4) The outcomes of this thesis represent a useful guide for practitioners and researchers seeking to understand the actual effect of psychological and pedagogical learning theories on e-learning acceptance and learners' perceptions in a developing country.

5) Although bias has been identified in TAM when applied to a non-Western culture (McCoy, Galletta & King, 2007), this research contributes by validating the soundness of this framework in an Arab context.

6) Another contribution of this research is its support for the effectiveness of UDL in gathering learners' perceptions and willingness to accept e-learning technology in the context of Iraqi higher education. To the best of the researcher's knowledge, the soundness of this framework has not been investigated in the Arab world to date.

7) There is a high rate of failure in e-learning acceptance in developing nations (Ali & Magalhaes, 2008; Tarus, Gichoya & Muumbo, 2015) and so this thesis offers possible explanations as to why the adoption of such technology has been slow in Iraq. These findings could thus help ascertain whether further research is required to tackle the technological gap faced by users in the developing world, in comparison to developed nations.

8) Other stakeholders who could benefit from these research findings are leaders, e-learning managers and instructors. By examining e-learning acceptance and implementation in Iraq, alongside learning styles and UDL, this study provides some insights into modes and approaches that should be implemented to enhance e-learning acceptance and application in the context.

1.9 Organisation of the Thesis

This thesis contains eight chapters, as summarised in this section (see also Figure 1.1, below).

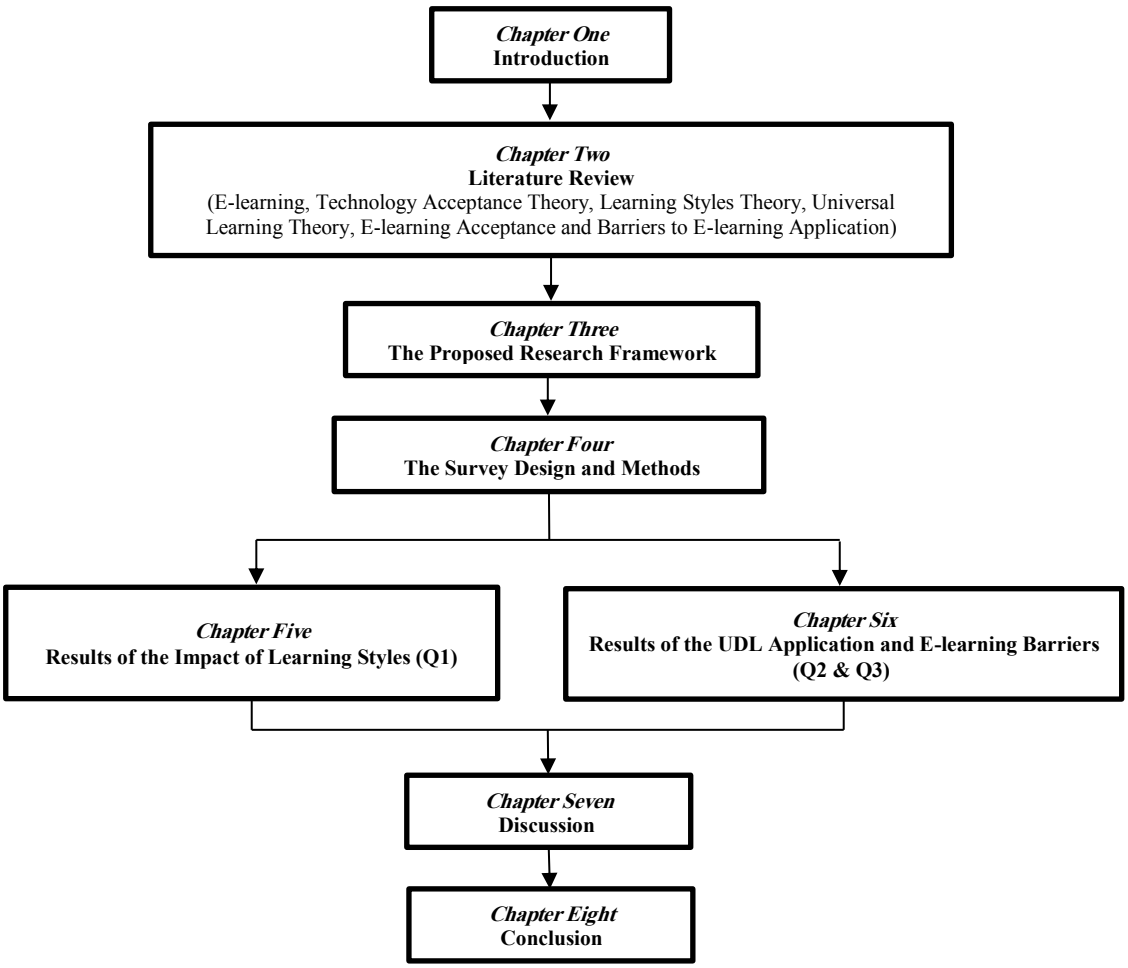


Figure 1.1: The Thesis Flow

Chapter Two: This Chapter consists of a review of the literature on the four central themes of the thesis, namely e-learning, Technology Acceptance Theory, Learning Styles Theory and Universal Learning Theory. The Chapter begins with a general view of e-learning and its possible advantages in contemporary education, accompanied by its possible limitations. The Chapter also reviews the development of TAM, the Felder and Silverman model, and the UDL framework since the proposed research framework is grounded on these three theories. It then discusses the influence of learning styles and environmental variables on e-learning acceptance and learners' perceptions. E-learning and barriers to its application in Arab countries are also discussed. Finally, the context of Iraqi higher education and the status of e-learning use in Iraq are reviewed. A few parts of this Chapter have already been published in Al-Azawei, Parslow and Lundqvist (2016) and Al-Azawei, Serenelli and Lundqvist (2016).

Chapter Three: This Chapter presents the proposed research model, which combines TAM, the Felder and Silverman model and the UDL framework. The research hypotheses

are also formulated here. A few parts of this Chapter have already been published in Al-azawei, Parslow and Lundqvist (2017), while others are about to appear in Al-Azawei, Parslow and Lundqvist (currently in press).

Chapter Four: The survey design and methods are discussed in this Chapter. It introduces the adopted research paradigm, research design methods, sampling techniques, data collection approaches and analysis tests. It also discusses the design of the three research experiments conducted in this study. The data pre-processing and the pilot studies are also presented in this Chapter. Finally, the ethical considerations are highlighted. This Chapter serves as a general guide to details of all the research steps. Several parts of this Chapter have already been published in Al-Azawei, Parslow and Lundqvist (2016) and Al-Azawei, Parslow and Lundqvist (2017), while others are about to appear in Al-Azawei, Parslow and Lundqvist (currently in press).

Chapter Five: The results of the first research question are reported here. This Chapter contains parts of the studies that have already been published in Al-Azawei, Al-Bermani and Lundqvist (2016) and Al-Azawei, Parslow and Lundqvist (2017).

Chapter Six: The results of the second and third research questions are reported in this Chapter. It contains parts of the study already published in Al-Azawei, Parslow and Lundqvist (2016). Other parts have been accepted for publication in Al-Azawei, Parslow and Lundqvist (currently in press).

Chapter Seven: This Chapter discusses all the findings of this thesis in relation to its three research questions. It also compares the research findings with previous literature and presents a comprehensive discussion of the research hypotheses formulated in Chapter Three. Moreover, it highlights the relationship between the quantitative and qualitative analyses and compares the predictive accuracy of Learning Styles Theory and the UDL framework for e-learning acceptance and learners' perceptions. Parts of this Chapter have already been published in Al-Azawei, Al-Bermani and Lundqvist (2016), Al-Azawei, Parslow and Lundqvist (2016), Al-Azawei, Parslow and Lundqvist (2017). Other parts have been accepted for publication in Al-Azawei, Parslow and Lundqvist (currently in press).

Chapter Eight: This Chapter concludes the key findings of the thesis. It highlights its theoretical and empirical implications, as well as practical recommendations that may be applied to improve e-learning in practice, particularly in Iraq. The research limitations and directions for further research are also discussed.

Some parts from each of the papers mentioned above have also been incorporated into Chapter Eight and this introductory Chapter.

1.10 Summary

This First Chapter has laid the foundation for the thesis. It has thereby covered some general background to the use of e-learning, particularly in Iraq, the current research context. Furthermore, the research problem, questions, aims and objectives have been presented. An overview of the survey research design and methods is also provided. This serves as a general guide to the ensuing research steps. A further section was allocated to discussing the research scope, alongside the original contribution made by the study. Finally, the structure of the thesis was described and illustrated.

In the next Chapter, the four main areas covered in this study, namely e-learning, Technology Acceptance Theory, Learning Styles Theory and Universal Learning Theory will be reviewed and discussed.

Chapter 2: Literature Review

2.1 Overview

This Chapter reviews the key areas of this thesis, namely e-learning, Technology Acceptance Theory, Learning Styles Theory and Universal Learning Theory. It begins with the search method applied to retrieve the relevant literature. Subsequently, Section 2.3 is dedicated to some discussion of the background to e-learning technology. Section 2.4 then introduces the development of the Technology Acceptance Model (TAM), alongside its parents and branches. In Section 2.5, Learning Styles Theory and its possible impact on e-learning acceptance and learners' experience is discussed. This section goes on to look at the development of the Felder and Silverman Learning Styles Model (FSLSM). Section 2.6 reviews Universal Learning Theory in general, with greater focus on the Universal Design for Learning (UDL) framework, along with its effect on e-learning acceptance and learners' perceptions. Meanwhile, Section 2.7 discusses the previous literature on e-learning acceptance in Arab countries, alongside the influence of individual and cultural differences, as well as environmental variables in terms of curricular design. Barriers to e-learning application in developing countries and in particular, the Arab world are explained in Section 2.8. Section 2.9 subsequently provides some discussion of the background to higher education in Iraq and reviews earlier work on e-learning application and acceptance in Iraqi higher education. Finally, Section 2.10 summarises the key themes discussed in this Chapter.

2.2. The Search Method

According to Liyanagunawardena, Adams and Williams (2013), there are many approaches that can be adopted to select relevant sources for research, such as searching databases and using search engines. In the present thesis, a systematic method was adopted to retrieve relevant studies based on the central themes. The main topics covered in this study are e-learning; Technology Acceptance Theory; learning styles and learners' experience; learning styles and e-learning acceptance; UDL and learners' perceptions; UDL and e-learning acceptance; e-learning acceptance and barriers to its use in the Arab world, and e-learning acceptance and barriers to its application in Iraq. The search was conducted via the Google Scholar search engine associated with the University of Reading database.

The search for relevant studies was not restricted by single keywords or terms. Instead, many keywords were combined to gather the most pertinent literature. Furthermore, the search was not limited to a particular period, but rather covered different time periods, in order to keep the main research themes up to date. Meta-analyses previously reviewing the main topics of the present study were also included. Table 2.1 illustrates the most frequently occurring keywords used in this method.

Table 2.1: Keywords Used in the Search Method

Theme	Keywords
Technology acceptance	E-learning acceptance, e-learning adoption, e-learning/technology acceptance model.
Learning styles	Learning Styles Theory, learning styles/satisfaction, learning styles/performance, learning styles/culture, learning styles/technology acceptance, learning styles/e-learning (online learning) acceptance (adoption).
Universal design for learning (UDL)	Universal Design for Learning, Universal Design for Learning/technology, Universal Design for Learning/technology adoption (acceptance), Universal Design for Learning/e-learning (online learning) acceptance (adoption).
Learner satisfaction	E-learning/satisfaction, satisfaction/technology adoption, satisfaction/e-learning acceptance.
Behavioural intention	Behavioural intention/e-learning, behavioural intention/online learning.
Self-efficacy	Self-efficacy, self-efficacy/e-learning (online learning) adoption (acceptance).
Multiple means of representation (MMR)	Multimedia instructions/e-learning (online learning) adoption or acceptance, multimedia instructions/e-learning (online learning) satisfaction, multimedia instructions/e-learning (online learning) usefulness.
Multiple means of action and expression (MMAE)	Diverse assessment/e-learning (online learning) adoption (acceptance), diverse assessment/e-learning (online learning) satisfaction, diverse assessment/e-learning (online learning) usefulness.
Multiple means of engagement (MME)	Engagement/e-learning (online learning) adoption (acceptance), engagement/e-learning (online learning) satisfaction, engagement/e-learning (online learning) usefulness.
Educational ICTs in developing countries	Barriers (obstacles)/ICTs/developing countries, Barriers (obstacles)/e-learning/developing countries, Barriers (obstacles)/ICTs/Middle East, e-learning implementation/Middle East.
E-learning acceptance/barriers in Arabic countries	E-learning (online learning) Acceptance/Adoption Arab/Arabic countries, E-learning (online learning) Acceptance/Adoption Arab/Arabic countries individual differences/course design/learning styles.
E-learning acceptance/barriers in Iraq	ICTs/Iraq, ICTs/barriers (obstacles, issues, problems)/Iraq, educational technologies/Iraq, e-learning (online learning)/application/Iraq, e-learning (online learning)/adoption (acceptance)/Iraq.

2.3 E-Learning

Several forms of information and communication technologies (ICTs) have already been used for educational purposes worldwide, namely "computers, the internet, broadcasting technologies (radio and television), and telephony" (Khan, Hasan, & Clement, 2012, p. 67). Such innovations have in fact revolutionised teaching and learning methods in some cases. Guri-Rosenblit (2005) states that at least a dozen terms are suggested to describe the use of ICTs for instruction, such as 'Web-based learning', 'online instruction', 'virtual classrooms', 'computer-mediated communication', 'electronic communication',

'distributed learning' and 'e-learning'. It has also been proposed that all types of teaching and learning through ICTs be brought under the umbrella term of 'e-learning' (Guri-Rosenblit, 2005), but it should be clarified that even where terms overlap, they are not necessarily identical.

E-learning is a relatively recent term, as it refers to the notion of using the Internet and computers in education, although it covers the use of other instructional technologies (Brown, 2007). It is defined as "instruction delivered via all electronic media including the Internet, intranets, extranets, satellite broadcasts, audio/video tape, interactive TV, and CD-ROM" (Govindasamy, 2002; p.288). The application of e-learning has had a significant impact on higher education, with learners enjoying flexibility in their choice of appropriate learning modes, according to personal preferences and/or commitments.

Previous studies have in fact demonstrated that effective e-learning implementation is a means of resolving authentic issues in learning and achievement (Govindasamy, 2002). As summarised in the literature (Al-Din & AlRadhi, 2008; Derouin, Fritzsche, & Salas, 2005; Sife et al., 2007; Zhang, Zhao, Zhou & Nunamaker, 2004), the main advantages of e-learning are:

- Information accessibility: students can easily access learning content anytime and anywhere. Another possible advantage of information accessibility is that learning technologies can serve learners' special needs.
- Adaptivity and adaptability: it can be difficult to accommodate various teaching approaches, content presentation and learning pathways for an individual learner using a traditional learning mode, but this is often greatly facilitated in e-learning.
- Efficient interaction: e-learning can provide additional and alternative interaction opportunities off-campus and outside normal working hours.
- Cooperation and collaboration: both can be improved using available communication tools in learning management systems (LMSs), such as forums, wikis and chat tools, as well as assigning learners to groups for collaborative work.
- Teaching and learning in synchronous or asynchronous mode: learners and teachers can choose the most appropriate method of content delivery and transmission.
- Reducing cost: learners can avoid tuition fees by undertaking e-learning courses. Additionally, e-learning will eliminate traveling expenditure and often saves time and effort.

- Promoting teaching quality: e-learning functionalities can be exploited to integrate pedagogical theories and make lessons more interactive.
- Ease of managing and tracking learners' activities: LMSs can provide rich log files that track learners' activities within the system.
- A self-paced learning and learner-centred environment: a face-to-face (F2F) approach relies heavily on the teacher. This does not work effectively for all students, if age inequality and uneven background knowledge are considered.

Despite the benefits listed above, it has been found that e-learning courses in general witness a more or less 90% drop-out rate (Liyanagunawardena, Parslow & Williams, 2014). This suggests that the e-learning experience is subject to many limitations that should be taken into consideration. According to previous studies (Arkorful & Abaidoo, 2015; Bouhnik & Marcus, 2006; Wu, Tennyson, & Hsia, 2010), the main disadvantages of e-learning are that:

- Learners need to be highly self-directed to continue using such technology.
- There is a lack of learning atmosphere, compared to the traditional F2F classroom.
- There is no direct interaction between the learners themselves and their instructors, which can have a negative effect on their comprehension of the content.
- Learners may need more time to understand a particular topic, compared to a traditional F2F classroom.
- Clarification and explanation may be less effective than in the traditional classroom.
- E-learning is less effective for enhancing learners' communication skills, whereas the literature indicates that such skills can improve learning outcomes.
- It is difficult to control or monitor certain illegal activities, such as plagiarism. Accordingly, learners may obtain academic certificates that they do not deserve.
- E-learning may be inappropriate for disciplines that require hands-on experience.

Because of such drawbacks, academic institutions seek methods of delivery that can offer the benefits of e-learning technology, while at the same time overcoming its limitations. Towards this end, 'blended learning' has been presented as a promising alternative learning approach. This refers to a combination of traditional F2F learning approaches,

combined or 'blended' with online learning modes (Garrison & Kanuka, 2004). Blended learning has many advantages over other teaching and learning approaches in that it offers:

- The integration and enhancement of F2F learning (López-Pérez, Pérez-López & Rodríguez-Ariza, 2011).
- A facility for learning activities that require direct interaction in the classroom, while activities of a reflective nature may be performed via asynchronous learning (Garrison & Kanuka, 2004).
- Its capacity to create a flexible learning environment, based on a combination of online and traditional methods (Hameed, Badii & Cullen, 2008).
- The potential to promote learners' experience and learning outcomes (Davis & Fill, 2007).

Accordingly, academic institutions all around the world have implemented numerous e-learning systems to obtain such advantages. LMSs, however, represent the most frequently used e-learning technology in higher education (Emelyanova & Voronina, 2014). For example, Blackboard, Moodle (Modular Object-Oriented Dynamic Learning Environment) and WebCT systems dominate this context.

Alias and Zainuddin (2005) define an LMS as "a software application or web-based technology used to plan, implement, and assess a specific learning process" (p.28). Other synonyms of LMSs are course management systems, virtual learning environments and knowledge management systems (Alias & Zainuddin, 2005; Graf, 2007). Here, both teachers and learners can benefit from the use of such systems, whereby teachers can upload and present learning content; track learners' activities; assess learners' knowledge, and keep their students up to date with course information. Conversely, learners can access learning content at any time and from any location, while also being able to interact with their peers and instructors, ask questions and upload their work.

Educational institutions, however, face many issues concerning the acceptance and implementation of e-learning, particularly in developing countries (Ali & Magalhaes, 2008; Tarus et al., 2015). According to Emelyanova and Voronina (2014), one of the most complex factors of success in e-learning is the willingness of the user to adopt it. Thus, understanding what can affect e-learning acceptance is a vital step towards benefiting from its potential advantages. Technology acceptance theories have therefore attempted to

identify the variables that predict technology acceptance, whereby TAM represents the most widely applied theory.

2.4 The Development of the Technology Acceptance Model (TAM)

User acceptance signifies an obvious willingness to adopt a particular technology for the activities it is developed for (Walldén, Mäkinen & Raisamo, 2015). On the contrary, technology failure refers to the "shortfall between actual and required performance" (Dwivedi et al., 2014). Due to the high failure rate of e-learning adoption and implementation, researchers have expended a great deal of effort in identifying the key factors influencing its acceptance. Research on e-learning success or failure is grounded on studies conducted on information systems (ISs), which identify the critical success factors of e-learning (Selim, 2007).

As a foundation to the present research, it is grounded on TAM (Davis, 1986; Davis, Bagozzi, & Warshaw, 1989). TAM is a widely cited and well-known model, as well as being one of the most influential theories in ISs research (Hwang, Al-Arabiat & Shin, 2015; Lee, Kozar & Larsen, 2003). TAM has also been theoretically, empirically and economically justified (Davis & Venkatesh, 1996). This model is proposed to explain ISs acceptance.

The main factors of TAM were inspired by the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) and the Theory of Planned Behaviour (TPB) (Ajzen, 1985). These theories may therefore be considered as the parents of TAM. TRA is based on research in social psychology. It suggests that people's actions are goal-directed, with the implications of specific actions being considered before their performance. Moreover, it relies on behavioural intention as a core predictor of behaviour and suggests that attitudes towards behaviour and subjective norms are the main predictors of behavioural intention. The former refers to people's positive or negative assessment of the behaviour enacted, whilst the latter identifies social pressures on an individual's decision to act or not to act in response to the behaviour in question. Furthermore, salient beliefs, such as perceived usefulness are proposed as a direct predictor of attitudes towards behaviour. Perceived usefulness refers to an individual's perception of whether specific behaviour will lead to a positive or negative outcome.

One of the main shortcomings of TRA, however, is that it does not take into account those individuals who have little control over their behaviour, or at least those who *feel* as if they

have no control. Consequently, Ajzen (1985) suggests adding another variable to address this limitation, known as perceived behavioural control. Perceived behavioural control defines users' perceptions of the ease or difficulty with which the behaviour of interest can be performed (Ajzen, 1991). Nevertheless, this modification has led to a further theory being proposed, namely the TPB. Figure 2.1, below illustrates the main factors and relationships in both theories.

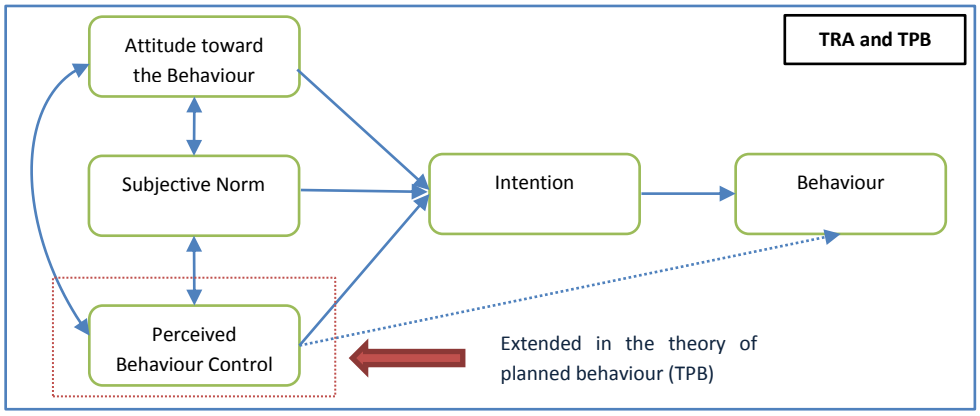


Figure 2.1: Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) and Theory of Planned Behaviour (TPB) (Ajzen, 1985)

Based on its parent theories, TAM represents an attitude towards behaviour, perceived usefulness and behavioural intention. However, the model suggests excluding the subjective norm, due to the uncertainty of the theoretical base and influence of this factor (Davis et al., 1989). It also combines another variable, known as perceived ease of use, whereby it assumes a causal link between perceived ease of use, perceived usefulness, attitude towards use and intention to use. Perceived ease of use refers to the extent of mental effort required to use a technology (Davis, 1986).

Unlike its parents, TAM proposes a direct relationship between perceived usefulness and intention to use. The theoretical justification for this change is that users may not like a certain technology, but will continue to use it because of its positive impact on their job performance (Davis et al., 1989). This modification is seen as the most important enhancement to TRA (Taylor & Todd, 1995b). The main relationships hypothesised in TAM are that: perceived ease of use is a direct determinant of perceived usefulness and attitude towards use, perceived usefulness has a direct impact on attitude towards use and intention to use, and that attitude towards use has a direct effect on intention to use (Davis, 1986). Figure 2.2 depicts the main factors in TAM and the proposed relationships between them.

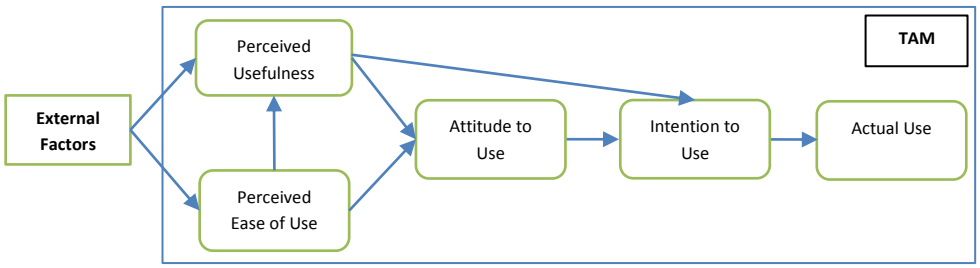


Figure 2.2: Technology Acceptance Model (TAM) (Davis et al., 1989)

The widespread use of TAM has nevertheless given rise to numerous criticisms: (1) TAM ignores the influence of individual and cultural differences on technology usage (Bagozzi, 2007), (2) Although TAM can explain 30-40% of behavioural intention, no obvious reasons are provided for the remaining unexplained 60% of variance (Lee et al., 2003), (3) Despite the fact that perceived usefulness and perceived ease of use can explain behavioural intention, TAM theory overlooks what might actually lead to perceived usefulness and perceived ease of use (Benbasat & Barki, 2007), and (4) The explanatory power of TAM has been questioned (Tarhini, 2013). Such criticisms have led to other theories being proposed on the basis of this model.

The Technology Acceptance Model 2 (TAM2) suggests that attitude towards use is a weak mediator between perceived usefulness, perceived ease of use and behavioural intention (Venkatesh & Davis, 2000), so it was excluded. Furthermore, two types of factor, namely (1) Social influence processing, and (2) Cognitive instrumental processing have been added. TAM2 aims to identify the predictors of perceived usefulness and understand the moderating effect of experience and voluntariness on the relationship between the subjective norm and behavioural intention. Figure 2.3 illustrates this theory.

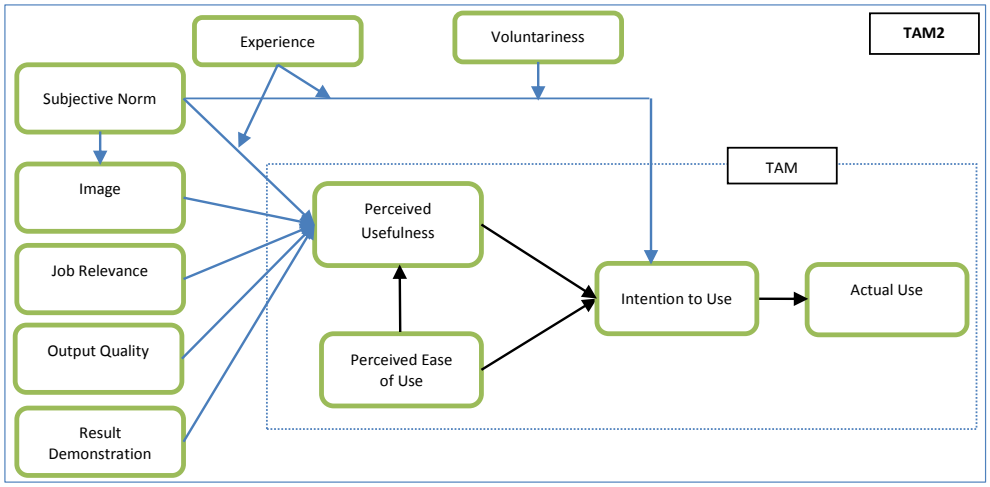


Figure 2.3: Revised Technology Acceptance Model (TAM2) (Venkatesh & Davis, 2000)

In the Unified Theory of Acceptance and Use of Technology (UTAUT), other predictors of behavioural intention are proposed, namely social influence and facilitating conditions (Venkatesh, Morris, Davis & Davis, 2003). Facilitating conditions refer to the support received by individuals from their organisations to facilitate technology use. UTAUT also considers the moderating effect of individual differences (gender, age, experience and voluntariness) on the relationship between the independent variables and behavioural intention. Figure 2.4 shows the main constructs and relationships of this model.

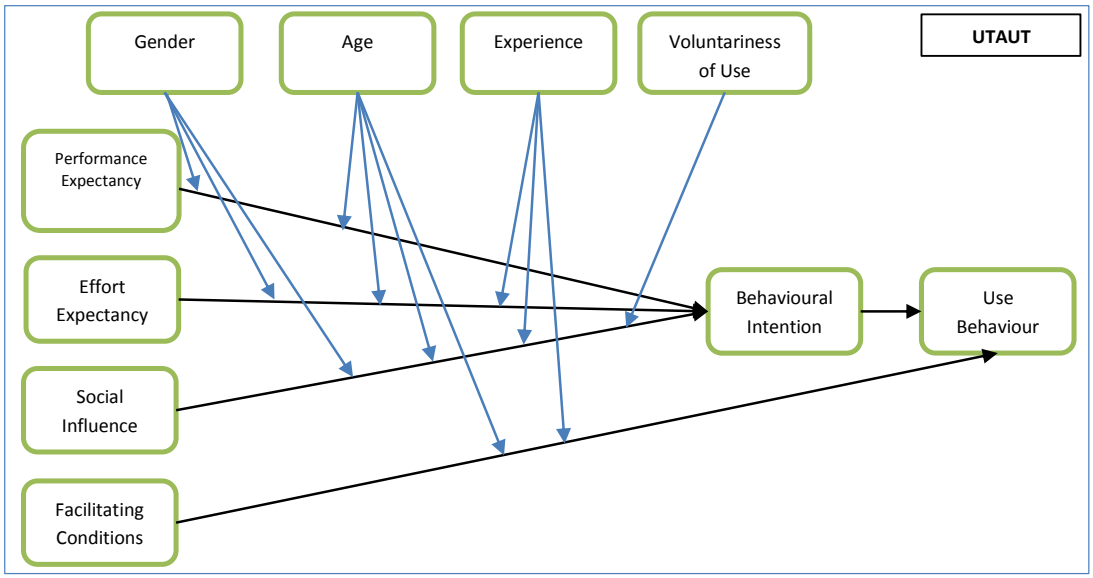


Figure 2.4: Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003)

The Technology Acceptance Model 3 (TAM3) manifests the continuous enhancement of TAM. Venkatesh and Bala (2008) reviewed prior research on TAM, proposing a more comprehensive framework that attempts to identify the main predictors of perceived ease of use and perceived usefulness, rather than behavioural intention. This model combines TAM and UTAUT, but proposes further predictors of perceived ease of use. It moreover hypothesises that individual differences can moderate the relationship between different variables and perceived ease of use, whereas users' beliefs about computer use (self-efficacy, anxiety, enjoyment, control and playfulness) and computers (objective usability) are determinants of perceived ease of use. Venkatesh and Bala (2008) classify these variables into three groups: "control beliefs, intrinsic motivation, and emotion" (p.281). Figure 2.5 depicts the model and the links between its constructs.

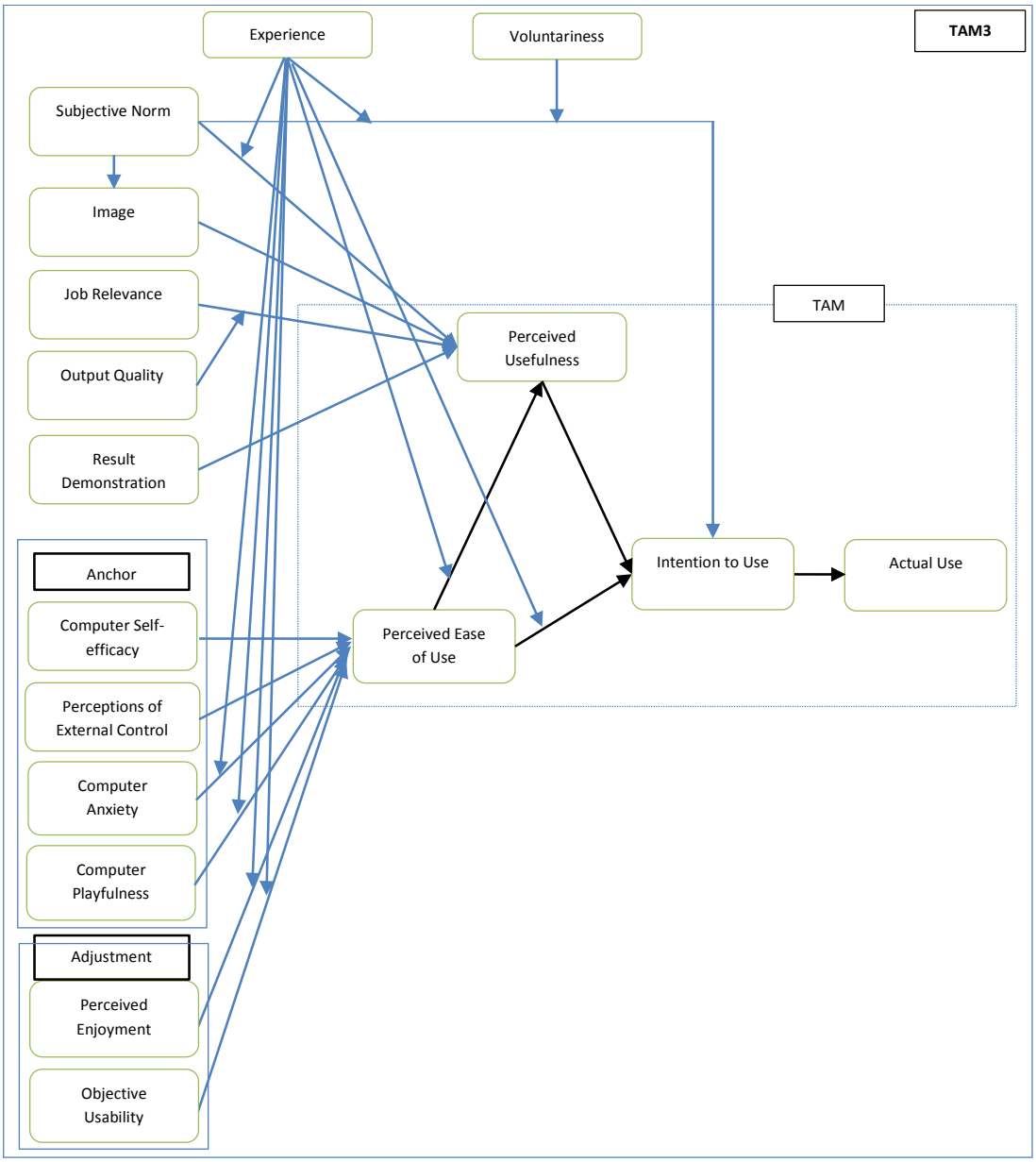


Figure 2.5: Technology Acceptance Model 3 (TAM3) (Venkatesh & Bala, 2008)

Nevertheless, in an e-learning context, the explanatory power of TAM branches (TAM2, UTAUT and TAM3) has not been found to be significantly higher than in the original model. Baker, Al-Gahtani and Hubona (2010) adopted TAM2 to examine users' willingness to accept computers in Saudi Arabia. The model consequently explained 40.3% of the variance of behavioural intention. Meanwhile, Mtebe, Mbwilo and Kissaka (2016) investigated the acceptance of multimedia instructions in Tanzania, based on UTAUT, whereby the model successfully explained 40.2% of the variance of behavioural intention. Similarly, Al-Gahtani (2016) used TAM3 to assess e-learning acceptance in Saudi Arabia. The collected data led to a prediction of 42% of the variance of behavioural intention towards this technology.

To conclude, the aforementioned theories have each sought to address the weaknesses in their predecessor. For instance, TRA fails to take into account those behaviours that cannot be completely controlled, whereas TPB attempts to overcome this limitation. Both consider the subjective norm to be an influential factor in behavioural intention. They also propose attitude towards use as a mediator between perceived usefulness and behavioural intention. In contrast, TAM excludes the subjective norm and brings about significant change in TRA and TPB by suggesting that the expectation of enhanced job performance (perceived usefulness) is a direct predictor of behavioural intention.

In the models based on TAM, the majority of the effort has been invested in explaining perceived usefulness and perceived ease of use. However, it has also been found that even with such extension, the overall power of the models is similar to, or slightly higher than the typical explanatory power of TAM. Furthermore, the parsimony and ease of evaluation inherent in TAM can provide further support for this model, which could explain why Šumak, Hericˇko and Pušnik (2011) found that 86% of the literature on e-learning acceptance exhibited the adoption of TAM.

To address TAM's limitations in the context of e-learning, this thesis combines Learning Styles Theory and Universal Learning Theory with this model. The next two sections discuss both theories, along with their potential impact on e-learning acceptance and learners' perceptions.

2.5 Learning Styles Theory

Learning styles are defined as "characteristic strengths and preferences in the ways they [learners] take in and process information" (Felder, 1996, p.18). Conversely, Willingham, Hughes and Dobolyi (2015) distinguish between two directions for defining learning styles. The first focuses on learning styles as "differential preferences for processing certain types of information", while the second refers to learning styles as "processing information in certain ways" (p.266). For example, one learning styles theory that classifies learners as 'visual' or 'verbal' lies in the first direction, whereas a theory that distinguishes between 'sensing' and 'intuitive' learners underpins the second.

Coffield, Moseley, Hall and Ecclestone (2004) found that more than 71 learning style models were evident in the literature. However, a few models have dominated this area, due to their theoretical bases, popularity in use and influence on other frameworks. Akbulut and Cardak (2012) point out that although some models are disadvantaged by

either low validity or poor empirical evidence, other theories are commonly adopted in learning styles research and are theoretically and empirically supported. Out of 70 studies reviewed by Akbulut and Cardak (2012), the Felder and Silverman model (50%) (Felder & Silverman, 1988), cognitive styles models (17.1%) (Pask, 1976; Witkin et al., 1977), Kolb's model (8.6%) (Kolb, 1981), the visual, aural, read/write, kinesthetic (VARK) model (7.1%) (Fleming & Mills, 1992), the Honey and Mumford model (5.7%) (Honey & Mumford, 1986), and others (e.g. the Dunn and Dunn model (Dunn & Dunn, 1974) and Keefe's model (Keefe, 1979)) were found to dominate. In agreement with these results, Truong (2015) also found that out of 51 studies on learning styles applied to e-learning, the most adopted theories are: the Felder and Silverman model (70.6%, N=36), the VARK model (9.8%, N=5), the Honey and Mumford model (3.9%, N=2), Kolb's model (3.9%, N=2) and others (11.8%, N=6).

The Felder and Silverman model is used in the present study, as it is perceivably robust and widely adopted, particularly in studies on education that focus on technology-enhanced learning (TEL) (Akbulut & Cardak, 2012; Huang, 2015; Graf, 2007; Lee & Sidhu, 2015).

2.5.1 The Development of the Felder and Silverman Learning Styles Model (FSLSM)

Based on the Myers-Briggs Type Indicator and Kolb's learning style theories, Felder and Silverman (1988) proposed the Felder and Silverman Learning Styles Model (FSLSM). The Myers-Briggs Type Indicator classifies people into four dichotomies, according to their personality patterns: extroversion/introversion, sensing/intuition, thinking/feeling, and judging/perceiving (Pittenger, 1993), amounting to a total of 16 patterns (2^4).

- The extroversion/introversion dimension refers to an individual's perceptual orientation. Extroverts focus on surrounding aspects, for example, other people or thoughts, while introverts are more concerned with their own ideas and less interested in others.
- The conceptual component consists of sensing/intuition, which reflects on individual perceptions. There are those who use their five senses to collect information (seeing, touching, smelling, tasting and hearing) by 'sensing', whereas others would rather use their intuition for unconscious perception.
- To evaluate the information they receive, people apply the thinking/feeling dimension, whereby 'thinkers' impose a logical structure on their evaluations, such

as 'true or false' and 'if or else'. Meanwhile, those who 'feel' adopt a 'more-less' or 'better-worse' approach.

- The fourth dimension involves judging/perceiving and here, someone with a 'judging' orientation will favour a structural approach, for example, step-by-step, whereas someone who 'perceives' as opposed to making judgements will be more flexible and keep their options open.

On the other hand, Kolb's model considers the learning process as a four-stage cycle: concrete experience, reflective observation, abstract conceptualisation, and active experimentation. The four learning styles diagnosed by this model are: diverging, converging, assimilating, and accommodating (Kolb, 1984).

- A learner with a diverging style has concrete experience and exercises reflective observation. The majority of learners demonstrating this style will favour viewing concrete situations from several perspectives. Their creativity is therefore enhanced because they can generate new ideas by 'brainstorming'.

- Individuals who adopt a converging style apply abstract conceptualisation and active experimentation. Convergers can find practical applications for their ideas and solve problems using appropriate means, due to their ability to collate facts and information.

- Assimilating learners have the capacity for reflective observation and abstract conceptualisation. They can therefore understand a broad range of information with ease, gathering it rationally and concisely.

- Accommodating learners possess concrete experience and favour active experimentation. They tend towards challenging expertise and making plans.

The Felder and Silverman model integrates the sensing/intuitive dimension from the Myers-Briggs Type Indicator and the active/reflective dimension from Kolb's model. However, it also encompasses other dichotomies. To clarify this further, the five dimensions initially included in the model were sensing/intuitive, visual/auditory, inductive/deductive, active/reflective and sequential/global (Felder & Silverman, 1988).

In 2002, the Felder and Silverman model was reviewed and modified by Felder. The inductive/deductive dimension was thus excluded, based on the notion that the traditional teaching method in higher education Engineering disciplines, for example, is deductive. Moreover, the visual/auditory dimension was replaced by the visual/verbal dimension,

based on the premise that the auditory aspect refers to spoken words or other sounds, but does not include the written word (Felder, 2002). From a psychological perspective, the term 'verbal' can refer to both the spoken and written word, due to the human tendency to translate the written word into its equivalent sounds (Felder, 2002). The four axes of this model may be briefly described as follows:

- Processing (active/reflective): learners process information in either active or reflective ways. Active learners prefer immediate participation in learning and learn better in groups, interacting with their environment through self-assessment. Moreover, they are more likely to enjoy experimentation, whereas reflective learners adopt an analytical approach and prefer to study alone or with a familiar partner.
- Perception (sensing/intuitive): 'sensing' learners prefer facts and have the capacity to memorise information with ease. They also tend to follow tutors' approaches when solving problems; patiently and carefully attending to simple details, while working slowly and methodically. In contrast, intuitive learners are more comfortable with theories and tend to apply innovative approaches to problem-solving. However, they are disinterested in detail, but gravitate more towards complicated issues, grasping concepts quickly.
- Input (visual/verbal): visual learners prioritise pictorial materials, for example, videos, demonstrations, graphs, images, animation and charts; while verbal learners favour written texts or listening to verbal explanations.
- Understanding (sequential/global): learners either prefer to take in information sequentially in a step-by-step learning approach, or globally, by viewing the overall picture, before focussing on surface-level details. Hence, sequential learners tend to learn in a series of steps, without looking at the whole picture. They are concerned with partial or shallow materials, but do not extrapolate from these. In contrast, global learners prefer an overview to learning step-by-step. They tend to make conceptual leaps to avoid working with incomplete or shallow materials and 'think outside the box' to group different ideas together.

In order to ascertain learning styles based on this model, the Index of Learning Styles (ILS) questionnaire was proposed (Felder & Soloman, n.d.). Figure 2.6 depicts this model and the scoring scheme (1-11), identifying the learning styles for each dimension.

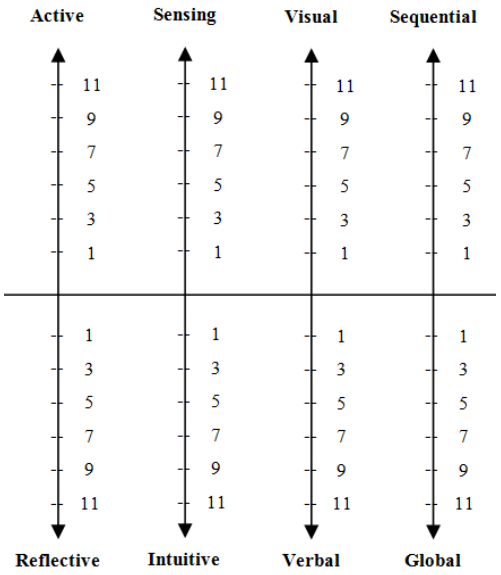


Figure 2.6: FSLSM and Scoring in its Instrument

The four dimensions of FSLSM also overlap other theories of learning styles. For example, the active/reflective dimension is identical to the activist/reflector in the Honey and Mumford model. Additionally, the sensing/intuitive dimension is consistent with the concrete/abstract dimension in Kolb's framework (Filippidis & Tsoukalas, 2009) and the pragmatist/theorist in Honey and Mumford's theory. In addition, the sequential/global dimension is compatible with the holistic/serialist group in Pask's model and field dependence/field independence in Witkin's model. Finally, the visual/verbal dimension corresponds to the VARK model and the visual/auditory in the Dunn and Dunn model. This overlap may further support Clarke's (1993) conclusion that the differences between these styles are merely in name rather than nature.

According to the literature, cultural background is an effective factor on learning styles (Oxford & Anderson, 1995; Wong, 2004). For the purposes of the current research therefore the relationship between culture and learning styles is considered, in order to support the importance of investigating learning styles in different educational contexts.

2.5.2 Learning Styles and Culture

Culture is defined as: "…the interactive aggregate of common characteristics that influence a human group's response to its environment. Culture determines the identity of a human group in the same way that personality determines the identity of an individual" (Hofstede, 1980, p.24).

Hofstede (1980), however, suggests that personality tests can sometimes be used to measure cultural traits. Accordingly, the importance of investigating the impact of learning styles in different educational contexts underlies the notion that such psychological traits are directly associated with cultural differences.

Wong (2004) points out that learning style is predetermined by a learner's culture. According to Guild (1994), "cultures do have distinctive learning style patterns and learning styles are a function of both nature and nurture" (p.19). Such perspectives are also supported by Cagiltay and Bichelmeyer (2000), who suggest a fundamental relationship between learning styles and culture, because individuals "learn how to learn". In fact, Dunn et al. (1990) found that cultural backgrounds have a strong effect on learning styles. This would support the need for more investigation on the possible impact of learning styles, particularly in under-represented learning contexts such as Iraq. Understanding the findings from the previous literature, however, is an essential step towards further research.

2.5.3 The Impact of Learning Styles on E-learning Acceptance and Learners' Experience

With the emergence of e-learning, learning styles have been widely used, either to adapt e-learning output to the preferences of individual learners (Akbulut & Cardak, 2012; Truong, 2015), or to understand its association with learners' beliefs and attitudes in relation to this technology (Huang, 2015; Li, 2015). The widespread application of learning styles in e-learning research may be attributed to the ability of such technology to accommodate diverse learning styles. For instance, visually-oriented students, who have a preference for videos, graphs and other pictorial materials, may find that e-learning is compatible with their learning style. Similarly, global learners, who gravitate towards making conceptual leaps in their learning and freely select the learning pathways that suit them best, may also favour e-learning (Huang, 2015). However, some of the meta-analyses previously reviewing learning styles applied to e-learning suggest that there is still a lack of empirical research on the effectiveness of this psychological trait (Akbulut & Cardak, 2012; Truong, 2015).

In the present study, the literature reviewed on the association between learning styles with learners' perceptions and behavioural intention towards e-learning are classified into three categories, according to statistical analysis techniques adopted in such studies. The first includes research investigating differences in learners' attitudes and perceptions, based on diverse learning styles. The second category comprises studies testing the moderating

effect of learning styles. Finally, the third category encompasses literature that extends e-learning acceptance theories by including learning styles as predictors.

With reference to the first category, many studies have used one-way ANOVA or t-test techniques to examine the differences between groups. Federico (2000), for example, investigated the differences in learners' attitudes to network-based instructions, according to Kolb's model. The analysis suggests that learners with a preference for assimilating and accommodating were more accepting of these than the other groups investigated. Similarly, Young, Klemz and Murphy (2003) also used Kolb's model to examine differences in learners' attitudes to five educational technologies (e-mail, Internet access, PowerPoint presentations, the Blackboard LMS and laptop computers). The results did not present any significant differences between any of the groups. In line with this research, Chen (2011) studied the relationship between learning styles and learners' attitudes to the use of Facebook in education, based on Kolb's model. The outcomes suggest that the 'converger' group possessed a positive and significant attitude to Facebook technology, whereas no significant differences were found between other dimensions. In another study carried out by Li (2015), the acceptance of interactive learning technology (wikis) was explored according to the Felder and Silverman model. The only significant difference was found between active and reflective learners, whereby active learners were more likely to accept wikis than their reflective peers. Furthermore, Balakrishnan and Gan (2016) explored learners' intention to use social media in education, based on three types of learning style: participatory, independent and collaborative. In this case, a significant difference was found between participatory and collaborative styles.

With regard to the second category of the literature, a multi-group analysis was conducted to understand the moderating effect of learning styles. Huang (2015) explored the influence of the sequential/global dimension of the Felder and Silverman model on learners' intention to use collaborative learning technology (Prezi). The findings demonstrate that students who prefer to learn sequentially are more likely to be concerned about the *usefulness* of the technology, whereas students with a global learning orientation were more concerned about the *effort* required to use it. Ramirez-Correa, Javier Rondan-Cataluña, Arenas-Gaitán andAlfaro-Perez (2017) also adopted the Felder and Silverman model to test the moderating effect of learning styles on e-learning success. The path strength between different variables in the research model they applied was subsequently affected by the learning style dimensions. Meanwhile, Ursavaş and Reisoglu (2017) found that the field dependence/field independence of Witkin's cognitive styles model

demonstrated a moderating influence on the path strength between many factors in an extended TAM.

Finally, another set of literature relates to techniques such as Pearson's correlation coefficient, linear regression and structural equation modelling to examine the association between learning styles and learners' attitudes, perceptions and/or behavioural intention. Shaw and Marlow (1999) used the Honey and Mumford model to highlight the relationship between learning styles and learners' attitudes to the use of ICTs in education. The results of the Pearson's correlation test indicated that the only significant weak and negative relationship was between the theorist style and the 'interactivity' and 'context' dimensions. Meanwhile, Eom, Wen and Ashill (2006) found that the VARK model was a significant determinant of learners' satisfaction. Brown et al. (2009), however, used the Felder and Silverman model to identify the capacity of learning styles to predict students' attitudes to an online learning environment. The regression analysis technique applied here demonstrated that learning styles were weak predictors of online learning.

Huang, Lin and Huang (2012) also adopted the Felder and Silverman model as a direct predictor of online participation behaviour in e-learning. Based on structured equation modelling, the only predictor revealed was the sensing/intuitive dimension. Conversely, Gu, Triche, Thompson and Cao (2012) hypothesised that the VARK model could predict perceived ease of use and perceived usefulness in TAM. Overall, the findings support both assumptions. Similarly, Toni and Holtbru (2012) used Kolb's model to ascertain its ability to determine perceived usefulness. The findings advocate that learning styles can explain an acceptable fit of the variance of this construct. However, the Felder and Silverman model failed to predict perceived enjoyment of a mobile learning game (Baek & Touati, 2016).

Table 2.2 summarises the findings of the reviewed literature in this section. It is clear that outcomes are inconsistent, whereby some studies establish a significant relationship between learning styles and the acceptance of e-learning and/or learners' perceptions, whereas others do not.

Table 2.2: Summary of the Reviewed Literature on Learning Styles and E-learning Use

Study	Learning Styles Model	Affecting	Results
Shaw & Marlow (1999)	Honey and Mumford	Learners' attitudes towards educational ICTs	Rejected
Federico (2000)	Kolb	Learners' attitudes towards network-based instruction	Supported
Young et al. (2003)	Kolb	Use of educational technology	Rejected
Eom et al. (2006)	VARK	Learners' satisfaction with e-learning	Supported
Brown et al. (2009)	FSLSM	Use of the online learning environment	Rejected
Chen (2011)	Kolb	Learners' attitudes towards the use of Facebook in education	Partially Supported
Gu et al. (2012)	VARK	PEOU and PU	Supported
Huang et al. (2012)	FSLSM	Learners' online participation	Supported
Toni & Holtbru (2012)	Kolb	PU	Supported
Huang (2015)	FSLSM	Learners' intention to use Prezi	Supported
Li (2015)	FSLSM	Acceptance of the use of wikis	Partially Supported
Baek & Touati (2016)	FSLSM	Perceived enjoyment	Rejected
Ramirez-Correa et al. (2017)	FSLSM	E-learning success	Supported

Learning styles have also been linked with academic achievement. According to Felder & Brent (2005), the mismatch between teaching and learning styles may lead to withdrawal from a course, learner disinterest and lower achievement. In instructions delivered to Engineering students, for example, such drawbacks are attributed to a bias towards reflective, intuitive, verbal and sequential styles (Felder, 1996). The learning experience of students who fall within other axes may thus be negatively affected.

Thomas, Ratcliffe, Woodbury and Jarman (2002) found that out of 107 undergraduate students on an introductory programming course, reflective and verbal students scored significantly higher than their active and visual peers. Similarly, Allert (2004) illustrated that out of 117 undergraduate students, those who adopted reflective and verbal styles on an introductory Computer Science course did significantly better than their active and visual counterparts. The results of a study conducted by Zapalska and Brozik (2006) also indicate that students' performance can be enhanced, if teaching approaches are compatible with their learning styles. In agreement with the above conclusion, Manochehr (2006) found that learners identified as assimilators or convergers in their learning approach achieved more in e-learning environments. Norwawi (2009) used the Felder and Silverman and Kolb models to determine the learning styles of 71 Computer Science graduate students, with findings to indicate that their achievement was highly correlated with their learning styles.

Conversely, Lu, Yu and Liu (2003) revealed no statistical significance between learning style and learning achievement amongst 76 graduate students. This is further supported by Campbell and Johnstone (2010), who recruited 74 undergraduate students on a Programming course, whereby the results also failed to confirm any significant association between learning styles and achievement. Furthermore, Gomes and Mendes (2010) found no significant discrepancy between learning style and academic performance. Prajapati, Dunne, Bartlett and Cubbidge (2011) support these results with their investigation, which did not reveal any statistical significance between the academic performance of 270 undergraduate students and learning styles. Finally, Brown (2007) adapted an e-learning system to the visual/verbal and sequential/global dimensions, where the academic performance of 200 students using adaptive and non-adaptive systems demonstrated no statistically significant differences in either case. Table 2.3 summarises the results of the reviewed literature on the relationship between learning styles and learning performance.

Table 2.3: Summary of the Reviewed Literature on Learning Styles and Academic Performance

Study	Learning Styles Model	Results
Thomas et al. (2002)	FSLSM	Partially Supported
Lu et al. (2003)	Witkin's model	Rejected
Allert (2004)	FSLSM	Partially Supported
Zapalska & Brozik (2006)	VARK	Supported
Manochehr (2006)	Kolb	Supported
Brown (2007)	FSLSM	Rejected
Norwawi (2009)	FSLSM, Kolb	Supported
Campbell & Johnstone (2010)	Kolb	Rejected
Gomes & Mendes (2010)	FSLSM	Rejected
Prajapati et al. (2011)	FSLSM	Rejected

2.5.4 Critiques of Learning Styles

Although learning style theories have attracted significant attention in the literature, many issues emerge from critiques of their theoretical bases, empirical implications and methodological rigour. First, there is no universal agreement on what constitutes a 'learning style' (Graf, 2007). The key concept of a learning style overlaps other terminologies, such as 'cognitive style' or 'learning strategy' (Peterson, Rayner andArmstrong, 2009). Entwistle (1991) has attempted to distinguish between the terms 'strategy' and 'style' in this regard, with a strategy being considered as a preferred way of approaching a particular task and a style being associated with preferences that are more closely related to the psychological concept of a cognitive style. This means that learning strategies or approaches are less stable features of task performance and responses to circumstances. However, Coffield et al. (2004) clarify that learning styles are a general

umbrella that can include other terminologies. Accordingly, they classify learning style theories into five families: 'constitutionally-based learning styles and preferences', 'cognitive structure', 'stable personality type', 'flexibly stable learning preferences', and 'learning approaches and strategies'. Figure 2.7 illustrates some of the dominant theories that underlie each family.

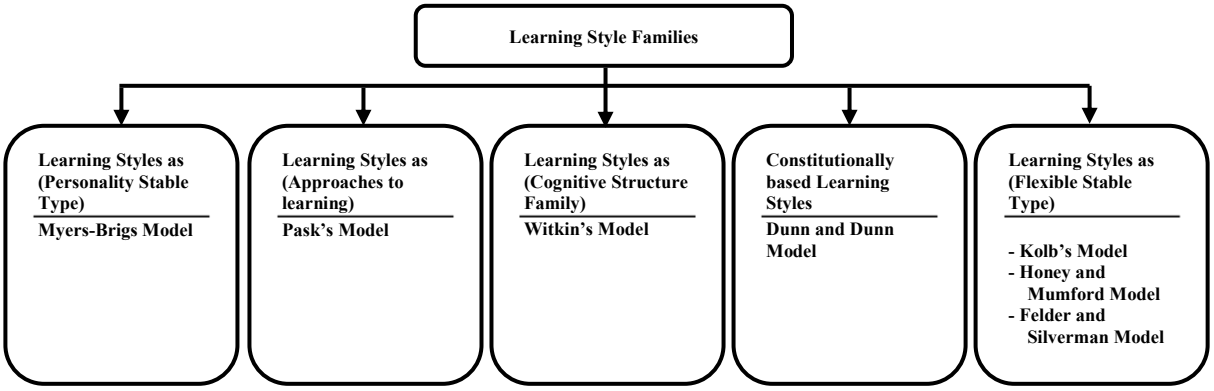


Figure 2.7: The Main Families of Learning Style Models

Coffield et al. (2004) also criticise the reliability of the measures developed to identify learning styles and Graf (2007) highlights many concerns over the use of questionnaires to infer learning styles. First, students need to be motivated to fill in the instrument, as their lack of interest could lead to arbitrary answers. Moreover, learners need to be aware of their own learning styles in the first place, in order to be able to self-assess their preferences. Finally, if the assumption that a learning style trait is malleable, it should be evaluated multiple times, which could in turn affect learners' willingness to participate.

The absence of convincing evidence to support the pedagogical implications of learning styles is a further criticism arising from the literature. Willingham et al. (2015) point out that the confusion between learning styles and learning abilities represents one reason for widespread reference to learning styles. However, it must be emphasised that 'ability' indicates how *well* learners do things, whereas 'style' explains the *way* in which the learner does them. Another reason for this confusion is that some things are widely regarded as scientific fact, even when the majority of people have scant knowledge about them (Willingham et al., 2015). Pashler, McDaniel, Rohrer and Bjork (2009) highlight other reasons for the common reference to learning styles. From one perspective, learners may think that they can learn effectively when instructional courses are designed according to their individual styles, or when everyone is considered as a unique learner. Accordingly,

Pashler et al. (2009) conclude that "there is no adequate evidence base to incorporate learning styles assessments into general educational practice" (p.105).

Finally, presenting learning materials according to students' learning styles is not necessarily the best instructional choice. For instance, exclusively delivering written or audio-materials to verbal learners will render content requiring visual presentation, less effective. According to Willingham et al. (2015), based on a learning styles assumption, when a learner is considered to be visually oriented, he/she is predicted to learn best through pictorial materials, irrespective of the subject matter (for example, whether literary, mathematical or scientific); however, studies fail to substantiate this.

Nevertheless, several arguments may arise against such criticisms. With regard to defining the term 'learning style', the conclusion of Willingham et al. (2015) may be adopted here, whereby learning styles are based on dimensions included in a particular theory. For example, the learning styles model adopted in the current research encompasses a dimension that classifies learners according to their preferences when processing certain types of information (the visual/verbal dimension). It also includes dimensions that categorise learners based on their tendency to process information in certain ways, such as the active/reflective and sequential/global dimensions. Furthermore, the reliability and validity of many learning styles questionnaires have been confirmed, such as the ILS questionnaire (Felder & Spurlin, 2005; Hosford & Siders, 2010; Zywno, 2003a).

Finally, a recent review of the possible implications of learning styles in higher education contexts found that out of 103 studies, 89% revealed positive outcomes (Newton, 2015), contradicting criticisms from Pashler et al. (2009) and Willingham et al. (2015), and supporting further research on learning styles. However, it is also acknowledged by the author of the present study that presenting learning content according to learners' preferences is not always feasible, because it is highly dependent on the nature of the subject being studied. The topic is therefore not closed, and well designed studies may still change the current view of learning styles.

In summary, the inconsistency of previous literature on the impact of learning styles may be attributed to cultural differences, thus encouraging further empirical studies in under-represented learning contexts. Jonassen and Grabowski (1993) highlighted other causes of such inconsistency; for example, sample size, abbreviated treatment, and the absence of a theoretical or conceptual relationship between aptitudes (the 'personological' variables, such as cognitive styles, personality, or prior knowledge).

2.6 Universal Learning Theory

The empirical application of learning styles focuses on accommodating learning contents to learners' individual preferences. Another learning theory, however, suggests that addressing environmental learning limitations in terms of curricular design is a key aspect of responding to learners' needs. The main concepts of this theory and its impact on e-learning acceptance and learners' perceptions are discussed in this section.

The term 'Universal Design' was coined by the innovative architect Ronald Mace in the 1970s, referring to the way in which products and environments are designed to be optimally usable, without the need for special accommodation or adaptive design (Center for Universal Design, 2015). Embracing Universal Design in architecture can therefore lead to the construction of buildings that are accessible to all, including people with disabilities, without the need for retrofitting. It also provides options for users to choose what will be most convenient for them. Synonyms of Universal Design are 'inclusive design', as it is known in the UK and 'design for all', as it is know across most of Europe (Clarkson & Coleman, 2015). This framework includes seven basic principles:

- Equitable use: diversity and varying ability in the general population should be taken into account during the design process.
- Flexibility of use: individual preferences and abilities should be served.
- Simple and intuitive use: designs should be easy to comprehend, regardless of the user's prior experience or knowledge.
- Perceptible information: the design should be able to effectively communicate the necessary information to all users, irrespective of the ambient conditions or their sensory abilities.
- Tolerance for error: the design should reduce and minimise risk and error due to unintentional actions.
- Low physical effort: the design should minimise the amount of physical effort required for its efficient and comfortable use.
- Size and space for approach and use: the design should be of an appropriate size and allow adequate space for use, irrespective of the user's body size, posture and/or mobility.

Universal Learning Theory is therefore grounded on the principles of Universal Design. The main concern of this theory is how to design flexible and accessible curricula that respond to learners' needs, irrespective of their individual differences or preferences. Three frameworks are hereby proposed for the design of accessible learning: Universal Design of Instruction (UDI), Universal Instructional Design (UID) and Universal Design for Learning (UDL) (Rao, Ok, & Bryant, 2014). Table 2.4 illustrates the main principles of these three models.

Table 2.4: Main Principles of Three Universal Learning Theories (Rao et al., 2014; p.154)

Universal Design of Instruction (UDI)	Universal Instructional Design (UID)	Universal Design for Learning (UDL)
• Class climate	• Creating a welcoming class	• Providing multiple means of representation (MMR)
• Interaction	• Determining essential components of a course	• Providing multiple means of action and expression (MMAE)
• Physical environments and products	• Communicating clear expectations	• Providing multiple means of engagement (MME)
• Methods of delivery	• Providing timely and constructive feedback	
• Information resources and technology	• Exploring the use of natural supports for learning, including technology	
• Feedback	• Designing teaching methods that consider diverse learning styles, abilities, ways of knowing, and previous experience and background knowledge	
• Assessment	• Creating multiple ways for students to demonstrate their knowledge	
• Accommodation	• Promoting interaction among and between the faculty and the students	

The present research uses the UDL model, which is increasingly attracting the attention of researchers and educators as an effective solution for designing an accessible learning environment (Kumar & Wideman, 2014; Rao et al., 2014; Mangiatordi & Serenelli, 2013). The main principles of this framework and its development are discussed below.

2.6.1 The Development of the Universal Design for Learning (UDL) Framework

The Center[Centre] for Applied Special Technology (CAST) proposed the UDL framework in 2002, as an iteration of Universal Design (Rose & Meyer, 2002). The model has been revised over the years, being presented as UDL 2.0 in 2011 (CAST, 2011). CAST defines UDL as: "a framework that addresses the primary barrier to fostering expert learners within instructional environments: inflexible, "one-size-fits-all" curricula. It is inflexible curricula that raise unintentional barriers to learning" (CAST, 2011, p.4). CAST

argues that learners' interaction with inflexible instructional content, goals, approaches and assessments are the primary barriers to learning and therefore, it is not within individual ability or capacity that the limitations lie.

UDL's evidence-based principles are grounded on research in neuroscience, relating to the way in which the human brain activates three main neural networks during any instructional experience (CAST, 2015). Rose and Strangman (2007) state that in every cognitive act, neuropsychological research identifies "three distinct functions". These include a component which recognises patterns, another which plans and generates patterns and a third which selects the most important patterns.

The above framework can be divided into two layers: a conceptual layer made up of three networks and an implementation layer consisting of three principles. The three networks are defined as follows:

- The recognition network: this represents the 'what' of the learning or input; learners use different ways of categorising 'what' they see, hear and read.
- The strategic network: this represents the 'how' of learning or expression; learners use different ways of organising and expressing their thoughts and ideas.
- The affective network: this represents the 'why' of learning or engagement; different methods can be applied to engage learners and keep them excited and interested.

In 2002, CAST researchers theorised a set of three principles corresponding to the three learning networks. The key concepts underlying these principles comprise adopting multiple means of content delivery, diverse methods of expression and assessment, and various means of engagement (Rose & Meyer, 2002). The three principles are described below:

- Providing multiple means of representation: this principle suggests presenting learning content in different ways; for instance, video, audio, text, graphs and other multimedia. This can offer better opportunities for all learners, whether disabled or able-bodied.
- Providing multiple means of action and expression: most learners would rather not have their understanding and knowledge assessed exclusively via formal examinations. This is due to the restricted time and organisational setting of this measurement. Therefore, asking students to express their understanding in other

formats, such as assignments, interviews, short quizzes, scientific papers and multimedia presentations can reflect their knowledge more effectively than using a single measurement.

- Providing multiple means of engagement: using only a lecture format may negatively affect learners' engagement. Hence, to maintain levels of interest during a lecture, other strategies can be used to motivate students, such as delivering learning content through open discussion, question and answer (Q&A) sessions, peer-tutoring, and an applied problem-solving approach.

Further to the above, these three principles include nine guidelines and 31 checkpoints, to be followed when adopting this model (see Table 2.5, below), whereas Figure 2.8 illustrates the main networks and principles of the UDL framework.

Table 2.5: Principles of the UDL Framework (CAST, 2015)

Universal Design for Learning Guidelines		
I. Provide Multiple Means of Representation	**II. Provide Multiple Means of Action and Expression**	**III. Provide Multiple Means of Engagement**
1: Provide options for perception 1.1 Offer ways of customizing the display of information 1.2 Offer alternatives for auditory information 1.3 Offer alternatives for visual information	**4: Provide options for physical** action 4.1 Vary the methods for response and navigation 4.2 Optimize access to tools and assistive technologies	**7: Provide options for recruiting interest** 7.1 Optimize individual choice and autonomy 7.2 Optimize relevance, value, and authenticity 7.3 Minimize threats and distractions
2: Provide options for language, mathematical expressions, and symbols 2.1 Clarify vocabulary and symbols 2.2 Clarify syntax and structure 2.3 Support decoding of text, mathematical notation, and symbols 2.4 Promote understanding across languages 2.5 Illustrate through multiple media	**5: Provide options for expression and communication** 5.1 Use multiple media for communication 5.2 Use multiple tools for construction and composition 5.3 Build fluencies with graduated levels of support for practice and performance	**8: Provide options for sustaining effort and persistence** 8.1 Heighten salience of goals and objectives 8.2 Vary demands and resources to optimize challenge 8.3 Foster collaboration and community 8.4 Increase mastery-oriented feedback
3: Provide options for comprehension 3.1 Activate or supply background knowledge 3.2. Highlight patterns, critical features, big ideas, and relationships 3.3 Guide information processing, visualization, and manipulation 3.4 Maximize transfer and generalization	**6: Provide options for executive functions** 6.1 Guide appropriate goal-setting 6.2 Support planning and strategy development 6.3 Facilitate managing information and resources 6.4 Enhance capacity for monitoring progress	**9: Provide options for self-regulation** 9.1 Promote expectations and beliefs that optimize motivation 9.2 Facilitate personal coping skills and strategies 9.3 Develop self-assessment and reflection
Resourceful, knowledgeable learners	**Strategic, goal-directed learners**	**Purposeful, motivated learners**

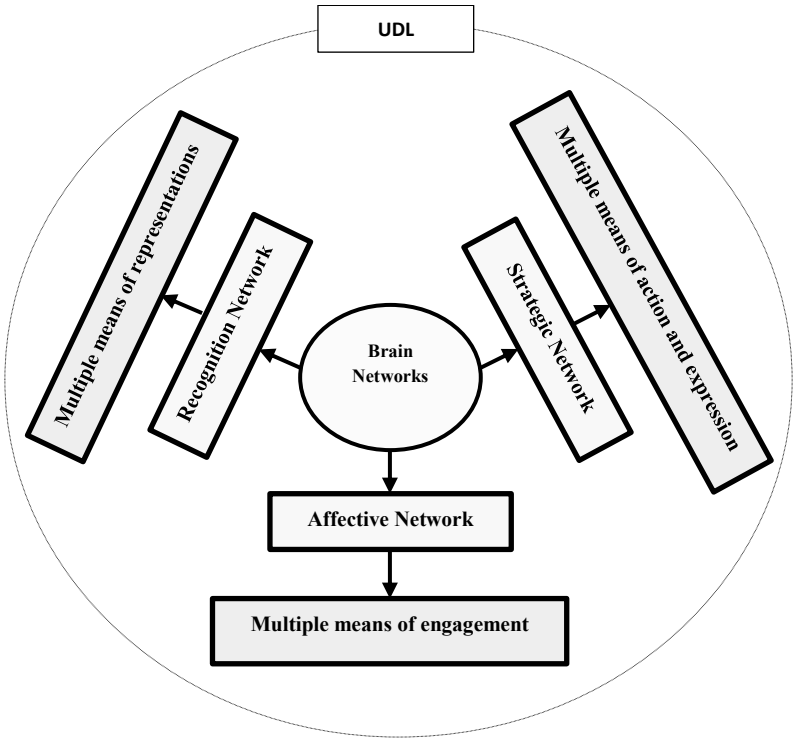


Figure 2.8: UDL Networks and Principles

2.6.2 The Effect of the UDL Application on E-learning Acceptance and Learners' Perceptions

The potential for designing accessible curricula using e-learning technology has already been discussed in the literature. Phipps, Witt and Kelly (2005) conclude that the use of e-learning can improve the accessibility of the traditional teaching mode, if it is designed and developed in a way that makes it accessible for all learners. In agreement with this conclusion, Seale and Cooper (2010) point out that e-learning should be blended with effective pedagogical approaches to ensure accessible learning and meet learners' needs.

Accordingly, the literature has established a theoretical relationship between UDL-inspired course design and e-learning. Rose and Strangman (2007), for example, declare that the use of educational technologies has the potential to enable successful UDL. Furthermore, Bühler and Fisseler (2007) clarify that the e-learning experience can be enhanced by integrating UDL principles into designs for e-learning courses. Based on this discussion, CAST (2011) concludes that "technology is not synonymous with UDL, but it does play a valuable role in its implementation and conceptualization" (p.10).

In line with previous literature, Bryans Bongey et al. (2010) used a course management system, WebCT/Blackboard, to design a UDL-based blended e-Biology course. By comparing usage of the course site with the traditionally structured e-learning course (from

the previous semester), it was shown that levels of perceived satisfaction and e-learning use were higher for the UDL-based blended course. Similarly, Smith (2012) established a significant relationship between the integration of UDL into a blended e-learning system and learners' engagement and interest. A comparison of the perceptions of students taking UDL-inspired blended e-courses with those of students attending traditional courses indicated that learners' perceptions were significantly improved through adherence to the UDL model (Davies, Schelly & Spooner, 2012).

Similarly, Kumar and Wideman (2014) found that applying UDL principles to a blended e-learning course led to a high level of interaction with the course site, better use of the system and great satisfaction. Other research has shown that applying the UDL model in a Web-based learning system leads to enhanced self-efficacy amongst learners in online learning and positively influencing their willingness to use this technology in future (He, 2014). The effect of using video-integrated closed captions, as an aspect of UDL, on learners' attitudes towards educational technology was also investigated by Dallas, Mccarthy and Long (2016), producing results that demonstrate how use of this technology has a significant positive influence on students' acceptance of multimedia instructions.

Even though none of the literature reviewed has investigated the direct effect of applying UDL on e-learning acceptance, it does support the improvement of e-learning adoption through the application of the framework. Moreover, other studies have examined the predictive ability of variables which correspond closely to UDL principles on e-learning acceptance and learners' perceptions.

The first principle of UDL involves 'multiple means of representation'. To some extent, this is identical to the factor of deploying multimedia instructions, as it refers to the use of different types of media, such as video, audio, animation and text in the presentation of learning content. Liaw (2008) found that multimedia instructions are a significant predictor of perceived usefulness, e-learning effectiveness, and learner satisfaction. Similarly, Cigdem and Ozturk (2016) investigated the predictability of multimedia instructions for perceived ease of use, perceived usefulness and learners' satisfaction, concluding that this variable is a significant predictor, except in the case of perceived satisfaction.

The second principle of UDL suggests that students should have the opportunity to express their understanding in different ways, using 'multiple means of action and expression'. Sun, Tsai, Finger, Chen and Yeh (2008) revealed that using diverse assessment methods has a significant influence on perceived satisfaction in blended e-learning systems.

According to the above authors, when instructors assess learners' knowledge and understanding in different ways, students can feel that a connection is established between themselves and their instructors and can also sense that their efforts are being evaluated properly. Moreover, Govindasamy (2002) recommends using several assessment approaches in e-learning to broaden learners' knowledge and understanding.

The third principle of UDL refers to 'multiple means of engagement'. According to Holley and Dobson (2008), integrating multimedia instructions can have a positive effect on learners' engagement, which will in turn improve their interaction with e-learning, even outside official university hours. Saadé and Bahli (2005) provocatively claim that a learner's engagement will have a positive influence on his/her acceptance of a learning technology, while Hu and Hui (2012) found that engagement had a direct effect on learning effectiveness and an indirect impact on perceived satisfaction. Another study, by Essam and Al-Ammary (2013), revealed that perceived motivation was a determinant of e-learning acceptance. Similarly, Moon and Kim (2001) extended TAM by incorporating perceived playfulness as an indicator of intrinsic motivation (engagement, fun and pleasure). The study found that this variable was a determinant of behavioural intention to use the World Wide Web. In contrast, Eom and Ashill (2016) revealed that intrinsic motivation was not a predictor of learners' satisfaction in e-learning settings.

To conclude, most of the reviewed literature establishes the existence of a significant effect of UDL application on e-learning use and learners' perceptions. However, none of these studies have quantitatively examined the direct ability of UDL implementation to predict such aspects. Therefore, the present thesis aims to address this research gap. Table 2.6, below, summarises the findings of the reviewed studies in chronological order.

Table 2.6: Summary of the Literature on the Relationship between Curricula Design and E-learning

Study	Factor	Affecting	Results
Moon & Kim (2001)	Perceived playfulness	Acceptance of the World Wide Web	Supported
Liaw (2008)	Multimedia instructions	Learner satisfaction	Supported
Sun et al. (2008)	Assessment methods	Learner satisfaction	Supported
Bryans Bongey et al. (2010)	UDL application	E-learning use and learner satisfaction	Supported
Davies et al. (2012)	UDL application	Learners' perceptions	Supported
Hu & Hui (2012)	Perceived engagement	E-learning effectiveness	Supported
Smith (2012)	UDL application	Learners' interest and engagement	Supported
Essam & Al-Ammary (2013)	Perceived motivation	E-learning acceptance	Supported
Kumar & Wideman (2014)	UDL application	E-learning use and learners' perceptions	Supported
He (2014)	UDL application	E-learning self-efficacy and use	Supported
Eom & Ashill (2016)	Intrinsic motivation	Learner satisfaction	Rejected
Cigdem & Ozturk (2016)	Multimedia instructions	Perceived ease of use	Supported
Cigdem & Ozturk (2016)	Multimedia instructions	Perceived usefulness	Supported
Cigdem & Ozturk (2016)	Multimedia instructions	Learner satisfaction	Rejected
Dallas et al. (2016)	Video-integrated closed captions	Learners' attitudes to adopting learning technology	Supported

2.7 E-learning Acceptance in the Arab World

It is logical to assume that the e-learning technology originally developed in the West tends to reflect Western beliefs, attitudes and values. Therefore, the overwhelming majority of the literature on its acceptance has investigated users' beliefs and perceptions in developed countries (Abbad, Morris & de Nahlik, 2009). The overall landscape of the developed world, however, does not resemble the Arab world in terms of culture, learners' characteristics or environmental variables. This means that such differences should be taken into account, when endeavouring to understand the factors affecting e-learning acceptance.

This section reviews some of the available literature on e-learning acceptance in Arab nations. It also highlights how previous studies have attempted to address TAM's limitations in the e-learning context. The reviewed literature is classified into five groups: (1) Using an original theory without any extension, (2) Considering individual/cultural differences in the extension process, (3) Combining environmental variables in terms of curricular design with the original theory, (4) Integrating individual/cultural differences and environmental variables, and (5) Extending the original theory with other constructs.

With regard to the first group listed above, many studies have used a range of technology acceptance theories to test e-learning adoption in the Arab context. For example, Tarhini, Hassouna and Abbasi (2015a) adopted TAM to investigate the acceptance of e-learning in

Lebanon. Even though the effect of perceived ease of use on perceived usefulness and attitude towards use was insignificant, the model explains an acceptable fit for behavioural intention. Similarly, Al-Adwan, Adwan and Smedley (2013) used the original TAM model to examine behavioural intention to adopt e-learning. However, their study failed to identify a significant relationship between perceived usefulness and attitude towards use, as well as attitude towards use and behavioural intention. Furthermore, Al-Suqri (2014) supported the use of UTAUT in investigating users' willingness to adopt an interactive e-learning tool in Oman. Even though TAM3 was developed in the West, its application in predicting e-learning acceptance in Saudi Arabia is confirmed by Al-Gahtani (2016).

Aside from the above, the effect of individual and cultural differences on e-learning adoption has been considered by many studies across the Arab world. Tarhini, Hone and Liu (2014a) extended TAM by including subjective norms and quality of work life as predictors, whereas individual differences in terms of gender, age, experience and educational level as moderators. They found that these individual differences had a significant moderating effect on many relationships in the extended model. Another study conducted by Tarhini, Hone, Xiaohui and Tarhini (2016) used the same variables as the above study (Tarhini et al., 2014a), but considered the moderating effect of cultural variables on path strength within the proposed model. Here, it was found that cultural dimensions had a significant moderating effect on the relationships between different constructs in the model. Additionally, Alshare, Mesak, Grandon and Badri (2011) compared the effect of cultural differences on relationships between TAM variables in three countries: the USA, Chile and the UAE, supporting that such differences can moderate the association between the model's factors.

Pertaining to the third group, Essam and Al-Ammary (2013) examined e-learning acceptance in Bahrain by combining two environmental variables, namely perceived interaction and perceived motivation. Both constructs were found to have a significant effect on e-learning adoption. Meanwhile, Almaiah, Jalil and Man (2016) extended TAM by including four environmental variables: quality of the learning content, quality of the content design, perceived interaction and accessibility of information as direct determinants of e-learning usefulness and ease of use. All relationships proposed in the above research were confirmed, supporting the significant effect of environmental factors on e-learning adoption.

Only one study was found to have tested e-learning acceptance based on cultural differences and environmental factors. Al-Ammari and Ahmad (2008) extended TAM by

including (1) The quality of the e-course content (environmental factor) as a predictor of perceived ease of use and perceived usefulness, and (2) Cultural differences as direct determinants of behavioural intention towards the use of e-learning. Both were significant predictors of the dependent factors.

Other studies in the Arab world have considered several different variables. Based on TAM, Abbad, Morris and de Nahlik (2009) included technical support, Internet experience, system interactivity, self-efficacy and subjective norm variables as determinants of perceived ease of use and perceived usefulness. Their model ultimately offers a good explanation of behavioural intention towards e-learning acceptance. Moreover, Abu-Shanab (2014) integrated perceived trust into TAM as a predictor of behavioural intention. The results supported the ability of this factor to determine e-learning acceptance. Moreover, another study used system quality and self-efficacy constructs to extend TAM (Alshibly, 2014). The proposed model demonstrated a more efficient explanatory power than the original TAM. In line with this study, Mabed and Koehler (2012) extended TAM by also combining system quality and self-efficacy. The soundness of the extended model in explaining e-learning acceptance was advocated. Additionally, Al-Busaidi (2013) extended TAM by using self-efficacy, technology experience, personal innovativeness and satisfaction as other direct determinants of e-learning acceptance. Three variables, namely, self-efficacy, perceived usefulness and learners' satisfaction had a significant influence on behavioural intention, thus supporting the soundness of the extended model.

Table 2.7 chronologically summarises the reviewed literature in different Arab countries and it becomes clear that TAM has been widely used in this context. However, many studies have extended this model by including other individual, cultural and/or environmental factors, either as predictors or moderators. Even though the reviewed literature showed that Arab learners are eager to accept e-learning technologies, many barriers still prevent its effective application. This should encourage investigation of the main barriers potentially hindering e-learning application in the Arab world.

Table 2.7: Summary of the Reviewed Literature on E-learning Acceptance in the Arab World

Study	Country	Model	Extended		Learner Differences	Environmental Variables	Other variables
			Yes	No			
Al-Ammari & Ahmad (2008)	Bahrain	TAM	X		X	X	
Abbad et al. (2009)	Jordan	TAM	X				X
Alshare et al. (2011)	UAE, USA, Chile	TAM	X		X		
Mabed & Koehler (2012)	Egypt	TAM	X				X
Al-Adwan et al. (2013)	Jordan	TAM		X			
Al-Busaidi (2013)	Oman	TAM	X				X
Essam & Al-Ammary (2013)	Bahrain	TAM	X			X	
Abu-Shanab (2014)	Jordan	TAM	X				X
Alshibly (2014)	Jordan	TAM	X				X
Al-Suqri (2014)	Oman	UTAUT		X			
Tarhini et al. (2014a)	Lebanon	TAM	X		X		
Tarhini et al. (2015a)	Lebanon	TAM		X			
Al-Gahtani (2016)	Saudi Arabia	TAM3		X			
Almaiah et al. (2016)	Jordan	TAM	X			X	
Tarhini et al. (2016)	Lebanon	TAM	X		X		

2.8 Barriers to E-learning Application in the Arab World

A considerable body of literature exists regarding the predictors of e-learning adoption. However, developing countries face many obstacles to the effective implementation of e-learning. An obstacle or resistance can occur because of cultural, financial, organisational, structural, environmental, technological, or personal issues. It could also be a combination of any or all of these. Identifying the factors potentially hindering successful e-learning application is a vital step towards ensuring that users will adopt the technology and that it will achieve its key aims.

Gulati (2008) reviewed the integration of TEL in different developing nations, producing a study that showed a potential for e-learning initiatives to improve the education sector in the developing world. However, poverty (financial) and an absence of ICTs infrastructure (technical) are the main issues preventing the introduction of e-learning into those environments. According to Zamani and Esfijani (2016), the obstacles faced by developing countries with regard to e-learning use can be classified into three groups. The first of these

may be defined as 'personal challenges', which include factors associated with internal personal features, characteristics and behavioural habits. The second group refers to 'attitudinal inhibitors', encompassing internal variables that are more relevant to the users' attitudes and perspectives of features of e-learning. Finally, the group indicated as 'contextual inhibitors' relates to external variables, which comprise a lack of ICTs skills and absence of organisational support.

Barriers to e-learning application in the Arab world and Middle East do not essentially differ from those encountered in other developing nations. According to Abouchedid and Eid (2004), "statistics on the access to computers and ICTs application in the Arab world show a serious digital divide between Arab countries and the developed world" (p.16). Moreover, Faqih (2016) points out that most Arab countries are experiencing slow e-learning adoption. Social barriers, attitudinal limitations, the prevalent economic stagnation and illiteracy are counted amongst the main hindrances to e-learning implementation in the above context (Abouchedid & Eid, 2004). Moreover, Al-Adwan and Smedley (2012) state that culture is the key barrier preventing effective e-learning application in Arab countries, suggesting a need for systematic training programmes and workshops to reduce the effect of this factor. It should be clarified here that cultural and social obstacles have a strong influence on technology adoption and whereas educational institutions can address the effect of technical issues through appropriate support, cultural and social barriers are more difficult to overcome. Elzawi and Wade (2012) and Abouchedid and Eid (2004) also found that both factors are hindrances to e-learning application in the Arab world.

Another barrier to e-learning implementation is the lack of individual skills and self-confidence. Unskilled users will face great difficulty in managing and implementing the technology involved and this will in turn lead to low adoption. Accordingly, technology acceptance theories suggest that self-efficacy and ease of technology use are significant positive factors of e-learning adoption (Venkatesh & Bala, 2008). A lack of confidence for performing tasks in e-learning systems was identified as one of the most important barriers preventing its effective uptake in Arab countries (Al-Senaidi, Lin & Poirot, 2009).

Aside from what has been discussed so far, the unavailability of basic infrastructure for the required technology will most certainly hinder e-learning implementation. Countries with this disadvantage will find it difficult to successfully adopt e-learning. This is because e-learning specifically requires a stable Internet connection, intranet networks, hardware, and software, integrated into the national infrastructure. In keeping with the previous literature,

poor ICTs infrastructure was found to be an essential barrier to e-learning implementation in the Arab world (Abdelraheem, 2006; Matar et al., 2010).

The available literature on barriers to e-learning adoption in Arab nations identifies many other obstacles that are still preventing successful implementation. These include, but are not limited to, (1) Strategies for e-learning adoption, (2) Copyright issues, (3) Limited availability of Web-based content for Arab users, (4) Lack of institutional support, (5) Language issues, (6) Uncertainty about the advantages of e-learning technologies in education, and (7) Lack of motivation and engagement.

The situation in the Arab Gulf States is no different from the scenario outlined above. According to Matar et al. (2010), poor or non-existent ICTs infrastructure and the dearth of Arabic e-resources are vital factors of slow e-learning adoption in the Middle East. An evaluation of e-learning use in the Arab and Middle-Eastern region revealed that the UAE, Jordan and Saudi Arabia lead the field in this area (Matar et al., 2010; Mirza & Al-Abdulkareem, 2011); while other, more recent research has shown that the UAE, Kuwait and Jordan rank top in e-learning implementation (Faqih, 2016).

In 1997, the Centre of Excellence for Applied Research and Training (CERT) was founded in the UAE as the largest education provider in the Middle East, with the aim of providing education, training and applied technology (Watt, 2012). Likewise, in Oman, Al Musawi and Abdelraheem (2004) point out that WebCT was adopted at Sultan Qaboos University in 2001. Following other Arab Gulf countries, Saudi Arabia has also moved towards the adoption of e-learning. The National Centre for E-learning and Distance Learning was launched in 2005, with the objective of integrating e-learning with the existing education system (Yamani, 2014). Furthermore, Jordan is considered as one of the nations pioneering e-learning uptake in the Middle East, with the first distance e-learning forum held there in 2003 (Al-Shboul & Alsmadi, 2010). However, Faqih (2016) mentions that e-learning usage in Jordan is still lower than expected.

Based on this discussion, further attention should be paid to the influence of the above-mentioned factors on research into e-learning acceptance. This should especially take into account individual and cultural characteristics, users' skills and self-confidence and e-learning ease of use as well as extrinsic and intrinsic motivation, such as e-learning usefulness and engagement. Accordingly, the present thesis has adopted these factors to extend TAM and investigate what is affecting e-learning acceptance in Iraq. Table 2.8

summarises the main barriers to e-learning implementation, as found in the reviewed literature.

Table 2.8: The Reviewed Literature on Barriers to E-learning Application

Study	Country	Challenges
Abouchedid & Eid (2004)	Lebanon	Social, attitudinal, economic, and rate of illiteracy
Abdelraheem (2006)	Oman	Infrastructure, culture, strategies of e-learning adoption, copyright issues, individual features, and limited Arabic e-resources
Ali & Magalhaes (2008)	Kuwait	Lack of institutional support, language obstacles, IT issues, workload, and lack of time.
Al-Senaidi et al. (2009)	Oman	Lack of equipment, lack of confidence, lack of institutional support, doubt in benefits of ICTs, and lack of time
Matar et al. (2010)	Middle East	ICTs infrastructure and lack of electronic resources
Mirza & Al-Abdulkareem (2011)	Saudi Arabia	Rate of Internet penetration, bandwidth, Internet costs, and public's lack of self-confidence in Web-based learning
Elzawi & Wade (2012)	Libya	Low Internet connectivity, lack of encouragement, low English proficiency, lack of training programmes, Internet costs, technical skills, disinterest, and social restrictions
Al-Shboul (2013)	Jordan	Lack of institutional encouragement and support, and inadequate training.

2.9 E-learning in Iraq

This section is dedicated to discussing the context of Iraqi higher education. It further focuses on understanding the current status of e-learning application in Iraq and reviewing previous academic research on its acceptance.

2.9.1 The Context of Higher Education

Iraq is located to the east of the Arabian Peninsula. Its ancient civilisations, such as the Assyrians, Babylonians and Chaldeans are known to be the first of their kind in the world. With such recorded history dating back over more than 8000 years, Iraq has been a leading force in the Arab region. Saheb (2005) points out that primitive form of schools and universities were initially established in Egypt and Babylon. In more modern times, Iraq's education system has been considered as one of the best in the region (Kaghed & Dezaye, 2009).

Education is currently provided free of charge for all Iraqi citizens at all levels, including higher education. At present, Iraq's higher education system comprises approximately 33 state-sector universities and 58 technical institutes, all under the management of the MHESR-I. This excludes private universities and educational institutes under the Kurdistan Regional Government. Six universities were established between 2002 and 2007, and 13 were founded in 2014. However, out of all these institutions, only three are

ranked amongst the top 100 Arab universities. These comprise the University of Babylon (N=50), the University of Baghdad (N=59) and the University of Technology Iraq (N=98) (Webmetrics, 2016).

The stages of study at university in Iraq are divided into three levels:

- Bachelor's level: A degree awarded after four, five or six years of study, depending on the discipline. Engineering degrees, for example, are conferred within four years, while dentistry or veterinary medicines take five years to achieve and medicine, six years.
- Master's level: A degree conferred within a minimum of two years. The first year is coursework-led and if a student successfully passes the first stage, the second year will be based on research only.
- Doctoral level: This type of degree has a similar structure to a Master's degree, except for the duration of study, which is at least three years and should result in a piece of novel research.

From 1975 to 1985, billions of Iraqi Dinars were spent by the government of Iraq to promote education nationwide. As such, this period is now thought of as the golden era of education in Iraq. The government established a number of projects to support learning technologies, such as computer laboratories and centres, as well as closed circuit television (Elameer & Idrus, 2010). The last three decades, however, have witnessed a gradual deterioration in Iraqi higher education. This is due to the budget deficit, as a result of two consecutive wars, sanctions imposed by the United Nations, political and military conflicts and a lack of systematic planning. Moreover, after 2003, higher education was affected by the widespread violence in most of Iraq's Governorates. According to a UNESCO report, from 2003 to 2012, approximately 500 academics in higher education were killed. The above report also revealed 31,600 attacks against universities and schools recorded by the Iraqi Ministry of Education (O'Malley, 2014).

2.9.2 E-learning Application and Acceptance

In contemporary education, the Internet represents the most dominant medium for the provision of e-learning. However, its use in Iraq is relatively recent, since only 1% of the Iraqi population had Internet access in 2009. This figure had increased by the end of 2015, which saw Internet penetration of approximately 33%. According to Al-Hammadany and Heshmati (2011), although the Iraqi people are eager to use the Internet in different areas

of their lives, insufficient resources, a lack of motivation and encouragement, and social barriers are the most influential factors impacting on its widespread adoption. Table 2.9 shows the Internet penetration in Iraq in comparison to other Middle Eastern countries.

Table 2.9: A Comparison of Internet Usage in the Middle East (Internet World Stats, 2016)

MIDDLE EAST	Population (2015 Est.)	Users, in Dec./2000	Internet Usage/2014	Internet Usage/2014	Population (Penetration) 2009 %	Population (Penetration) 2014%	Population (Penetration) 2015%
Bahrain	1,346,613	40,000	1,297,500	1,297,500	55.3	96.4%	96.4%
Iran	81,824,270	250,000	46,800,000	46,800,000	48.5	57.2%	57.2%
Iraq	**33,309,836**	**12,500**	**2,997,884**	**11,000,000**	**1.0**	**9.0%**	**33.0%**
Israel	7,935,149	1,270,000	5,928,772	5,928,772	72.8	74.7%	74.7%
Jordan	6,623,279	127,300	5,700,000	5,700,000	23.9	86.1%	86.1%
Kuwait	3,996,899	150,000	3,022,010	3,145,559	37.1	75.6%	78.7%
Lebanon	4,151,234	300,000	3,336,517	3,336,517	23.5	80.4%	80.4%
Oman	3,286,936	90,000	2,584,316	2,584,316	13.6	78.6%	78.6%
Palestine (West Bk.)	2,785,366	35,000	1,687,739	1,800,000	14.4	60.6%	64.6%
Qatar	2,194,817	30,000	2,016,400	2,016,400	52.3	91.9%	91.9%
Saudi Arabia	27,752,316	200,000	18,300,000	18,300,000	26.8	65.9%	65.9%
Syria	22,878,524	30,000	5,920,553	6,426,577	16.4	25.9%	28.1%
UAE	9,445,624	735,000	8,807,226	8,807,226	60.9	93.2%	93.2%
Yemen	26,737,317	15,000	5,210,593	6,029,265	1.6	19.5%	22.6%
Gaza Strip	1,869,055	n/a	n/a	n/a	n/a	n/a	n/a
TOTAL Middle East	**236,137,235**	**3,284,800**	**113,609,510**	**123,172,132**	**28.3**	**48.1%**	**52.2%**

Iraq is the last country in the Middle East to implement e-learning innovations. Iraq remains behind in the great ICTs revolution in higher education. To rehabilitate this sector, MHESR-I has implemented many procedures. E-learning strategies, however, have only had limited implementation, since various obstacles still prevent the successful adoption of such technology. Al-Din and AlRadhi (2008) discuss many of the challenges that have led to Iraq being left behind in terms of e-learning enhancement. These include a lack of funding, unstable security, and a lack of readiness and encouragement. According to Elameer and Idrus (2011a), Iraqi universities suffer from a lack of adequate ICTs infrastructure, a limited number of devices and laboratories, and limited Internet access inside universities. To support e-learning application in Iraq's public-sector universities, UNESCO has established and funded a new project, called Ibn Sina. However, Basha, Mnaathr, Alkhayat and Jamaludin (2013) emphasise that this project is still in its infancy.

Nevertheless, e-learning initiatives have been introduced into public-sector universities in Iraq since 2010. The University of Babylon is one of the leading institutions in this regard, whereby the Learning Care System was developed and implemented in the Department of Computer Science/College of Science in 2010 (Al-Azawei & Mudheher, 2010). At the end

of 2013, the College of Information Technology adopted Moodle as a precursor to its use in other colleges. This University has now established multiple e-learning units to maintain its implementation and support academic staff and students to use it effectively. Moreover, the University provides Internet connectivity free of charge for all users on campus. Even though utilisation of the system was initially limited to uploading electronic lectures, such as Word, pdf and PowerPoint files, as well as online-based exams, it currently also provides forums, wikis and chat facilities. Furthermore, since establishing the multimedia centre in 2016, its application has been further improved by integrating multimedia instructions into several modules.

Another leading university in this area is the University of Kufa. Moodle was installed and initially used by just a few departments in 2010, but by 2015, all the University's colleges had been registered on Moodle. On the other hand, although Mustansiriyah University is one of Iraq's most prestigious institutions, its readiness to adopt e-learning was only recently evaluated (Elameer & Idrus, 2011a; Elameer & Idrus, 2011b). Other universities that have implemented Moodle include, but are not limited to, the University of Baghdad, the University of Information Technology and Communications, the University of Kerbala and the University of Al-Qadisiyah. Al-Din and AlRadhi (2008) highlight factors such as excellent teaching staff, good budgetary resources, the ability to build a network with international universities, and benefiting from the experience of neighbouring countries can all contribute to successful e-learning application in Iraq.

Reviewing the previous literature on e-learning acceptance in Iraq can clearly reveal a noticeable gap in this context. Mnaathr, Basha, Mohain and Jamaludin (2013) investigated the attitudes and self-efficacy of undergraduate students (N=60) at the University of Baghdad with regard to the use of portable devices in learning. The study used mean and standard deviation to identify both variables, without examining the cause and effect relationships between these and e-learning acceptance. Another study was conducted by Jawad and Hassan (2015) to examine the acceptance of mobile learning at the University of Babylon. UTAUT was adopted in the above research, with a sample consisting of 132 students and 27 lecturers. A multiple linear regressions technique was used to test the associations between the model constructs, which subsequently explained an acceptable fit of the variance of behavioural intention (39%), where perceived usefulness was the strongest predictor.

Radif (2016), on the other hand, combined the Technology-Organisation-Environment (TOE) framework with TAM to understand the factors likely to predict e-learning (via an

LMS) acceptance at the University of Al-Qadisiyah. A total of 283 academic staff took part in the study. The collected data were then analysed using Pearson's correlation coefficient and multiple linear regression tests. Overall, the study supports the combining of both models to identify e-learning acceptance in an economic region recovering from war, such as Iraq.

To summarise, it should be clarified here that there is a dearth of available academic resources or even official reports about the current status of e-learning application in Iraqi public-sector universities. Additionally, only three studies on e-learning acceptance in Iraqi higher education were retrieved, whereas no research was found for the other educational stages. This review should therefore encourage further academic research in this context.

2.10 Summary

This Chapter has discussed the four central areas of the thesis, namely e-learning, TAM, Learning Styles Theory and Universal Learning Theory. It has highlighted the relationship between these four themes and then reviewed a selection of relevant studies on e-learning acceptance in the Arab world. Especially, this Chapter has concentrated on the extension of TAM by integrating individual and cultural differences, and environmental learning variables. It also studied potential hindrances to successful e-learning application in the Arab world. Finally, this Chapter reviewed the context of Iraqi higher education alongside the literature on the status of e-learning acceptance and implementation in Iraq. Based on this review, several conclusions may be highlighted:

- Blended learning represents an optimal means of gaining the advantages of both traditional and e-learning methods and overcoming their individual limitations. However, the acceptance and implementation of blended e-learning is still an issue that needs further research, particularly in developing nations.
- Technology acceptance theories constitute attempts to understand the factors potentially leading to technology acceptance. Here, TAM is the most commonly adopted theory, wherein users' willingness to accept e-learning technology is investigated. However, TAM does not consider the influence of learners' differences or environmental learning limitations on e-learning acceptance.
- The aim of identifying learning styles and formulating Universal Learning Theory is to reduce learning barriers, albeit from different angles. Learning Styles Theory suggests overcoming learning deficiencies by serving individual learning

preferences and prioritising the design of instructional content. In contrast, Universal Learning Theory seeks to address learning limitations from a wider perspective, comprising multiple means of content representation, knowledge expression and learner engagement.

- Many studies have established the existence of a significant relationship between learning styles and curricular design, and e-learning adoption and learners' perceptions. However, none of the studies obtained have directly incorporated the Felder and Silverman model or UDL framework with TAM, whether in the Arab world or anywhere else.
- The evaluation of learners' acceptance of e-learning technology has recently begun in Arab countries, where TAM represents the most commonly applied technology acceptance theory.
- The introduction of the concept of differences between learners in the Arab world has been limited to cultural and demographic variables. Furthermore, only a few studies have considered the influence of environmental variables in terms of curricular design on e-learning acceptance.
- There are still many barriers to successful e-learning implementation in the Arab world, such as cultural, financial, personal and technical inhibitions.
- The research surrounding e-learning acceptance and barriers to its application in Iraq is negligible. In the present research, only three studies on e-learning acceptance in this country were found.

In the next Chapter, the proposed research framework is introduced, based on TAM, the Felder and Silverman model and the UDL framework. This research framework aims to address TAM's limitations in the e-learning context and investigate e-learning acceptance in Iraq.

Chapter 3: The Proposed Research Framework

3.1 Overview

Chapter Two discussed the main theories in this thesis: e-learning, the Technology Acceptance Model (TAM), the Felder and Silverman Learning Styles Model (FSLSM), and the Universal Design for Learning (UDL) framework. It was demonstrated that there is a noticeable gap in the research on the influence of learning styles and universal learning theories on e-learning acceptance, even though some positive relationships have been highlighted in earlier literature. This Chapter now presents a proposed research model that integrates TAM, FSLSM and UDL. It also justifies the incorporation of the variables included in the framework. Here, all factors of the model are articulated, alongside the hypothesised assumptions. Furthermore, the proposed framework forms the foundation for data collection and analysis in two experiments conducted in this study.

3.2 Conceptualising the Model

Since the 1980's, a growing body of research has been theoretically and empirically produced to examine the diffusion and acceptance of information systems (ISs). The root of such models is grounded on information technologies (ITs), psychology and sociology (Venkatesh et al., 2003). This Chapter aims to develop and extend one of the most influential theories in ISs research, namely TAM. James, Mulaik and Brett (1982, p.27) define five components that should be considered in the design and development of a theory or theoretical research model:

1. Phenomena, or the variables that act as causes and effect[s].
2. Causal connections between the variables. A causal connection refers to the hypothesised causal association between one cause and one effect.
3. A theoretical rationale for each causal hypothesis (causal connection) that describes the processes through which a cause acts on (operates on, produces) an effect.
4. Boundaries, which specify the context (e.g., types of subjects and situations).
5. Stability, which implies that the hypothesised structure of [the] causal connections will be consistent over specified time intervals.

In the present research, these components are taken into account when extending TAM. First, the proposed variables in the research model act as causes and effects (component 1). Next, the connection between these variables is based on a causal relationship (component

2). Moreover, all the hypothesised connections are supported theoretically (component 3). Fourth, the study's parameters are clearly identified by combining variables that are relevant to educational contexts and adopting well-known instruments to measure the variables integrated (component 4). Finally, the stability of the proposed framework was tested amongst students with e-learning experience, in order to highlight the relationship between the model's constructs (component 5).

There were several reasons leading to the adoption of TAM as a research foundation for the present study. According to Bagozzi (2007), the most frequently acknowledged strength of TAM is its 'parsimony'. Furthermore, it is easy to implement and evaluate, due to its simplicity (Hwang et al., 2015). In addition, its soundness has been supported in various settings using different technologies (Hwang et al., 2015). Šumak et al. (2011) concludes that this model constitutes a sound adoption theory for evaluating e-learning acceptance. Thus, Taylor and Todd (1995b) clarify:

> The appeal of this model, then, is that it is both specific and simple. It suggests a small number of factors which jointly account for usage. These factors are specific, easy to understand, and can be manipulated through system design and implementation (p.148)

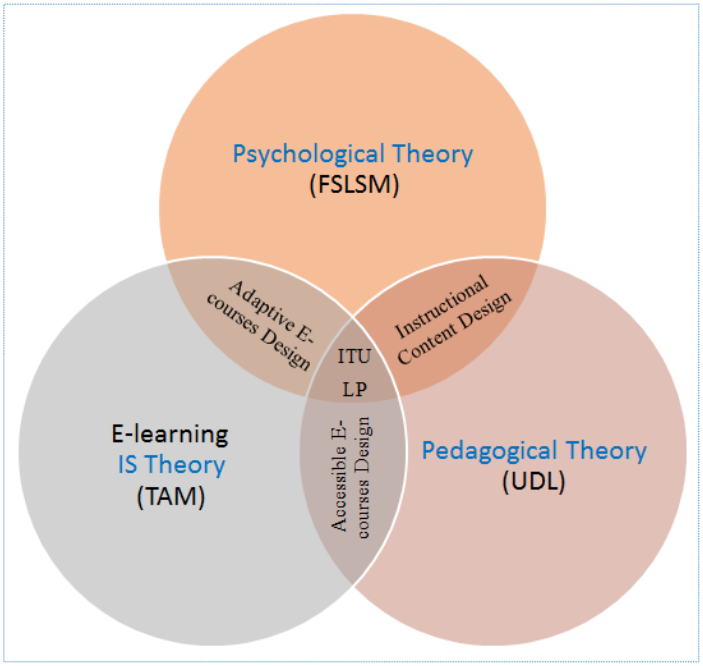
Venkatesh and Davis (1996), on the other hand, illustrate that this model can be extended to enhance its effectiveness. Legris, Ingham and Collerette (2003) critically reviewed TAM, stating that other variables should be included to understand the factors affecting technology adoption. This conclusion was also confirmed by Marangunic and Granic (2015), indicating that the two factors of TAM ('usefulness' and 'ease of use') may not identify all significant components in predicting technology acceptance. Accordingly, many studies that have utilised TAM to investigate e-learning adoption have incorporated other factors relating to users' differences (Gefen & Straub, 2000; Li, 2015; Ong & Lai, 2006), cultural variables (Tarhini, 2013), and curricula design (Liaw, 2008; Liu, Chen, Sun, Wible, & Kuo, 2010; Teng, 2015). This thesis attempts to overcome TAM's limitations by considering the Felder and Silverman model and the UDL framework.

3.3 Overview of the Relationship between the Combined Theories

Figure 3.1 depicts the relationship between the three theories integrated in the proposed framework (TAM, FSLSM and UDL). It is clear that FSLSM and UDL share the same concept of designing learning content using multiple means. However, the relationship

between learning styles and e-learning lies in the adaptation of e-learning output, according to learners' preferences (Akbulut & Cardak, 2012; Graf, 2007). The association between e-learning and UDL, on the other hand, considers designing an accessible e-learning environment from the start, rather than incorporating a later stage of adaptation or retrofitting (Rao et al., 2014).

This research investigates the relationship between the three theories from another angle. It examines the extent to which FSLSM and UDL variables affect the explanatory power of TAM in terms of the intention to use (ITU) e-learning and learners' perceptions (LP) in terms of usefulness and satisfaction. Therefore, ITU and LP lie at the heart of the proposed model.



ITU: Intention to use; LP: Learners' perceptions

Figure 3.1: The Combined Theories in the Proposed Research Framework

3.4 Constructs and Hypotheses of the Proposed Model

The proposed model includes four groups of constructs. The first one encompasses the original factors of TAM, which comprise 'perceived ease of use' (PEOU) and 'perceived usefulness' (PU). In this research, both variables are suggested to mediate the relationship between independent and dependent factors and to draw a direct relationship with the dependent constructs. The second group comprises the independent variables that may directly or indirectly affect learners' satisfaction and behavioural intention. These factors are the learning style dimensions (processing, perception, input and understanding), the

UDL principles (multiple means of representation, multiple means of action and expression, and multiple means of engagement), and e-learning self-efficacy (ELSE). The third group comprises two dependent variables, namely perceived satisfaction (PS) and intention to use (ITU) e-learning. For further analysis, the active/reflective and sequential/global dimensions are assumed to moderate the relationships between the model's variables. Accordingly, the fourth group of constructs includes active/reflective and sequential/global learning style dimensions as moderators. Figure 3.2 (below) depicts the proposed framework and the relationships between its constructs.

It is worth mentioning here that the original TAM hypotheses and their extension through the inclusion of ELSE and PS were examined in two separate experiments in the current study. Hence, 'a' and 'b' are used with the number of the hypothesis to refer to the first and second experiment, respectively. Aside from the above, the learning styles hypothesis was tested in the first experiment, while the UDL hypothesis was investigated in the second.

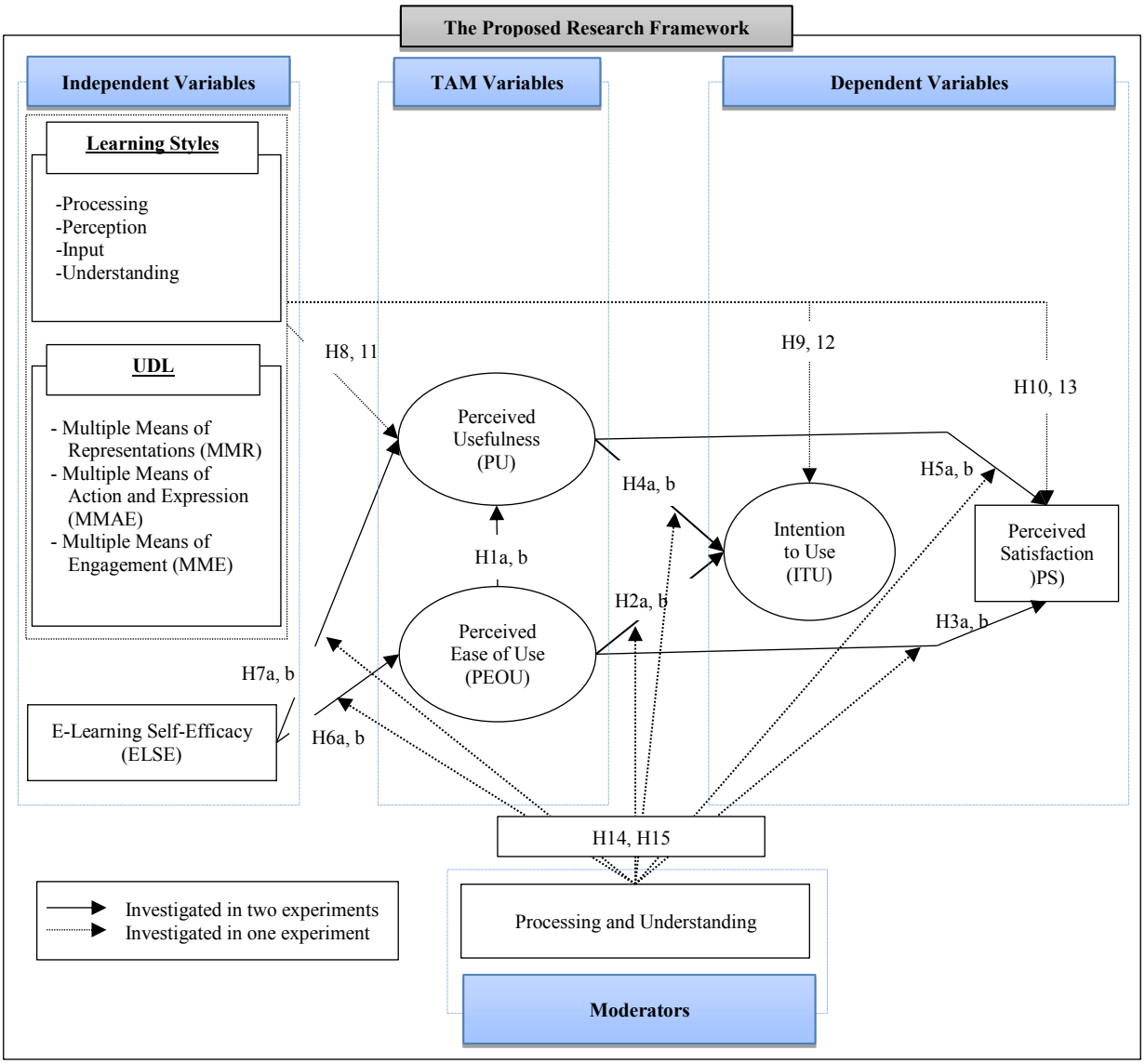


Figure 3.2: The Proposed Research Framework

3.4.1 The Original Variables of TAM

This section is dedicated to identifying the role of the original TAM variables that are proposed to mediate the relationship between the dependent and independent variables. Both constructs are also anticipated to be direct predictors of behavioural intention and learner satisfaction.

A. Perceived Ease of Use (PEOU)

According to Davis (1986), PEOU refers to the extent of mental effort required to use a technology. Another synonym of PEOU is 'performance expectancy' as it is referred to in UTAUT (Venkatesh et al., 2003). TAM suggests that PEOU indirectly affects ITU via the mediation of 'attitude towards use'. However, a recent revision of TAM simplified the

model by excluding attitude towards use, since it has proven to be a weak mediator between PEOU and behavioural intention (Venkatesh & Davis, 2000). Arguably, if a particular technology requires a great deal of effort or is difficult to apply, users' willingness to accept it will be negatively affected and this can lead to avoidance of the technology, or the search for an alternative. Furthermore, PEOU was found to have a significant influence on perceived usefulness (Davis et al., 1989).

Earlier literature advocates the use of PEOU as a predictor of e-learning acceptance (Al-Gahtani, 2016; Liu et al., 2010; Weng, Tsai, & Weng, 2015). On the other hand, Cigdem and Ozturk (2016) and Park (2009) failed to identify such a significant relationship. Empirical findings also vary regarding the degree to which PEOU affects behavioural intention. According to Hwang et al. (2015), "it has been found that PU [perceived usefulness] seems to carry more weight in western cultures, while PEOU appears to be of greater relevance in non-western cultures" (p.6). Moreover, Lee et al. (2003) reported a stronger relationship between the two constructs at an early stage of adoption. Such inconsistent findings may be attributed to several factors, such as a technology's maturity, the adoption stage, users' experience, culture, users' styles and sample size of the experiment. The issue of ease of e-learning use is growing in significance in the Arab world, because one of the barriers to e-learning adoption in this context consists of the generally poor technology skills of Arab users (Mirza & Al-Abdulkareem, 2011).

In keeping with previous studies, PEOU has also been found to be a significant predictor of learner satisfaction (Sun et al., 2008; Weng et al., 2015). The correlation between these variables is based on the notion that users will not be satisfied, if they believe that a particular system will be difficult to use. In theory, this could be an axiomatic correlation between learner satisfaction and ease of use. Hence, it may be assumed that:

> ***H1a, b:*** *perceived ease of use (PEOU) positively affects perceived usefulness (PU).*
> ***H2a, b:*** *perceived ease of use (PEOU) positively affects intention to use (ITU).*
> ***H3a, b:*** *perceived ease of use (PEOU) positively affects perceived satisfaction (PS).*

B. Perceived Usefulness (PU)

Davis (1986) defines PU as a user's belief that the adoption of a particular technology can improve his or her performance. As mentioned in earlier research, PU is also known as 'performance expectancy' in UTAUT (Venkatesh et al., 2003). The significant influence of PU on behavioural intention has been highlighted in many studies, and Hwang et al. (2015)

report that this relationship is consistent in the literature. Liaw (2008) demonstrates that PU is the strongest predictor of the behavioural intention towards e-learning adoption. Such results are further supported by Weng et al. (2015), whereby PU was observed to have a directly significant effect on trainees' willingness to accept e-learning. Furthermore, the influence of PU on the acceptance of online learning was found to surpass that of other constructs in a study conducted by Liu et al. (2010).

Such findings may indicate that a belief in improving work performance is more important for users than the effort required to perform a particular learning task. PU also points to an important role in predicting learner satisfaction (Arbaugh, 2000; Sun et al., 2008; Weng et al., 2015). The high expectation that a particular learning technology will enhance learning outcomes may also enhance satisfaction. Al-Senaidi et al. (2009) found that doubt amongst users concerning the benefits or usefulness of e-learning presents a barrier to its adoption in the Arab world. Based on this discussion, the following hypotheses are suggested:

H4a, b: *perceived usefulness (PU) positively affects intention to use (ITU).*
H5a, b: *perceived usefulness (PU) positively affects perceived satisfaction (PS).*

3.4.2 Independent Variables

Three constructs are proposed to have direct and indirect effects on dependent variables. Learning style dimensions and UDL principles represent the main constructs extended in TAM to predict learner satisfaction and behavioural intention. E-learning self-efficacy is assumed to have an indirect influence on the dependent factors through PEOU and PU.

A. E-Learning Self-Efficacy (ELSE)

Another cognitive factor integrated into the proposed model is ELSE. Tarhini et al. (2014b) define ELSE as "a student's self-confidence in his or her ability to perform certain learning tasks using the e-learning system" (pp.167-168). According to Bandura (1990), people's beliefs about their capabilities can influence their choices, the effort that they should exert and how long they are prepared to persevere in facing difficulties. Users with a low perception of their ability to use a technology may not persist in tackling the obstacles that face them.

In earlier work, ELSE has been found to be a significant predictor of PEOU and/or PU (Alshibly, 2014; Hong, Thong, Wong, & Tam, 2001; Ong & Lai, 2006). Hence, it is

assumed that learners with high ELSE are more likely to possess high PEOU and PU than students with low self-efficacy. The literature on barriers to e-learning use in the Arab world reveals that low ELSE is an obstacle to e-learning adoption (Al-Senaidi et al., 2009). This points to the need for users to gain confidence in their individual skills when they endeavour to use a technology. Hence, ELSE was incorporated with the proposed model as a direct determinant of PEOU and PU.

> ***H6a, b:*** *E-learning self-efficacy (ELSE) positively affects perceived ease of use (PEOU).*
> ***H7a, b:*** *E-learning self-efficacy (ELSE) positively affects perceived usefulness (PU).*

B. Learning Styles

This research hypothesised that learners with certain learning preferences would experience e-learning differently. The reason behind the selection of learning styles is that this psychological trait has been regarded as a function of individual and cultural differences (Chang et al., 2011; Dunn et al., 1990; Oxford & Anderson, 1995).

According to Marangunic and Granic (2015), although previous literature on TAM included certain individual variables, there are other characteristics of users that require further attention, such as cognitive abilities and differences in personality. Moreover, Grasha and Yangarber-Hicks (2000) state that students' "performance when faced with technology is very much tied to their particular learning style preferences" (p.3). However, some studies emphasise that investigation into learners' intention to use a learning technology from the perspective of learning styles remains scant (Brown et al., 2009; Ursavaş & Reisoglu, 2017).

For this research, the Felder and Silverman model was adopted. Several criteria have led to its popularity. Firstly, this model was invented for educational purposes, especially students of Engineering. Moreover, it has a strong theoretical base, due to its reliance on deep investigation into the dominant teaching and learning styles in Engineering education (Felder & Silverman, 1988). Additionally, the prior literature have validated the instrument proposed for diagnosing the model (Felder & Spurlin, 2005; Zywno, 2003a). Another criterion of FSLSM is the commercial aspect. Whilst some models bear a fee for identifying learning styles, such as the Dunn and Dunn model, Kolb's model, the Myers and Briggs Type Indicator and the Honey and Mumford model (Brown, 2007), the questionnaire used in the present study was available free of charge.

Previous studies in the literature have investigated the relationship between learning styles and e-learning use as discussed in Chapter Two, Section 2.5.3. However, as far as the current researcher is aware, none have integrated learning styles with extended TAM prior to the present research. Furthermore, the impact of learning styles on e-learning adoption has not been investigated in the Arab region to date. In keeping with barriers to e-learning application in the Arab world, the literature indicates that cultural and individual variables have an influence on e-learning adoption in such nations (Abdelraheem, 2006; Al-Adwan & Smedley, 2012). Accordingly, this research assumed that learning style dimensions are predictors of PU, learner satisfaction, and behavioural intention towards e-learning.

H8: *Learning styles positively affect perceived usefulness (PU).*
H9: *Learning styles positively affect intention to use (ITU) e-learning.*
H10: *Learning styles positively affect perceived satisfaction (PS).*

C. Principles of Universal Design for Learning (UDL)

UDL aims to reduce environmental learning limitations, in order to be able to respond to individual learners' needs. Accordingly, the present research also suggests that its three principles are predictors of learners' perceptions and behavioural intention towards e-learning. Meyer, Rose and Gordon (2014) indicate that this framework exploits the flexibility of learning technologies to design educational contexts that provide options for different learners from the start.

The background behind integrating UDL with TAM underlies educational studies that recommend designing e-learning courses in accordance with effective pedagogical approaches. Rovai (2004) points out that learners' needs should be considered in the designing of e-learning curricula. Moreover, Govindasamy (2002) concludes that "it has become clear that the impact of not considering the underlying pedagogical principles when implementing e-Learning will undermine the implementation process" (p.296). Rienties and Toetenel (2016) also state that a learning design informed by an efficient pedagogical theory will have a direct positive impact on students' behaviour, outcomes and satisfaction in e-learning environments.

As discussed in Chapter Two, Section 2.6.2, previous studies have not yet investigated the direct predictive ability of UDL applied to e-learning acceptance and learners' perceptions, although variables, which to some extent resemble the principles of UDL, have been incorporated with different technology acceptance theories (see Chapter Two, Section

2.6.2). The UDL model also suggests that users should be highly motivated and engaged in learning settings, in order to maintain their attention and interest. However, a review of the hindrances to successful e-learning implementation in Arab countries revealed that disinterest and demotivation as influential factors on e-learning adoption (Al-Shboul, 2013; Elzawi & Wade, 2012). This may indicate that the application of UDL can enhance users' interest and motivation in accepting this technology. As such, the following hypotheses are proposed:

H11: *UDL principles positively affect perceived usefulness (PU).*
H12: *UDL principles positively affect intention to use (ITU).*
H13: *UDL principles positively affect perceived satisfaction (PS).*

3.4.3 Dependent Variables

The third group of variables in the proposed research framework consists of the dependent constructs. The main dependent variables in this study are behavioural intention towards e-learning acceptance and perceived satisfaction.

A. Intention to Use (ITU)

Intention to use (ITU) is defined as a user's cognitive representation of his or her willingness to perform certain behaviours (Ajzen & Fishbein, 1980). It has been identified in all the theories discussed in Chapter Two, Section 2.4 as a direct predictor of actual usage. Ajzen and Fishbein (1980) argue that the intention of human beings to perform or not perform a particular behaviour represents one of the most important determinants of their actions. In the existing literature, this assumption has been widely supported (Tarhini, 2013; Taylor & Todd, 1995b; Venkatesh et al., 2003). However, Taylor and Todd (1995a) found that users' experience can significantly affect the relationship between ITU and actual usage. Moreover, the behavioural intention of users with previous experience of a particular technology can be more effective for predicting technology usage than it is in users with less experience.

The consistency of the findings for the positive effect of behavioural intention on actual behaviour has led to the investigation of factors that can determine ITU instead of the behaviour itself. As such, many studies in the e-learning context have attempted to identify predictors of ITU, in order to understand learners' willingness to adopt a technology (Cigdem & Ozturk, 2016; Huang, 2015; Park, 2009). The present research also aims to

enhance behavioural intention towards e-learning acceptance by considering the influence of learning styles and UDL.

B. Perceived Satisfaction (PS)

Wu et al. (2010) define learner satisfaction in blended e-learning as "the sum of student's behavioural beliefs and attitudes that result from aggregating all the benefits that a student receives from using BELS [blended e-learning system]" (p.157). Assessing learner satisfaction in pure online or blended e-learning environments is highly important, because this can provide a sophisticated view of the effectiveness of this technology (Garrison & Kanuka, 2004). Learners' dissatisfaction, on the other hand, may lead to withdrawing from their e-learning courses or weaker performance. As such, Bollinger and Wasilik (2009) suggest a link between PS and academic achievement.

Wixom and Todd (2005) point out that successful technology integration has been examined in two directions: users' satisfaction and technology acceptance. Sun et al. (2008) also emphasise that learner satisfaction is an important variable in evaluating e-learning success. Therefore, previous studies have integrated several variables to identify the main determinants of this construct in e-learning settings (Capece & Campisi, 2013; Eom et al., 2006; Hong et al., 2016).

According to Wixom and Todd (2005), one model can be developed to assess PS and behavioural intention, instead of proposing separate frameworks. In agreement with this assumption, recent studies have shown that identical factors can be used to predict both constructs (Capece & Campisi, 2013; Weng et al., 2015). As such, the current study assumes that the proposed predictors of ITU are also determinants of PS. Furthermore, all hypotheses regarding the influence of the model constructs on PS are also advocated by earlier research, as discussed above.

3.4.4 Moderators (Active/Reflective and Sequential/Global)

In the first experiment of this research, the moderating effect of the active/reflective and sequential/global dimensions of the path's strength between the model's constructs was tested. This investigation was based on the findings of numerous studies, whereby learning styles have been able to moderate e-learning acceptance (see Chapter Two, Section 2.5.3). However, because the number of learners with intuitive and verbal preferences was low in the present dataset, the moderating influence of perception (sensing/intuitive) and input

(visual/verbal) dimensions was not examined. Thus, the following two hypotheses were tested:

H14: *The active/reflective learning styles dimension moderates the relationship between the Model's constructs.*

H15: *The sequential/global learning styles dimension moderates the relationship between the Model's constructs.*

Table 3.1 summarises all hypotheses proposed in the present research, while Table 3.2 demonstrates the main concepts and definition of all variables included in the research framework.

Table 3.1: Summary of the Research Hypotheses

Code	Hypothesis
H1a, b	Perceived ease of use (PEOU) positively affects perceived usefulness (PU).
H2a, b	Perceived ease of use (PEOU) positively affects intention to use (ITU).
H3a, b	Perceived ease of use (PEOU) positively affects perceived satisfaction (PS).
H4a, b	Perceived usefulness (PU) positively affects intention to use (ITU).
H5a, b	Perceived usefulness (PU) positively affects perceived satisfaction (PS).
H6a, b	E-learning self-efficacy (ELSE) positively affects perceived ease of use (PEOU).
H7a, b	E-learning self-efficacy (ELSE) positively affects perceived usefulness (PU).
H8	Learning styles positively affect perceived usefulness (PU).
H9	Learning styles positively affect intention to use (ITU).
H10	Learning styles positively affect perceived satisfaction (PS).
H11	UDL principles positively affect perceived usefulness (PU).
H12	UDL principles positively affect intention to use (ITU).
H13	UDL principles positively affect perceived satisfaction (PS).
H14	The active/reflective learning styles dimension moderates the relationship between the Model's constructs.
H15	The sequential/global learning styles dimension moderates the relationship between the Model's constructs.

Table 3.2: Summary of Constructs Used in the Research Model

Construct	Definition
TAM	A proposed model to predict users' willingness to accept a technology and use it in their work.
Perceived Usefulness (PU)	Users' beliefs that the use of a particular technology can enhance their performance (Davis, 1986).
Perceived Ease of Use (PEOU)	Users' beliefs about the extent of mental effort required to use a technology (Davis, 1986).
Intention to Use (ITU)	"[T]he cognitive representation of a person's readiness to perform a given behavior [behaviour]" (Punnoose, 2012, p.305).
Learning Styles	"Characteristic strengths and preferences in the ways… learners' take in and process information" (Felder, 1996, p.18).
Processing (active/reflective)	Active learners prefer to study in groups and undertake learning tasks immediately, while reflective learners apply analytical approaches and prefer to study alone.
Perception (sensing/intuitive)	'Sensing' learners favour facts and following their tutor's approach to problem-solving, whereas intuitive learners tend to prefer complex content and applying their own innovation approaches.
Input (visual/verbal)	Preferred ways of receiving information: visual learners prefer videos, demonstrations, pictures and graphs. In contrast, verbal learners prefer written materials and listening to explanations provided by others.
Understanding (sequential/global)	Sequential learners focus on details and study step by step, whereas global learners connect all concepts together in order to understand the bigger picture before looking at the details.
The Universal Design for Learning (UDL) framework	This "addresses the primary barrier to fostering expert learners within instructional environments: inflexible, "one-size-fits-all" curricula. It is inflexible curricula that raise unintentional barriers to learning" (CAST, 2011, p.4).
Multiple Means of Representations (MMR)	Tutors need to present learning content and information using multiple means. This can assist learners in mastering learning content with less effort.
Multiple Means of Action and Expression (MMAE)	An essential step in the learning process, whereby students are given a chance to express their understanding. These approaches should be differentiated according to students' individual features.
Multiple Means of Engagement (MME)	In order to engage students, they should be stimulated and motivated in different ways and through various actions.
Other Factors	
Perceived Satisfaction (PS)	"[T]he sum of students' behavioural beliefs and attitudes that result from aggregating all the benefits that a student receives from using BELS" (Wu et al., 2010, p.157).
E-learning Self-Efficacy (ELSE)	"A student's self-confidence in his or her ability to perform certain learning tasks" (Tarhini et al., 2014a, pp.167-168).

3.5 Summary

In this Chapter, TAM was extended by integrating other variables, namely learning style dimensions, UDL principles, learner satisfaction and self-efficacy. The construction of the proposed model was based on three well-known and frequently adopted theories from ISs, psychological and pedagogical research. The theoretical concept of all the variables and the relationship between them was also defined, alongside the research hypotheses.

In the next Chapter, the survey design and methods applied in this study are explained along with the experiments design, in order to validate the proposed framework and answer the three research questions.

Chapter 4: The Survey Design and Methods

4.1 Overview

Chapter Two discussed the central theories applied in this thesis, whereas Chapter Three was dedicated to constructing the research framework. The aim of this Chapter is to present the research philosophy, survey design and methods. In Section 4.2, the philosophical paradigm adopted in this instance is therefore briefly described. Section 4.3 then justifies the appropriateness of the analytical and descriptive survey research design methods. Support for the selection of non-probabilistic sampling strategies is provided in Section 4.4, while Section 4.5 shows data analysis techniques. Section 4.6 illustrates the design of the first, second and third experiments conducted in response to the three research questions, with particular reference to the surveys formulated to answer these questions. The pilot studies performed in advance of the main research experiments are subsequently introduced in Section 4.7. Section 4.8 demonstrates how the datasets used in this study were cleaned and pre-processed, prior to conducting the statistical analysis. Meanwhile, Section 4.9 discusses the ethical considerations and finally, Section 4.10 summarises the main topics presented in this Chapter.

4.2 The Research Philosophy

According to Gray (2013), the selection of research methods will be affected by the research methodology adopted and this will in turn be influenced by the relevant 'research paradigm', a term first introduced by Kuhn (1962). Guba and Lincoln (1994) define research paradigm as "the basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways" (p.105). In information systems (ISs), it is important to identify an appropriate research paradigm before selecting the research methods (Cater-Steel, 2004).

In relation to the present study, positivist and interpretivist paradigms are adopted. Lee (1991) encourages the use of both paradigms in ISs research. For the first two questions (Q1 and Q2), a positivist philosophy is adopted as the most convenient research paradigm. The key aim of both questions is to identify cause and effect relationships between the constructs of the proposed research model (see Chapter Three, Figure 3.1). Lee (1991) confirms the appropriateness of this paradigm for 'hypothetico-deductive' research. Accordingly, Cater-Steel (2004) clarifies that the majority of ISs research in the USA and

Australia adopts the positivist paradigm. In keeping with previous literature, this paradigm has been frequently adopted in investigating e-learning acceptance (Al-Sabawy, 2013; Jaber, 2016).

For the third research question (Q3), the interpretivist paradigm was chosen. The perspective here is that the nature of the enquiry is interpretive (Tuli, 2010). This paradigm is intended to provide in-depth understanding of the phenomenon under scrutiny (Falconer & Mackay, 1999). The interpretivist paradigm is also useful for identifying factors that are not part of 'the original research focus' (Gray, 2013). Moreover, according to Al-Sabawy (2013), there are no predefined dependent or independent factors in the interpretivist paradigm. This assumption is appropriate for the scope of the respective research question, since it seeks to identify barriers to e-learning application, without examining the cause and effect relationship between the identified variables. Figure 4.1 demonstrates the research paradigm adopted to the scope of this thesis.

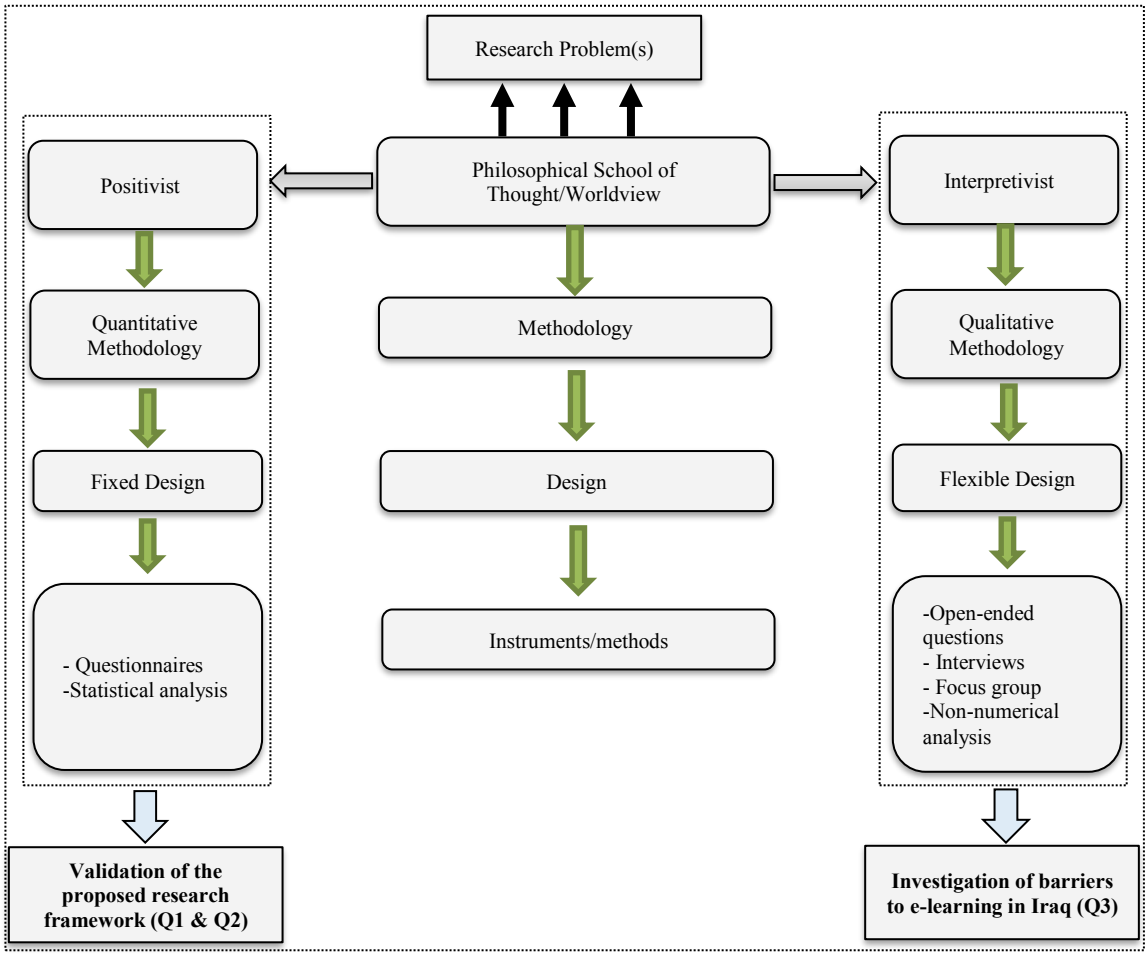


Figure 4.1: The Research Philosophy Adopted (adapted from Tuli, 2010)

4.3 The Survey Research Design Method

As mentioned briefly in Chapter One, Section 1.6, the survey design was adopted in the present research. Leedy and Ormrod (2001) define this method as "acquiring information about one or more groups of people - perhaps about their characteristics, opinions, attitudes, or previous experiences by asking them questions and tabulating their answers" (p.183). Pinsonneault and Kraemer (1993) identify three characteristics of the survey research method. First, the design is aimed at quantitatively building up a description of certain aspects of a sample under investigation. Second, researchers need to predetermine a set of questions for collecting the research data. Third, information should be collected from a representative sample of the population.

The survey research design encompasses 'cross-sectional' and 'longitudinal' methods (Creswell, 2003). The key difference between these lies in the attention given to the time dimension (Pinsonneault & Kraemer, 1993). In the former, data are gathered from a sample chosen at a specific point in time, whereas a longitudinal design is more appropriate when a problem needs to be examined over a longer period, or at more than one point in time. The present study, however, is 'cross-sectional' in its design, since the data for each research question were collected during a single time period. The survey research design is also classified into 'analytical' and 'descriptive' methods (Oppenheim, 1992). Based on the nature of each research question, both were adopted in the present study.

4.3.1 The Analytical Survey Method

An analytical survey research method corresponds to the first aim of this study, in order to extend TAM, investigate the causal relationships between the constructs of the proposed framework and to support or reject the hypotheses constructed (see Chapter Three, Figure 3.1 and Table 3.1). The application of this design to the present research is well-supported, in that it seeks to explain the relationship between the research constructs and causality association (Al-Sabawy, 2013). It is also consistent with the positivist paradigm, which implies the notion of considering the relationship between different variables. Moreover, such an analytical method facilitates the collection of large amounts of data at low cost and with minimal effort. It therefore remains one of the most popular quantitative research methods in the Social Sciences (Muijs, 2004). In keeping with earlier literature on extending TAM, it is also the dominant research method (Al-Sabawy, 2013; Tarhini, 2013). However, it can be difficult to obtain an in-depth understanding of a phenomenon in

this way (Muijs, 2004), which is why a descriptive research method was also adopted in the present study.

4.3.2 The Descriptive Survey Method

As briefly indicated above, the present study also adopted a descriptive survey research method for gaining an in-depth understanding of the barriers to successful e-learning implementation in Iraq. A descriptive design seeks to identify how many or what proportion of, for example, a whole population has a particular view or opinion of a specific phenomenon (Oppenheim, 1992). This method was chosen for the present study, because it is congruous with interpretivist philosophy. It is furthermore concentrating on understanding a phenomenon as it is, without examining any of the relationships between factors or proving a hypothesis. According to Tarus et al. (2015), a descriptive method is suitable for highlighting obstacles to e-learning use in developing countries.

4.4 Sampling Strategies

Sampling strategies refer to techniques or approaches for the selection of research participants (Cohen, Manion, & Keith, 2007). A variety of methods can be applied to reduce the amount of data required by only using data from a sub-group, instead of from all possible subjects. This approach is adopted where there are time, financial and access restrictions (Saunders, Lewis, & Thornhill, 2009). The two main sampling strategies are described as probabilistic and non-probabilistic (Leedy & Ormrod, 2005). In the former, there is a known and equal probability of each user being chosen, because every subject in the population may be included. However, in non-probabilistic sampling, the probability of being selected as a participant is not known. The first group includes simple random, systematic, stratified random and cluster techniques, while the second encompasses quota, purposive and convenience techniques (Saunders et al., 2009).

In the current research, a non-probabilistic convenience sampling technique was used for the selection of undergraduate students and the majority of the academic staff. This is because it was very difficult, if not impossible, to gain access to the whole population. Furthermore, constraints of time and effort were additional factors favouring this strategy. According to Muijs (2004), convenience sampling is one of the most popular sampling methods, as it enables researchers to choose subjects according to their availability, based on established research criteria (Tarhini et al., 2015b).

On the other hand, the choice of lecturers to take part in the semi-structured interviews corresponded to a non-probabilistic purposive technique. Leedy and Ormrod (2005) clarify that in qualitative studies, researchers can purposively choose a sample of individuals or objects to provide rich information about a phenomenon under investigation.

Another criterion to be considered in academic research is sample size. In this study, the main statistical method used to investigate the relationship between the model's constructs and to validate the research hypotheses was the partial least square structural equation modelling (PLS-SEM) technique. Bentler and Chou (1987) suggest that five cases per variable is an acceptable number for structural equation modelling, so long as the data are normally distributed, whilst 10 observations per variable are the minimum sample accepted for other distributions. Lowry and Gaskin (2014) identify two other methods of determining the number of observations required for the application of this technique. The first suggests that the smallest sample size can be identified by 10, multiplied by the largest number of variables used to determine a particular construct. The second method recommends a statistical power of regression set at 80% and an alpha level of 0.05. Based on such recommendations, both experiments conducted in this thesis, for the purpose of validating the proposed research framework, were met the minimum required sample sizes in each case.

4.5 Analysis Techniques

Statistical Package for Social Science (SPSS) software, version 22 for Windows 7 was used to conduct different analyses, including descriptive statistics and some inferential tests. Descriptive statistics are essential to be conducted prior to performing statistical techniques, such as correlations between variables or differences between groups, to check that the assumptions made by a particular test have not been violated (Pallant, 2005). Accordingly, descriptive statistics, including mean, standard deviation, frequency, data distribution and multi-collinearity tests were computed in the preliminary analysis stage. Pearson's correlation coefficient, independent samples t-test, one-way ANOVA and factor analysis were also performed as inferential techniques using SPSS.

Pearson's correlation is used to reveal the strength and direction of the relationship between two continuous variables or if one of them is dichotomous such as gender (male/female) where its value could be either positive or negative. The ideal Pearson's correlation coefficient (r) is 1 or -1, which means that the value of one factor can be precisely determined from the value of another (Pallant, 2013). An independent sample t-

test can be used when the aim is to investigate the relationship between one independent variable and one dependent variable in two groups. In order to compare the differences between two or more groups when there is also one independent variable and one dependent variable, one-way ANOVA technique can be applied (Pallant, 2013). In this technique, F ratio is calculated to identify the 'variance between the groups divided by the variance within the groups'. The probability (P) value is used as a measurement to reveal the statistical significance. The relationships between variables or differences between groups are significant if the P value is equal to or less than 0.05, whereas P value greater than 0.05 means that the null hypothesis is supported.

The SmartPLS software package, version 3.0 for Windows 7 was used to carry out the remaining analysis. This included the PLS-SEM technique, multi-group analysis, convergent validity (average variance extracted (AVE), composite reliability (CR) and Cronbach's alpha) and discriminant validity. Moreover, all the research hypotheses (see Chapter Three, Table 3.1) were also tested using this software.

There were several reasons for choosing the PLS-SEM technique to test the path associated between the proposed model constructs. First, it is "superior for the complex causal modeling [modelling]" (Lowry & Gaskin, 2014). This technique is also adequate for small samples (Hair, Hult, Ringle, & Sarstedt, 2016). Third, there is no specific assumption about the normality of data distribution (Lowry & Gaskin, 2014). Moreover, PLS-SEM is appropriate for complex models with many constructs (Hair et al., 2016). It is especially fitting in a case where the research model includes factors measured using different scales (Lei & Wu, 2007). Finally, this technique is recommended for exploratory studies, when developing a new model or extending an existing one (Hair et al., 2016).

As in regression techniques, four values should be considered to interpret the findings obtained through PLS-SEM. The first is the standardised coefficient (β), which gives an indication of the contribution from each independent construct in the model. This takes values from -1 to 1, whereby the highest value indicates the strongest contribution. It is standardised, because the values for the variables used have been converted to the same scale (Pallant, 2013). The other value is R-squared (R^2), referring to the amount of variation in the dependent construct explained by the model. It takes values ranging from 0-1. Third, the P value is obtained to ascertain whether this independent construct makes a significant contribution to explaining the dependent variable: if it is less than or equal to 0.05, it points to a significant effect. Finally, the t-value gives an indication of the strength of the relationship between the independent and dependent variables, where a t-value equal

to or greater than 1.96 represents the threshold value of significance (Al-Samarraie, Selim, Teo & Zaqout, 2016).

The qualitative data collected in the research experiments were categorised into different groups according to a thematic approach. This approach has the advantage of classifying qualitative data into several themes, in order to build up a general picture. Braun and Clarke (2006) proposed six phases to be followed when categorising research data into different themes, namely familiarising oneself with the data; generating initial codes; searching for themes; reviewing themes; defining and naming themes, and finally, producing the report. These phases were adopted during the data analysis process.

4.6 Design of the Research Experiments

Three experiments were conducted in this study to address the research problem presented in Chapter One, Section 1.3, to meet the research aims established in Chapter One, Section 1.4 and to answer the three questions listed in Chapter One, Section 1.5. Figure 4.2 consequently displays the research design method and techniques adopted for each experiment.

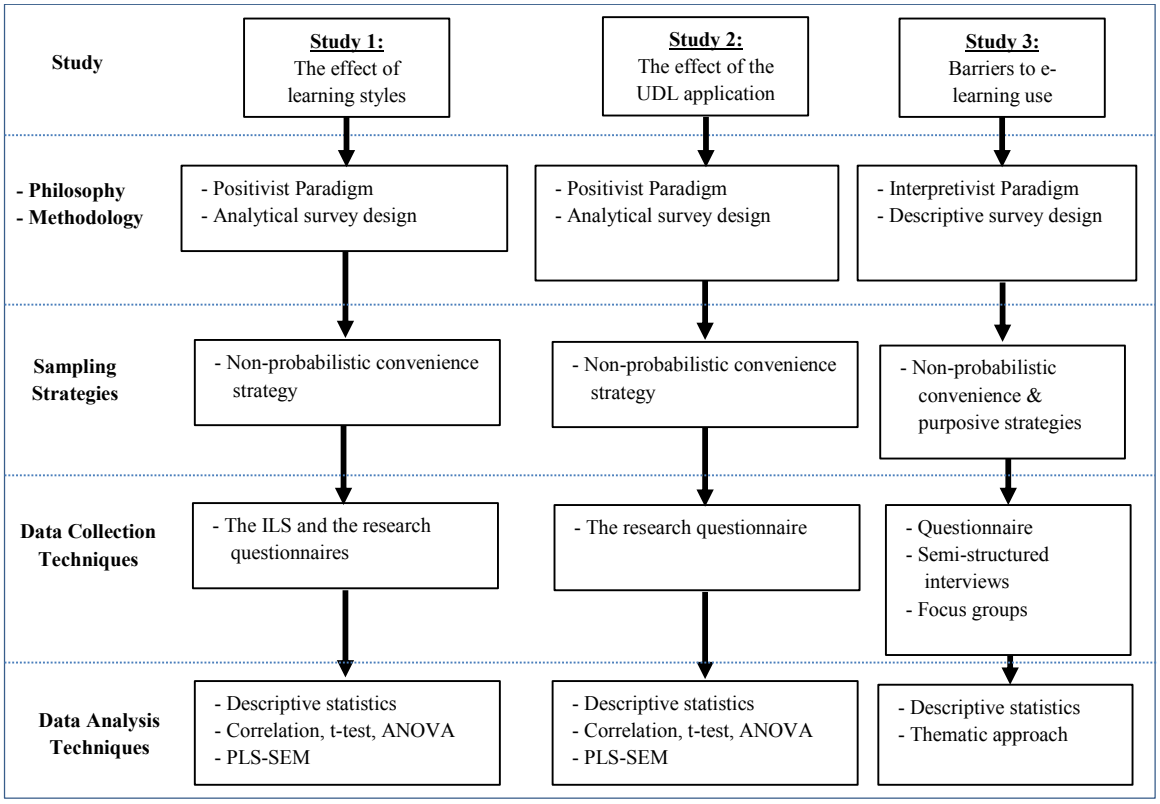


Figure 4.2: Design of the Research Experiments

4.6.1 Design of the First Experiment

The first research question was intended to investigate the impact of the Felder and Silverman model on the explanatory power of TAM:

Research Question 1: *What impact does Learning Styles Theory have on:*

i. E-learning acceptance? and

ii. Learners' experience?

To answer this question, a study was carried out at a public-sector Iraqi university during the academic year 2014-2015. The aim of this was to investigate the factors affecting e-learning acceptance and learners' perceptions by considering the role of learning styles. An analytical survey design was consequently employed in this research. It was appropriate for the experiment, because it was intended to reveal the causal relationship between the identified variables. A non-probabilistic convenience sampling technique was then used to select the research sample, while PLS-SEM was performed to identify the cause and effect relationship between the model's constructs and test the research hypotheses.

A. The Participants

This study targeted undergraduate Computer Science students, who had already attended several courses implementing blended e-learning systems (F2F and Moodle). In the second semester, they were asked in class and via the Moodle announcements page to complete two online questionnaires. These questionnaires were distributed separately to avoid respondent fatigue. According to Dillman (2007), long questionnaires can even lead to low rates of response. From the entire population targeted (around 464 students), 260 (approximately 56%) responded to either both or one of the distributed questionnaires. This sample comprised 169 students, who completed both the Index of Learning Styles (ILS) and a research questionnaire, and 50 and 41 students who only filled out one or the other (either the ILS or the research questionnaire). A voluntary approach was adopted in the recruitment of all the participants.

B. Context

At the College of Information Technology, Moodle has been used alongside physical classrooms since the end of 2013. Courses have thus been formally taught via blended e-learning (F2F and LMS), whereby all students were registered in the system and the

learning materials were uploaded to the LMS as pdf or PowerPoint files, in order to facilitate the retrieval of information. Moreover, theory exams were taken online to avoid paper-based approaches. Students were also encouraged to use communication tools, such as the forum and wiki to support their educational interaction with peers and instructors.

In order to understand the relationship between learning styles and learners' achievement, various levels of four programming courses were selected. These modules were chosen, because the students were requested to participate in the study by the instructors of these courses. Furthermore, the four modules focus on programming languages, whereas many other studies have attempted to link learners' performance on programming courses with their individual learning styles (Allert, 2004; Thomas et al., 2002; Shaw, 2012).

All the modules were mandatory and taught over a 14-week period. Every week therefore the students attended a two-hour lecture and a two-hour laboratory session. The theoretical concepts of each lecture were thereby explained in the classroom, whereas problem-solving tasks were performed in laboratories. Further discussions of course content were additionally supported via Moodle, while communication tools, such as a wiki and forum were activated on all the courses.

On every course, the lecturers referred the students to further reading materials on Moodle and the minimum pass mark for each course was 50%. The modules included in the present research were:

(1) Fundamentals of Programming Language II: A first-year module covering the fundamentals of the C++ programming language.

(2) Dynamic HTML: A second-year module, consisting of an introduction to HTML, CSS, Java Script and HTML5.

(3) Network Security: A course taught in the third year via laboratory tasks and using simulation software to design and set up networks.

(4) PHP programming: A fourth-year course introducing the designing of dynamic websites using PHP and the MySql database.

Once the modules had been completed, the overall mean score was used as an indicator of academic achievement. The maximum average for students' performance was 50%. This was calculated as follows:

- By grading two online theory exams in Moodle, consisting of a variety of questions, including multiple-choice, true-or-false, short-answer and fill-in-the-

blank items. The purpose of these exams was to assess learners' knowledge of the theoretical concepts of the respective module.

- By conducting two laboratory tests measuring students' problem-solving ability.
- Through other learning activities, such as participation in online and classroom activities and attendance. Table 4.1 illustrates an example of how students' performance was calculated.

Table 4.1: The Calculation of Students' Performance

Activity	Percentage
Two online theory exams	20%
Two laboratory tests	18%
Participation and attendance in the classroom	6%
Participation and attendance in the laboratory	6%
Other online and classroom activities	Extra marks (Maximum 3)

C. Data Collection Techniques

Two well-known and widely-accepted questionnaires developed in the West were used in this experiment. These comprised the ILS questionnaire (for identifying learning styles) and another questionnaire designed to measure other constructs of the proposed research framework. According to Brislin (1986), the use of existing questionnaires has the potential advantage of comparing findings with those of other studies adopting the same instrument. This will in turn enable literature to be collated. Both questionnaires were administered online via the Moodle announcements page.

The advantages of an online questionnaire entail, (1) Ease of access to populations in different regions (Fox, Murray & Warm, 2003; Wright, 2006), (2) Cost-saving in terms of both time and money (Wright, 2006), and (3) Ease of data analysis and assurance that data will not be omitted, as all questions can be identified as mandatory. In contrast, there are many drawbacks associated with online questionnaires, such as (1) A lack of knowledge concerning the participants' characteristics in the relevant communities (Wright, 2006), (2) The difficulty involved in trying to clarify ambiguities or complexities (Fox et al., 2003), and (3) The risk of a low response rate (Elzawi & Wade, 2012). As far as possible, these weaknesses were avoided in the present research, because the selected sample was known to the researcher, the language used in the instruments was carefully selected, and the students were strongly encouraged to take part in the study.

The first questionnaire was administered mid-February 2015 and then mid-April 2015. The second questionnaire was distributed over a period of approximately one month. Both

questionnaires were translated into Arabic, because English was not the first language of the Iraqi undergraduate students targeted. As such, the use of English versions of the questionnaire would have been unduly time-consuming and may have led to lower participation or arbitrary responses. The translations of the questionnaires were then approved by two first language Arabic PhD students studying in the United Kingdom at the time. All questionnaires were hosted by Google Drive.

The above questionnaires also included open-ended questions to provide an opportunity for the participants to freely express their perspectives of e-learning usage. Upon submission of the completed questionnaires, data were saved in Excel files and the respondents were directed to a page thanking them for their participation. Below, a brief description of the questionnaires used in this research is outlined.

The Index of Learning Styles (ILS)

The ILS questionnaire is proposed by Felder and Soloman (n.d.) to infer learning styles in accordance with the Felder and Silverman Model (Felder & Silverman, 1988). It comprises 44 forced-choice questions, of which 11 are used to identify each dimension. For each question, users can therefore choose either 'a' or 'b'. Van Zwanenberg, Wilkinson and Anderson (2000) point out that one of the main issues in the dichotomous nature of questionnaires is the difficulty of implementing standard statistical methods. Accordingly, the above researchers suggest using a value of 1 for (a) Items, and 0 for (b) Options. This binary method was used in the present study and accordingly, the total scores for each style ranged from 0-11.

Each dimension includes two dichotomies: a score of 0-1 indicates a strong style for the left axis; 2-3, a moderate style for the left axis; 4-5, a mild style for the left axis; 6-7, a mild style for the right axis; 8-9, a moderate style for the right axis, and 10-11, a strong preference for the right axis. Table 4.2 illustrates the questions used to identify each dimension in the Felder and Silverman model, while the English and Arabic versions of the questionnaire are presented in Appendix A.

Table 4.2: Questions in Each Dimension of the ILS

Dimension	Questions	Dimension	Questions
Processing	1,5,9,13,17,21,25,29,33,37,41	Perception	2,6,10,14,18,22,26,30,34,38,42
Input	3,7,11,15,19,23,27,31,35,39,43	Understanding	4,8,12,16,20,24,28,32,36,40,44

The Research Questionnaire

This instrument consisted of three parts. The first encompassed a certain amount of demographic information on the participants. Part Two then contained items identifying the research variables. Finally, Part Three represented an optional open-ended question to gather qualitative data, where the students were asked to add any comments relating to the use of e-learning.

In total, 17 items were included to identify the research constructs, namely intention to use (ITU), perceived usefulness (PU), perceived ease of use (PEOU), e-learning self-efficacy (ELSE) and perceived satisfaction (PS). However, two items were excluded following the factor analysis in this experiment, due to their weak loading. A seven-point Likert scale was adopted, ranging from 1 for 'Strongly disagree' to 7 for 'Strongly agree'. Even though the questionnaire items were adapted from previous literature and based on instruments already validated in earlier research (Chiu, Hsu, Sun, Lin & Sun, 2005; Venkatesh & Davis, 2000; Wu et al., 2010), their features were also considered in this research. The number of items used to infer each construct may be listed as follows: four items for PEOU; three items for PU; three items for ELSE; three items for PS, and two items for ITU.

4.6.2 Design of the Second Experiment

The second research question was dedicated to understanding the effect of the UDL application on the explanatory power of TAM:

Research Question 2: *Can applying the principles of the UDL model enhance:*

i. E-learning acceptance? and

ii. *Learners' perceptions?*

To answer this question, an experiment was conducted at a public-sector university in Iraq. It was performed over half an academic course in the first semester of the academic year 2015-2016. In this experiment, an analytical survey design was adopted as in the first experiment, in order to identify the cause and effect relationship between the model's constructs. The sample for the experiment was selected based on a non-probabilistic convenience sampling technique, while PLS-SEM was conducted to test the cause and effect association between the proposed framework variables and validate its hypotheses.

A. The Participants

Out of 115 second-year undergraduate students enrolled on a Web design module, 92 (80%) voluntarily responded to the distributed research questionnaire. To compare the effect of UDL-based blended e-learning with traditional blended e-learning, a sample of students who had experienced e-learning in a traditional setting, without embracing UDL principles, was used as a control group. A total of 77 second-year undergraduate students from the previous academic year (2014-2015), who had completed all items of the research survey in the first experiment, except for the UDL variables, were studied.

B. Context

The researcher developed the course design in accordance with UDL principles. The course was then delivered using blended e-learning integrated into classroom lectures and via Moodle. The design included a representation of learning content, methods of knowledge expression and assessment, and means of student engagement. Moodle was widely used on this course to deliver the learning content using multiple methods, in order to engage the students; notify them of any upcoming activities; discuss the learning content; receive uploaded assignments, and administer online theory exams.

The module covered the main principles of website design using HTML (HyperText Markup Language), CSS (Cascading Style Sheet), and JavaScript. These three concepts (HTML, CSS and JavaScript) complement each other in the designing of interactive websites. The first five lectures included general concepts of Web design and HTML. These lectures were carefully tailored to embrace UDL principles, as follows:

Multiple Means of Representation (MMR)

To meet this principle, the learning content was presented in a wide range of formats. All the learning materials were designed to explain the same content, but using multiple means. The syllabus and grading procedures were presented in the first lecture. Additionally, a course overview that included a pdf, Word and PowerPoint files, as well as a video was posted on the course LMS, one week before commencement. Next, each lecture was uploaded at least two days before a classroom session, in order to provide students with a general overview of the coming lecture. According to Kumar and Wideman (2014), posting learning materials ahead of time, prior to classroom sessions, can reduce learners' anxiety. For each lecture, the learning materials were delivered in pdf format

(including all details of the lecture, with the most important concepts highlighted in different colours and fonts), an equivalent Word file (to give students more flexibility over the presentation of the text font, for example, minimising or maximising, according to their preferences), and a PowerPoint file, which included the main outline of the lecture, its goals, examples and a summary. Furthermore, a detailed explanation of each lecture was also provided, using a series of short videos integrating closed notes and illustrations. Each video was less than 10 minutes long, in order to mitigate the issue of low Internet bandwidth in Iraq. These videos were developed using Camtasia software for Windows 7.

The video lectures consisted of short introductory videos, briefly reviewing the concepts discussed in the previous lecture. Some general questions were also asked in the videos, which the students were called upon to answer, before continuing with new concepts and introducing the main goals of the lecture. Additionally, a series of short videos was presented, containing detailed explanations of core concepts with practical implementation. Finally, short videos summarising the main points were also posted.

In the weekly classroom sessions, the tutor also used multiple means of representation. These comprised DataShow and PowerPoint slides, a Smartboard, a whole class discussion, a brief Q&A session, and a small group discussion. During the laboratory sessions, the instructor used a short one-to-one lecture format to pinpoint the weaknesses of each student and help him or her to address them. Applying such mixed methods in the classroom and laboratory sessions was essential, in order for the instructor to be able to respond to students' individual needs.

Furthermore, text-based guidelines (pdfs and Word files) were also posted on Moodle to explain the main structure and specifications for the assignments, as well as the steps to be followed when designing a high quality website. Moodle was also used to provide the students with additional learning resources, either for knowledge development, or to obtain background information. The purpose of this was to eliminate the differential in background knowledge between the students. A brief summary of two lectures was also uploaded to the course website as a pdf and Word file to help the students learn strategies for remembering the main concepts of a lecture, as well as clarifying how to summarise a lecture. Thus, the course design covered the first principle of the UDL model by integrating multiple means of representation. These ensured improved access to the learning content for all the students.

Multiple Means of Action and Expression (MMAE)

A wide range of learning evaluation methods was applied to allow the learners to demonstrate their knowledge and understanding in various ways. It must be added here that general assessment rules were to be followed by each instructor as part of the University's assessment procedure and as such, the instructors respected these rules. On the other hand, multiple means of evaluation were incorporated into the course design, at the lecturer's discretion. The learners were assigned two theory exams, a laboratory test and a final exam. For the theory exam relating to this current experiment, different question styles were included, such as multiple choice, fill-in-the-blank, brief narrative description, and problem-solving items. This gave the students more flexibility in the way they could respond to each question. The dominant method used to evaluate the students' problem-solving ability was a laboratory test. However, the instructor did not use just one test for this assessment, because some of the students may have underperformed, due to miscellaneous external circumstances unrelated to their actual understanding. Hence, a weekly assessment method was adopted, rather than relying on a single test.

According to Rose, Harbour, Johnston, Daley and Abarbanell (2006), the decision over the most suitable assessment method will depend on the core goals of a module. The course being targeted by the present study aimed to develop the abilities of undergraduate students in designing an interactive website using HTML, CSS and JavaScript. Based on this perspective, the students were informed in the very first week that they should start planning an individual project as from the second week, using HTML principles only. This would be developed further by applying CSS and JavaScript concepts. Such an approach would allow the students to empirically acquire comprehensive understanding and knowledge on the course. They were given a flexible window of six to eight weeks to submit their work, so that they could choose the most suitable time, according to their schedule and time commitments for other courses. The teacher also identified additional activities for the students to complete, whether in the classroom or on Moodle.

Using the Moodle LMS, four self-assessments were posted; each assessment associated with one of the lectures. This was not only important for assessment, but also for the learners' engagement. In addition, the students were asked to choose one of two assignment topics, according to the one they were most interested in. Their completed work was then to be uploaded onto Moodle. Moreover, although a deadline was set for this assignment, it would not be strictly imposed by the lecturer. Therefore, the students had the option of selecting the most convenient due date for their schedule. This flexibility of

submission was adopted, because the students had no previous of experience of completing such assignments. Therefore, a strict due date could have led to a low response rate. In addition, a text-based guideline was provided to help the students prepare their reports, along with a short video instructing them on how to upload their work. Other daily activities were also integrated as part of the students' assessment. This wide range of evaluation methods met the UDL principle of including more than one assessment method to address every student's needs.

Multiple Means of Engagement (MME)

According to Conner (2016), engagement represents one of the key concerns of educators in contemporary learning. In this study, different engagement methods were applied in both classroom-based sessions and the LMS. After registration, a course overview was posted, including a general introduction outlining its importance and goals, the main topics to be covered, and the teaching approaches and assessment methods to be applied. The announcements page of the module's Moodle website was also used to inform students of all upcoming activities. The purpose of this was to positively impact on students' engagement by keeping them up to date about the course. Earlier literature has shown that using notification tools in e-learning systems can significantly influence technology adoption (Atchariyachanvanich, Siripujaka & Jaiwong, 2014).

In the present case, the instructor posted many questions in the course forum, in order to motivate the students and enhance their interest in the course. Prompt replies to all the students' enquiries were subsequently provided by the lecturer, as well as answering the questions posted. Another approach to student engagement involved the use of online self-assessments for each lecture. These self-assessment tests were designed so that direct feedback could be given for each question, indicating whether or not the answer was correct. As discussed by Rose et al. (2006), self-assessment plays a vital role in student engagement. Aside from the above, at the beginning of each lecture, many questions associated with the previous topic were triggered and the students were asked to pause the videos, until these questions were answered. This method was used to motivate the students, so that their knowledge and focus on the course content could be evaluated. Intensive feedback was provided for all students on their online assignments and projects.

In the classroom sessions, the instructor focused on extending students' knowledge about the course, motivating them to express their limitations and giving them further advice and comments to improve their work. Generally speaking, the presentation of learning contents

via multiple means alongside the inclusion of different kinds of assessment, were aimed at maintaining students' motivation on the course. The students' interest in the course was also demonstrated in their high level of interaction with the LMS, as presented in the Moodle log files.

C. Data Collection Techniques

The data were collected through the research questionnaire, as in the previous experiment. At the end of Week Six, the research questionnaire was posted on the announcements page of the course site, Moodle. All students were requested and encouraged to complete the instrument in their free time and it was emphasised that their feedback was important for enhancing e-learning implementation in public-sector universities in Iraq, as well as for specifically developing the corresponding course design.

The same variables and items used in the research questionnaire in the first experiment were adopted to evaluate the effect of UDL principles on e-learning acceptance and learners' perceptions. However, in order to measure UDL principles, extra items were added. These included multiple means of representation (MMR): three items; multiple means of action and expression: (MMAE): four items; and multiple means of engagement (MME): four items. All questions were adapted from previously examined instruments (Liaw, 2008; Said, Kirgis, Verkamp & Johnson, 2015; Smith, 2012).

The above questionnaire comprised another section for identifying the most useful course materials (15 questions) and helpful attributes (9 questions). This section was adapted from Kumar and Wideman (2014). Alongside these questions, three open-ended questions were included, asking students to express views on their most preferred course materials, attributes and course design. Furthermore, it was clarified that the students' instructor would not be able to access the results and as such, the students could freely express their true perceptions, without fearing that this would affect their grades. Moreover, the data were to be gathered by the present researcher, who did not have a direct relationship with the students. Both the English and Arabic versions of the questionnaire are shown in Appendix B.

4.6.3 Design of the Third Experiment

The third research question sought to shed some light on barriers to e-learning use in Iraq. The key aims of this question were to support the quantitative analysis conducted in the

first and second experiments and to identify other factors potentially affecting e-learning acceptance, other than the constructs identified in the proposed research framework:

> **Research Question 3:** *In the context of public-sector universities in Iraq, what barriers to the use of e-learning are reported by academic staff and students?*

To answer this question, this experiment was carried out according to a descriptive survey design method. The research data were collected from a sample selected using both convenience and purposive sampling techniques. Moreover, the recruitment of all the participants was based on a voluntary approach.

A. The Participants

Overall, 74 teaching staff participated by completing an online instrument consisting of two open-ended questions, all working at public-sector universities located in different Governorates and all universities with some experience of attempting to implement e-learning. Additionally, three academics in charge of e-learning implementation and 31 undergraduate students also took part in this study. Thus, the subjects in this current experiment totalled 108 respondents.

B. Procedure

The data collection methods applied here included the use of a questionnaire, focus groups and semi-structured interviews. The following two questions were adapted from previous research, where the hindrances to the application of e-learning had been successfully identified in another developing country (Tarus et al., 2015):

1. What challenges do public-sector universities in Iraq face that may hinder the successful implementation of e-learning?
2. What are your recommendations for addressing these challenges?

The questionnaire consisted of two parts: the first identifying some general information about the participants and the second comprising the two open-ended questions presented above. This questionnaire was administered via social media over a period of two weeks.

In addition to the above, focus groups were arranged amongst 57 undergraduate Computer Science students. According to Cohen et al. (2007), the focus group technique can potentially develop new ideas through interaction between participants. Moreover, it is an

effective time-saving method. All the focus group participants had already experienced e-learning for approximately one year. The focus groups were organised as follows:

- First, in a Web-design module, the students were divided into several groups, each consisting of 3-4 students.
- The groups were each given 10 minutes to reflect on and discuss the possible challenges to their e-learning and their recommendations for tackling these.
- The students were then asked to write down their ideas.
- Finally, each group nominated one member to complete the online survey posted on the announcements page of their module website (Moodle). Eight groups (31 students) filled out the online survey, whereas others did not respond.

The third method implemented for data collection in this instance consisted of semi-structured interviews. These have the advantage over unstructured interviews, in that they enable the main predetermined research themes to be covered. In unstructured interviews, however, participants have an opportunity to freely discuss what they believe to be important. In turn, this may alter the direction of the interview, in accordance with the interviewee's perspectives (Saunders et al., 2009). Three Computer Science professors were purposively chosen, based on three criteria: they were in charge of an e-learning application, they possessed individual expertise in the field and they were highly qualified. All the interviews were carried out online, audio-recorded and transcribed for documentation purposes.

Following data collection, the researcher reviewed all the comments to identify the main themes. Subsequently, all the themes were coded to accurately define the main categories. It should be noted here that all comments and the interviews themselves were in Arabic. After identifying the main themes, the researcher translated the interviewees' comments into English, so that they could be incorporated in this thesis. The translation was then verified by two Arab PhD students studying in the United Kingdom.

4.7 The Pilot Studies

As a step in the development of the research questions, research questionnaire and the proposed framework, as well as to ensure that the translation of the ILS questionnaire was comprehensible to the participants, two pilot studies were carried out (Al-Azawei & Lundqvist, 2014; Al-Azawei & Lundqvist, 2015). In the first, the ILS questionnaire was

distributed to a total of 111 first-year Computer Science undergraduate students in a programming module at the University of Babylon. Out of these, 59 students completed the questionnaire. The aim of this pilot study was to highlight the correlation between learning styles, gender and academic achievement. The students were asked to contact the researcher for any further information or clarification.

The other pilot study implemented two instruments: the ILS and another questionnaire developed to measure ELSE, PEOU, PU and PS. Overall, 70 learners participated in the study, in an online environment intentionally customised to serve one of the categories in the Felder and Silverman model. For instance, the learning content was heavily focused on visual materials that corresponded with the preferences of visual learners. The purpose of this study was to identify the relationship between the proposed variables. It also examined differences in learners' perceptions, based on learning style dimensions. Although the sample size was small, the findings provided a general picture of the role of learning styles in e-learning.

These two pilot studies are reported in Appendices C and D, respectively. After the two pilot investigations, the final research framework and its questionnaire were developed.

4.8 Data Cleaning and Pre-processing

It must be added here that all the questionnaires received were valid. This is because every item had been identified as required, in order to avoid receiving incomplete answers. However, some of the cases were duplicated on two or even more occasions, since a few students had either filled out the instruments several times, or else there was a technical issue concerning the Google Form. This happened to all the online questionnaires distributed. Therefore, prior to the data analysis, the datasets were checked to exclude the duplicated cases. This procedure was performed twice to ensure that the datasets did not contain any duplication.

The original datasets were in Excel format. Firstly, all the textual options, except for the open-ended questions, were converted into numerical data so that they could be statistically analysed. For example, gender was assigned the number, 1 for 'male' and 2 for 'female'. Moreover, items in the research questionnaires were also assigned numbers, ranging from 1 for 'Strongly disagree' to 7 for 'Strongly agree'. In addition, the ILS questionnaire was assigned the numbers, 1 and 0 for all 'a' and 'b' items, respectively. Then, based on a summation of the 11 questions designed to measure each dimension (0-

11), the values 0-5 were categorised as Group 1 (left style), with 6-11 being classified as Group 2 (right style). For instance, the value of 1 was assigned to active learners, whereas the value of 2 was assigned to reflective learners.

The summation values (0-11) were used to investigate the capacity of learning styles to predict dependent variables in the research framework. Conversely, the two categories (1 and 2) were used to analyse the differences between the groups, based on the learning styles. Finally, the files generated were converted into .SAV (SPSS) and .CSV (SmartPLS) formats for the purpose of statistical analysis.

4.9 Ethical Considerations

Social research projects involving human subjects (whether quantitative, qualitative or mixed research studies) require ethical clearance before their commencement. According to Saunders et al. (2009), ethics refer to the requirement for researchers to behave appropriately by considering the rights of those who will be involved in or influenced by planned research. Research ethics are defined in a procedure applied to "formulate and clarify our research topic, design our research and gain access, collect data, process and store our data, analyse our data and write up our research findings in a moral and responsible way" (Saunders et al., 2009, p.184).

The main requirements for performing research amongst human populations are to ensure that integrity, anonymity, privacy and confidentiality are preserved, while at the same time emphasising the voluntary nature of the participation (Saunders et al., 2009). In the present research, this process correspondingly fell into two main stages:

- Ethical approval was obtained according to the procedure stipulated by the Ethics Committee at the University of Reading. Two approvals were obtained for conducting the research experiments (see Appendices E and F).
- In the second stage, permission from the Head of the Information Networks Department in the College of Information Technology at the University of Babylon was obtained to conduct the research experiments. The experiments were performed following his authorisation (see Appendix G).

The purpose of each experiment was explained in the cover letter accompanying the distributed questionnaire. It was also guaranteed that all data would be treated as confidential and so none of the participants' identities would be published. Furthermore, it was mentioned that their personal information would not be provided to or shared with any

third party and the researcher would be the only person dealing with the gathered data. Other aspects highlighted in the research instruments were that participation was purely voluntary and so the users could withdraw at any time they wished, without having to give a reason. Moreover, the collected data would only be used for the purposes of this research. The researcher's contact details were also included in the cover letter, so that the respondents could contact him for any further explanation or information, if required.

4.10 Summary

This Chapter introduced and justified the choice of philosophical assumptions, research design and research methods adopted in the present study. The research is based on an analytical survey, aimed at validating the proposed research framework. On the other hand, a descriptive survey was selected to identify any barriers preventing successful e-learning implementation in Iraq.

The majority of the research subjects were chosen based on a non-probabilistic convenience sampling technique, determined as the most suitable approach for selecting participants on the basis of their availability and the research criteria. However, a non-probabilistic purposive sampling technique was also adopted for the semi-structured interviews, because this was deemed to be more convenient for choosing a specific type of participant, who could provide rich information about the phenomenon under investigation. Another aspect discussed in this Chapter was the sample size required for executing the PLS-SEM technique.

Besides the above, this Chapter demonstrated the data analysis techniques applied, encompassing different statistical tests and a thematic approach to analyse and categorise the quantitative and qualitative data, respectively. The main technique used to validate the research framework was PLS-SEM. SmartPLS software version 3.0 and SPSS software version 22 were used to perform the data analysis. Consequently, the design of the three experiments conducted was described. Questionnaires and interviews were the primary methods used for data collection. The ILS questionnaire and a research questionnaire were used to validate the research framework and address the first and second research questions. Furthermore, the procedure for collecting qualitative data using open-ended questions, semi-structured interviews and focus groups in response to the third research question was discussed. Meanwhile, the data cleaning and pre-processing procedure was summarised, followed by a brief discussion of the pilot studies carried out prior to the main

research experiments. Finally, this Chapter was concluded with a description of the ethical considerations related to the current study.

Chapters Five and Six will now present the findings of the three experiments conducted to answer the research questions.

Chapter 5: Results of the Impact of Learning Styles (Q1)

5.1 Overview

This Chapter is dedicated to answering the first research question. It assesses e-learning acceptance and learners' perceptions based on the Technology Acceptance Model (TAM), as well as learning styles. It also examines the relationship between learning styles and academic performance. In Section 5.2, the participants' demographic features are presented, while Section 5.3 reports on the preliminary analysis carried out, prior to integrating learning styles with TAM. This analysis takes into account the scores from the Index of Learning Styles (ILS) questionnaire, descriptive statistics, data distribution, multicollinearity assumption and differences between groups. Section 5.4 then presents the findings of the proposed research framework and hypothesis testing.

The analysis consisted of five steps to validate the relationships between the research constructs, including the psychometric properties of the research questionnaire, the predictive ability of the original TAM constructs, the capability of learning styles to predict the dependent variables and the change in the explanatory power of TAM after the inclusion of learning styles. This Section also highlights the moderating effect of learning styles on the path strength between the proposed research model factors. In Section 5.5, the influence of learning styles on academic performance is analysed, while Section 5.6 reports the main themes generated by the respondents' comments. Finally, Section 5.7 summarises the key findings of this Chapter.

5.2 The Participants' Demographic Information

To investigate the impact of learning styles on e-learning acceptance and learners' perceptions, a total of 210 Computer Science undergraduates took part in this study. The sample included 122 females and 88 males, mainly ranging between 18 and 23 years old. These consisted of freshmen (N=68), sophomores (N=77), juniors (N=42), and seniors (N=23) (see also Figure 5.1, below).

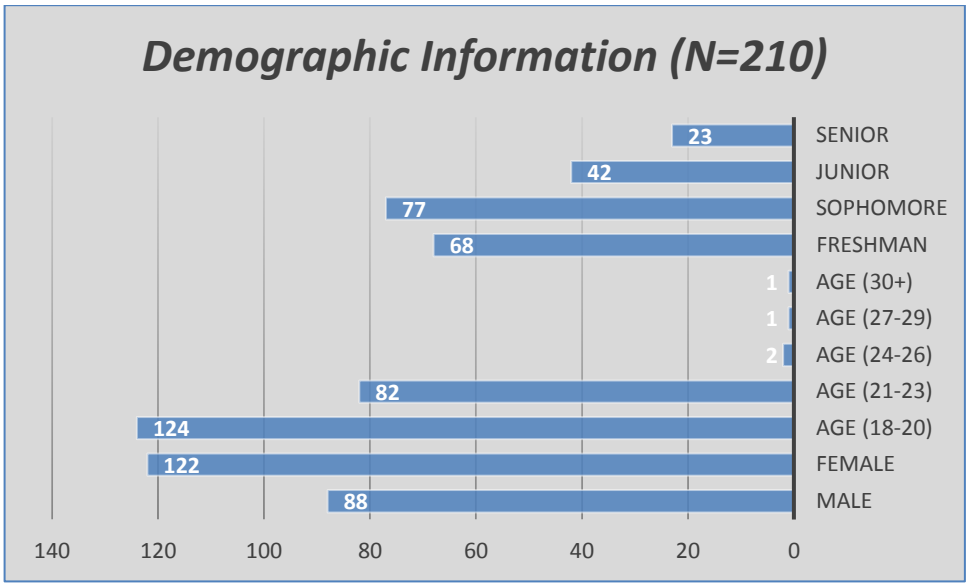


Figure 5.1: The Participants' Demographic Information (N=210)

For the purpose of investigating the relationship between learning styles and academic performance, the total number of 219 undergraduates completing the ILS questionnaire was used. This sample included: 65 freshmen, 90 sophomores, 41 juniors, and 23 seniors. The majority of these were aged between 18 and 23 years and the subject team consisted of 124 (56.6%) female and 95 (43.4%) male students.

5.3 Preliminary Analysis of the Integration of Learning Styles with TAM

The four dimensions of the Felder and Silverman Learning Styles Model (FSLSM) were integrated with TAM to evaluate their effect on e-learning acceptance and learners' perceptions. Before examining the proposed relationships in the research framework (see Chapter Three, Figure 3.1), several preliminary analyses were carried out to determine the learning style scores, mean (M), standard deviation (SD), normality of data distribution, multicollinearity assumption and differences between groups, based on learning style dimensions.

5.3.1 Index of Learning Styles (ILS) Scores

Table 5.1 illustrates the participants' preferences based on their ILS scores. The students were 'fairly well balanced' in the 'understanding' dimension (sequential/global); the M of the sequential preference being 5.871 and the M of the global value is 5.129, computed as a complement of 11. For the other dimensions, the students indicated mild to moderate preferences for the active/reflective, sensing/intuitive and visual/verbal dimensions. The

most commonly occurring styles indicated by the participants were active (N=120, 71%), sensing (N=143, 84.6%), visual (N=140, 82.8%) and sequential (N=88, 52.1%). This outcome supports the assumption of Felder and Silverman (1988) about the preferences of Engineering students. Figure 5.2 (below) depicts the box plot of the four scales.

Table 5.1: Descriptive Statistics of the Learning Style Dimensions

Learning Style Scales	N	Range	Min	Max	M	SD
Processing (active/reflective)	169	10.00	1.00	11.00	6.432	1.907
Perception (sensing/intuitive)	169	10.00	1.00	11.00	7.272	1.963
Input (visual/verbal)	169	10.00	1.00	11.00	7.574	2.213
Understanding (sequential/global)	169	11.00	0	11.00	5.781	2.114

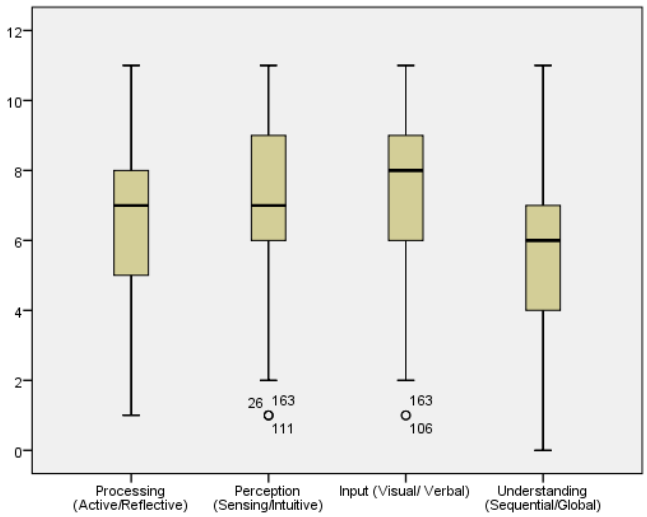


Figure 5.2: Box Plot of the Four Learning Style Scales

5.3.2 Descriptive Statistics

Table 5.2 depicts the M scores and SD of all the factors. It also reports the results of the data distribution analysis and multicollinearity assumption. The M scores for all the items were higher than the midpoint of 3.5 and ranged from 4.90 to 5.29, whereas the SD ranged from 1.19 to 1.32. This indicates a moderate spread of values around the M.

The normal distribution of the data was tested according to the values of skewness and kurtosis. Skewness provides "an indication of the symmetry of the distribution", whereas kurtosis provides "information about the 'peakedness' of the distribution" (Pallant, 2013, p.59). Peat and Barton (2005) state that skewness and kurtosis "values above +3 and below -3 are a good indication that the variable is not normally distributed" (p.31). In Table 5.2, skewness (Std. Error=0.168) and kurtosis (Std. Error=0.334) indicate that the data were approximately normally distributed. Appendix H also shows that the data from all the

items were approximately normally distributed and thus used in the analysis, without further action or treatment being required.

Further to the above, the multicollinearity assumption was analysed according to the values of tolerance and variance inflation factors (VIF). Multicollinearity occurs where two or more constructs are highly correlated (for example, r=0.9) (Pallant, 2005). While tolerance refers to the extent to which the variability of a particular construct is not explained by other factors in the model, VIF is the inverse of tolerance. According to Pallant (2005), if tolerance values are less than 0.10 and VIF values are above 10, this should be an issue indicating multicollinearity. Based on these thresholds, Table 5.2 clearly illustrates that the multicollinearity assumption was not violated in this experiment.

Table 5.2: Descriptive Statistics of the Model Constructs

Factor	Item	M	SD	Skewness	Kurtosis	Tolerance	VIF
ITU	2	5.29	1.287	-1.429	1.801	0.516	1.938
PU	3	4.90	1.32	-0.911	0.378	0.523	1.913
PEOU	4	5.135	1.192	-1.082	1.039	0.533	1.875
ELSE	3	5.03	1.294	-0.837	0.237	0.639	1.565
PS	3	5.076	1.319	-1.204	1.124	0.497	2.010

Intention to use (ITU), perceived usefulness (PU), perceived ease of use (PEOU), e-learning self-efficacy (ELSE) and perceived satisfaction (PS)

Moreover, the M and SD scores for each item used in the research questionnaire were calculated. The items of the proposed research framework were measured based on a seven-point Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree), except for the learning style dimensions. Table 5.3 demonstrates the range of M scores and SD of all constructs.

Table 5.3: Descriptive Statistics of the Model Variables

Item	M	SD
PEOU1	5.04	1.543
PEOU2	4.80	1.813
PEOU3	5.34	1.375
PEOU4	5.36	1.481
PU1	5.10	1.563
PU2	4.72	1.703
PU3	4.88	1.482
ELSE1	5.08	1.589
ELSE2	5.29	1.446
ELSE3	4.72	1.604
PS1	4.93	1.591
PS2	5.05	1.453
PS3	5.25	1.396
ITU1	5.30	1.397
ITU2	5.29	1.403

5.3.3 Correlation and Differences in Factors between the Groups

Pearson's correlation coefficient was applied to measure the relationship between learning styles and factors of the model. Table 5.4 shows that the majority of the constructs were significantly correlated and no correlation was above 0.7. The highest correlation was between PU and PS (r=0.662). Learning styles were insignificantly correlated with all factors, except for the processing dimension, where it showed a significant relationship with most constructs.

An independent sample t-test was applied to analyse the differences in ITU, PS, PEOU, ELSE and PU, according to the learning style dimensions (Table 5.5, 5.6 and 5.7). None of the groups indicated a significant difference. The only exception was in the processing dimension, where active learners were more likely to accept e-learning and had more positive perceptions. Figure 5.3 illustrates the box plot of the model factors.

Table 5.4: Correlation between Factors

	PU	PEOU	ELSE	PS	Processing	Perception	Input	Understanding
ITU	0.620**	0.561**	0.485**	0.602**	0.188*	0.087	0.045	0.017
PU		0.498**	0.426**	0.662**	0.153*	0.123	0.053	0.093
PEOU			0.580**	0.551**	0.218**	0.049	0.053	-0.009
ELSE				0.394**	0.154*	-0.022	0.041	-0.054
PS					0.203**	0.053	0.007	0.133
Processing						0.310**	0.378**	0.146
Perception							0.365**	0.446**
Input								0.295**

*Correlation is significant at 0.05 (2-tailed), **Correlation is significant at 0.01 (2-tailed).

Table 5.5: Differences between Groups (Learning Style, ITU and PS)

Intention to Use (ITU)					Perceived Satisfaction (PS)				
Factor	**M**	**SD**	**t-test**	**P**	**Factor**	**M**	**SD**	**t-test**	**P**
Active	5.500	1.076	T(167)=2.032	0.044	**Active**	5.227	1.254	T(167)=2.226	0.027
Reflective	5.091	1.416			**Reflective**	4.748	1.309		
Sensing	5.391	1.186	T(167)=0.253	0.801	**Sensing**	5.067	1.344	T(167)=0.501	0.617
Intuitive	5.326	1.264			**Intuitive**	5.205	0.904		
Visual	5.392	1.221	T(167)=0.267	0.790	**Visual**	5.095	1.308	T(167)=0.144	0.886
Verbal	5.327	1.079			**Verbal**	5.057	1.192		
Sequential	5.295	1.368	T(167)=0.977	0.330	**Sequential**	5.136	1.350	T(167)=0.562	0.617
Global	5.475	0.974			**Global**	5.037	1.217		

Table 5.6: Differences between Groups (Learning Style, PEOU and ELSE)

Perceived Ease of Use (PEOU)					E-Learning Self-Efficacy (ELSE)				
Factor	**M**	**SD**	**t-test**	**P**	**Factor**	**M**	**SD**	**t-test**	**P**
Active	5.322	1.093	T(167)=2.022	0.045	**Active**	5.244	1.165	T(167)=2.196	0.029
Reflective	4.933	1.234			**Reflective**	4.782	1.411		
Sensing	5.225	1.170	T(167)=0.411	0.682	**Sensing**	5.130	1.246	T(167)=0.487	0.627
Intuitive	5.125	1.017			**Intuitive**	5.000	1.323		
Visual	5.192	1.182	T(167)=0.428	0.669	**Visual**	5.092	1.272	T(167)=0.399	0.690
Verbal	5.293	0.963			**Verbal**	5.195	1.186		
Sequential	5.184	1.250	T(167)=0.300	0.765	**Sequential**	5.018	1.341	T(167)=0.988	0.325
Global	5.237	1.027			**Global**	5.209	1.155		

Table 5.7: Differences between Groups (Learning Styles and PU)

Perceived Usefulness (PU)				
Factor	**M**	**SD**	**t-test**	**P**
Active	5.038	1.300	T(90)=1.290	0.199
Reflective	4.755	1.290		
Sensing	4.981	1.337	T(90)=0.579	0.563
Intuitive	4.820	1.084		
Visual	4.964	1.277	T(90)=0.168	0.867
Verbal	4.919	1.427		
Sequential	4.981	1.347	T(90)=0.254	0.800
Global	4.930	1.254		

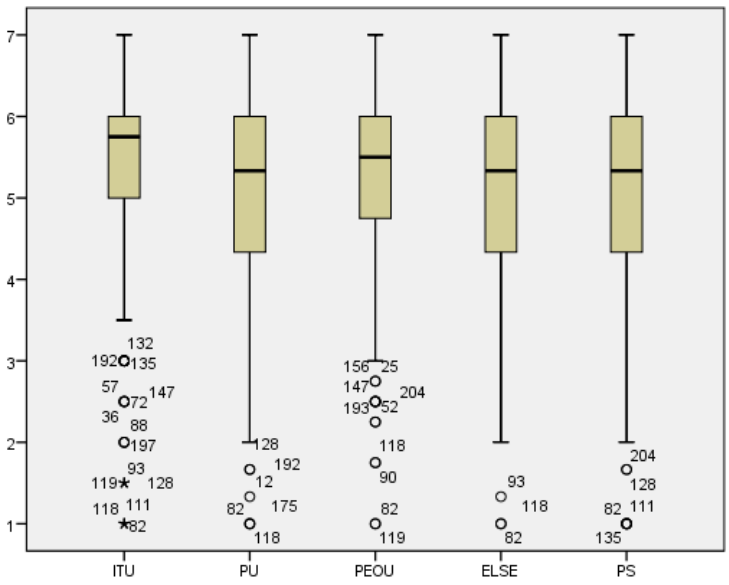


Figure 5.3: Box Plot of the Model Factors

5.4 Investigating the Proposed Framework and Testing the Hypotheses

Five steps were undertaken in the analysis to identify the improvement in the explanatory power of TAM after incorporating learning style dimensions. The first step included testing the properties of the research questionnaire. Second, the effect of the original variables of TAM (PEOU and PU) on the dependent factors (PS and behavioural intention to use e-learning) was examined. This step would assist in understanding the variance of the dependent factors explained by the independent constructs. In the third step, the capacity of the learning style dimensions to predict learners' perceptions and behavioural intention was investigated. The aim of this analysis was to identify the actual predictive power of learning styles. The fourth step consisted of integrating learning styles with TAM (the proposed research model). It showed the change in the explanatory power of TAM after including learning styles as predictors. Finally, the moderating effect of the active/reflective and sequential/global dimensions was examined.

5.4.1 Instrument Properties

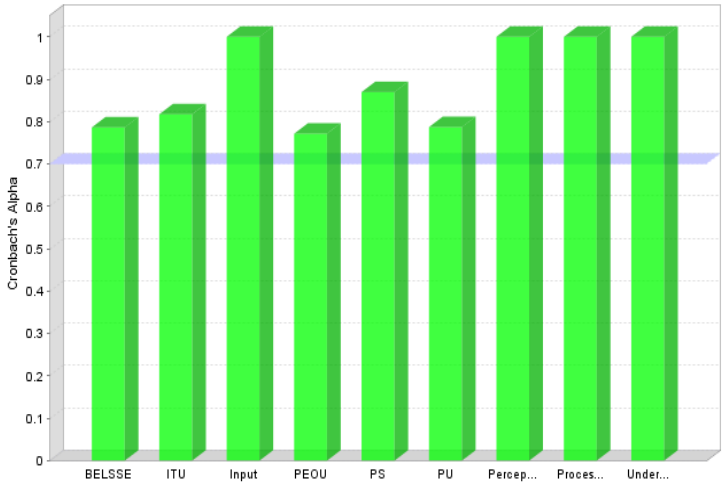
An important step before testing the constructed hypotheses in the proposed research model was to check the validity and reliability of the research questionnaire. One of the most common types of psychometric validity is known as 'construct validity'. It refers to "the degree to which a scale measures what it intends to measure" (Garver & Mentzer, 1999, p.34). According to Pallant (2013), Cronbach's coefficient alpha represents the most commonly applied indicator for investigating instrument reliability. The values in this measurement range from 0 to 1. Generally, an acceptable level of reliability is recommended as being over 0.7 (Garver & Mentzer, 1999). Based on this threshold, the instrument achieved excellent reliability in its internal consistency (α=0.910) and all constructs exhibited acceptable or high reliability, with alphas ranging from 0.77 to 0.87.

Convergent and discriminant validity are other widely used tests for measuring instrument properties. Convergent validity refers to the extent to which a construct correlates with the indicators developed to measure it (Garver & Mentzer, 1999). To statistically validate this, the values of average variance extracted (AVE) and composite reliability (CR) should exceed the acceptable level of 0.5 and 0.7 for both measurements, respectively (Hair, Black, Babin, Anderson, & Tatham, 2006). Discriminant validity, on the other hand, refers to the extent to which indicators representing the construct distinguish that variable from other indicators representing other constructs (Garver & Mentzer, 1999). It may be supported when the variance shared between one variable and another is less than the variance shared by a variable with its own constructs (Fornell & Larcker, 1981).

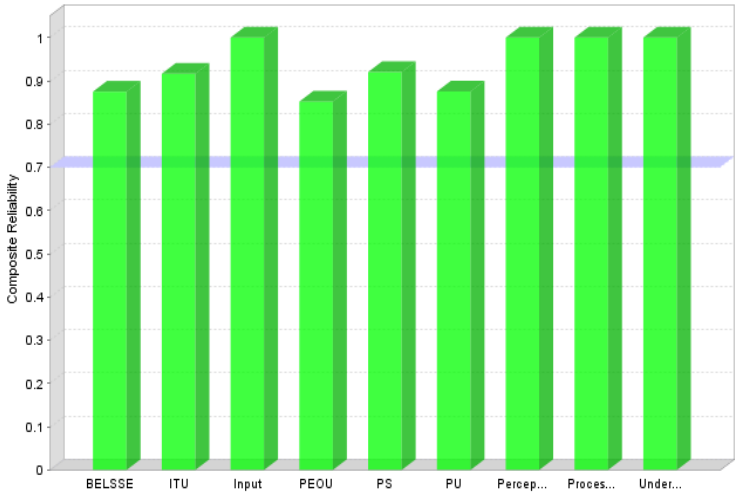
In this experiment, the convergent validity of the instrument was supported, because the AVE and CR values exceeded the acceptable level of 0.5 and 0.7 in both measurements, respectively. The discriminant validity was also confirmed, since the variance shared between one variable and another was less than the variance shared by the variables with their own constructs. Table 5.8 illustrates that both the convergent and discriminant validity of the instrument were advocated. A graphic is used here to illustrate the instrument properties, while Figure 5.4 depicts the convergent validity of the research questionnaire.

Table 5.8: Convergent and Discriminant Validity

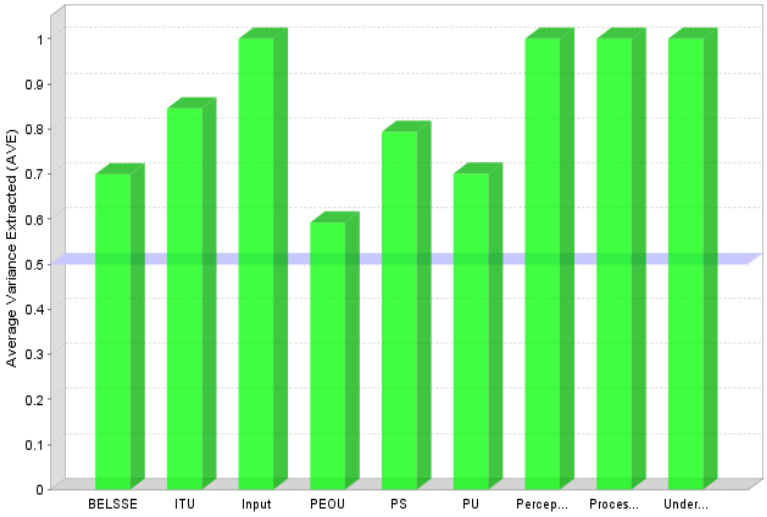
Latent factor	AVE (>0.5)	CR (>0.7)	Cronbach's α	Discriminant validity				
				ELSE	ITU	PEOU	PS	PU
ELSE	0.70	0.875	0.786	0.836				
ITU	0.846	0.916	0.817	0.487	0.920			
PEOU	0.593	0.852	0.771	0.59	0.59	0.770		
PS	0.793	0.920	0.870	0.402	0.607	0.594	0.891	
PU	0.701	0.875	0.787	0.421	0.631	0.525	0.670	0.837



a. Cronbach's Alpha



b. Composite Reliability (CR)



c. Average Variance Extracted (AVE)

Figure 5.4: Convergent Validity of the Questionnaire

Next, Table 5.9 demonstrates the outer loadings of the questionnaire items, indicating that most of the items exceeded the acceptable threshold of >0.7. Hence, all properties of the research questionnaire were confirmed.

Table 5.9: Items Loading

	ELSE	ITU	PEOU	PS	PU
ELSE1	0.847				
ELSE2	0.823				
ELSE3	0.839				
ITU1		0.917			
ITU2		0.922			
PEOU1			0.755		
PEOU2			0.654		
PEOU3			0.853		
PEOU4			0.803		
PS1				0.906	
PS2				0.907	
PS3				0.858	
PU1					0.848
PU2					0.798
PU3					0.864

For further measurement, factor analysis was conducted. The dataset was appropriate for this test, because all the criteria recommended by Pallant (2013) were met. First, the number of observations exceeded 150. Second, the correlation matrix revealed correlations greater than 0.3 among many items. Third, the values of the Kaiser-Meyer-Olkin index and Bartlett's sphericity test, taken as data factorability measurements, were greater than 0.6 (0.890) and P-value was less than 0.05 (P<0.001) for both tests, respectively. Table 5.10

(below) depicts the findings of the principle component analysis, using a Varimax rotation method. The presence of the five factors model explains 73.98% of the variance.

Table 5.10: Factor Analysis

		Factors				
Latent Factor	**Item**	**1**	**2**	**3**	**4**	**5**
ITU	ITU1	.360		**.733**		
	ITU2			**.816**		
PU	PU1			.565	**.610**	
	PU2				**.719**	
	PU3	.424			**.698**	
PEOU	PEOU1					**.644**
	PEOU2					**.854**
	PEOU3	.510		.326		**.471**
	PEOU4	.341	.404	.438		**.457**
ELSE	ELSE1		**.725**			.310
	ELSE2		**.781**			
	ELSE3		**.827**			
PS	PS1	**.852**				
	PS2	**.797**				
	PS3	**.710**			.318	
	Variance %	18.979	15.834	14.505	12.471	12.191
Rotation converged in 8 iterations. Loading of less than 0.3 excluded.						

5.4.2 Investigating the Original Factors of TAM

This Section presents the predictive ability of the original variables of TAM referred to as perceived ease of use and perceived usefulness. It aims to support the validity of this model in a non-Western culture and understand the improvement in TAM's explanatory power after including learning style dimensions. The results of the partial least square structural equation modelling (PLS-SEM) technique are shown in Table 5.11 and Figure 5.5, below. Generally speaking, the model achieved a good fit and significance, explaining 49.1% and 53.1% of variance in ITU and PS, respectively. Additionally, PEOU was found to be a predictor of PU ($\beta_{PEOU \rightarrow PU} = 0.424$, $P<0.001$).

To predict ITU, PU ($\beta_{PU \rightarrow ITU}=0.443$, $P<0.001$) and PEOU ($\beta_{PEOU \rightarrow ITU}=0.358$, $P<0.001$) had a significant direct influence on this factor. Similarly, both PU ($\beta_{PU \rightarrow PS}= 0.494$, $P<0.001$) and PEOU ($\beta_{PEOU \rightarrow PS}=0.335$, $P<0.001$) were predictors of PS. The analysis also supports the influence of ELSE on PEOU ($\beta_{ELSE \rightarrow PEOU}=0.590$, $P<0.001$) and PU ($\beta_{ELSE \rightarrow PU}=0.171$, $P=0.02$).

Table 5.11: Original TAM Hypotheses and Perceived Satisfaction (PS)

Perceived Satisfaction (PS)				Intention to Use (ITU)			
Path	**R^2**	**β**	**P**	**Path**	**R^2**	**β**	**P**
	0.531				0.491		
PU→ PS		0.494	<0.001	**PU→ ITU**		0.443	<0.001
PEOU→ PS		0.335	<0.001	**PEOU→ ITU**		0.358	<0.001
PEOU→ PU		0.424	<0.001	**PEOU→ PU**		0.424	<0.001
ELSE→ PEOU		0.590	<0.001	**ELSE→ PEOU**		0.590	<0.001
ELSE→ PU		0.171	0.02	**ELSE→ PU**		0.171	0.02

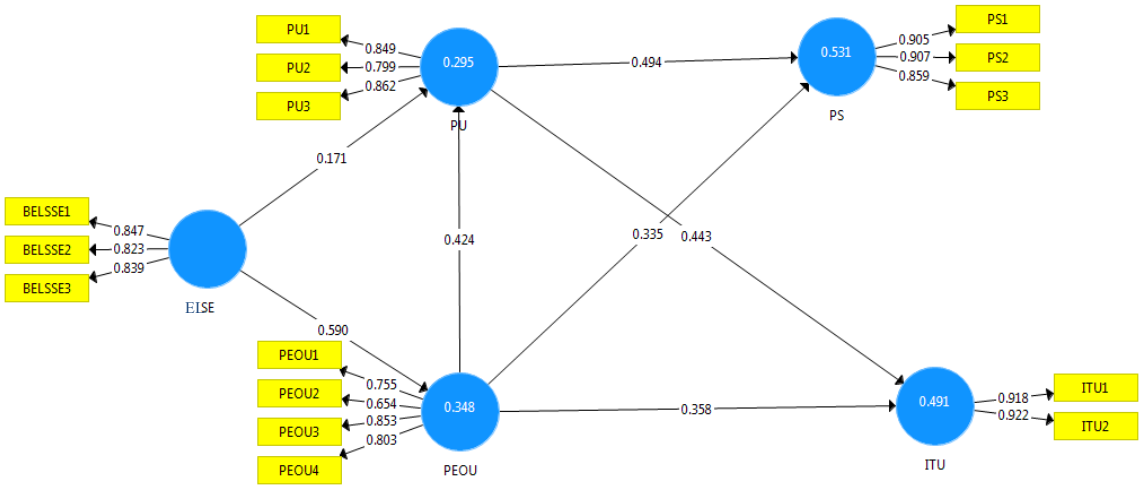


Figure 5.5: Results of the Original Model

5.4.3 Learning Style Dimensions as Predictors of the Model's Factors

A further stage was then entered into, aimed at determining the predictive power of learning style dimensions. This involved examining the direct effect of learning styles on the three factors, PU, PS and ITU, without referring to the relationship between the original TAM variables. Table 5.12 and Figure 5.6 demonstrate that learning style dimensions have a mild ability to predict the dependent constructs.

The processing dimension is the only one with a direct significant but limited influence on ITU ($\beta_{Processing \rightarrow ITU}$=0.159, P=0.045) and PS ($\beta_{Processing \rightarrow PS}$=0.208, P=0.008). Other dimensions did not show any significant impact. The four dimensions explained 2.7%, 5.0%, and 3.3% of the variance in ITU, PS and PU, respectively. This clearly reveals the weak potential of learning styles to determine e-learning acceptance and learners' perceptions.

Table 5.12: Predictability of Learning Styles for ITU, PS and PU

Intention to Use (ITU)				
Path	**R^2**	**β**	**t-value**	**P**
	2.7%			
Processing→ ITU		0.159	2.010	0.045
Perception→ ITU		0.043	0.493	0.622
Input→ ITU		-0.033	0.439	0.661
Understanding→ITU		-0.018	0.177	0.860
Perceived Satisfaction (PS)				
Path	**R^2**	**β**	**t-value**	**P**
	5.0%			
Processing→ PS		0.208	2.647	0.008
Perception→ PS		-0.045	0.543	0.587
Input→ PS		-0.095	1.270	0.205
Understanding→PS		0.136	1.794	0.073
Perceived Usefulness (PU)				
Path	**R^2**	**β**	**t-value**	**P**
	3.3%			
Processing→ PU		0.136	1.538	0.125
Perception→ PU		0.075	0.687	0.387
Input→ PU		-0.072	0.654	0.514
Understanding→PU		0.067	0.684	0.494

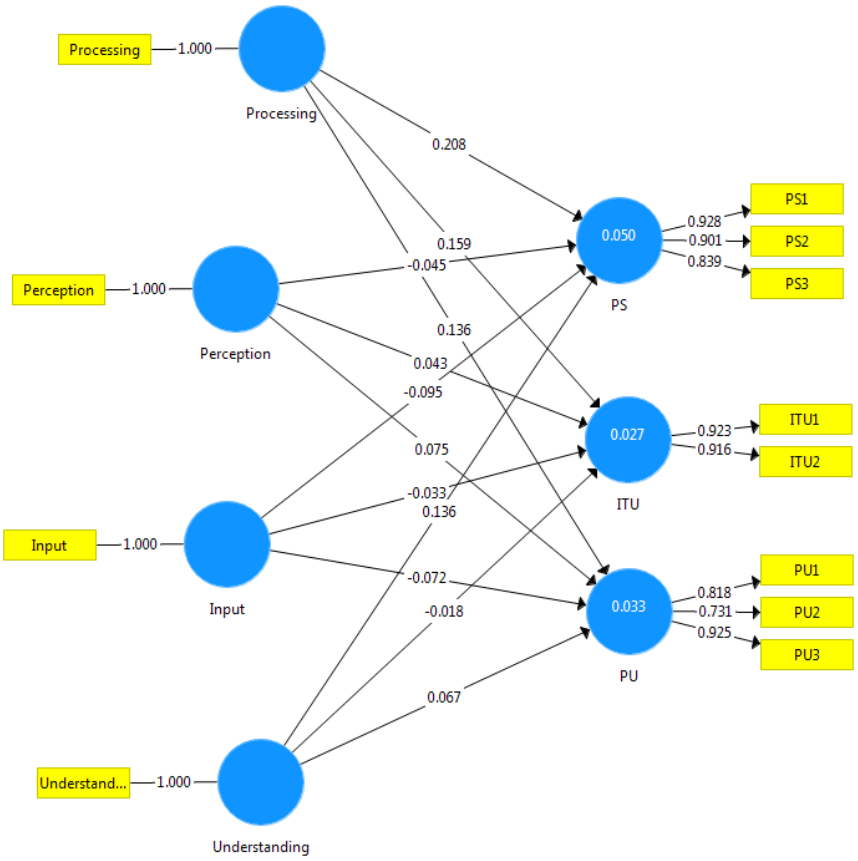


Figure 5.6: The Predictive Power of Learning Style Dimensions

5.4.4 Investigating the Hypotheses of the Proposed Model

To analyse the direct and indirect association between independent and dependent constructs in the proposed research framework, PLS-SEM was conducted. All relationships and hypotheses were constructed in Chapter Three during the extension and development of the research model. The following hypotheses were examined in this experiment:

H1a: *Perceived ease of use (PEOU) positively affects perceived usefulness (PU).*

H2a: *Perceived ease of use (PEOU) positively affects intention to use (ITU).*

H3a: *Perceived ease of use (PEOU) positively affects perceived satisfaction (PS).*

H4a: *Perceived usefulness (PU) positively affects intention to use (ITU).*

H5a: *Perceived usefulness (PU) positively affects perceived satisfaction (PS).*

H6a: *E-learning self-efficacy (ELSE) positively affects Perceived ease of use (PEOU).*

H7a: *E-learning self-efficacy (ELSE) positively affects perceived usefulness (PU).*

H8: *Learning styles positively affect perceived usefulness (PU).*

H9: *Learning styles positively affect intention to use (ITU).*

H10: *Learning styles positively affect perceived satisfaction (PS).*

H14: *The active/reflective learning styles dimension moderates the relationship between the model's constructs.*

H15: *The sequential/global learning styles dimension moderates the relationship between the model's constructs.*

Figure 5.7 depicts the model following the application of PLS-SEM. Table 5.13 (below) illustrates the findings for the path between the constructs of the proposed framework and the hypotheses. Seven out of 10 hypotheses were confirmed: H1a-H7a. However, none of the learning style dimensions appeared to predict PU, PS or ITU, except for the understanding dimension which only had a limited direct significant effect on learner satisfaction. Accordingly, hypotheses H8 and H9 were rejected, whereas H10 was partially supported.

Meanwhile, in order to identify predictors of ITU, the PLS-SEM equation revealed that two factors, PU ($\beta_{PU \rightarrow ITU}$=0.443, P<0.001) and PEOU ($\beta_{PEOU \rightarrow ITU}$=0.352, P<0.001) were significant determinants of ITU (R^2=0.492).

Moreover, the PLS-SEM result indicated that PEOU ($\beta_{PEOU \rightarrow PS}$= 0.331, P<0.001), PU ($\beta_{PU \rightarrow PS}$=0.486, P<0.001) and the understanding dimension ($\beta_{Understanding \rightarrow PS}$=0.112, P=0.050) were predictors of PS (R^2=0.545).

Finally, ELSE showed a direct significant influence on PEOU ($\beta_{ELSE \rightarrow PEOU}$=0.590, P<0.001) ($R^2$=0.348), while both ELSE ($\beta_{ELSE \rightarrow PU}$=0.181, P=0.012) and PEOU ($\beta_{PEOU \rightarrow PU}$=0.415, P=<0.001) also had a direct significant influence on PU (R^2=0.309).

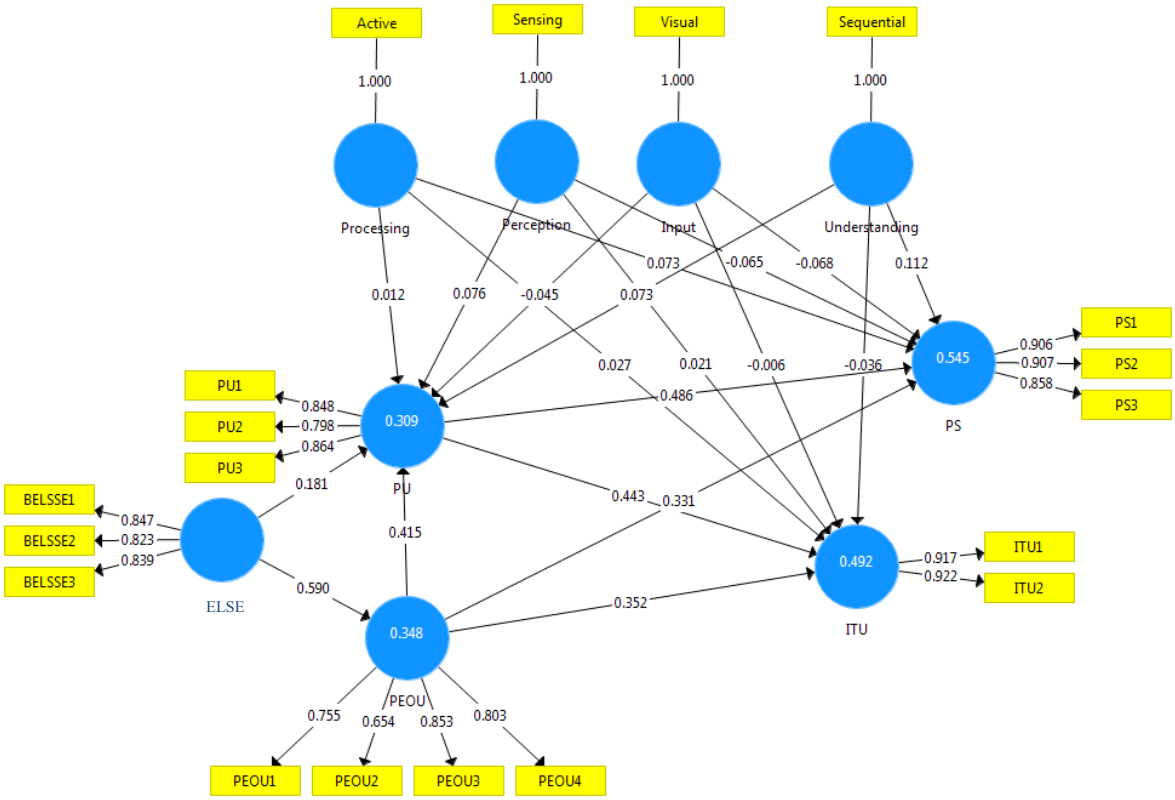


Figure 5.7: Results of the Research Framework

Table 5.13: Findings of the Research Hypotheses

Hypothesis	Direct Effect	t-value	P	Indirect Effect	t-value	Total Effect	Finding
H1a: PEOU→PU	0.415	5.655	<0.001				Supported
H2a: PEOU→ITU	0.352	5.217	<0.001	0.148	4.4550	0.536	Supported
H3a: PEOU→PS	0.331	4.821	<0.001	0.202	4.320	0.533	Supported
H4a: PU→ITU	0.443	6.765	<0.001				Supported
H5a: PU→PS	0.486	7.713	<0.001			0.486	Supported
H6a: ELSE→PEOU	0.590	10.228	<0.001			0.590	Supported
H7a: ELSE→PU	0.181	2.503	0.012	0.245	4.740	0.426	Supported
H8: Learning Styles→PU							
Processing	0.012	0.192	0.848			0.012	
Perception	0.076	1.351	0.16			0.076	Rejected
Input	-0.045	0.587	0.557			-0.045	
Understanding	0.073	0.891	0.373			0.073	
H9: Learning Styles→ITU							
Processing	0.027	0.511	0.610	0.005	0.189	0.032	
Perception	0.021	0.361	0.718	0.034	1.036	0.055	Rejected
Input	-0.006	0.121	0.904	-0.020	0.569	-0.026	
Understanding	-0.036	0.570	0.569	0.032	0.867	-0.003	
H10: Learning Styles→PS							
Processing	0.073	1.342	0.180			0.073	
Perception	-0.065	1.154	0.249	0.037	1.075	-0.028	Partially
Input	-0.068	1.395	0.16	-0.022	0.573	-0.090	Supported
Understanding	0.112	1.958	0.050	0.035	0.843	0.147	

5.4.5 The Moderating Effect of Learning Styles

Multi-group analysis was conducted in SmartPLS software to show the moderating effect of the learning style dimensions on the path between the model's factors. However, due to the small sample size in the intuitive (N=26) and verbal (N=29) groups, the difference between sensing/intuitive and visual/verbal learners was not investigated. Tarhini (2013) concluded that "When categorising the sample into sub-groups (e.g., older/younger, postgraduate/undergraduate), a minimum size of 30 is required within each category" (p.110). Hence, this analysis includes only the active/reflective and sequential/global groups.

The instrument properties for each group were subsequently measured to ensure that their reliability and validity were supported. Table 5.14 illustrates that the questionnaire was validated for the four groups (active, reflective, sequential and global). All recommendations to establish convergent and discriminant validity were also met, whereby the Cronbach's alpha values ranged from 0.602 to 0.897, with AVE ranging between 0.526 and 0.899, and all CR, between 0.707 and 0.897.

Table 5.14: Convergent and Discriminant Validity of the Four Groups

Latent factor	AVE (>0.5)	CR (>0.7)	Cronbach's α	Discriminant validity				
				ITU	PEOU	PS	PU	ELSE
Active Group								
ITU	0.853	0.921	0.828	0.924				
PEOU	0.565	0.838	0.746	0.502	0.752			
PS	0.813	0.929	0.885	0.511	0.518	0.902		
PU	0.713	0.882	0.800	0.536	0.405	0.600	0.844	
ELSE	0.684	0.866	0.769	0.452	0.556	0.267	0.322	0.827
Reflective Group								
ITU	0.795	0.886	0.743	0.892				
PEOU	0.591	0.849	0.758	0.664	0.769			
PS	0.736	0.893	0.817	0.706	0.611	0.858		
PU	0.663	0.855	0.747	0.701	0.593	0.699	0.814	
ELSE	0.712	0.881	0.800	0.457	0.507	0.476	0.473	0.844
Sequential Group								
ITU	0.899	0.947	0.887	0.948				
PEOU	0.621	0.867	0.797	0.603	0.788			
PS	0.829	0.936	0.897	0.631	0.604	0.911		
PU	0.769	0.909	0.850	0.723	0.510	0.611	0.877	
ELSE	0.729	0.890	0.815	0.589	0.624	0.443	0.467	0.854
Global Group								
ITU	0.714	0.833	0.602	0.845				
PEOU	0.526	0.809	0.700	0.564	0.725			
PS	0.746	0.898	0.830	0.527	0.537	0.864		
PU	0.632	0.836	0.707	0.407	0.437	0.677	0.795	
ELSE	0.645	0.843	0.731	0.238	0.447	0.233	0.269	0.803

Next, Table 5.15 summarises the findings of the moderating effect of the learning style dimensions, showing that the active/reflective and sequential/global groups of learning styles had a moderating influence on many associations between the model's variables. The active/reflective dimension was found to have a moderating effect on the relationship between PEOU_PU, PU_ITU and PU_PS. This association was stronger amongst the reflective learners. Overall, the R^2 for ITU was 38.4% and 45.0% for PS within the active dimension; while in the reflective dimension, 58.7% was calculated for ITU and 54.9% for PS. Such results indicate a moderate fit for the active group model and a good fit for the reflective group model. Accordingly, hypothesis H14 was supported.

The sequential/global dimension was then found to moderate the associations between ELSE_PU, ELSE_PEOU, PU_ITU, PEOU_PS, PEOU_ITU and PU_PS. In terms of ELSE_PU, ELSE_PEOU, PU_ITU and PEOU_PS, the association was stronger for the sequential learners, and stronger for the global group, in terms of PEOU_ITU and PU_PS. In addition, R^2 was 59.7% for ITU and 48.9% for PS within the sequential dimension, but 35.0% for ITU and 53.1% for PS within the global dimension. As such, hypothesis H15 was also confirmed.

Table 5.15: The Moderating Effect of the 'Processing' and 'Understanding' Dimensions

Path	Dimension 1				Dimension 4			
	Active (N=120)	R^2	Reflective (N=49)	R^2	Sequential (N=88)	R^2	Global (N=81)	R^2
ELSE→PU	0.139	**17.8%**	0.232	**39.1%**	***0.243****	**29.6%**	***0.092***	**19.7%**
PEOU→PU	***0.328****		***0.475*****		0.359**		0.396***	
ELSE→PEOU	0.556***	**31.0%**	0.507***	**25.7%**	***0.624*****	**39.0%**	***0.447*****	**20.0%**
PU→ITU	***0.398*****	**38.4%**	***0.475*****	**58.7%**	***0.561*****	**59.7%**	***0.198***	**35.0%**
PEOU→ITU	0.340***		0.382**		***0.317****		***0.478*****	
PU→PS	***0.466*****	**45.0%**	***0.520*****	**54.9%**	***0.409*****	**48.9%**	***0.548*****	**53.1%**
PEOU→PS	0.329**		0.302**		***0.395*****		***0.297****	

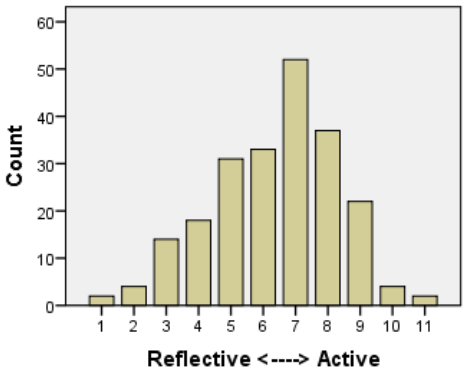
**Significant at 0.01. ***Significant at 0.001.

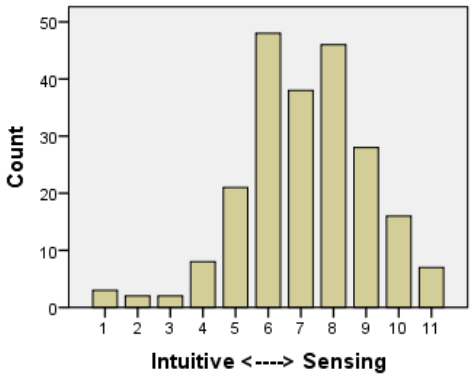
5.5 Investigating the Relationship between Learning Styles and Performance

Academic performance is another aspect relating to learners' experience. As discussed in Chapter Two, Section 2.5.3, many studies have associated learners' achievement in courses on Programming Languages with their individual learning styles. In the present thesis, this relationship was also examined to gain a wider understanding of the possible implications of learning styles.

5.5.1 Scores for Learning Styles

As presented in Figure 5.8 (below), there was a clear tendency demonstrated by the participants towards active 150 (68.5%), sensing 183 (83.6%), visual 178 (81.3%), and sequential 112 (51.1%) styles. Two dimensions were approximately normally distributed around the zero scale, whereas perception (sensing/intuitive) and input (visual/verbal) were slightly skewed to the left.





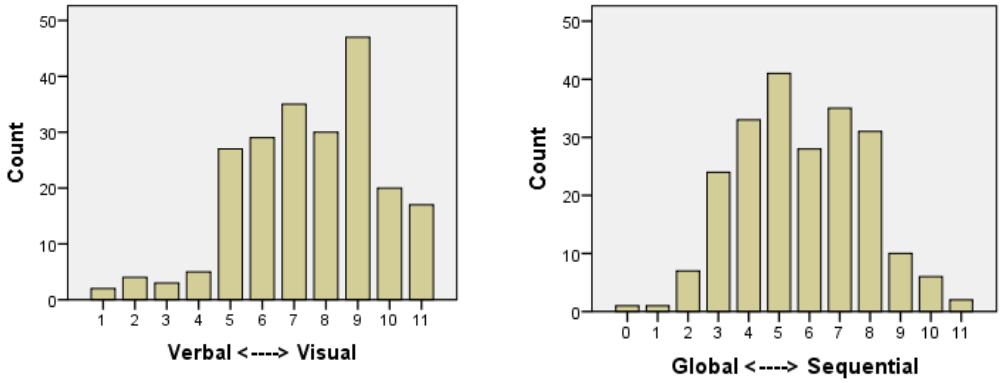


Figure 5.8: Scores for Learning Styles Examined in Terms of Performance

5.5.2 Learning Styles and Performance

Figure 5.9 depicts the relationship between learning style groups and academic achievement. However, the grades for two cases were missing. Therefore, the analysis was based on 217 observations. The students' performance was subsequently found to be approximately normally distributed according to learning style dichotomies.

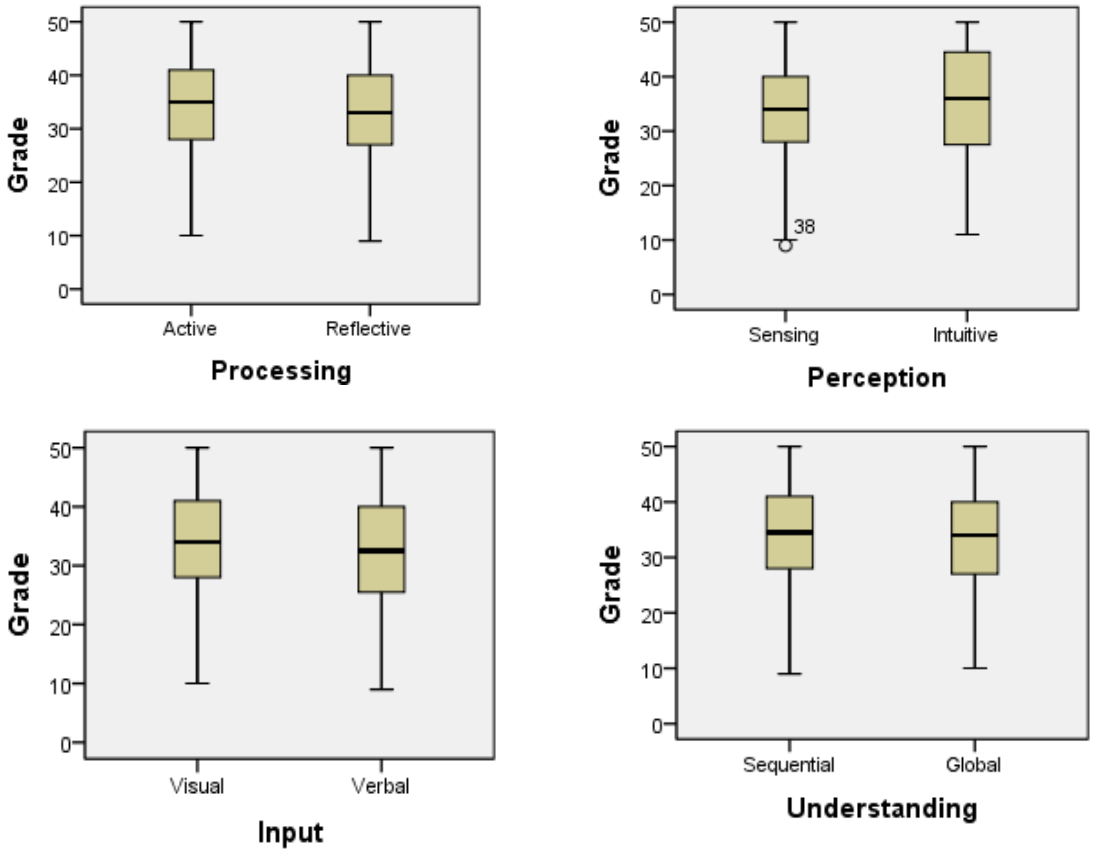


Figure 5.9: Box Plots of Mean Scores for each Learning Style Dichotomy

In order to test the potential association between learning style dimensions and learners' performance, one-way ANOVA was used. The correlation between these factors on each course was checked on its own and then the overall performance of all the groups was analysed. Tables 5.16, 5.17 and 5.18 illustrate the results of the one-way ANOVA technique in which M, SD, degree of freedom (df), F ratio and P value are reported. It is clear that there were no significant variations in learners' achievement on any of the courses. The only exception was in the Fundamentals of Programming Language II course, where the intuitive learners achieved significantly higher grades than the sensing group (P=0.021).

Table 5.16: ANOVA Results for Learning Styles and Achievement (First and Second Years)

First-year (Number of Participants=65)						Second-year (Number of Participants=89)					
Dichotomy	**M**	**SD**	**df**	**F**	**P**	**Dichotomy**	**M**	**SD**	**df**	**F**	**P**
Active	34.85	7.51	1,63	3.18	0.079	**Active**	30.55	8.74	1,87	0.10	0.74
Reflective	31.28	6.37				**Reflective**	29.84	11.66			
Sensing	32.72	6.14	1,63	5.60	0.021	**Sensing**	29.92	9.68	1,87	0.62	0.43
Intuitive	37.67	9.72				**Intuitive**	32.06	10.45			
Visual	34.71	7.01	1,63	3.62	0.062	**Visual**	30.32	9.45	1,87	.001	0.97
Verbal	30.46	7.93				**Verbal**	30.24	11.45			
Sequential	32.56	7.55	1,63	2.28	0.135	**Sequential**	32.18	8.63	1,87	3.42	0.063
Global	35.29	6.94				**Global**	28.39	10.62			

Table 5.17: ANOVA Results for Learning Styles and Achievement (Third and Fourth Years)

Third-year (Number of Participants=40)						Fourth-year (Number of Participants=23)					
Dichotomy	**M**	**SD**	**df**	**F**	**P**	**Dichotomy**	**M**	**SD**	**df**	**F**	**P**
Active	37.54	6.65	1,38	0.25	0.61	**Active**	38.20	8.44	1,21	0.39	0.53
Reflective	38.63	6.59				**Reflective**	41.33	2.88			
Sensing	38.21	6.53	1,38	0.97	0.32	**Sensing**	39.35	6.961	1,21	1.34	0.25
Intuitive	33.50	7.77				**Intuitive**	33.67	14.01			
Visual	37.84	6.42	1,38	0.05	0.81	**Visual**	38.52	8.34	1,21	0.026	0.87
Verbal	38.44	7.43				**Verbal**	39.50	2.121			
Sequential	39.00	7.13	1,38	0.79	0.37	**Sequential**	37.71	8.194	1,21	0.43	0.51
Global	37.14	6.10				**Global**	40.00	7.874			

Table 5.18: Summary of All Groups (One-way ANOVA)

Number of Participants=217 (Grades for Two of the Cases were Missing)						
Dichotomy	**N**	**Course Result**		**df**	**F**	**P**
		M	**SD**			
Active	150	34.06	8.478	1,215	0.826	0.36
Reflective	67	32.87	9.918			
Sensing	182	33.48	8.667	1,215	0.641	0.42
Intuitive	35	34.80	10.318			
Visual	177	33.92	8.719	1,215	0.632	0.427
Verbal	40	32.68	9.919			
Sequential	111	34.10	8.402	1,215	0.472	0.493
Global	106	33.26	9.493			

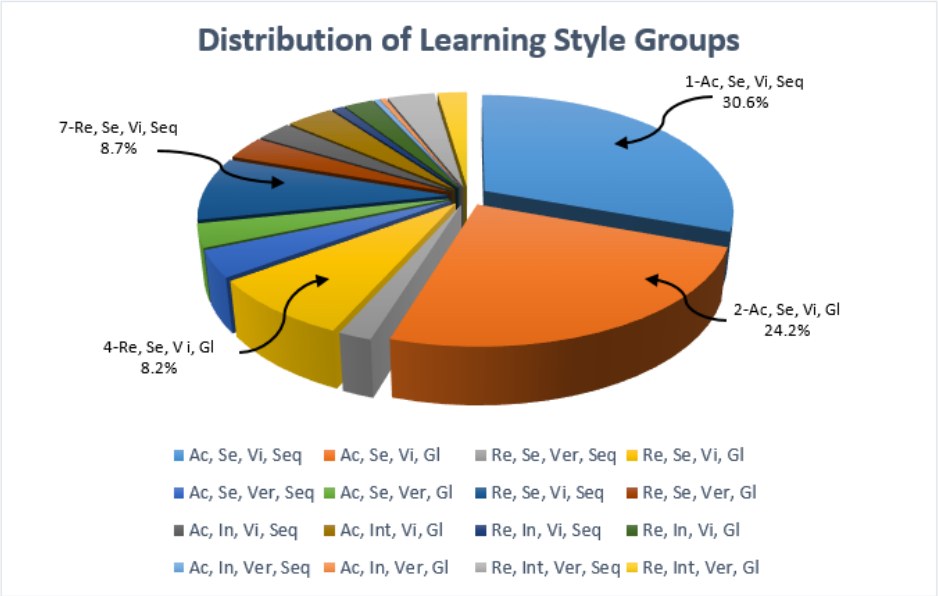
Based on the Felder and Silverman learning style dimensions (FSLSDs): {active/reflective, sensing/intuitive, visual/verbal, sequential/global}, there are 16 (2^4) possible learning style groups (LSGs):

{(Active, Sensing, Visual, Sequential), (Active, Sensing, Visual, Global), (Reflective, Sensing, Verbal, Sequential), (Reflective, Sensing, Visual, Global), (Active, Sensing, Verbal, Sequential), (Active, Sensing, Verbal, Global), (Reflective, Sensing, Visual, Sequential), (Reflective, Sensing, Verbal, Global), (Active, Intuitive, Visual, Sequential), (Active, Intuitive, Visual, Global), (Reflective, Intuitive, Visual, Sequential), (Reflective, Intuitive, Visual, Global), (Active, Intuitive, Verbal, Sequential), (Active, Intuitive, Verbal, Global), (Reflective, Intuitive, Verbal, Sequential), (Reflective, Intuitive, Verbal, Global)}. Even though the results did not reveal a significant correlation between learning styles and learners' achievement, one-way ANOVA was used to calculate the differences between the 16 groups in Felder and Silverman model, as further investigation.

Table 5.19 illustrates that there were no significant variations between the M scores of all the groups (df= 15, 200, F=1.340, P=0.181). As such, it may be concluded that learning styles and performance are independent factors. Groups that included less than five cases were excluded. Figure 5.10 demonstrates the distribution of the 16 learning style groups.

Table 5.19: Mean and SD of the 16 Learning Style Groups

Group	N	M	SD
1. Active, Sensing, Visual, Sequential	66	34.12	7.236
2. Active, Sensing, Visual, Global	53	33.02	8.969
4. Reflective, Sensing, Visual, Global	17	32.12	9.158
5. Active, Sensing, Verbal, Sequential	8	30.88	8.823
6. Active, Sensing, Verbal, Global	7	34.29	10.111
7. Reflective, Sensing, Visual, Sequential	19	36.53	9.008
8. Reflective, Sensing, Verbal, Global	7	33.86	12.681
9. Active, Intuitive, Visual, Sequential	6	40.00	11.645
10. Active, Intuitive, Visual, Global	8	38.13	10.869
12. Reflective, Intuitive, Visual, Global	5	24.60	9.182
15. Reflective, Intuitive, Verbal, Sequential	7	35.57	9.235
16. Reflective, Intuitive, Verbal, Global	5	34.00	8.246
Total	208 (groups that included less than five cases were excluded)		



Ac: Active, Re: Reflective, Se: Sensing, Int: Intuitive, Vi: Visual, Ver: Verbal, Seq: Sequential, Gl: Global

Figure 5.10: Distribution of Learning Style Groups

5.6 Findings from the Content Analysis of the Students' Comments

To gain a deeper understanding of the learners' perspectives of e-learning technology, qualitative data were also collected and categorised into different groups, using a thematic approach. All the collected comments were in Arabic, but the present researcher translated those cited in this thesis into English. A total of 48 (18.46%) students responded to the optional open-ended question and all comments were coded based on the identified themes. Eight advantages and one issue were highlighted by the participants.

Table 5.20 demonstrates the number and percentage of students who identified similar themes. It should be borne in mind that some participants reported more than one benefit of the e-learning application.

Table 5.20: Themes Generated from the Participants' Comments

Blended E-learning Advantages		
Theme	**N**	**%**
A useful tool in teaching and learning	15	31.25
Providing alternative opportunities to understand a subject	9	18.75
Improving 'learner-content' interaction	5	10.41
Improving 'learner-teacher' interaction	4	8.33
Improving 'learner-learner' interaction	1	2.08
Expanding students' knowledge	2	4.16
Saving learning time and effort	2	4.16
Promoting intellectual abilities and individual skills of students	2	4.16
The Issue Associated with Blended E-learning		
Theme	**N**	**%**
The use of Moodle in online tests	19	39.58

5.7 Summary

This Chapter has attempted to answer the first research question, reporting the findings derived from validating the impact of learning styles on e-learning acceptance and learning experience. It has also sought to test the constructed hypotheses in Chapter Three. Based on this analysis, the following conclusions were drawn:

- Pertaining to the differences between groups, active learners were more likely to accept e-learning and had more positive perceptions of this technology in terms of self-efficacy, ease of use and satisfaction. The differences based on other dimensions were insignificant.
- The learning style dimensions showed an insignificant relationship with academic achievement in four Programming modules.
- All hypotheses proposed in the research model were confirmed, except for learning style assumptions. As such, hypotheses H1a-H7a were advocated, supporting the soundness of TAM for a non-Western culture.
- Learning styles were found to have a limited capacity to determine PU, learner satisfaction, and behavioural intention. Learning style dimensions explained 3.3%, 5.0%, and 2.7% of the variance of these variables, respectively.
- The explanatory power of TAM did not improve after integrating learning styles as predictors. TAM explained 29.5%, 53.1%, and 49.1% of variance for PU, PS and ITU, respectively. After including learning styles, however, the model explained variance of 30.9% for PU, 54.5% for PS and 49.2% for ITU, indicating a very slight influence. Thus, hypotheses H8 and H9 were rejected. The only weak significant effect was found for the understanding dimension in relation to learner satisfaction. Accordingly, H10 was partially supported.
- By using the active/reflective and sequential/global dimensions as moderators, the explanatory power of TAM was enhanced. Overall, R^2 was 38.4% for ITU and 45.0% for PS in the active dimension. Within the reflective dimension, 58.7% was calculated for ITU and 54.9% for PS. Furthermore, R^2 for ITU and PS was 59.7% and 48.9%, respectively, within the sequential dimension, and in the global dimension, 35.0% was found for ITU and 53.1% for PS. Such results support the proposed hypotheses, H14 and H15, namely that learning styles can moderate the path strength between the model's constructs.

The mild effect of learning styles in terms of predictive ability subsequently led to the integration of the UDL framework, which suggests addressing environmental learning limitations to meet individual learners' needs.

Chapter Six reports the findings of the influence of the UDL application on e-learning acceptance and learners' perceptions, in addition to the barriers to e-learning implementation in Iraq as identified by academic staff and students.

Chapter 6: Results of the UDL Application and E-Learning Barriers (Q2 and Q3)

6.1 Overview

This Chapter is dedicated to reporting the findings of the second and third experiments, which were carried out to answer the second and third research questions. In the second experiment, the principles of the UDL framework were integrated with TAM. This combination was aimed at testing the improvement in the explanatory power of TAM by addressing the environmental learning limitations. The third experiment focused on highlighting the barriers that hinder successful e-learning implementation in Iraq. The key goals of this experiment were to support the findings of the first and second research experiments and identify any other variables that could affect e-learning acceptance.

This Chapter is structured into six main Sections. Section 6.2 demonstrates the characteristics of the samples participating in both experiments. Section 6.3 illustrates the findings of the preliminary analysis, prior to integrating the UDL model with TAM. The investigation of the structural framework and testing of the research hypotheses are then presented in Section 6.4, while Section 6.5 reports the main themes generated from the subjects' comments. In Section 6.6, the findings for the barriers to e-learning application are reported, based on three types of e-learning stakeholder. Finally, Section 6.7 summarises the main themes in this Chapter.

6.2 Demographic Information

6.2.1 The Participants in the Second Experiment

This experiment targeted Computer Science undergraduates, with 92 students taking part in the study. Most of the respondents ranged in age from 18 to 22 years, 52.2% of whom were male. The entire sample, however, was ethnically Iraqi Arab, with no type of hearing or visual impairment. All the participants were comfortable with Moodle, because they had used it during their first year at university. The students' profiles are summarised in Figure 6.1 (below), with this set of participants being used as the experimental group.

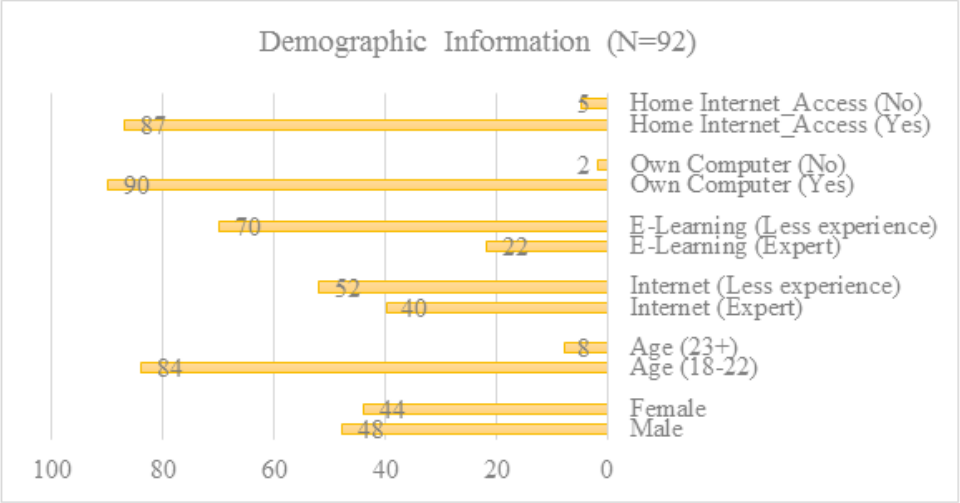


Figure 6.1: Profile of the Participants (Experimental Group)

The perceptions and behavioural intention towards e-learning of the experimental group were compared with data from students who had experienced e-learning in a traditional setting (the first experiment). A total of 77 second year undergraduate students from the previous academic year (2014-2015) were also used as a control group. Most of these control group subjects were aged between 18 and 23 (N=74, 96.1%). Furthermore, the gender split was 39 (50.64%) male and 38 (49.36%) female. Thus, the overall features of both groups were comparable.

6.2.2 The Participants in the Third Experiment

Overall, the sample size for this study totalled 108 participants, comprising academic staff (N=74), lecturers in charge of applying e-learning (N=3) and undergraduate students (N=31). Table 6.1 provides general information on the teaching staff participating in this experiment. Although all were from universities introducing either Moodle or custom e-learning systems, the results indicate that most had not yet experienced e-learning. Additionally, it emerged that e-learning was a very new trend in all Iraq's universities, whereby the majority of the respondents had been using this technology for less than two years.

Table 6.1: General Information (the Academic Staff, N=74)

Factor	N	%
Gender		
Male	46	62.2
Female	28	37.8
Years of work experience		
1-3	2	2.7
4-6	8	10.8
7-9	13	17.6
10+	51	68.9
Qualification		
Master's	12	16.2
PhD candidate	23	31.1
PhD	39	52.7
E-learning system		
Custom system	13	17.6
Moodle	15	20.3
None	46	62.2
Years of using e-learning		
0	46	62.2
1	12	16.2
2	11	14.9
3	4	5.4
5	1	1.4

6.3 Preliminary Analysis of the Integration of the Universal Design for Learning (UDL) with TAM

The three principles of the UDL model were incorporated with TAM, in order to evaluate the improvement in the explanatory power of this model. Before investigating the proposed relationships in the research framework (Chapter Three, Figure 3.1), however, several preliminary analyses were carried out to identify the mean (M), standard deviation (SD), normality of data distribution and multicollinearity assumption as well as differences between groups, based on the participants' Internet and e-learning experience.

6.3.1 Descriptive Analysis

Table 6.2 depicts the M and SD of the model's factors. All the M scores are greater than the midpoint of 3.5 and the SD is narrowly spread around the M. This means that the subjects responded positively to all the factors in the research model.

The same criteria as were applied in Chapter Five, Section 5.3.2, were also used here to evaluate the data distribution and multicollinearity assumption. Skewness (Std. Error =0.251) and kurtosis (Std. Error=0.498) were calculated to measure the normality of the research data. It was found that all the variables were approximately normally distributed, because all the values fell between +3 and -3, except for the multiple means of representation variable, where the kurtosis value was greater than 3. However, Peat and

Barton (2005) point out that "peakness is not as important as skewness for deciding when to use parametric tests because deviations in kurtosis do not bias mean values" (p.46). Furthermore, this study uses the partial least squares structural equation modelling (PLS-SEM) formula, which does not assume normal distribution (Hair et al., 2016). Appendix I illustrates that the data for all the items were approximately normally distributed and are thus used in this analysis, without further action or treatment.

Tolerance and variance inflation factors (VIF) were also calculated to examine the multicollinearity assumption. It was consequently evident that it was not violated, based on the threshold values of greater than 0.1 and less than 10 for both indicators, respectively (see Chapter Five, Section 5.3.2).

Table 6.2: Descriptive Statistics

Factor	Item	M	SD	Skewness	Kurtosis	Tolerance	VIF
ITU	2	6.0489	0.62923	-0.188	-0.491	0.578	1.730
PU	3	5.8333	0.88881	-0.636	-0.007	0.563	1.776
PEOU	4	5.6766	0.92992	-1.114	2.196	0.666	1.501
ELSE	3	5.2971	1.17821	-1.358	1.841	0.819	1.222
PS	3	5.9022	0.68033	-0.757	1.759	0.552	1.813
MMR	3	6.3080	0.82280	-2.438	10.344	0.737	1.357
MMAE	4	5.7772	0.76447	-1.107	2.806	0.581	1.722
MME	4	5.8696	0.79012	-1.332	3.008	0.642	1.558

Intention to use (ITU), perceived usefulness (PU), perceived ease of use (PEOU), e-learning self-efficacy (ELSE), perceived satisfaction (PS), multiple means of representations (MMR), multiple means of action and expression (MMAE) and multiple means of engagement (MME)

For further analysis, the M and SD scores for all items used in the research questionnaire were also calculated. Pertaining to PEOU, PU, ITU, PS and ELSE, these variables were measured as in the first experiment (Chapter Five, Section 5.3.2). The new variables integrated into this experiment were the principles of the UDL model: MMR, MMAE and MME. Table 6.3 shows the range of the M scores and SD for all factors.

Table 6.3: Descriptive Statistics of the Model's Variables

Item	M	SD
PEOU1	5.78	1.147
PEOU2	5.37	1.495
PEOU3	5.78	1.127
PEOU4	5.77	1.017
PU1	5.97	0.831
PU2	5.64	1.297
PU3	5.89	1.021
ELSE1	5.48	1.271
ELSE2	5.42	1.303
ELSE3	4.99	1.558
PS1	5.86	1.001
PS2	5.85	0.710
PS3	6.00	0.711
ITU1	6.13	0.714
ITU2	5.97	0.733
MMR1	6.38	0.900
MMR2	6.23	0.939
MMR3	6.32	0.864
MMAE1	5.85	1.058
MMAE2	5.96	0.876
MMAE3	5.52	1.134
MMAE4	5.78	1.004
MME1	5.84	1.019
MME2	5.87	0.952
MME3	5.90	0.826
MME4	5.87	1.071

6.3.2 Factor Correlation and Differences between Groups

Tables 6.4, 6.5 and 6.6 show the findings from the independent samples t-test, whereby a statistically significant relationship was found between the Internet and e-learning experience, in terms of ITU, PEOU, PU and ELSE.

Students with more experience displayed a greater likelihood of accepting e-learning, in comparison to less experienced participants. Furthermore, the more expert students found the relevant e-learning system more useful and easy to use. They also had a higher level of self-confidence to accomplish specific learning tasks. The factors relating to being expert in the use of the Internet, less experienced in Internet use, expert in e-learning and less experienced in e-learning were abbreviated to Int $_{\text{Expert}}$, Int $_{\text{Less-Exper}}$, E-Ler $_{\text{Expert}}$ and E-Ler $_{\text{Less-Exper}}$, respectively.

Table 6.7 demonstrates the Pearson's correlation coefficient between the model's variables, whereby a significant relationship was found between most factors and the largest correlation was less than 0.7. The three principles of the UDL framework were also significantly correlated with e-learning usefulness, learner satisfaction and behavioural intention towards e-learning. This supports the assumption of this research that addressing

environmental learning limitations can enhance e-learning acceptance and learners' perceptions in blended e-learning systems. Meanwhile, Figure 6.2 depicts the box plot of the model's constructs.

Table 6.4: Findings from the Independent Samples t-test (ITU and PS)

Intention to Use (ITU)					Perceived Satisfaction (PS)				
Factor	**M**	**SD**	**t-test**	**P**	**Factor**	**M**	**SD**	**t-test**	**P**
Int Expert	6.27	0.61	T(90)=3.169	0.002	**Int** Expert	6.00	0.67	T(90)=1.213	0.228
Int Less-Exper	5.87	0.58			**Int** Less-Exper	5.82	0.68		
E-Ler Expert	6.50	0.53	T(90)=4.191	<0.001	**E-Ler** Expert	6.09	.68	T(90)=1.502	0.137
E-Ler Les-Exper	5.90	0.59			**E-Ler** Les-Exper	5.84	.67		

Table 6.5: Findings from the Independent Sample t-Test (PEOU and ELSE)

Perceived Ease of Use (PEOU)					E-Learning Self-Efficacy (ELSE)				
Factor	**M**	**SD**	**t-test**	**P**	**Factor**	**M**	**SD**	**t-test**	**P**
Int Expert	5.956	0.905	T(90)=2.609	0.011	**Int** Expert	5.683	0.823	T(90)=2.865	0.005
Int Less-Exper	5.461	0.898			**Int** Less-Exper	5.000	1.323		
E-Ler Expert	5.897	1.013	T(90)=1.283	0.203	**E-Ler** Expert	5.863	0.746	T(90)=2.671	0.009
E-Ler Les-Exper	5.607	0.898			**E-Ler** Les-Exper	5.119	1.235		

Table 6.6: Findings from the Independent Sample t-test (PU)

Perceived Usefulness (PU)				
Factor	**M**	**SD**	**t-test**	**P**
Int Expert	6.058	0.905	T(90)=2.173	0.032
Int Less-Exper	5.660	0.844		
E-Ler Expert	6.287	0.729	T(90)=2.856	0.005
E-Ler Les-Exper	5.960	0.890		

Table 6.7: Pearson's Correlation Coefficient between Variables

	PU	**PEOU**	**ELSE**	**PS**	**MMR**	**MMAE**	**MME**
ITU	0.519**	0.316**	0.010	0.371**	0.179	0.483**	0.488**
PU		0.364**	0.033	0.480**	0.388**	0.477**	0.485**
PEOU			0.330**	0.388**	0.314**	0.311**	0.128
ELSE				0.262*	-0.002	0.079	0.127
PS					0.131	0.542**	0.398**
MMR						0.330**	0.317**
MMAE							0.458**

*Correlation is significant at 0.05 (2-tailed). **Correlation is significant at 0.01 (2-tailed).

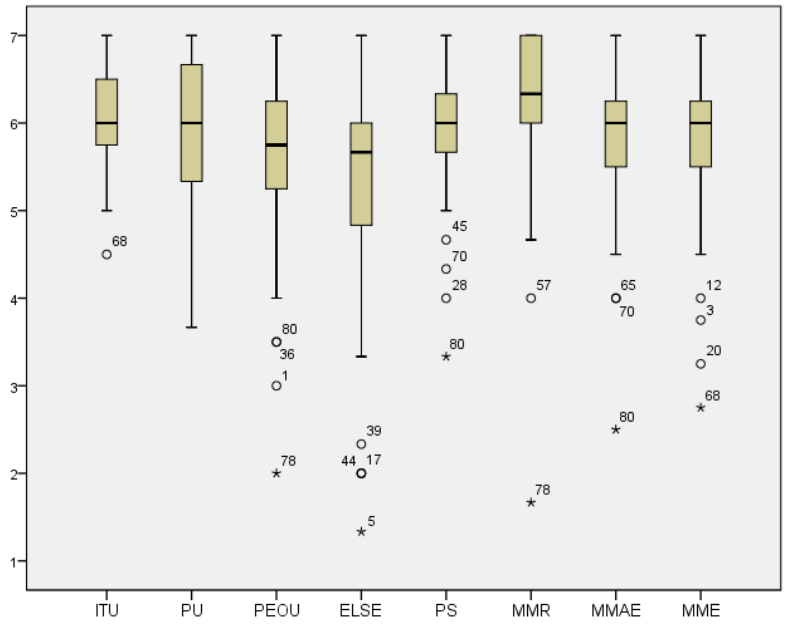


Figure 6.2: Box Plot of the Model Constructs

6.4 Investigating the Proposed Research Framework and Testing Hypotheses

As in the first experiment, a five-step analysis was carried out to identify the improvement in the explanatory power of TAM, using UDL principles. In the first step, the psychometric properties of the research questionnaire were measured. Additionally, the influence of the original factors of TAM on the dependent constructs (PS and ITU) was tested. The aim of this step was to reveal the variance of the dependent factors, explained by the independent variables. Step three then revealed the capacity of the UDL variables to predict e-learning usefulness, learner satisfaction and behavioural intention. In step four, the UDL principles were included in TAM. This step highlighted the improvement in the explanatory power of TAM, after combining the UDL principles. The last step focused on comparing the learners' perceptions and willingness to accept e-learning in this experiment, with those of the control group in the first experiment.

6.4.1 Instrument Properties

To establish the validity and reliability of the research questionnaire, the same criteria as were identified in Chapter Five, Section 5.4.1, were also applied here. The reliability of the internal consistency of the instrument was measured using Cronbach's alpha (α) and overall, the instrument achieved good reliability (α=0.881). Cronbach's alpha in the model's factors ranged from 0.677 to 0.901 and the average variance extracted (AVE) values were all above 0.5 and all above 0.8 for composite reliability (CR). Thus, the

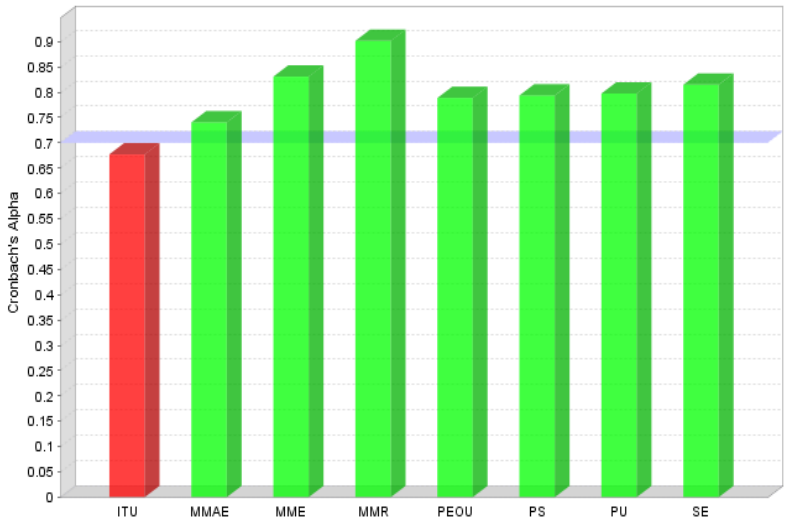
convergent validity was advocated. A low α for the ITU variable could be due to its high M value (6.048) and low SD (0.629). Discriminant validity was also established, because the variance shared by the variables with their own constructs was greater than the variance shared with other factors. Table 6.8 shows that all recommendations to support the soundness of the instrument were met.

For a visual illustration, Figure 6.3 presents the convergent validity of the instrument. It is clear that all the values (AVE, CR and α) exceed the minimum threshold, except for the Cronbach's alpha of ITU, which is 0.677. However, Hair et al. (2006) point out that Cronbach's alpha is also acceptable if it exceeds 0.6 for exploratory research.

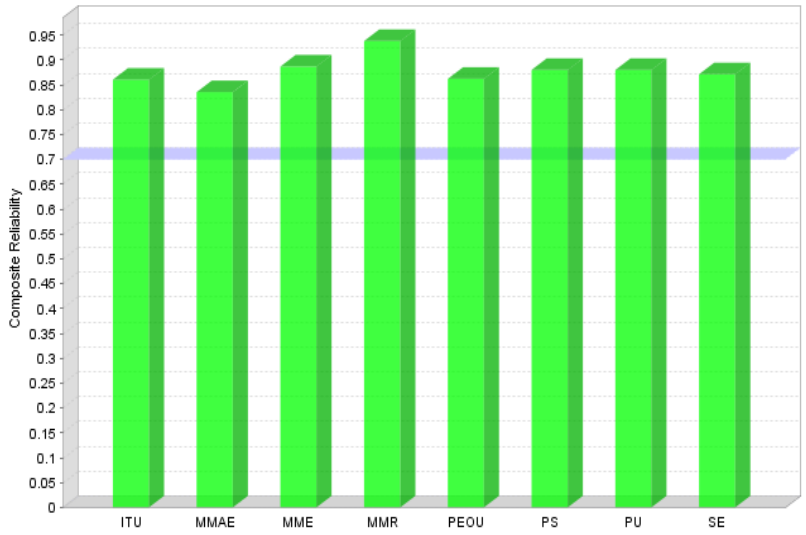
Table 6.8: Properties of the Measurement

Convergent validity			
Latent factor	**AVE (>0.5)**	**CR (>0.7)**	**Cronbach's α**
ITU	0.755	0.861	0.677
MMAE	0.561	0.836	0.741
MME	0.663	0.887	0.831
MMR	0.835	0.938	0.901
PEOU	0.614	0.862	0.789
PS	0.711	0.880	0.794
PU	0.710	0.880	0.797
ELSE	0.695	0.871	0.815

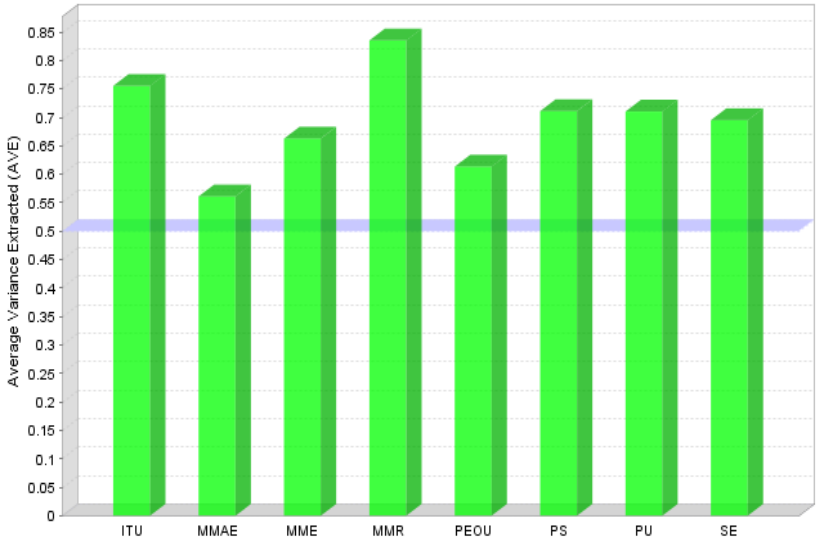
Discriminant validity								
Latent factor	**ITU**	**MMAE**	**MME**	**MMR**	**PEOU**	**PS**	**PU**	**ELSE**
ITU	0.869							
MMAE	0.485	0.749						
MME	0.493	0.504	0.814					
MMR	0.184	0.341	0.320	0.914				
PEOU	0.363	0.357	0.162	0.304	0.783			
PS	0.379	0.571	0.422	0.163	0.437	0.843		
PU	0.536	0.512	0.503	0.403	0.406	0.510	0.843	
ELSE	0.037	0.114	0.141	0.044	0.352	0.287	0.088	0.834



a. Cronbach's Alpha



b. Composite Reliability (CR)



c. Average Variance Extracted (AVE)

Figure 6.3: Convergent Validity of the Instrument

Table 6.9 demonstrates the outer loadings of the instrument items, with most of the items exceeding the minimum acceptable item load (>0.7). These analyses support the overall reliability and validity of the research questionnaire and all the constructs used in the research framework.

Table 6.9: Outer Loadings of the Questionnaire Items

	ITU	MMAE	MME	MMR	PEOU	PS	PU	ELSE
ITU1	0.853							
ITU2	0.885							
MMAE1		0.814						
MMAE2		0.684						
MMAE3		0.682						
MMAE4		0.806						
MME1			0.749					
MME2			0.868					
MME3			0.794					
MME4			0.840					
MMR1				0.918				
MMR2				0.889				
MMR3				0.934				
PEOU1					0.816			
PEOU2					0.615			
PEOU3					0.830			
PEOU4					0.851			
PS1						0.826		
PS2						0.924		
PS3						0.772		
PU1							0.850	
PU2							0.818	
PU3							0.859	
ELSE1								0.928
ELSE2								0.832
ELSE3								0.729

6.4.2 Investigating the Explanatory Power of TAM

Before examining the paths between the proposed model constructs, the association between the original factors of TAM (PU and PEOU) was investigated. The aim of this analysis was to show the improvement in the research model after integrating the UDL variables.

Table 6.10 and Figure 6.4 illustrate that both PEOU ($\beta_{PEOU \rightarrow PS}$=0.283, P=0.009) and PU ($\beta_{PU \rightarrow PS}$=0.387, P=0.001) were predictors of PS (R^2=31.8%). However, PEOU ($\beta_{PEOU \rightarrow ITU}$=0.175, P=0.155) was not a significant determinant of ITU, whereas PU ($\beta_{PU \rightarrow ITU}$=0.467, P<0.001) had a strong significant influence on ITU (R^2=31.5%). Such outcomes confirm that TAM should be extended by other factors to improve its power. PEOU was also a significant predictor of PU ($\beta_{PEOU \rightarrow PU}$=0.428, P<0.001). ELSE, on the other hand, failed to significantly determine PU ($\beta_{ELSE \rightarrow PU}$=-0.062, P=0.563), although it did have a significant effect on PEOU ($\beta_{ELSE \rightarrow PEOU}$=0.358, P<0.001).

Table 6.10: The Effect of PU and PEOU on PS and ITU

Perceived Satisfaction (PS)				Intention to Use (ITU)			
Path	**R^2**	**β**	**P**	**Path**	**R^2**	**β**	**P**
	31.8%				31.5%		
PU→ PS		0.387	0.001	**PU→ ITU**		0.467	<0.001
PEOU→ PS		0.283	0.009	**PEOU→ ITU**		0.175	0.155
PEOU→ PU		0.428	<0.001	**PEOU→ PU**		0.428	<0.001
ELSE→ PEOU		0.358	<0.001	**ELSE→ PEOU**		0.358	<0.001
ELSE→ PU		-0.062	0.563	**ELSE→ PU**		-0.062	0.563

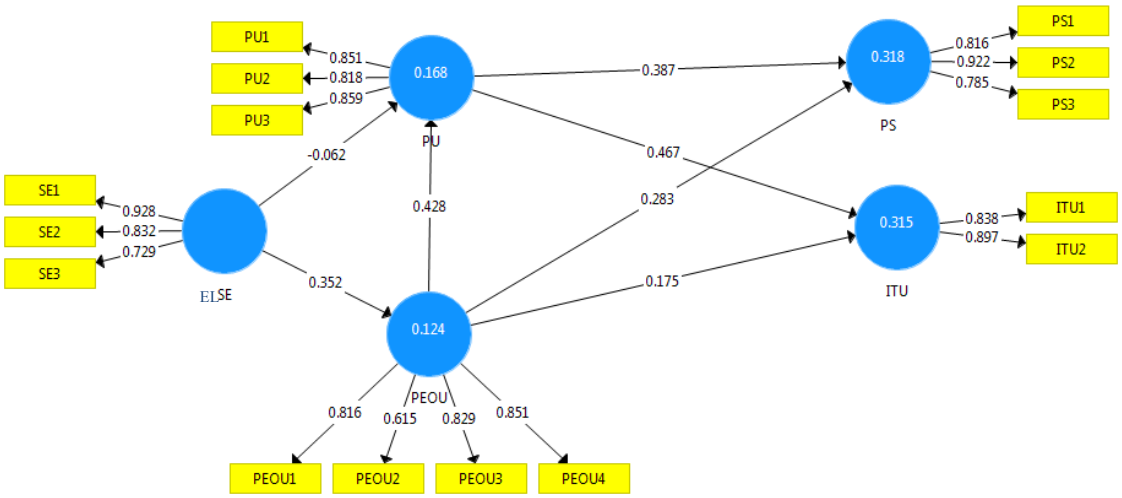


Figure 6.4: Findings of the Original TAM

6.4.3 Universal Design for Learning (UDL) Principles as Predictors of the Model's Factors

The capacity of the UDL principles to predict the dependent variables was examined at this stage, shedding more light on the effect of applying the UDL to e-learning acceptance and learners' perceptions. Table 6.11 and Figure 6.5 demonstrate that the UDL variables had an acceptable fit to explain the dependent constructs.

The MMAE ($\beta_{MMAE\rightarrow ITU}$=0.328, P=0.001) and MME ($\beta_{MME\rightarrow ITU}$=0.338, P=0.005) were determinants of ITU, with a predictive ability of 32%. Moreover, MMAE ($\beta_{MMAE\rightarrow PS}$=0.498, P<0.001) and MME ($\beta_{MME\rightarrow PS}$=0.193, P=0.040) also had a significant positive impact on PS, explaining 35.6% of the variance of this construct. Finally, the three principles had a positive effect on PU, with MMAE ($\beta_{MMAE\rightarrow PU}$= 0.297, P=0.008) and MME ($\beta_{MME\rightarrow PU}$=0.287, P=0.001) emerging as significant prediction ability for PU to explain 38.1% of its variance. Overall, such findings suggest that UDL variables can play a key role in predicting PU, PS and ITU.

Table 6.11: Predictability of UDL Principles for ITU, PS and PU

Intention to Use (ITU)				
Path	**R^2**	**β**	**t-value**	**P**
	32%			
MMR→ ITU		-0.035	0.313	0.755
MMAE→ ITU		0.328	3.481	0.001
MME→ ITU		0.338	2.798	0.005
Perceived Satisfaction (PS)				
Path	**R^2**	**β**	**t-value**	**P**
	35.6%			
MMR→ PS		-0.065	0.706	0.480
MMAE→ PS		0.498	4.355	<0.001
MME→ PS		0.193	2.060	0.040
Perceived Usefulness (PU)				
Path	**R^2**	**β**	**t-value**	**P**
	38.1%			
MMR→ PU		0.210	1.793	0.074
MMAE→ PU		0.297	2.684	0.008
MME→ PU		0.287	3.312	0.001

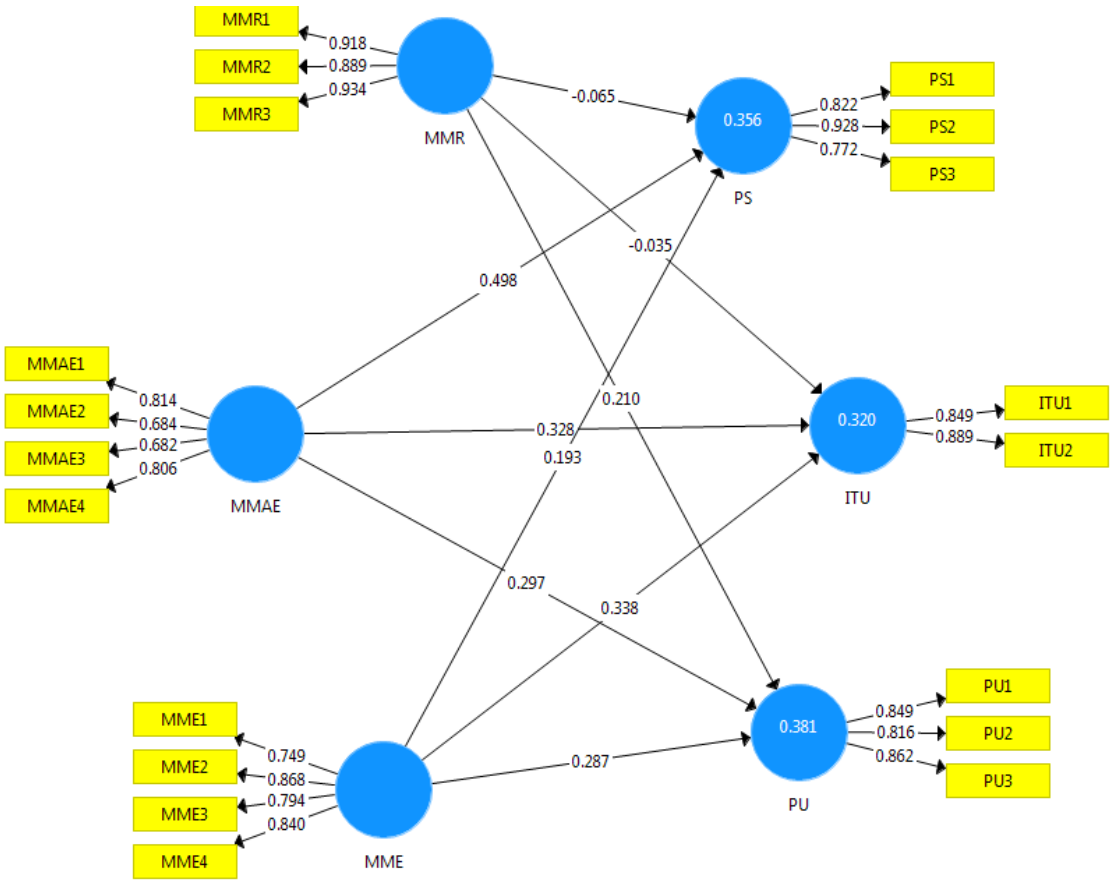


Figure 6.5: The Effect of UDL Variables on the Model's Constructs

6.4.4 Investigating the Hypotheses of the Proposed Research Framework

To investigate the direct and indirect association between the model's constructs, the PLS-SEM formula was used. These relationships and their hypotheses were theoretically established in Chapter Three. In this experiment, the following hypotheses were tested:

H1b: *Perceived ease of use (PEOU) positively affects perceived usefulness (PU).*

H2b: *Perceived ease of use (PEOU) positively affects intention to use (ITU).*

H3b: *Perceived ease of use (PEOU) positively affects perceived satisfaction (PS).*

H4b: *Perceived usefulness (PU) positively affects intention to use (ITU).*

H5b: *Perceived usefulness (PU) positively affects perceived satisfaction (PS).*

H6b: *E-learning self-efficacy (ELSE) positively affects Perceived ease of use (PEOU).*

H7b: *E-learning self-efficacy (ELSE) positively affects perceived usefulness (PU).*

H11: *UDL principles positively affect perceived usefulness (PU).*

H12: *UDL principles positively affect intention to use (ITU).*

H13: *UDL principles positively affect perceived satisfaction (PS).*

Table 6.12 and Figure 6.6 illustrate the standardised path coefficient among the variables in the research framework. Three hypotheses were confirmed, namely H3b, H4b and H6b, whereas all hypotheses of the UDL model were partially supported (H11, H12 and H13). However, the findings of the hypotheses, H1b, H2b and H5b were on the border of significance (P<0.1 and >0.05). Therefore, it was expected that a larger sample could produce more satisfactory results and support more hypothetical associations.

PU ($\beta_{PU\rightarrow ITU}$=0.288, P=0.019) and MME ($\beta_{MME\rightarrow ITU}$=0.270, P=0.044) had a significant positive direct effect on ITU. Meanwhile, PEOU and MMAE had a direct positive influence on ITU, but this was insignificant where P-values were 0.098 and 0.073 for both variables, respectively. These factors accounted for 41.6% of the variance of ITU, where PU had the biggest impact.

The findings also indicate that PEOU ($\beta_{PEOU\rightarrow PS}$=0.252, P=0.005) and MMAE ($\beta_{MMAE\rightarrow PS}$=0.356, P<0.001) had a significant direct influence on PS. Meanwhile, PU and MME had a direct positive effect on PS, but this was not significant where P-values were 0.094 and 0.124 for both factors, respectively. Overall, these constructs accounted for 45.4% of the variance of PS.

To predict PU, MME ($\beta_{MME\rightarrow PU}$=0.313, P=0.001) was found to have a significant effect on this variable, whereas PEOU had an insignificant but positive direct impact (P=0.066). Finally, it was shown that ELSE ($\beta_{ELSE\rightarrow PEOU}$=0.352, P<0.001) was a predictor of PEOU alone.

Table 6.12: Findings of the Research Hypotheses

Hypothesis	*Standardised Estimate*						
	Direct effect	**t-value**	**P-value**	**Indirect effect**	**t-value**	**Total effect**	**Finding**
H1b: PEOU → PU	0.258	1.838	0.066			0.258	Rejected
H2b: PEOU → ITU	0.177	1.655	0.098	0.074	1.205	0.252	Rejected
H3b: PEOU → PS	0.252	2.838	0.005	0.054	1.259	0.306	Supported
H4b: PU → ITU	0.288	2.350	0.019			0.288	Supported
H5b: PU → PS	0.209	1.674	0.094			0.209	Rejected
H6b: ELSE → PEOU	0.352	4.139	<0.001			0.352	Supported
H7b: ELSE → PU	-0.078	0.839	0.402	0.091	1.546	0.066	Rejected
H11: UDL → PU	0.154	1.531	0.126			0.154	
MMR							Partially
MMAE	0.219	1.806	0.071			0.219	Supported
MME	0.313	3.309	0.001			0.313	
H12: UDL → ITU	-0.135	0.905	0.365	0.044	1.365	-0.091	
MMR							Partially
MMAE	0.184	1.792	0.073	0.063	1.389	0.247	Supported
MME	0.270	2.017	0.044	0.090	1.739	0.360	
H13: UDL → PS	-0.167	1.304	0.192	0.032	0.949	-0.134	
MMR							Partially
MMAE	0.356	3.639	<0.001	0.036	1.095	0.402	Supported
MME	0.150	1.540	0.124	0.065	1.518	0.215	

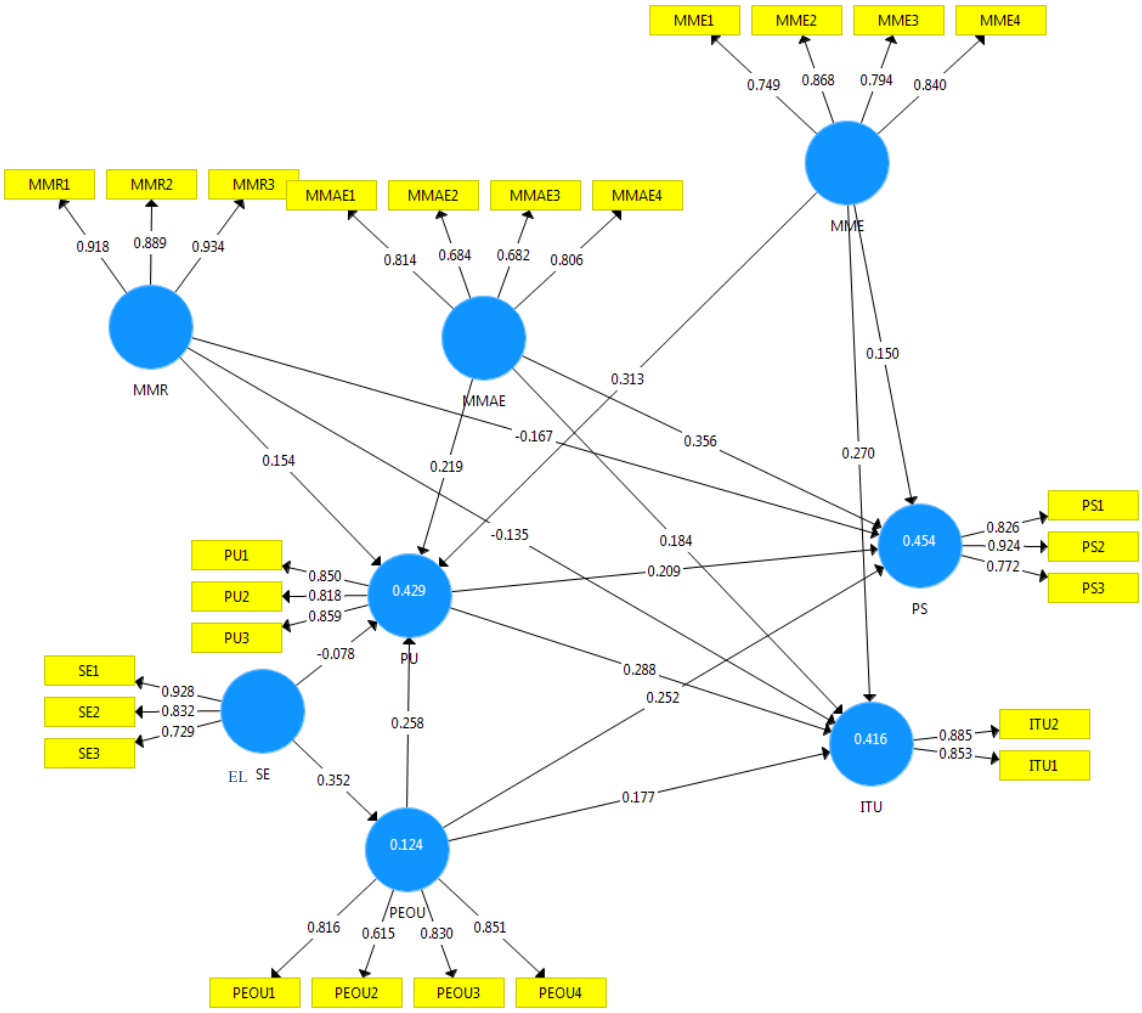


Figure 6.6: Findings of the Research Framework

6.4.5 Comparing ITU, PS and PU in the Experimental and Control Groups

To demonstrate the effect of the UDL-based blended e-learning design on PU, PS and ITU, the findings of this experiment were compared with those derived from a group of learners, who had completed the same instrument in the previous academic year, whereby their PU, PS and ITU were measured on the traditional blended e-learning platform (the first experiment).

Table 6.13 shows that there was a significant difference between all the factors. The M scores for the second experiment (UDL-based blended e-learning) are significantly higher than those of the previous year (traditional blended e-learning). Based on this outcome, it could be stated that embracing UDL principles in the e-learning design had a direct significant impact on students' perceptions and behavioural intention to accept e-learning.

Table 6.13: PU, PS and ITU in the Experimental and Control Groups (one-way ANOVA)

			Perceived Usefulness (PU)			
Course	**N**	**M**	**SD**	**df**	**F**	**P**
Traditional Blended E-learning	77	5.1688	1.161	1, 167	17.716	<0.001
UDL-Based Blended E-learning	92	5.8333	0.888			
			Perceived Satisfaction (PS)			
Course	**N**	**M**	**SD**	**df**	**F**	**P**
Traditional Blended E-learning	77	5.1688	1.351	1, 167	20.808	<0.001
UDL-Based Blended E-learning	92	5.9022	0.680			
			Intention to Use (ITU)			
Course	**N**	**M**	**SD**	**df**	**F**	**P**
Traditional Blended E-learning	77	5.3831	1.240	1, 167	20.248	<0.001
UDL-Based Blended E-learning	92	6.0489	0.629			

6.5 Course Attributes, Features and Content Analysis

To gain further information about the learners' perceptions and preferences in this blended e-learning course, the students were requested to highlight the most useful materials and attributes. All the students responded to these questions, with some providing further qualitative data, identifying reasons for their choice. The students were basically called on to select the most helpful course attributes and identify why these were helpful. Figure 6.7 presents the most commonly preferred course attributes, which amounted to nine identified for this course. An open-ended question followed, where the respondents could list the reasons why particular attributes were helpful.

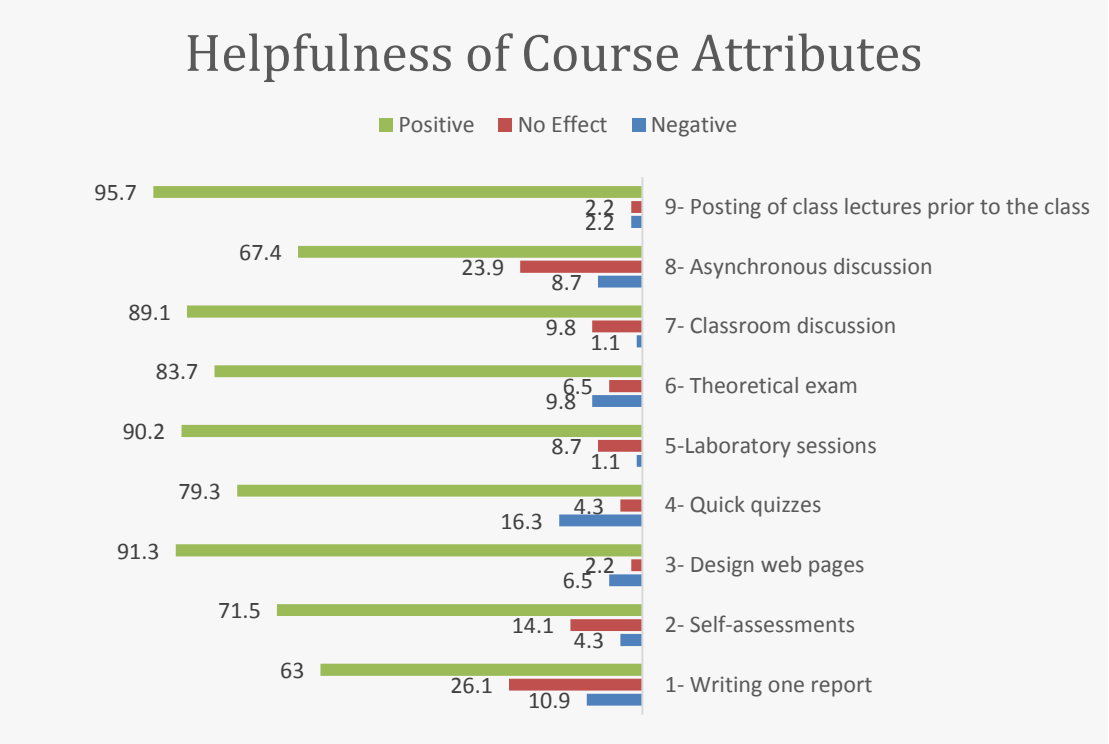
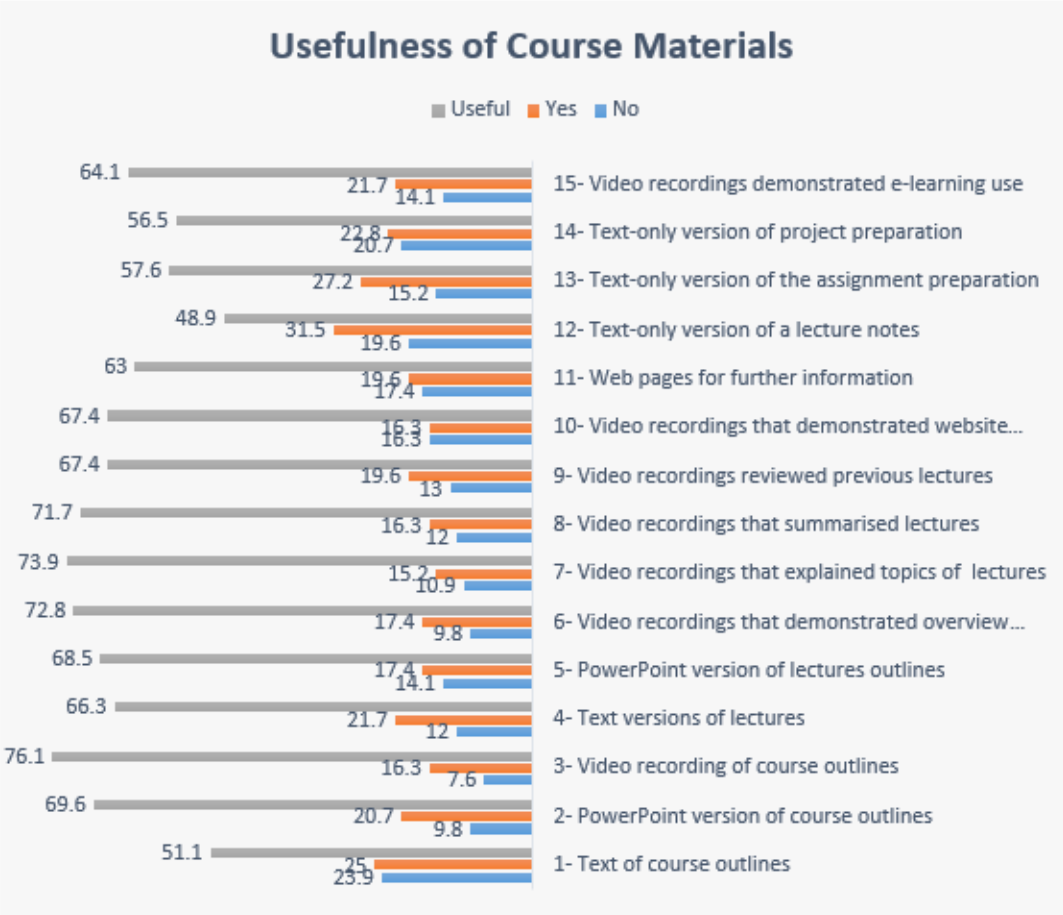


Figure 6.7: Helpfulness of the Course Attributes (%)

Out of the 15 types of course materials used, the students were also asked to identify which they had accessed, found useful, or omitted to use. This was followed by an open-ended question, asking for the subjective reasons behind their choices. Figure 6.8 displays the students' opinions regarding the usefulness of the materials used in the course design.



No: Did not access; **Yes:** Accessed, but did not find useful; **Useful:** Accessed and found useful

Figure 6.8: Usefulness of the Course Materials (%)

The participants were also asked to add any comments which they thought relevant to the course design, use of e-learning, and advantages and disadvantages of e-learning. A total of 23 students responded to this optional open-ended question. A thematic method was then used to identify the main themes of students' comments. In general, the participants highlighted four advantages and one obstacle.

Table 6.14 shows the main themes identified, as well as the number and percentage of respondents who highlighted similar themes. It should be mentioned here that a few students reported more than one advantage.

Table 6.14: The Themes Generated from the Students' Comments (N=23)

Blended E-Learning Advantages and the Course Design		
Theme	**N**	**%**
A useful tool in teaching and learning	10	43.47
Improving learning engagement	3	13.04
Reducing learning stress	3	13.04
Enhancing learners' performance	3	13.04
Enhancing learners' understanding	3	13.04
Enhancing 'learner-content' interaction	2	8.69
Issues Associated with the Application of Blended E-Learning		
Theme	**N**	**%**
Unavailability of Internet access	2	8.69

6.6 Findings of the Experiment on Barriers to E-learning Use

This research also sought to identify the main challenges to e-learning adoption faced by Iraq's public-sector universities, based on the perspectives of academic staff, lecturers in charge of the e-learning application and undergraduate students. The responses could be generally classified into either external or internal factors. The external factors relate to the technical implementation of e-learning and environmental issues. Conversely, internal factors are associated with intrinsic features and the users' motivation to accept this technology.

Table 6.15 depicts these two categories. The interesting result is that academic staff and students highlighted similar challenges. This suggests that decision-makers, the leadership and e-learning administrators should exert appropriate effort to address such barriers.

Table 6.15: External and Internal Barriers

	N=74 Lecturers		**N=31 students (Eight Groups)**	
External Challenges	**N**	**%**	**N of Groups**	**%**
Low Internet bandwidth	17	22.97	5	62.5
Insufficient financial support	13	18.91	2	25
Inadequate training programmes	40	54.05	5	62.5
Lack of technical support	15	20.27	2	25
Lack of ICTs infrastructure	33	43.24	4	50
Ambiguous plans and policies	16	21.62	1	12.5
Frequent power cuts	5	6.75	1	12.5
Internal Challenges	**N**	**%**	**N of Groups**	**%**
ICTs and E-learning literacy	23	31.08	4	50
Lack of awareness, interest and motivation	35	47.29	6	75

6.7 Summary

This Chapter has focused on answering the second and third research questions of this thesis. It first presented findings from an investigation of the effect of applying UDL principles to e-learning acceptance. It then moved on to present the main barriers which

Iraqi faculty staff and students come up against, when encountering e-learning in public-sector universities. Based on these investigations, the following conclusions were drawn:

- With regard to the differences between groups based on the Internet and e-learning experience, the students with more experience showed stronger perceptions and willingness to accept e-learning.
- All hypotheses in the research model were confirmed before integrating the UDL variables, except for PEOU, which was an insignificant predictor of ITU. ELSE also failed to significantly affect PU. Overall, this result confirms the effectiveness of TAM for Arabic culture, as in the first experiment.
- The three principles of the UDL model demonstrated an acceptable ability to predict PU, PS and ITU. These variables explained 38.1%, 35.6% and 32.0% of the variance of PU, PS and ITU, respectively.
- After including the UDL constructs in the research model, three hypotheses were supported: H3b, H4b and H6b. Moreover, all hypotheses of the UDL framework were partially confirmed (H11, H12 and H13).
- The overall explanatory power of TAM was significantly enhanced after combining the UDL variables. The original TAM explained 16.8%, 31.8% and 31.5% of the variance of PU, PS and ITU, respectively. After including the UDL principles, however, the model explained 42.9% of PU, 45.5% of PS and 41.6% of ITU.
- By comparing learners' perceptions and behavioural intention towards e-learning in the first (control group) and second experiments (the experimental group), it was revealed that the students held more positive perceptions of e-learning in the UDL-based e-learning environment and more willingness to undertake it, thus advocating the research assumption.
- The investigation of e-learning acceptance in the first and second experiments conducted in Iraq illustrated that Iraqi students were very willing to accept this technology. However, the third experiment revealed many barriers still hindering successful e-learning implementation in this country. Such obstacles included, but were not limited to, a lack of ICTs infrastructure, insufficient budget, poor Internet bandwidth, frequent power cuts, inadequate training programmes, a lack of

technical support, unclear e-learning plans, poor or non-existent e-learning literacy, and a lack of awareness and motivation.

Chapter Seven will now discuss the findings of the three experiments performed. It also compares the research findings with the existing literature and combines the quantitative and qualitative findings, so as to build a more general picture of the research outcomes.

Chapter 7: Discussion

7.1 Overview

This Chapter explains, discusses and interprets the findings from Chapters Five and Six in relation to the research problem and research questions presented in Chapter One, the research theories discussed in Chapter Two, and the research hypotheses laid down in Chapter Three. This discussion is presented alongside the qualitative analysis, which highlights the advantages and disadvantages of e-learning, as well as the barriers to its implementation in Iraq. Section 7.2 especially compares the learning style preferences of Iraqi learners with those from other backgrounds and cultures. It is also dedicated to identifying the differences between learners' experience and behavioural intention, based on learning styles. The differences in learners' perceptions and e-learning acceptance according to individual Internet and e-learning experience are also discussed. Section 7.3 then interprets the outcomes of the proposed research framework and its hypotheses, in accordance with the two experiments conducted and the previous literature. Section 7.4 compares the influence of the Felder and Silverman model and the Universal Design for Learning (UDL) framework on TAM's explanatory power. Section 7.5 subsequently explains the qualitative and quantitative analyses and outcomes; examining how these support each other and identifying any other variables that could affect e-learning acceptance. Finally, Section 7.6 summarises the main themes presented in this Chapter.

7.2 Discussion of the Differences between Groups

This section discusses the differences between groups, based on learning style dimensions and experience of using the Internet and e-learning.

7.2.1 Learning Styles of Engineering Students in Different Cultures

According to Chang et al. (2011), students from the East differ from their Western counterparts in many aspects, such as in their social relationships, autonomy and learning styles. Based on such diversity, it was anticipated that Arab Engineering students would display different learning styles from students coming from other backgrounds, since learning styles are linked with both nature and nurture (Hsu, 1999). Felder and Silverman (1988), on the other hand, point out that Engineering students in general tend to favour active, sensing, visual and sequential styles.

In the present research, the participants' main learning preferences were for active, sensing, visual and sequential learning approaches, supporting Felder and Silverman's (1988) assumptions. Table 7.1 illustrates a comparison between Engineering students in Iraq, with those from other countries and it is clear that there are many similarities, regardless of the cultural differences. Moreover, Table 5.19 and Figure 5.10 show that out of the 16 learning style combinations, Group 1 (Active, Sensing, Visual, Sequential), Group 2 (Active, Sensing, Visual, Global) and Group 7 (Reflective, Sensing, Verbal, Global) accounted for 63.9% of the participants' overall preferences. This result confirmed one study conducted by Zywno (2003b) in Canada to determine the dominant learning styles in groups of Engineering students, whereby the three groups described above accounted for over 50% of the Canadian participants.

Table 7.1: Learning Style Preferences of Engineering Students from Different Cultures

Study	Country	Sample	Active	Sensing	Visual	Sequential
Van Zwanenberg et al. (2000)	UK	135	Y*	Y*	Y*	Y*
Kuri & Truzzi (2002)	Brazil	351	60%	74%	79%	50%
Zywno (2003a)	Canada	338	61%	65%	88%	63%
Litzinger, Lee, Wise, & Felder (2005)	United States	235	Y*	Y*	Y*	Y*
Graf, Viola & Leo (2007)	New Zealand and Austria	207	57%	58%	87%	56%
Franzoni & Assar (2009)	México	26	62%	62%	85%	62%
Gomes & Mendes (2010)	Portugal	173	64.91%	61.44%	96.49%	73.68%
Prajapati et al. (2011)	UK	360	Y*	Y*	Y*	Y*
Fang & Zhao (2013)	China	71	55%	80%	76%	54%
The present study	Iraq	219	68.5%	83.6%	81.3%	51.1%

*Authors stated that the dominant preferences were Active, Sensing, Visual and Sequential.

7.2.2 Differences in Learners' Experience and Behavioural Intention Based on Learning Styles

In the first experiment, differences in intention to use (ITU), perceived satisfaction (PS), perceived ease of use (PEOU), perceived usefulness (PU), e-learning self-efficacy (ELSE) and academic performance were examined, based on learning styles. This analysis shed more light on the possible implications of individual differences in learning styles for e-learning acceptance and the learning experience.

The findings of the independent samples t-test showed that the learners rated their perceptions and behavioural intention in similar ways, irrespective of their individual styles (Tables 5.5, 5.6 and 5.7). The only exception was indicated in the 'processing' dimension. The t-test analysis demonstrated that active learners were more likely to accept e-learning

and have more positive perceptions. Based on the Felder and Silverman model, active learners tend not to enjoy passive participation in educational activities and one of their strongest preferences is working with peers. This is because they are most likely to discuss, brainstorm, question and get involved on a practical level. Given these characteristics, e-learning and its communication tools, such as chat, forums and wikis, may represent a suitable learning platform to satisfy the preferences of this kind of learner. Such findings suggested that the use of e-learning alongside the traditional classroom could help improve interaction between students and their instructors. Therefore, active learners have more positive perceptions and exhibit greater acceptance of e-learning. This was also clear from the qualitative data, whereby some of the participants attributed their positive attitudes to e-learning to the improvement they had observed in interaction methods (see Table 5.20). This result could therefore indicate a need to design e-learning content and activities in a way that will also ensure that reflective learners perceive the usefulness of e-learning and adopt it effectively.

Earlier literature supports this outcome, with many studies revealing the active/reflective dimension as the only one in the Felder and Silverman model to affect learners' perceptions and behavioural intention towards different e-learning technologies. For example, Li (2015) indicated that active learners possessed significantly higher ITU for interactive learning technologies (in the study concerned, a wiki) than was witnessed in a group of reflective learners. Similarly, Cheng (2014) demonstrated that active learners were the group most in agreement with the usefulness, ease of use and learning satisfaction afforded by the Second Life learning tool. Cela, Sicilia and Sánchez-Alonso (2016) also revealed that active learners had a greater tendency to use online forums, compared to their reflective peers.

Meanwhile, with regard to variation in academic performance based on learning styles, learners' achievement did not appear to be affected by such traits. The students' mean scores were very similar, regardless of their learning styles. The results of the one-way ANOVA test (presented in Table 5.18) showed that the difference in academic achievement recorded for participants in various learning style groups was insignificant. One explanation for this could be that the preferences of all types of learner were addressed in the blended e-learning courses. However, in acknowledgement of the fact that the students were taught using a direct teaching approach, with the same learning materials and pathway being provided for all, a second explanation may be plausible. It suggests that

students can flexibly change their individual styles and adapt to specific learning contexts and teaching styles to meet their learning aims.

It may therefore be deduced from this discussion that learning styles represent malleable traits, which can be adapted by learners to different learning environments. This finding from the current analysis is consistent with some of the prior literature (Akkoyunlu & Soylu 2008; Gomes & Mendes, 2010; Prajapati et al., 2011).

7.2.3 Differences in Learners' Perceptions and Behavioural Intention Based on Experience

In the second experiment, the differences between groups based on Internet and e-learning experience were analysed. The independent samples t-test suggested that such experience had a significant impact on technology acceptance, where P-values were less than 0.01 for both variables. Students with more experience had a greater willingness to accept e-learning. Liu et al. (2010) also demonstrated that previous online learning experience had a significant impact on behavioural intention towards e-learning. In line with such results, Tarhini (2013) found that previous experience can moderate the relationship between different variables and e-learning acceptance.

Previous experience was also significant for PEOU, PU and ELSE. Students with more experience had more positive perceptions of these constructs. In support of this result, a study by Abbad et al. (2009) revealed that experience of using the Internet had a significant effect on PEOU. Thus, educational institutions, especially in developing countries, should consider the importance of conducting intensive training courses and workshops for all students, in order to promote their individual experience of using e-learning and Internet technologies.

7.3 Discussion of the Research Framework Hypotheses

The proposed model addressed TAM's limitations in the e-learning context by considering the effect of individual differences in learning style and environmental variables in relation to UDL principles. All findings relating to the research hypotheses presented in Chapters Five and Six are discussed in this section. These findings corresponded to the proposed research framework constructed in Chapter Three. Moreover, the research outcomes were also compared with the existing literature.

The overall results of the first experiment did not support the influence of learning styles in terms of predictability. However, the active/reflective and sequential/global dimensions showed a moderating effect on many relationships in the research framework, thus supporting an improvement in the explanatory power of TAM using learning styles as moderators.

In the second experiment, TAM was extended by incorporating UDL principles, namely multiple means of representation (MMR), multiple means of action and expression (MMAE) and multiple means of engagement (MME). The analysis revealed that the explanatory power of TAM was greatly improved by integrating the UDL framework with TAM.

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

In TAM, PEOU was used as a predictor of PU (Davis, 1986). This relationship was also supported in e-learning literature (Park, 2009; Teo, 2009). Accordingly, it was assumed that:

H1a, b: *Perceived ease of use (PEOU) positively affects perceived usefulness (PU).*

Following the first experiment, PEOU was a significant determinant of PU, as illustrated in other TAM literature (Davis, 1986; Davis et al., 1989; Teo, 2009). This meant that the learners did not perceive e-learning as useful, if its use required a high degree of mental effort. As such, hypothesis H1a was confirmed.

In the second experiment, PEOU was found to be a predictor of PU, before the inclusion of UDL principles (see Table 6.10). However, its effect was reduced after combining the three variables of the UDL framework. Thus, hypothesis H1b was rejected, supporting the findings of Tarhini et al. (2015a), namely that PEOU was not a predictor of e-learning usefulness. Such inconsistent findings can be attributed to various factors. First, embracing the UDL model led to enhanced PU, regardless of the mental effort required to use the e-learning technology. The learners may have found this learning environment useful, even if it required some effort to perform particular tasks.

Next, the experience of individual learners in the second experiment could be another reason leading to the insignificant influence of PEOU on PU. Previous literature also suggests that PEOU may only have a significant influence during the early stages of adoption (Lee et al., 2003), whereas users with a great deal of experience of using a particular technology will be less concerned about its ease of use. Finally, the sample size

in the second experiment was relatively small and this could have affected the power of this variable. In agreement with the above explanation, Tarhini (2013) points out that sample size can affect the relationship between the constructs of a research framework.

7.3.2 Perceived Ease of Use (PEOU) and Intention to Use (ITU)

TAM2 and UTAUT suggest that PEOU is a direct predictor of ITU (Venkatesh & Davis, 2000; Venkatesh et al., 2003), which was also assumed in the present study:

H2a, b: *Perceived ease of use (PEOU) positively affects intention to use (ITU).*

In the first experiment, the findings supported this relationship, advocating hypothesis H2a. This result is consistent with other studies (Liu et al., 2010; Tarhini et al., 2014a; Weng et al., 2015). Zhang, Yin, Luo and Yan (2017) also explored the influence of PEOU on MOOC acceptance in China, concluding that this variable was a significant determinant.

In the second experiment, PEOU was found to have a direct impact on ITU, but it was not a significant determinant of it (P=0.098). Hence, hypothesis H2b was rejected. This analysis was in agreement with other studies, which have indicated PEOU as a weak determinant of ITU (Khechine, Pascot, & Bytha, 2014; Mohammadi, 2015). The outcomes may demonstrate that when students believe a particular technology to be useful, they will be willing to use it continuously, regardless of the mental effort required.

Corresponding to this explanation, the influence of PEOU was found to only be significant during the early stage of adoption (Venkatesh et al., 2003). Venkatesh and Bala (2008) also confirmed that PEOU affected ITU during certain time periods, but not in others, due to the level of the participants' experience. Similarly, Tarhini et al. (2015a) stated that the significance of PEOU was evident during the early stages of adoption, but had little to no effect on a population that was highly experienced in using a particular technology. Accordingly, Hwang et al. (2015) concluded that the association between PEOU and ITU was contradictory.

Another reason for the above-mentioned inconsistency may be attributed to the superior individual e-learning skills of the participants in the UDL-based blended learning experiment. All these subjects had experienced Moodle during their previous academic year and an instructional video on using the system had been posted on the course website. This visual guidance could have assisted them with improving their skills in using Moodle and so they had fewer concerns about its ease of use.

Further explanation of the reasons underlying the weak effect of PEOU on ITU was provided by Gefen and Straub (2000), who mentioned that this factor related to the nature of the task being undertaken, which would have implications for the intrinsic features of the technology, such as its flexibility, clarity and ease of use. PU, on the other hand, represents the user's response to a technology's extrinsic features, such as outcomes and its facilitation of task achievement. Accordingly, extrinsic features have a stronger influence on technology acceptance in comparison to the intrinsic characteristics.

7.3.3 Perceived Ease of Use (PEOU) and Perceived Satisfaction (PS)

Based on the literature, PEOU has been found to predict PS in e-learning settings (Lee & Mendlinger, 2011; Weng et al., 2015). The present research also investigated this relationship:

H3a, b: *Perceived ease of use (PEOU) positively affects perceived satisfaction (PS).*

Hypothesis H3a, b was confirmed in both experiments. Learners may be reluctant to continue using an e-learning system, if they face difficulties in performing particular learning tasks. E-learning systems that require a high degree of mental effort to accomplish a particular task will negatively affect learners' satisfaction and thus lead to the technology being rejected in favour of an alternative. This may also mean that an understanding of the required level of effort can promise a long-term relationship between the learner and the technology. As mentioned previously, e-learning is a new experience for Iraqi students and so intensive training programmes are necessary to reduce the amount of effort needed to use e-learning systems effectively.

In keeping with the literature, Sun et al. (2008) showed that the influence of PEOU on learners' satisfaction was even stronger than the effect of e-learning usefulness. Ease of use of e-learning systems can assist learners in focusing on learning and interacting with e-learning materials, instead of expending time and effort trying to understand how technology should be used. In turn, this could lead to a greater sense of satisfaction. On the contrary, Al-Hawari and Mouakket (2010) failed to identify a significant relationship between these two constructs in the Blackboard blended learning system; they attributed such results to the skills of the participants in e-learning use. Consequently, it may be concluded that users' experience may moderate the relationship between PEOU and PS.

7.3.4 Perceived Usefulness (PU) and Intention to Use (ITU)

According to Hwang et al. (2015), the relationship between PU and ITU is more consistent in the literature. Here, this association was also tested.

H4a, b: *Perceived usefulness (PU) positively affects intention to use (ITU).*

In both experiments, PU was found to be the strongest predictor of ITU e-learning. This result confirmed hypothesis H4a, b. Even though Davis et al. (1989) found that PU was more significant in Western cultures, other studies in e-learning contexts are consistent with the current findings that PU is the most influential factor of ITU (Liu et al., 2010; Weng et al., 2015; Yi & Hwang, 2003). Such outcomes may reject Hwang et al.'s (2015) conclusion that PU appeared to bear more weight in Western cultures, whereas ease of use seemed to carry more weight in non-Western contexts. The findings of the present research suggested that the participants were more likely to have been driven by the usefulness of e-learning, rather than its ease of use.

Accordingly, educational institutions need to understand the factors leading to enhanced PU. Learners should feel that e-learning systems can help them improve their learning and understanding. This means using e-learning as a medium to upload textual learning materials will not assist learners in perceiving its usefulness. The flexibility of e-learning systems should therefore be exploited by integrating multimedia instructions and using various communication tools to promote methods of interaction between learners and instructors. Hence, further attention should be paid to the designing of e-learning courses to meet learners' needs. The present study suggests that embracing UDL principles in an e-learning design can significantly improve its PU.

The qualitative analysis in this research provided an explanation of why the learners perceived e-learning to be useful. It was mentioned that effective e-learning application can assist in enhancing academic performance, interaction methods and understanding of the learning content. Moreover, it was also pointed out that this technology could lead to reduced learning stress and cost (see Tables 5.20 and 6.14).

7.3.5 Perceived Usefulness (PU) and Perceived Satisfaction (PS)

According to the previous literature, PU is a significant predictor of PS (Sun et al., 2008; Weng et al., 2015). Therefore, this relationship was also examined in this research.

H5a, b: *Perceived usefulness (PU) positively affects perceived satisfaction (PS).*

Pertaining to the first experiment, PU was an important factor in predicting PS. The criteria applied by the students when rating e-learning satisfaction were based on the expectation that this technology could assist with goal accomplishment and outcome amelioration. Hence, hypothesis H5a was retained. This result highlighted a rational link between these constructs, suggesting that the beliefs of learners regarding the usefulness of blended learning was crucial to their satisfaction, as found in other studies on e-learning (Sun et al., 2008; Weng et al., 2015).

Pertaining to the second experiment, an unexpected result was that the contribution of PU in predicting PS was insignificant. In this experiment, the analysis of the effect of PU on the original model indicated a significant direct impact on PS (see Table 6.10). This could indicate that PU is an important factor in determining PS, as in the previous experiment, but because of the application of UDL variables, its significant effect was decreased.

Accordingly, the researcher's conclusion does not necessarily confirm that PU is not a significant determinant of PS in overall terms; this may simply have been the case here, due to the small sample size, or greater effect of UDL principles. Consequently, the alpha value was P=0.094, which bordered on significant (<0.05). The integration of a larger sample size could highlight the importance of PU, as in the first experiment. The insignificant effect of PU on PS in this experiment led to the hypothesis, H5b being rejected.

7.3.6 E-learning Self-Efficacy (ELSE) and Perceived Ease of Use (PEOU)

ELSE was expected to have a substantial influence on PEOU, as in the previous literature (Alshibly, 2014; Ong & Lai, 2006):

H6a, b: *E-learning self-efficacy (ELSE) positively affects perceived ease of use (PEOU).*

The analysis in both experiments supported this assumption (H6a, b), thus indicating that ELSE has an indirect effect on PS and ITU. Moreover, the influence of ELSE on PEOU was greater than its influence on PU in both experiments. A plausible explanation was that less experienced students may feel that they need to exert greater effort in accomplishing their learning tasks properly. Research conducted by Venkatesh and Davis (1996) is aligned with these findings. Their conclusion indicated that the influence of self-efficacy on PEOU was demonstrated both before and after hands-on adoption. Additionally, Zhang et al. (2017) found ELSE to be a predictor of PEOU in a Web-based learning system.

Such outcomes should encourage educational institutions, particularly in developing countries, to provide structured guidelines and special training courses as a means of improving students' self-confidence. As a consequence, the expectation in the present study was that Iraqi students needed further training courses to encourage them in the use of blended learning, as well as to promote their individual skills. Furthermore, the improvement in learners' self-efficacy could lead to them locating specific information for their learning and communicating easily with their peers and educators.

Meanwhile, the qualitative analysis demonstrated that e-learning illiteracy, a lack of training courses and absence of technical support were obstacles to successful e-learning implementation in Iraq (see Table 6.15). These issues bring together the effect of ELSE and ease of use with e-learning acceptance and learners' perceptions. A lack of the type of knowledge required to use a particular technology is a critical barrier that could prevent its widespread acceptance. Therefore, a large number of users in Iraq still appear to prefer using traditional teaching and learning approaches, rather than exerting effort to learn about utilising e-learning.

7.3.7 E-learning Self-Efficacy (ELSE) and Perceived Usefulness (PU)

ELSE was also proposed as a predictor of PU in this research, as in the lietrature (Alshibly, 2014; Ong & Lai, 2006).

H7a, b: *E-learning self-efficacy (ELSE) positively affects perceived usefulness (PU).*

Hypothesis H7a was confirmed in the first experiment, where ELSE demonstrated a significant mild impact on PU. This finding was in agreement with a study conducted by Ong and Lai (2006), whereby self-efficacy was a predictor of PU. However, the above authors also found that self-efficacy had a greater impact on PEOU than on PU. Similarly, Lee and Mendlinger (2011) demonstrated the ability of ELSE to determinine PU in online learning.

With regard to the second experiment, ELSE was not found to be a significant predictor of PU, supporting the findings of Shin and Kang (2015). Accordingly, hypothesis H7b was not confirmed. One possible interpretation of this is that when learners believe in a system's usefulness, they are less concerned about their personal skills. However, where there is little experience in using a particular technology, more effort is required to achieve learning tasks.

Even though the effect of ELSE on PU was only demonstrated in the first experiment, both experiments were in agreement that this variable had a limited effect on PU, compared to PEOU. Additionally, Shin and Kang (2015) found that ELSE was a significant predictor of PEOU, whereas it did not influence PU. The effect of ELSE may also depend on other factors, such as users' experience, individual skills and the maturity of the technology implemented. Consequently, the low effect of ELSE in the second experiment may be attributable to the small sample size, or to the high self-confidence of this group in performing their learning tasks in the Moodle system.

7.3.8 Learning Styles and Perceived Usefulness (PU)

Based on the literature (Gu et al., 2012), learning styles were assumed as predictors of e-learning usefulness:

H8: *Learning styles positively affect perceived usefulness (PU).*

In this research, hypothesis H8 was not confirmed. None of the learning style dimensions were significant predictors of PU. However, learning styles showed a very mild effect on this dependent construct (PU) in terms of predictibility, with the four learning style groups explaining only 3.3% of PU variance. Furthermore, the power of TAM to explain PU was not improved after including learning styles. The model explained 29.5% of PU variance before applying learning style variables, whereas it explained 30.9% of this factor after including learning styles, showing a limited influence.

This implied that the students found e-learning to be a useful learning technology, irrespective of their individual styles. On the other hand, Gu et al. (2012) indicated that the VARK learning styles model was a significant determinant of PU and PEOU for e-learning systems. Similarly, Toni and Holtbru (2012) also demonstrated that Kolb's model was a predictor of e-learning usefulness. A possible explanation for these contradictory findings is that cultural differences can affect the predictive ability of learning styles. Therefore, learning style was found to be a predictive factor in one culture, but not in another. The other possible reason is that while some students may be able to adapt their learning styles in a particular learning environment, others may only perceive e-learning as useful, if it corresponds to their individual styles.

7.3.9 Learning Styles and Intention to Use (ITU)

The positive influence of learning styles on e-learning acceptance in some of the previous literature (see Chapter Two, Section 2.5.3) led to the suggestion that:

H9: *Learning styles positively affect intention to use (ITU).*

This hypothesis was not confirmed in the present study. The outcomes suggest that learning styles had a mild ability to predict ITU. This may indicate that the learners had either a high flexibility to adapt their individual preferences to the learning environment, or their preferences were met in the blended learning setting. The outcomes of this research suggested that learning styles did not bias students' adoption or rejection of e-learning. Students with different styles indicated very positive attitudes to e-learning, regardless of their individual preferences.

This result was in agreement with research carried out by Brown et al. (2009). In their study, learning styles were also shown to have a limited predictive power for online learning environments. It was also compatible with a study conducted by Lynch, Steele, Johnson Palensky, Lacy and Duffy (2001) which demonstrated that learners' preferences had a limited correlation with their attitudes to e-learning. In line with this conclusion, Baek and Touati (2016) found that the Felder and Silverman model was not a significant predictor of learners' enjoyment in a mobile learning environment.

In this research, the original factors of TAM (PEOU and PU) explained 49.1% of ITU variance. Conversely, the four dimensions of the Felder and Silverman model explained only 2.7% of the variance of this factor. By combining learning styles and TAM constructs, a slight improvement was found in ITU, where the model explained 49.2% of its variance. This is very close to the predictive ability of the original TAM variables. Accordingly, such outcomes suggest that practitioners and researchers do not need to consider learning styles as a possible predictor, in order to understand what can lead to e-learning acceptance.

7.3.10 Learning Styles and Perceived Satisfaction (PS)

Many studies have established a significant relationship between PS and learners' differences in terms of learning styles (Brown, 2007; Eom et al., 2006; Felder & Brent, 2005). Hence, it was suggested here that learning styles were determinants of PS in a blended e-learning environment.

H10: *Learning styles positively affect perceived satisfaction (PS).*

Hypothesis H10 was partially confirmed, as the understanding dimension was a significant predictor of PS. However, it had a weak effect on improving the variance of PS explained by the independent constructs. The model explained 53.1% of PS variance, before incorporating learning styles. After including the four dimensions of the Felder and Silverman model, extended TAM explained 54.5% of PS variance, indicating a limited improvement in the explanatory power of the model.

The overall results of this analysis were to some extent in agreement with studies conducted by Henry (2008) and Hong (2002) where no relationship was found between learning styles and satisfaction in e-learning sessions. On the contrary, Eom et al. (2006) found that the VARK learning styles model was a strong predictor of learner satisfaction. This could be attributed to the cultural differences between the two groups, or to the individual characteristics of the samples. The difference in the learning styles theory adopted in this research and a study carried out by Eom et al. (2006) may be another reason leading to this inconsistency.

Other reported studies, for example, Brown (2007) qualitatively examined the impact of learning styles on PS in an adaptive e-learning environment. It was found that personalising e-learning according to individual learning styles could enhance students' satisfaction. However, it is essential in such a study to ensure that the students are unaware that the e-learning system concerned is designed on the basis of their learning preferences, in order to avoid a placebo effect.

7.3.11 UDL Principles and Perceived Usefulness (PU)

This current research assumed that embracing UDL principles could lead to enhanced PU. As such, the following hypothesis was examined:

H11: *UDL principles positively affect perceived usefulness (PU).*

This hypothesis was partially confirmed. The three principles of the UDL framework were significantly correlated with PU, as demonstrated by the Pearson's correlation coefficient (see Table 6.7). MMAE and MME were also significant predictors of PU before incorporating TAM constructs and both explained 38.1% of PU (see Table 6.11). Additionally, MMR had a direct, positive, but insignificant impact on PU, contrasting the results of Cigdem and Ozturk (2016) and Liaw (2008), where it was found that the multimedia instructions factor was a determinant of PU. Moreover, after including TAM

factors, the three principles also had a positive direct impact on PU. However, MMR and MMAE bordered on significance, whereby the P-values were 0.126 and 0.071 for both factors, respectively. The strongest predictor was MME, which was even stronger than PEOU.

A possible explanation of the above is that engaging learners in different ways can help them realise the usefulness of e-learning as an optimal solution for improving learning outcomes. Overall, the integration of UDL variables significantly affected the explanatory power of TAM in explaining e-learning usefulness. Whilst the original model explained 16.8% of PU variance, this increased to 42.9% after including the UDL factors, which clearly indicated that addressing environmental learning limitations could enhance the usefulness of e-learning.

The qualitative results were also in agreement with this quantitative analysis. Some of the users investigated did not believe e-learning differed from traditional teaching methods, because teachers can distribute textual learning materials in both environments. This negative perspective should confirm the importance of blending the design of e-learning courses with practical and effective pedagogical theories and multimedia instructions. Thus, the benefits of e-learning technologies could be further realised.

As discussed above, e-learning usefulness is the strongest predictor of ITU. Here, it was shown that usefulness can be greatly improved by considering environmental limitations in the curriculum design. This signified a positive relationship between learners' willingness to accept e-learning and the application of UDL, advocating the assumptions of the present research. Table 7.2 summarises the findings of all variables suggested in this thesis as predictors of PU.

Table 7.2: Summary of Predictors of PU

	First Experiment		**Second Experiment**	
	R^2 without learning styles: **29.5%**, **R^2** with learning styles: **30.9%**		**R^2** without UDL: **16.8%**, **R^2** with UDL: **42.9%**	
Proposed Path	**Hypothesis Code**	**Finding**	**Hypothesis Code**	**Finding**
PEOU→ PU	H1a	Supported	H1b	Rejected
ELSE→ PU	H7a	Supported	H7b	Rejected
Learning Styles→ PU	H8	Rejected	-	NA
UDL→ PU	-	NA	H11	Partially Supported

7.3.12 UDL Principles and Intention to Use (ITU)

The present study also suggested that addressing environmental learning limitations could affect learners' willingness to accept e-learning:

H12: *UDL principles positively affect intention to use (ITU).*

The findings partially supported this hypothesis. The learners' willingness to accept e-learning was found to be greatly improved by using the UDL variables. Two principles of the UDL framework (MMAE and MME) were significantly correlated with ITU, based on the Pearson's correlation coefficient (see Table 6.7). Both also had a significant positive effect on ITU before combining the original factors of TAM, explaining 32.0% of its variance. This clearly validates the assumption made here that embracing UDL principles can promote e-learning acceptance. Thus, educators should follow a flexible and accessible e-learning design to ensure that they respond to learners' needs.

After combining UDL with TAM, the explanatory power of the model to determine behavioural intention was found to be greatly improved from 31.5% to 41.6%. MME had a more significant influence on ITU than the original TAM factor (PEOU). MMAE also produced a positive but insignificant effect, which means that different approaches to engagement need to be integrated into the design of blended learning courses. In this current experiment, the students were intensely engaged in class sessions and via Moodle, exploiting its flexibility and interactive features. Consequently, such methods of engagement positively influenced learners' behavioural intention to accept e-learning, which corroborated other studies. Essam and Al-Ammary (2013) found that perceived motivation, equivalent to methods of engagement, was a predictor of behavioural intention. Moon and Kim (2001) also demonstrated that perceived playfulness had a significant influence on acceptance of the World Wide Web. Thus, a high level of engagement and motivation is necessary for learners to succeed in e-learning.

In the qualitative analysis, the respondents identified a lack of motivation, interest and encouragement as barriers to e-learning use in Iraq (see Table 6.15). This means that e-users should be intensely engaged and motivated to accept e-learning and use it continuously. Table 7.3 summarises the findings of all predictors of ITU in the first and second experiments. It also shows the improvement in the model's power before and after the inclusion of the learning style and UDL variables.

Table 7.3: Summary of Predictors of ITU

	First Experiment		**Second Experiment**	
	R^2 without learning styles: **49.1%**, **R^2** with learning styles: **49.2%**		**R^2** without UDL= 31.5%, **R^2** with UDL= 41.6%	
Proposed Path	**Hypothesis Code**	**Finding**	**Hypothesis Code**	**Finding**
PEOU→ ITU	H2a	Supported	H2b	Rejected
PU→ ITU	H4a	Supported	H4b	Supported
Learning Styles→ ITU	H9	Rejected	-	NA
UDL→ ITU	-	NA	H12	Partially Supported

7.3.13 UDL Principles and Perceived Satisfaction (PS)

Based on other studies (Davies et al., 2012; Kumar & Wideman, 2014), the UDL application was also assumed to affect learners' satisfaction. This led to examining the following hypothesis:

H13: *UDL principles positively affect perceived satisfaction (PS).*

The outcomes partially confirmed hypothesis H13. The Pearson's correlation coefficient showed that MMAE and MME were significantly associated with PS (see Table 6.7). The analysis of the PLS-SEM also demonstrated that both variables were significant determinants of PS before the incorporation of TAM variables. This means that diversity in the assessment and engagement methods applied can greatly enhance learners' satisfaction in a blended learning setting. Such outcomes further support the importance of incorporating effective pedagogical theories into the design of e-learning courses. MMR, on the other hand, was found to be an insignificant predictor of PS, thus confirming a study conducted by Cigdem and Ozturk (2016), whereby varied multimedia instructions had an insignificant effect on learner satisfaction.

After including the TAM constructs, MMAE demonstrated the highest effect on PS. The significance of this was compatible with a study by Sun et al. (2008), where it was found that different types of assessment method had a significant ability to predict PS. Moreover, this finding advocated Govindasamy's (2002) recommendation that the use of a range of evaluation and assessment methods is the cornerstone of e-learning success.

Table 7.4 demonstrates all predictors of learner satisfaction, as constructed in the proposed research framework (Chapter Three, Figure 3.1). It shows the explanatory power of the proposed model before and after extending TAM in both experiments.

Table 7.4: Summary of Predictors of PS

	First Experiment		**Second Experiment**	
	R^2 without learning styles: **53.1%**, **R^2** with learning styles: **54.5%**		**R^2** without UDL: **31.8%**, **R^2** with UDL: **45.4%**	
Proposed Path	**Hypothesis Code**	**Finding**	**Hypothesis Code**	**Finding**
PEOU→ PS	H3a	Supported	H3b	Supported
PU→ PS	H5a	Supported	H5b	Rejected
Learning Styles→ PS	H10	Partially Supported	-	NA
UDL→ PS	-	NA	H13	Partially Supported

7.3.14 Discussion of the Moderating Effect of Learning Styles

The previous literature showed that learning styles could moderate the relationship between different variables towards e-learning acceptance (Huang, 2015; Ramirez-Correa et al., 2017; Ursavaş & Reisoglu, 2017). Therefore, it was hypothesised here that:

> ***H14:*** *The active/reflective learning styles dimension moderates the relationship between the model's constructs.*
>
> ***H15:*** *The sequential/global learning styles dimension moderates the relationship between the model's constructs.*

In this research, learning styles demonstrated a limited ability to predict behavioural intention and learners' perceptions. Furthermore, students who fell within speific learning style dichotomies did not show a significant difference in their perceptions, behavioural intention or academic performance. This led to testing the moderating influence of the active/reflective and sequential/global groups on the path strength between many variables in the research model (see Table 5.15).

The effect of these two moderators was examined by applying a multi-group analysis technique. This involved dividing a dataset into two subsets, with the structural model then being run for each simultaneously. This step was followed by a pairwise comparison in the relationships between path coefficients across the two groups generated. However, due to the small sample size of the other dimensions (sensing/intuitive and visual/verbal), their moderating effect was not analysed.

A. The Moderating Effect of the Active/Reflective Group

Hypothesis H14 was confirmed, whereby the moderating influence of the active/reflective group was identified for the two sub-samples generated by multi-group analysis. The number of active learners amounted to 120 and the total number of reflective learners was 49. Thus, the findings needed to be interepreted with caution, due to the small sample size of the reflective group. For the active dimension, the independent constructs explained 38.4% of ITU and 45.0% of PS. On the other hand, within the reflective group, 58.7% and 54.9% of variance was explained for ITU and PS, respectively. Overall, this meant that the active group model displayed an acceptable and moderate fit, whereas the reflective group model exhibited a good fit. In this dimension, the association between PEOU_PU, PU_ITU and PU_PS was found to be stronger for the reflective group.

The outcomes showed that when learners have a tendency to process information reflectively, PEOU increases its significance in determining the usefulness of e-learning. Similarly, PU increases its influence in predicting both behavioural intention and PS. Thus, the reflective group was more concerned about ease of use, which would then lead to them benefiting from the usefulness of the e-learning. They were also more concerned with usefulness, so that they could accept e-learning and be satisfied with it. This may be because reflective learners tend not to favour doing practical tasks, working with groups, or interacting with peers and so they cannot perceive the usefulness of e-learning if its use requires a great deal of mental effort. Moreover, because these participants did not have a high degree of willingness to explore this learning technology, they were more concerned about its usefulness, so that they could adopt it and obtain a high level of satisfaction. This outcome confirmed the assumption of TAM that a technology should be useful in terms of enhancing job performance, but without requiring much mental effort to be effective.

B. The Moderating Effect of the Sequential/Global Group

Hypothesis H15 was also supported, whereby the sequential/global dimension moderated the association between ELSE_PU, ELSE_PEOU, PU_ITU, PEOU_PS, PEOU_ITU and PU_PS. The moderating effect of these groups on the path strength of the research model led to explaining 59.7% of ITU and 48.9% of PS within the sequential dimension. Moreover, the variance explained for ITU was 35.0% and for PS, 53.1% in the global dimension.

Firstly, the sequential/global dimension moderated the influence of ELSE on PU and PEOU. When learners tend to understand the learning content sequentially, ELSE increases its significance for determining PU and PEOU. On the other hand, if students would rather understand information globally, the self-efficacy becomes less significant. Huang (2015) argued that the level of motivation for sequential students to explore learning technologies is low. Thus, they are more concerned about their individual skills in perceiving the usefulness of the e-learning. Global learners, on the other side, have a strong willingness to explore e-learning. Accordingly, they may perceive its usefulness, regardless of their self-efficacy. Even though ELSE has a reduced effect on PEOU amongst global learners, it is still a significant predictor (see Table 5.15).

Secondly, the sequential/global dimension modified the path strength between PU and ITU. PU was a significant determinant of ITU for sequential learners, but not for the global group. The dominant characteristics of sequential learners are that they adopt a step-by-

step learning approach, do not look at the bigger picture and do not look far beyond the materials provided. This contrasts with global learners, who look at the general picture, skip over incomplete or shallow materials and 'think outside the box', in order to collate different ideas together (Felder & Silverman, 1988). Furthermore, this dimension is equivalent to field dependence/field independence in the Witkin and Moore (1977) model, which hypothesises that field dependent learners tending to build social relationships with colleagues. As such, sequential learners may benefit more from e-learning, because of its features for developing social connections.

This current finding was consistent with a study performed by Huang (2015), which revealed that sequential students were more concerned with the usefulness of a collaborative learning technology. Conversely, global learners have a high willingness to explore e-learning. Accordingly, they are more concerned with ease of use, so that they can benefit from its features. This may explain why PEOU was a significant predictor for global students in the present study, whereas PU was not. The findings perhaps also indicated that the sequential students benefited more from the use of an LMS, because they focused their attention on its advantages for improving their learning performance, while global learners focused their attention on its ease of use.

Lastly, for PS, the sequential and global learners indicated different concerns. It was found that this dimension moderated the relationship between PU, PEOU and PS. However, when the students had a tendency to understand information sequentially, PEOU increased its significance for explaining PS. In contrast, when the students had a global learning tendency, PEOU decreased its effect on determining learner satisfaction, whereas PU increased its influence. Overall, these findings supported a study conducted by Ramirez-Correa et al. (2017), who demonstrated that some dimensions of the Felder and Silverman model could moderate the relationship between different variables in predicting e-learning success.

7.4 Comparing the Predictive Ability of Learning Styles and UDL Principles

The ability of learning styles to predict e-learning acceptance and learners' perceptions was investigated in two stages. The first phase involved testing learning style dimensions alone as predictors of PU, PS and ITU (see also Table 5.12). The second phase involved incorporating learning styles with TAM (see Table 5.13). Both analyses demonstrated that learning styles had a mild influence on the dependent constructs. Hence, it was suggested

that learning styles do not bias e-learning acceptance or learners' perceptions in a blended e-learning setting.

With regard to the effect of the UDL model on e-learning acceptance and learners' perceptions, looking at the predictive ability of the original model (see Table 6.10) and comparing its predictive power with the extended model (see Table 6.12) clearly indicates an enhancement of TAM's explanatory power. Furthermore, the UDL principles alone explained an acceptable fit of the variance of PU (38.1%), PS (35.6%) and ITU (32%). Thus, their predictive ability was even better than that of the original factors of TAM (see Table 6.11).

A comparison of the perceptions and behavioural intention of the learners using traditional and UDL-based blended learning systems showed that the second group had more positive perceptions and intentions to adopt e-learning (see Table 6.13). Such outcomes may be attributed to the high flexibility of the UDL-based e-learning course. The learning content was presented in different modes, with learners being given varying opportunities to express their understanding. They were consequently highly motivated.

The current findings were compatable with the conclusion derived by Zurita, Baloian, Baytelman and Farias (2007) that learners who engage with e-learning settings perceive greater success and satisfaction than those who do not. Moreover, Bryans Bongey et al. (2010) found that e-learning use and PS were significantly improved in a UDL-based blended learning environment, compared with traditional blended learning. Such results further confirmed the theoretical suggestions made by Morra and Reynolds (2010) and Rose and Strangman (2007), namely that the combining of UDL principles with instructional technologies can enhance learners' perceptions and experience.

To conclude, adopting the UDL framework in e-learning settings may help reduce the rate of e-learning failure. This is because learners' needs can be addressed from the outset, so that they become aware of the advantages of this technology for improving their learning outcomes. The present research suggests that using educational technologies to address curricular limitations is a bridge to the enhancement of e-learning acceptance.

Table 7.5 compares the predictive power of the Felder and Silverman model and the UDL framework for PU, PS and ITU. It demonstrates that learning styles combined with TAM did not affect the overall explanatory power of the model, whereas UDL principles significantly improved it.

Table 7.5: A Comparison of the Impact of Learning Styles and UDL on PU, PS and ITU

Experiment	PU (R^2)	PS (R^2)	ITU (R^2)
Learning style and UDL Dimensions as Predictors			
Learning style dimensions as predictors	0.033	0.050	0.027
UDL dimensions as predictors	0.381	0.356	0.320
TAM without and with Learning Styles			
TAM without learning styles	0.295	0.531	0.491
TAM with learning styles	0.309	0.545	0.492
TAM without and with UDL Principles			
TAM without UDL	0.168	0.318	0.315
TAM with UDL	0.429	0.454	0.416

7.5 Discussion of the Content Analyses

The qualitative analysis in the first and second experiments of this study revealed that the advantages of e-learning outweighed the disadvantages, indicating that these results were compatible with the quantitative analysis. University students may endeavour to use e-learning technology, because they believe that this experience can enhance their learning outcomes. The other possible reason is that learners in developing nations may not wish to feel left behind by students in developed countries, who use e-learning frequently.

In the third experiment, the qualitative analysis demonstrated that many barriers still hinder the successful implementation of e-learning in Iraq, as in the case of other developing countries. Without addressing such obstacles, the e-learning experience will not be able to access its anticipated advantages. This experiment also supported the quantitative outcomes and highlighted other factors that could affect e-learning acceptance. The next sub-sections discuss the main findings of the qualitative data collected in the present research.

7.5.1 Content Analysis of the First Experiment

Table 5.20 summarised the main themes inferred by this qualitative analysis. On the positive side, 31.25% of the respondents (N=48) believed e-learning to be a useful technology, offering an opportunity to improve learning and teaching in higher education. In addition, 8.33% of the students found that the use of e-learning alongside physical classrooms promoted interaction with their instructors. This technology also enhanced interaction between students and the learning content as reported by 10.41% of the respondents. Only one student (2.08%) stated that the use of e-learning had assisted in improving 'learner-learner' interaction. This may be because the practical application of e-learning in the investigated context did not support collaboration between learners via the Moodle system implemented.

E-learning can also provide an alternative approach to absorbing information on a topic. This advantage was identified by 18.75% of the participants. Fewer students (4.16%) stated that the delivery of additional resources on the e-learning platform had assisted them in expanding their knowledge. Others (4.16%) found that the effective use of e-learning saved their time and effort. Similarly, 4.16% of the respondents indicated that they could enhance their intellectual abilities by experiencing a new learning method such as e-learning technology. These advantages were reflected in some of the students' comments, cited below:

> Blended e-learning is very important where a topic is explained firstly in detail in a classroom and all questions are discussed and answered. Then, in Moodle, the topic can be discussed again by using external information or ideas that may have a strong relationship with the topic.
>
> …[blended e-learning] maintains the interaction between students and subjects and it facilitates obtaining particular information when it is needed…
>
> The advantages are that students do not need to use social networks to access lectures and this in turn saves time, as a topic can be discussed with a lecturer after reading it; students' questions can assist the lecturer in identifying students' weaknesses and then to address these in as short a timeframe as possible, with other students benefiting from these questions… [this technology] responds to the digital era…

However, the drawbacks of inappropriately using e-learning systems in online tests can negatively affect students' willingness to accept it. This issue was highlighted by 39.58% of the participants. A possible reason was that some instructors might lack experience in the use of e-learning for online testing. Thus, various effective and diverse training programmes could help address this issue. Moreover, other reasons highlighted by the respondents were the limited types of question in the Web-based exams and inconsistencies between the monthly and final exams, since the latter involved a paper-based approach. Therefore, the students highly recommended the use of either online or paper-based tests. An example of the students' responses regarding this issue included:

> It is a limited system, without great benefit because [online-based] questions and tests are either true-false or multiple choice. In general, it is okay, but it should be developed further to obtain more advantages… for me as a student, I visit the system once a week to download the lectures…

7.5.2 Content Analysis of the Second Experiment

To provide further understanding of the possible implications of the UDL application, the questionnaire included a section on the helpfulness and usefulness of course attributes and materials, respectively (see Appendix B). Three open-ended questions were also used to collect the qualitative data.

Pertaining to the course attributes, Figure 6.7 demonstrated that lectures posted before class (95.7%), videos explaining website design (91.3%), laboratory sessions (90.2%) and classroom discussion (89.1%) were the most helpful course attributes. This meant that several attributes should be combined to motivate the learners and ensure that their individual needs were met. Here, some of the students' comments are reported:

> [I prefer] posting and explaining lectures in the system [Moodle] before the class lecture because I can obtain an overview of the topic and translate any unclear terms… before explaining them in the class, this has helped me a lot.
>
> Designing a website… provided great benefits, because it assisted us in recalling the subject content… and used them to produce an interactive project that exhibits our individual ideas and abilities.

As shown in Figure 6.8, the first principle of the UDL model was further confirmed. The design adopted indicated that MMR had the potential to improve the e-learning experience. Several materials were chosen for their usefulness, such as video lectures, outlines, text lectures and animated lectures. Hence, learning content should be presented in different ways and this will in turn provide better opportunities for proficiency in a topic. Based on Figure 6.8, the participants found that the most useful materials were the video lectures explaining the course outlines (76.1%), details of the lecture content (73.9%), overview and goals of the lectures (72.8%) and summary of the lectures (71.7%). Accordingly, instructors need to integrate multimedia instructions, rather than using e-learning platforms purely as a medium for uploading textual materials. This result corroborated the quantitative findings, which demonstrated the usefulness of MMR and multimedia instructions (M=6.30, SD=0.82). Such benefits were also reflected by some of the participants' responses to the open-ended question:

> …if I do not understand the topic from the lecturer; I can watch the video lecture to understand the unclear content and attempt to repeat it more than once, [this] helps me to understand the topic easily… I can keep the video as well; it explains the subject step-by-step…

> The most beneficial material for me is the PowerPoint lectures, because the topic is ordered, summarised and the [PowerPoint files] summarise the important things in the topic.
>
> [The most beneficial material for me is] the review of the lectures after studying them in detail. This [review] recalls [information] for students in a brief and quick form and this in turn can assist the students by saving their time in understanding the subject.

Table 6.14 illustrates seven themes identified by the students, who responded to the final optional open-ended question (N=23). Overall, 43.47% of the participants found e-learning to be a useful tool that could improve learning and teaching. This was compatible with the results for PU (M=5.83, SD=0.88). Furthermore, the subjective data showed that 13.04% of the participants believed that this course had engaged them and reduced their learning stress. This qualitative finding was compatible with the third principle of the UDL framework, which suggested that using MME could maintain learners' attention. Out of the students, 13.04% found that this course assisted them in enhancing their academic achievement, whereas 13.04% of the participants thought that this design has led to enhancing their understanding. Finally, 8.69% found that this course assisted them in improving their interaction with the learning content. This analysis confirmed the conclusion drawn from previous literature that the implementation of the UDL model could improve learning quality (Hall, Cohen, Vue, & Ganley, 2015; Kumar & Wideman, 2014). Below, some of the students' comments are reported:

> [Its advantages are that] it is a gorgeous and very useful design from all sides: video lectures and the way they are displayed, notices, and the preparation of reports and tests. All of these features encourage students to visit the website continuously and rely on themselves to follow, study and take in information…
>
> …I see that it is a useful system that can improve students' performance, especially the video lectures and quizzes in the system; they are useful to test ourselves…Also the ease of obtaining the lectures from the system; this saves [our] time and effort. It also enables us to gain an overview of the lectures, before they are explained in class.
>
> …Therefore, learning in this system is enjoyable; I would also like to thank the instructor, because he makes the subject easy and enjoyable.

On the other hand, a few students (8.69%) highlighted that the unavailability of Internet access was the main barrier to obtaining the full benefit of this course. Although only two students mentioned this obstacle, it could be an indicator of the limited availability of the Internet in Iraq.

> E-learning is good, but there are some obstacles, such as the difficulty of getting Internet access sometimes inside the university… There are many advantages of the system [such as] the ease of understanding and good interaction with the subject.

7.5.3 Content Analysis of the Third Experiment

This experiment was carried out to identify the main obstacles hindering the application of e-learning in Iraq. It aimed to provide further support for the quantitative results and to highlight other factors potentially affecting e-learning acceptance. The three types of stakeholders taking part in this experiment identified seven external and two internal obstacles. This was in addition to other factors identified by certain individuals. Table 7.6 summarises these barriers as mentioned earlier in Chapter Six, Section 6.6.

Table 7.6: The External and Internal Barriers to E-learning Application in Iraq

	Lecturers: N=74		Students: N=31, Groups: N=8	
External Challenges	**N**	**%**	**N of Groups**	**%**
Low Internet bandwidth	17	22.97	5	62.5
Insufficient financial support	13	18.91	2	25
Inadequate training programmes	40	54.05	5	62.5
Lack of technical support	15	20.27	2	25
Lack of ICTs infrastructure	33	43.24	4	50
Ambiguous plans and policies	16	21.62	1	12.5
Frequent power cuts	5	6.75	1	12.5
Internal Challenges	**N**	**%**	**N of Groups**	**%**
ICTs and e-learning literacy	23	31.08	4	50
Lack of awareness, interest, or motivation	35	47.29	6	75

A. External Challenges

The external challenges included the technical implementation of e-learning. Looking at the results in Table 7.6, many lecturers (22.97%) and most students (62.5%) agreed that low Internet bandwidth was one of the issues hindering the successful application of e-learning in Iraq. Users needed to spend a long time trying to upload or download pictorial learning materials, for example, videos, graphs and animation. The present study revealed that low Internet connectivity, whether at university or at home, was an inhibiting factor for e-learning use, as highlighted by previous literature (Mirza & Al-Abdulkareem, 2011;

Tarus et al., 2015). It is worth noting here that the students identified this issue more frequently and emphatically than the lecturers, because they could not afford services such as 'golden' Internet, which provided high-speed Internet connectivity, whereas the instructors could. Accordingly, 'Internet quality' could be another influential factor for e-learning acceptance in developing countries. Indicative is the following response from one of the lecturers interviewed:

> …low Internet bandwidth is the underlying factor when it comes to infrastructural issues… if e-learning is applied in all colleges, or if we want to connect this system to other universities, the problem of low Internet signal will face us and this will in turn influence this experience…

Another hindrance to e-learning application according to the lecturers (18.91%) and students (25%) was the shortage of financial funding. Generally, the budget for higher education in Iraq is adequate, in comparison to other sectors, but there is still a need to allocate specific funding for e-learning. Thus, more attention should be given to the requirements of e-learning application. Other literature has also found a lack of financial support to be one of the main obstacles to e-learning implementation (Khan et al., 2012; Sife et al., 2007; Tarus et al., 2015). Furthermore, possible e-learning systems that can be implemented are commercial systems, such as Blackboard, custom applications developed according to the specific requirements of organisations, or open source LMSs.

The main issues arising with commercially available systems are the high maintenance costs and inflexibility for adaptation to an institute's specific needs (Sife et al., 2007). Regarding custom applications, the most prominent issue is the lack of reliability. Thus, in order to avoid the unaffordable expenses of commercial systems and unreliability of custom applications, open-source LMSs, such as Moodle can be adopted. According to previous studies, this software has attracted significant attention all around the world (Cavus & Zabadi, 2014; Graf, 2007). The following response from the interviews confirmed this:

> …a lack of funding is another challenge that Iraqi universities face in implementing e-learning, more specifically nowadays, where there is a general deficit… there is [currently] no allocated budget for e-learning, but universities have a plan to allocate part of their [general] budget for e-learning…

In addition, Table 7.6 shows that most of the lecturers (54.05%) and students (62.5%) pointed out that intensive training programmes were required to enhance users' skills in using computer and e-learning technologies. Undoubtedly, a lack of individual skills can negatively affect users' ITU. This qualitative analysis supported the quantitative findings of the present research, namely that ELSE and PEOU had a significant impact on e-learning acceptance and learners' perceptions. It suggested a clear lack of support from educational institutions for improving users' confidence in adopting such technologies. As a consequence, users face difficulty in using e-learning and this can in turn lead them to seek different reasons for avoiding it. Earlier literature has also highlighted this issue (Ali & Magalhaes, 2008; Al-Shboul, 2013). In the interviews, this was clear from all the respondents:

> …we should attempt to spread the e-learning culture by holding workshops, conferences and inviting experts in this field, whether from Iraq or other international institutions, so as to benefit from their experience… and there is a need to conduct training programmes [for Iraqi academic staff] in international universities that have extensive experience in this sector…
>
> …we need to conduct training programmes for all instructors, in order to show them the advantages of e-learning systems and how to use these technologies… and attempt to involve students in such an experience… where they need illustrative lectures.

Successful implementation of any technology cannot be achieved without professional technical staff to set up and maintain it. As demonstrated in Table 7.6, the instructors (20.27%) and students (25%) found that there was a lack of technical support to address any issues faced by users. This result was consistent with the findings of other studies, where insufficient technical support proved to be a key challenge to fostering e-learning (Al-Shboul, 2013; Sife et al., 2007). This means that the preparation of professional staff should be the first step taken before launching a system. As such, any system failure can thus be directly tackled to prevent disruption for the user. Based on this discussion, 'technical support' could be another effective variable on e-learning acceptance. One interviewee commented that:

> …[there is a] limit number of experts, more specifically, in the networks' field to manage the system and solve any problems that users may face…

It may be noted from Table 7.6 that many lecturers (43.24%) and students (50%) believed inadequate ICTs infrastructure to be a major challenge hindering e-learning use in public-sector universities. As stated by the participants, this entailed the unavailability of special laboratories, the lack of free Internet within universities and insufficient numbers of computers. This finding confirmed the investigation carried out by Elameer and Idrus (2010), where the authors stated that there were no wireless networks on a particular university campus. Although public-sector universities have witnessed very satisfactory development in their ICTs infrastructure since 2003, it was evident from this analysis that the project is still under development. Integrated infrastructure as a preliminary step towards adopting e-learning should include free Wi-Fi and network connections on campuses. Furthermore, laboratories should be supplied with adequate numbers of computers. In keeping with the literature, this barrier identified as a core challenge to fulfilling the objectives of e-learning implementation (Abdelraheem, 2006; Khan et al., 2012; Matar et al., 2010; Tarus et al., 2015). Hence, the 'facilitating conditions' could be defined as another influential factor on e-learning adoption. Here, this referred to the users' perceptions that the ICTs infrastructure and organisational support required to use e-learning are available. The issue of inadequate ICTs infrastructure was mentioned by all the interviewees:

> …poor infrastructure, which includes not enough servers, laboratories, computers or Internet and/or intranet networks within the university. If we want to apply e-learning, we should build the infrastructure and then move to the next step… insufficient infrastructure means e-learning implementation will fail before starting, whether directly or indirectly…

> The important thing that should be implemented first is the ICTs infrastructure. Some colleges do not have the infrastructure, such as information networks, servers, computers, software and laboratories connected to a network; this hinders e-learning application…

Furthermore, as displayed in Table 7.6, some lecturers (21.62%) and students (12.5%) referred to ambiguous policies preventing the implementation of e-learning. Even though the Iraqi Ministry of Higher Education and Scientific Research (MHESR-I) aims to integrate ICTs and e-learning into higher education, this requires a systematic approach, from the preparation of principle requirements, to installation, execution, testing and monitoring. The lack of proper strategies to foster e-learning was also counted as a

hindrance in relevant studies (Khan et al., 2012; Tarus et al., 2015). An interviewee also commented that:

> …there are improvisational steps to implement e-learning. They started with Computer Science colleges and other colleges that support this notion. Currently, there is no clear plan, but there will be in the near future, as the University is soon to start using central servers…It has initially been endorsed by one college and will subsequently spread to others, too…

Furthermore, the results in Table 7.6 also demonstrate that a few of the lecturers (6.75%) and students (12.5%) considered frequent power cuts to be a factor that negatively influenced successful e-learning implementation in Iraq. This issue emerged in 1991 after the first Gulf war and up to now, there has been little improvement. On the other hand, people use many alternative methods of maintaining a minimum electricity supply. This may explain why only a few participants mentioned this as a challenge affecting the application of e-learning.

Some of the individual respondents identified other barriers: (1) A lack of electronic Arabic language resources for Humanities disciplines and so it required more effort to prepare e-lectures. This was also confirmed by the literature (Matar et al., 2010); (2) The lack of rigorous laws to protect copyright in Iraq, with the consequent fear of plagiarism if lectures are uploaded electronically, and (3) The current unstable circumstances in Iraq, involving corruption and war. This was one of the most important obstacles identified, with a potentially negative effect on e-learning adoption. Currently, the global war on terrorism affects all aspects of public life in Iraq, education included.

B. Internal Challenges

The internal challenges were more relevant to users' willingness to move from traditional to more advanced teaching and learning approaches. They included personal and motivational aspects. Some of the users believed that e-learning meant delivering learning content by electronic means; for example, via a computer, iPhone or other mobile device, whether offline or online. E-learning, on the other hand, entails a much wider concept than this superficial perspective. Derouin et al. (2005) pointed out that e-learning involves technology merging effective educational theories, as opposed to solely being used as an information delivery agent. An example of such theory is the multimedia principles theory (Mayer, 2009). Its notion is based on blending graphics and texts as e-learning content,

rather than using text alone. Another example is the UDL framework, where its effectiveness for the learning experience has been proven in the present research.

The results in Table 7.6 indicate that many lecturers (31.08%) and half the students (50%) considered ICTs and e-learning illiteracy as hindering the effective integration of e-learning. Modern instructional technologies have recently been introduced into the Iraqi higher education context. Therefore, older members of teaching staff and students from the Humanities, or certain other disciplines, may be unfamiliar with such technologies. They may also have a fear of moving from traditional teaching and learning approaches to e-learning approaches. This result advocated the significant role of ELSE and ease of technology use, leading to its acceptance and adoption by stakeholders. It may also suggest considering the possible effect of 'e-learning anxiety' on its acceptance. E-learning anxiety refers to the fear or concern experienced by a user when intending to use this technology. Tarus et al. (2015) also found that e-learning illiteracy is an issue in developing nations. Successful implementation of e-learning cannot be achieved without developing individual skills. Two of the respondents interviewed agreed that the lack of ICTs skills was another obstacle:

> …it is difficult to persuade academic staff dedicated to traditional F2F methods to endorse e-learning… so they find it difficult to prepare e-lectures… in summary, there is a problem with using modern learning technologies…

Table 7.6 also demonstrates that both staff (47.29%) and students (75%) pinpointed unwillingness, disinterest and demotivation as other major challenges hindering the adoption of e-learning. Some users resist new experiences and need to be able to see the hedonic value of using a technology. Thus, they will adopt it to enhance teaching and learning alongside fun and pleasure. This outcome may identify another factor to be considered in investigating e-learning acceptance in developing nations, which is 'perceived playfulness'.

The respondents mentioned several aspects that could lead to unwillingness, disinterest and demotivation. For instance, the preparation of e-learning content requiring more time than the traditional approach; e-learning reducing the role of the teacher in educational practice, and the advantage of e-learning being limited to uploading electronic lectures only. Based on such perspectives, these users found no difference between e-learning and other communication technologies, such as email or even the distribution of written lectures in

classrooms. This outcome corresponded to the assumption of the present research that the design of e-learning courses should be blended with effective pedagogical approaches, such as the UDL framework, in order to enhance learning quality. It also supported the importance of PU for technology, to ensure its acceptance by users. This qualitative analysis therefore advocated the importance of methods of engagement, as indicated by the quantitative findings, whereby multiple means of engagement constituted a predictive factor of e-learning acceptance (see Table 6.12).

Moreover, Khan et al. (2012) stated that lecturers need to adopt a positive attitude to e-learning. Accordingly, huge effort should be directed towards extending their academic understanding of the potential pedagogical impact of e-learning on different various aspects of learning, such as learners' performance, satisfaction and engagement. Academic members necessarily have an obligation to implement e-learning, in order to support students in achieving their learning goals with greater ease and enhanced enjoyment.

Another possible reason for poor attitude and low interest in e-learning adoption is English proficiency. Whilst users need acceptable English skills to be able to use the available learning technologies and e-resources, the overall English proficiency of Iraqi academic staff and students is low to intermediate (Borg, 2015). The interviewees also mentioned this challenge:

> …as well as lecturers' belief in using electronic technologies, such as computers and web pages… teachers' motivation to use e-learning is low… most lecturers lack knowledge of such types of system and need training courses to understand their benefits… students are reluctant to try what they have not experienced, but of course, if it is implemented they will be eager to use it…
>
> …there is considerable unawareness of most lecturers and students about the advantages of e-learning and what such systems may offer… It is the absence of motivation that prevents teachers from interacting with e-learning…

To sum up, the findings of the third experiment supported the quantitative analysis, relating to users' self-confidence and skills, e-learning ease of use, e-learning usefulness and the design of e-learning courses being influential factors of e-learning acceptance and users' perceptions. However, other variables potentially affecting e-learning acceptance have been inferred based on this qualitative analysis. These include Internet quality, technical support, facilitating conditions, e-learning anxiety and perceived playfulness.

Investigating e-learning acceptance in developing countries by combining such factors with TAM could thus lead to further enhancement of the explanatory power of this model.

7.6 Summary

This Chapter has provided an in-depth discussion and interpretation of the key outcomes of the proposed research framework, alongside its qualitative analysis. Specifically, it was divided into five main parts; the first discussed the differences between the groups studied, based on learning styles and experience of the Internet and e-learning. The second part explained the overall relationships between the constructs of the proposed research framework in the two experiments conducted. The third part was then dedicated to discussing the findings related to the moderating influence of learning styles on the path strength between the model's constructs, while the fourth part investigated the enhancement of the explanatory power of TAM, using learning styles and the UDL principles as predictors. Finally, the fifth part discussed the content analysis, showing that the qualitative findings were in agreement with the quantitative results and identifying factors other than those explored in the research framework. An overview of all the findings discussed in this Chapter is provided below:

- Significant results for learning styles were found by moderating the path strength between many relationships in the research framework. Furthermore, active learners had more positive perceptions of e-learning and were more likely to declare that they would adopt it in future. However, learning styles failed to predict learners' perceptions and behavioural intention towards e-learning acceptance. Neither was this trait correlated with the learners' performance.
- Based on this research, it would seem that the UDL model was an effective pedagogical approach for promoting e-learning acceptance and learners' perceptions. The explanatory power of TAM was significantly enhanced by the integration of UDL principles. The findings suggested that presenting learning content via multiple means, using different assessment methods and engaging learners in many different ways could improve learners' willingness to use e-learning on an ongoing basis. Such findings should be highly encouraging for e-learning instructors to prioritise the use of effective pedagogical approaches in the corresponding e-learning design.

- The present research also showed that ELSE, PEOU and PU were all significant variables in determining e-learning acceptance and PS in blended learning settings. This means that educational institutions should do their best to improve users' self-confidence in using e-learning systems. This is because users need to be motivated towards e-learning, remaining aware of its possible advantages in contemporary education.

- Even though a few of the hypotheses supported in the first experiment were not supported in the second, the rationale behind this inconsistency was explained in this Chapter. The participants' individual experience of using a particular technology could have affected the relationship between the model's constructs. Difference in sample size is a further influential variable on the cause and effect relationship between different variables.

- Following the third experiment, seven external and two internal factors were found to be hindrances to successful e-learning application in Iraq. The main barriers comprised, but were not limited to: low Internet bandwidth; insufficient financial support; inadequate training programmes; a lack of technical support; a lack of ICTs infrastructure; ambiguous policies and objectives; frequent power cuts; ICTs and e-learning illiteracy; a lack of awareness, interest and motivation, and unstable security. This analysis supported the quantitative findings and identified other variables to be considered when investigating e-learning acceptance in developing countries, such as Internet quality; technical support; facilitating conditions; e-learning anxiety, and perceived playfulness.

Chapter Eight now concludes the key outcomes of this research. It also highlights its theoretical and practical implications; makes recommendations; lists the limitations and proposes future research directions.

Chapter 8: Conclusion

8.1 Overview

This Chapter provides a general overview of the study presented in this thesis, summarising all the research steps and recapitulating the research findings. It also highlights the theoretical and practical implications of the thesis. Key recommendations are also made, based on the research findings. Finally, the study's limitations and directions for future research are reported.

8.2 Overview of the Research

This section provides a brief overview of the thesis, in a summary of the steps taken to achieve its key aims and answer the three main research questions.

8.2.1 Identifying the Research Problem, Aims and Questions

In Chapter One, the research context, problem and motives were introduced, alongside the aims and objectives. It was demonstrated that TAM is the dominant theory for predicting technology acceptance. However, TAM fails to take into account the role of individual and cultural differences, and environmental variables in technology adoption behaviour. Nevertheless, the existing literature illustrates that technology adoption is a process that can be affected by variables other than technological aspects. Moreover, Chapter One highlighted the academic research gap regarding e-learning acceptance and application in Iraq.

Accordingly, this research has addressed TAM's limitations in the e-learning context. TAM was consequently extended by integrating individual differences in learning styles and environmental limitations, according to the UDL framework. Based on previous literature, the amount of academic research on the impact of learning styles and UDL principles on e-learning acceptance is negligible. Hence, the proposed research framework has sought to bridge this gap. The resulting study findings are therefore significant for comprehending the role of individual learning styles and environmental limitations in e-learning acceptance and the formation of learners' perceptions. Moreover, these findings are important for identifying any barriers to e-learning application. Thus, investigations were conducted in response to the three main research questions presented below.

Research Question 1: *What impact does Learning Styles Theory have on:*

i. E-learning acceptance? and

ii. Learners' experience?

Learners' perceptions, behavioural intention towards e-learning acceptance, and academic performance in relation to learning styles failed to indicate any significant differences between the groups. The only exception was the 'processing' dimension, where active learners expressed more positive perceptions and behavioural intention towards e-learning. Aside from this, the overall explanatory power of TAM was not improved after including learning styles as predictors. However, the active/reflective and sequential/global dimensions showed a moderate relationship between many variables in the research framework, providing some support for the influence of learning styles on e-learning acceptance and learners' perceptions.

The results of the above suggested that learners with reflective and sequential learning preferences required further improvement in their e-learning skills, in order to be able to continue implementing e-learning. Moreover, the effect of perceived usefulness (PU) was found to be stronger for students with reflective and sequential preferences, whereas ease of use had the strongest effect on the global learners' behavioural intention. Thus, the preferences of all types of learner need to be accommodated from the outset, if their willingness to accept e-learning is to be retained. This outcome confirmed the assumption of TAM that the usefulness and ease of use of a technology are important variables for predicting its acceptance.

Overall, the weak effect of learning style dimensions as predictors of technology acceptance led to a more comprehensive learning theory being considered and here, the UDL framework was adopted, suggesting that the learners' differences could be accommodated by addressing environmental learning limitations.

Research Question 2: *Can applying the principles of the UDL model enhance:*

i. E-learning acceptance? and

ii. Learners' perceptions?

A second experiment was performed to investigate the effect of applying the UDL framework to e-learning acceptance and learners' perceptions. The findings suggested that addressing environmental limitations in terms of curriculum design could greatly enhance the e-learning experience. The UDL principles were found to have a significant correlation

with PU, perceived satisfaction (PS) and behavioural intention. Furthermore, the explanatory power of TAM was significantly improved by including such variables as predictors. This experiment demonstrated that out of the learners attending traditional and UDL-based blended learning courses, those taking the UDL-based courses had more positive perceptions and behavioural intention in relation to e-learning.

Based on the first and second experiments, it was consequently found that Iraqi students in general were very willing to accept e-learning. However, its actual use was still only in its early stages, which meant that the obstacles hindering its efficient implementation in Iraq were investigated, in response to the third research question:

Research Question 3: *In the context of public-sector universities in Iraq, what barriers to the use of e-learning are reported by academic staff and students?*

The third experiment sought to identify barriers to e-learning application in Iraq, in order to support the quantitative analysis and highlight other variables possibly affecting e-learning acceptance. The findings from this analysis showed that the academic staff and students taking part in this experiment identified similar issues, whereby multiple internal and external variables continued to prevent the effective use of e-learning in Iraq. This analysis provided more support for the quantitative findings and highlighted other variables that should be considered when investigating e-learning acceptance in developing countries, such as the quality of the Internet connection, facilitating conditions, technical support, e-learning anxiety and perceived playfulness.

8.2.2 Reviewing the Key Theories

Chapter Two reviewed earlier literature on the central topics of this research, namely e-learning, technology acceptance, learning styles and universal learning theories. It commenced with a review of e-learning technology and its role in contemporary education. Subsequently, Chapter Two discussed the development of TAM as the dominant technology acceptance theory, particularly in e-learning research. This was followed by an introduction to learning styles and universal learning theories, alongside their possible impact on e-learning acceptance and learners' perceptions. A comprehensive review of e-learning acceptance and barriers to its implementation in the Arab world was then presented. Moreover, Chapter Two highlighted the research surrounding e-learning application and acceptance in Iraqi higher education. Based on this comprehensive review,

a noticeable gap in the research was identified, relating to the influence of learning styles and universal learning theories on e-learning acceptance.

8.2.3 Extending TAM and Developing the Research Framework

Chapter Three extended and developed TAM by combining the Felder and Silverman model and UDL framework. It further justified the reasons behind the selection of TAM, the Felder and Silverman model and UDL principles to construct the research framework. In this Chapter, the rationale underpinning all the relationships between the variables of the proposed model and its hypotheses was explained and supported by the literature.

8.2.4 Identifying the Survey Design and Methods

The reasons behind the choice of research philosophy, design, methods and techniques were introduced and justified in Chapter Four. The decision over adopting both positivist and interpretivist paradigms was discussed, in order to achieve the key aims of this study. Accordingly, the research applied an analytical survey method to answer the first and second research questions, whereas a descriptive survey method was used to answer the third research question. The reason for a multi-methodological approach was based on the nature of each research question. Accordingly, structured questionnaires were incorporated into the analytical research design to produce numerical data, whereas open-ended questions, focus groups and semi-structured interviews were conducted to collect textual data in the descriptive design.

In addition, the selection of the research participants took place via a non-probabilistic convenience sampling technique, except in the recruitment of the lecturers participating in the semi-structured interviews. Instead, these were chosen according to a non-probabilistic purposive sampling technique. Descriptive and inferential statistical tests were used to analyse the collected data. Partial least square structural equation modelling (PLS-SEM) was then applied to investigate the relationships between the proposed model constructs and to test the research hypotheses, while a thematic approach was adopted for the analysis of the qualitative data.

8.2.5 Findings from the Research Questions

Chapters Five and Six provided a detailed analysis of the research data collected in the three experiments. Before testing the research framework in both the above Chapters,

several preliminary analyses were carried out. These were followed by validating the research questionnaire in both experiments. The relationships between the proposed model constructs and hypotheses were tested in two separate experiments. The first investigated the influence of learning styles on e-learning acceptance and learners' experience. The second then examined the effect of applying UDL to e-learning acceptance and learners' perceptions. In contrast, the third experiment investigated the barriers hindering effective e-learning application in Iraq. Based on the overall research findings, this thesis is considered to have achieved its main aims and adequately answered the three main research questions.

8.2.6 Discussion of the Research Findings

Chapter Seven discussed and interpreted the research findings. It also explained the rationale behind the results obtained and why some hypotheses supported in the first experiment were rejected in the second. The Chapter combined the quantitative and qualitative findings, so that these supported each other and highlighted specific variables to be considered. Although the research experiments were carried out in Iraq, the findings are all advocated by the results of other studies from different cultural contexts. This further supported the validity of the research outcomes and the proposed framework.

8.3 Summary of the Tested Hypotheses

Table 8.1 summarises the findings of the first and second experiments, with the overall findings for the hypotheses investigated in this research leading to the following conclusions:

- Learning styles moderated the relationship between learners' perceptions and e-learning acceptance, but they only possessed a limited ability to predict e-learning usefulness, learner satisfaction and behavioural intention. Learning styles were also uncorrelated with learners' performance.
- Addressing environmental learning limitations in terms of content representation, knowledge expression and methods of engagement enhanced the e-learning experience in terms of usefulness, satisfaction and users' willingness to accept this technology.
- The learners who were more confident about performing e-learning tasks and had high Internet experience were more likely to become e-learning users.

- The learners who believed that e-learning was useful and easy to use had a greater intention to adopt it in future and were more satisfied. It was demonstrated here that behavioural intention was more closely correlated with e-learning usefulness, whereas learner satisfaction was related to usage ease.
- The learners were more likely to believe in the usefulness of e-learning, if they found it easy to use.

However, some of the hypotheses supported in the first experiment were not confirmed in the second. The findings of hypotheses H1a, b; H2a, b; H5a, b, and H7a, b were therefore inconsistent. Plausible interpretations are summarised here for the failure to identify significant relationships for these hypotheses in the second experiment, as compared to the first:

1) Self-efficacy was not found to be a determinant of e-learning usefulness: if users find that a technology has an important impact on their job performance, they may perceive its usefulness, regardless of their individual skill in using it. However, its ease of use is largely based on an individual's self-confidence in performing a specific task with e-learning technology. Thus, it was found in the first and second experiments, as in previous research, that self-efficacy had more influence on ease of use than it did on usefulness.
2) PEOU failed to have a significant effect on PU and behavioural intention: PEOU can influence PU and/or behavioural intention, if users have limited experience in using a particular technology, such as e-learning. Conversely, for participants with more substantial experience, their perceptions and behavioural intention are more likely to be based on PU than PEOU. A possible reason for this was indicated in the present study, where the learners in the second experiment had fewer concerns with using Moodle, because they had already used it previously. In addition, visual guidance for its use was posted on the Moodle course website. This may explain why PU had a higher impact on behavioural intention than PEOU in both experiments. Tarhini (2013) confirmed that sample size and users' experience could affect the relationship between different variables.
3) PU was not found to significantly influence learner satisfaction: an unexpected result in the second experiment was that PU had an insignificant influence on learner satisfaction. This relationship was in fact approved in the original TAM (see Table 6.10). However, the integration of UDL variables led to reduced impact of PU on PS.

This may be attributed either to the small sample size of the UDL-based e-learning experiment, or to the greater effect of the UDL principles.

Table 8.1: Summary of the Research Hypotheses

		Experiment	
Code	**Hypothesis**	**First Experiment**	**Second Experiment**
H1a, b	Perceived ease of use (PEOU) positively affects perceived usefulness (PU).	**Supported**	Rejected
H2a, b	Perceived ease of use (PEOU) positively affects intention to use (ITU).	**Supported**	Rejected
H3a, b	Perceived ease of use (PEOU) positively affects perceived satisfaction (PS).	**Supported**	**Supported**
H4a, b	Perceived usefulness (PU) positively affects intention to use (ITU).	**Supported**	**Supported**
H5a, b	Perceived usefulness (PU) positively affects perceived satisfaction (PS).	**Supported**	Rejected
H6a, b	E-learning self-efficacy (ELSE) positively affects Perceived ease of use (PEOU).	**Supported**	**Supported**
H7a, b	E-learning self-efficacy (ELSE) positively affects perceived usefulness (PU).	**Supported**	Rejected
H8	Learning styles positively affect perceived usefulness (PU).	Rejected	Not-applicable
H9	Learning styles positively affect intention to use (ITU).	Rejected	Not-applicable
H10	Learning styles positively affect perceived satisfaction (PS).	**Partially Supported**	Not-applicable
H11	UDL principles positively affect perceived usefulness (PU).	Not-applicable	**Partially Supported**
H12	UDL principles positively affect intention to use (ITU).	Not-applicable	**Partially Supported**
H13	UDL principles positively affect perceived satisfaction (PS).	Not-applicable	**Partially Supported**
H14	The active/reflective learning styles dimension moderates the relationship between the model's constructs.	**Supported**	Not-applicable
H15	The sequential/global learning styles dimension moderates the relationship between the model's constructs.	**Supported**	Not-applicable

8.4 The Research Implications

This thesis makes several contributions to the theory and knowledge of e-learning acceptance and information systems (ISs) research. TAM was extended by including two well-known and frequently adopted psychological and pedagogical theories. This research also contributes to the literature by highlighting the barriers to e-learning use in Iraq and identifying other variables that should be considered when investigating e-learning acceptance in developing countries. Accordingly, several theoretical and practical implications arise from this thesis, as presented below:

1) To the best of the researcher's knowledge, this thesis is the first to compare the influence of individual differences and environmental limitations on e-learning acceptance and learners' perceptions. Research on the impact of learning styles and UDL application on e-learning adoption is rare, especially in the Arab world. As a result, this thesis bridges the research gap and contributes to the literature on the impact of these two theories in educational practice, but from a new angle.

2) There is some debate about the soundness of TAM across cultures. Even though it is stated that students from Eastern and Western backgrounds differ in many respects, such as in their physical environment, social relationships, autonomy and learning styles (Chang et al., 2011), the present study has demonstrated that the original factors of TAM can be used to determine technology acceptance, regardless of such cultural variation. This research therefore clearly contributes to existing evidence of the robustness of TAM for investigating e-learning acceptance in an Arab context.

3) This study shows how identical factors can be successfully used to predict adoption behaviour and learner satisfaction, which suggests that both constructs can be combined in a single model, instead of proposing separate models to explain each one.

4) From a methodological point of view, studies on technology acceptance are intensely concentrated on quantitative data, which examines the phenomenon from a positivist viewpoint. However, previous literature confirms the need for a methodological shift towards a mixed method (Tarhini, 213). An important contribution of the present thesis lies in the fact that it combines quantitative and qualitative methods; comparing their findings, highlighting how the effect of these variables can be identified in both methods, and identifying other variables to be considered in e-learning acceptance research. This integration consequently assists in building up a more general picture of the use and adoption of e-learning technology in the context of Iraqi higher education.

5) The psychological trait (learning styles) was extended to examine its impact on learner satisfaction and behavioural intention towards e-learning. The results revealed that learning styles have a limited predictive power for predicting the research variables. Moreover, no significant differences were found in students' willingness to adopt e-learning or their perceptions, based on learning styles, except for the 'processing' dimension. Accordingly, this study contributes to existing

literature that critiques the possible impact of learning styles on educational practice. Nevertheless, these research outcomes should not be treated as confirmation that learning styles can be ignored. In fact, learning styles were shown to moderate the path strength between numerous variables in the research framework. As such, the conclusion drawn here is that e-learning should be designed to ensure flexibility and accessibility, instead of customising its output according to individual learners' preferences.

6) This study provides an empirical solution to e-learning failure. It indicates that such failure can be addressed by considering technical, environmental, pedagogical and motivational factors, which will potentially enhance e-learning acceptance and learner satisfaction. It could potentially find practical applications in the designing of online and blended learning settings. Accordingly, e-learning managers and e-content designers should focus greater attention on designing e-learning courses that motivate learners to accept this use of technology.

7) The present study provides a valid and reliable Arabic instrument to evaluate e-learning acceptance and the accessibility of blended e-learning. This instrument could be used to evaluate learners' willingness to accept e-learning across different educational institutions and in other Arab nations.

8) This research represents the first attempt to identify barriers to e-learning in Iraq, based on three types of stakeholder: academic staff, lecturers in charge of e-learning and undergraduate students. Therefore, another contribution of this thesis is its extension of previous literature on obstacles to e-learning use in developing countries. It also fills the academic research gap in the Iraqi context and opens the door for more studies in this area within other cultures.

9) This research brings to light the main barriers that educational institutions need to overcome, eliminate or circumvent, in order to be able to apply e-learning successfully. Based on a review of e-learning obstacles in developing countries and the findings of the present research, the study lays the cornerstone for improving e-learning implementation in the context of Iraqi higher education.

10) The study empirically identifies the active role of e-learning in teaching and learning from the learners' perspective. As such, leadership and those in positions of decision-making in Iraqi educational institutions need to pay further attention to e-learning application, because of its potential to positively impact learning outcomes.

11) Over recent decades, Iraq has faced adversity as a result of war and ongoing instability, insecurity and the war on terrorism. In some Governorates, these problems prevent many students from attending traditional classes. This study shows that the successful implementation of e-learning could provide an alternative for those restricted by such circumstances.

12) As a further consequence of political conflict and war in Iraq, the number of people with disabilities has increased. In fact Rutherford and Hinton (2015) emphasised that Iraq has some of the highest percentages of people with disabilities. Moreover, according to Alborz et al. (2011), children and young people with disabilities at primary school level and above receive limited support for further education and have few employment opportunities. The present research suggests that if barriers to e-learning application are addressed in Iraq, this technology would offer an alternative opportunity and solution for people with disabilities.

13) Based on the research findings, several recommendations were made to assist educational institutions in optimising their e-learning experience. Acting on these recommendations could lead to a more fruitful e-learning experience in developing countries in general and Iraq in particular.

8.5 Recommendations

From this research, it may be concluded that the successful implementation of e-learning is not something that can be achieved by, for example, simply instituting an e-learning system and providing access for all users. On the contrary, a set of initial steps must be taken prior to implementation. Several recommendations are therefore made here, which could be applied in practice to fulfil e-learning objectives and ensure its effectiveness and adoption. These recommendations were derived from the outcomes of both the quantitative and qualitative analyses:

1) Users' attitudes, perceptions and behavioural intention towards e-learning should be examined at an early stage of implementation, in order to highlight the factors leading to a successful e-learning experience. The results of this research revealed that learners' attitudes to e-learning are based on many factors, such as individual differences, environmental limitations, motivation, technical issues and pedagogical theories. Without considering such dimensions, the e-learning experience will fail to reap its anticipated benefits.

2) It is not recommended to accommodate e-learning content or treat learners differently based on their individual learning styles. However, it is suggested that individual requirements, based on diverse learning styles, should be considered from the outset. This can be achieved by designing a flexible e-learning environment, instead of exerting time and effort over trying to accommodate individual learning styles in the e-learning design.

3) User engagement is the cornerstone of effective e-learning implementation. As an example of a way of engaging academic staff, rewards could be allocated to lecturers who extensively and efficiently exploit e-learning features in their teaching approach. According to Govindasamy (2002), educational institutions could also run competitions for best e-content development, while the efforts of students could be acknowledged by extra marks for the effective use of e-learning.

4) The flexibility of e-learning should be exploited by adopting a range of assessment approaches. This would encourage learners to express their knowledge and understanding in different ways. However, online tests need to be administered in a professional manner that responds to learners' needs, as poorly implemented online exams can have a negative impact on e-learning acceptance.

5) In the light of the above, instructors should therefore carefully design online or blended e-learning courses to provide multimedia instruction, rather than using e-learning systems merely as a means of delivering textual materials, or of presenting student grades. Instead, the medium can be fully exploited to promote interaction between learners and instructors.

6) Intensive training programmes are a necessary part of e-learning implementation and these should be driven in two directions; firstly, to familiarise users with e-learning functionalities and build their self-confidence and secondly, to positively influence their beliefs and technology acceptance. Furthermore, experts in e-content development and the pedagogical theory of e-learning need to explain and disseminate the potential implications of e-learning for educational practice. The integration of pedagogical learning theory into e-learning design will ensure that users' willingness to accept this technology is fostered.

7) The preparation of professional technical staff is a vital step towards maintaining e-learning application and supporting users. If learners or instructors face difficulties, prompt support should be provided to avoid disruption to use.

8) A systematic strategy is required for e-learning implementation. Since this is a new departure for Iraqi universities, the present researcher highly recommends collaboration with other universities, which have already made progress in the application of e-learning, whether in neighbouring or developed countries.

9) A budget for e-learning and an integrated ICTs infrastructure should be prioritised, as well as for other key requirements. However, the adoption of open source learning management systems, such as Moodle, could reduce the expense of software licensing and maintenance.

10) In Iraq, academic staff cannot teach at tertiary level until they have attended and successfully passed a teaching methodology course. Hence, it is recommended here that e-learning theory be introduced into the syllabus of such courses.

11) The current researcher also suggests including e-learning use as a further criterion for the annual assessment of teaching performance. This would promote and stimulate the further application of e-learning.

8.6 Limitations

Despite the significant theoretical and practical findings of this research, it is subject to several limitations, which could be addressed in future research:

1) The research experiments reported in this study were carried out in Iraq. As discussed in Chapter Two, circumstances in Iraq are exceptional, compared to those in neighbouring countries, due to its national instability and low security, exaggerated by political conflict and the war on terrorism. Accordingly, these research findings may not be generalisable to other countries.

2) Two of the research experiments were carried out at a single university and exclusively with Computer Science students. Therefore, these findings cannot be generalised to the entire population in higher education. Moreover, although the samples were of an adequate size, the recruitment of participants from several universities and disciplines could have enhanced the generalisability of the results. However, the reason for limiting the sample to Computer Science undergraduates was that e-learning is a new trend in Iraq and has not been effectively applied to other disciplines.

3) The overall outcomes of the proposed model may indicate the need for further research, integrating other variables or including larger samples. This would enhance the model's ability to predict learner satisfaction and technology adoption. However, the researcher intentionally avoided integrating other factors, because the key objective was to show the role of psychological and pedagogical variables in predicting technology acceptance and learner satisfaction.

4) To test the proposed framework, data were collected through self-assessment surveys. This approach is prone to subjectivity, based on the perspectives of the participants in the environments being investigated.

5) The study applied the Felder and Silverman model to investigate the impact of learning styles on e-learning use. Thus, the weak ability of this framework to predict dependent variables may not be generalisable to other learning style theories, such as Kolb's model, the Honey and Mumford model, or the Dunn and Dunn model.

6) The participants in the UDL-based blended learning experiment had only attended one UDL-based blended course. This may indicate subjective perspectives of that individual course.

7) The experimental group in the UDL-based blended learning study was relatively small. This could explain why the alpha values of the five hypotheses were lower than 0.1 and greater than 0.05. It is therefore anticipated that recruiting a larger sample size would produce better results.

8) The qualitative data were coded and grouped by the researcher himself. As such, the identified themes could have been influenced by his interpretations. On the other hand, the researcher re-visited the data and all categories produced to reduce this influence and ensure that the interpretations were not biased.

8.7 Future Research Directions

This research provides valuable information on the influence of Felder and Silverman's model and the UDL framework on e-learning acceptance and learners' perceptions in blended e-learning environments. It also covers a broader area of research into technology diffusion theory, with particular relevance for e-learning. The outcomes of this thesis are significant for practitioners, educational institutions, e-learning stakeholders and researchers. More specifically, it will have special significance for academics seeking to improve e-learning implementation and adoption in developing countries. However, the

present study opens the door to further investigation into the impact of psychological and pedagogical factors on e-learning acceptance; acknowledging the gap in this research area in the Middle East and the Arab world in general. Accordingly, further possible research directions would include:

1) Further confirmation of these research findings, either by using the same learning styles and universal learning theories, or adopting other frameworks: This could be further recommended for the learning styles model, since it showed a mild ability to predict e-learning acceptance and learners' perceptions, while its dimensions (processing and understanding) had a moderating effect on many relationships in the proposed research framework.

2) Replication of this research in various learning settings with students across disciplines and sociological backgrounds: Even though the present research provides significant information for educational institutions with regard to e-learning adoption, this would further support its findings.

3) Further studies on e-learning success in Iraq and other Arab nations are needed, due to the scarcity of such research, compared to Western countries.

4) Variables drawn from the qualitative analysis in this study (Internet quality, technical support, facilitating conditions, e-learning anxiety and perceived playfulness) can be incorporated into a more comprehensive model to examine their effect, thus building a clearer picture of their role. Here, more quantitative investigation would be able to ascertain their ability to determine e-learning acceptance in greater detail. This investigation could also be conducted amongst different groups of learners, such as those with disabilities, pre-K-12 learners and postgraduate students.

5) Further investigation into the moderating influence of learning styles on technology adoption and comparing the predictive ability of learning styles in different cultures: To the best of the researcher's knowledge, this research direction has not been widely examined in the literature so far. These investigations would shed more light on the role of learning styles theory and derive a more conclusive answer in response to its possible implications.

6) Further focus on e-learning acceptance in learning styles-based adaptive e-learning systems: A comparison of behavioural intention towards e-learning acceptance could be made amongst students accessing an e-learning environment that either

corresponds to, or is at odds with their individual preferences. To the best of the researcher's knowledge, this kind of research has not yet been carried out in previous literature.

7) Finally, due to the cultural and religious factors potentially affecting the interaction behaviour of e-learning users based on their gender differences in the Arab world, there is a need for more focus on the influence of gender on e-learning acceptance and online interaction. This could assist in identifying the relationship between gender, e-learning adoption, communication patterns and culture.

8.8 Personal Reflection

This PhD journey has been a unique and inestimable experience for me, the researcher, not only in academic terms, but also in relation to my life overall. It has been one of my most significant experiences, with a profound and enduring impact on my lifestyle, behaviour and mentality. Throughout this journey, I have gathered a vast amount of information from a substantial array of literature drawn from across multiple disciplines, especially relating to technological, psychological and pedagogical theories. I subsequently found that even though learning styles theory has attracted a considerable amount of attention in e-learning design and adaptation, the empirical findings of the present research did not fully support it. Alternatively, addressing environmental learning limitations proved to be more fruitful in terms of the e-learning experience.

To sum up, undertaking this PhD journey has influenced my thinking with knowledge and information that have consequently opened up avenues for other research in future. As a result, it is my hope that these potential research directions will help to enhance e-learning acceptance and implementation in the developing world in general, with special significance for Iraq.

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Appendix A: The Index of Learning Styles (ILS) Questionnaire

The ILS: English Version

Index of Learning Styles Questionnaire

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Directions
For each of the 44 questions below select either "a" or "b" to indicate your answer. Please choose only one answer for each question. If both "a" and "b" seem to apply to you, choose the one that applies more frequently. When you are finished selecting answers to each question please select the submit button at the end of the form.

1. I understand something better after I
   - **(a)** try it out.
   - **(b)** think it through.
2. I would rather be considered
   - **(a)** realistic.
   - **(b)** innovative.
3. When I think about what I did yesterday, I am most likely to get
   - **(a)** a picture.
   - **(b)** words.
4. I tend to
   - **(a)** understand details of a subject but may be fuzzy about its overall structure.
   - **(b)** understand the overall structure but may be fuzzy about details.
5. When I am learning something new, it helps me to
   - **(a)** talk about it.
   - **(b)** think about it.
6. If I were a teacher, I would rather teach a course
   - **(a)** that deals with facts and real life situations.
   - **(b)** that deals with ideas and theories.
7. I prefer to get new information in
   - **(a)** pictures, diagrams, graphs, or maps.
   - **(b)** written directions or verbal information.
8. Once I understand
   - **(a)** all the parts, I understand the whole thing.
   - **(b)** the whole thing, I see how the parts fit.
9. In a study group working on difficult material, I am more likely to
   - **(a)** jump in and contribute ideas.

- **(b)** sit back and listen.

10. I find it easier
    - **(a)** to learn facts.
    - **(b)** to learn concepts.
11. In a book with lots of pictures and charts, I am likely to
    - **(a)** look over the pictures and charts carefully.
    - **(b)** focus on the written text.
12. When I solve math problems
    - **(a)** I usually work my way to the solutions one step at a time.
    - **(b)** I often just see the solutions but then have to struggle to figure out the steps to get to them.
13. In classes I have taken
    - **(a)** I have usually gotten to know many of the students.
    - **(b)** I have rarely gotten to know many of the students.
14. In reading nonfiction, I prefer
    - **(a)** something that teaches me new facts or tells me how to do something.
    - **(b)** something that gives me new ideas to think about.
15. I like teachers
    - **(a)** who put a lot of diagrams on the board.
    - **(b)** who spend a lot of time explaining.
16. When I'm analyzing a story or a novel
    - **(a)** I think of the incidents and try to put them together to figure out the themes.
    - **(b)** I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.
17. When I start a homework problem, I am more likely to
    - **(a)** start working on the solution immediately.
    - **(b)** try to fully understand the problem first.
18. I prefer the idea of
    - **(a)** certainty.
    - **(b)** theory.
19. I remember best
    - **(a)** what I see.
    - **(b)** what I hear.
20. It is more important to me that an instructor
    - **(a)** lay out the material in clear sequential steps.
    - **(b)** give me an overall picture and relate the material to other subjects.
21. I prefer to study
    - **(a)** in a study group.
    - **(b)** alone.
22. I am more likely to be considered
    - **(a)** careful about the details of my work.

○ **(b)** creative about how to do my work.

23. When I get directions to a new place, I prefer

○ **(a)** a map.

○ **(b)** written instructions.

24. I learn

○ **(a)** at a fairly regular pace. If I study hard, I'll "get it."

○ **(b)** in fits and starts. I'll be totally confused and then suddenly it all "clicks."

25. I would rather first

○ **(a)** try things out.

○ **(b)** think about how I'm going to do it.

26. When I am reading for enjoyment, I like writers to

○ **(a)** clearly say what they mean.

○ **(b)** say things in creative, interesting ways.

27. When I see a diagram or sketch in class, I am most likely to remember

○ **(a)** the picture.

○ **(b)** what the instructor said about it.

28. When considering a body of information, I am more likely to

○ **(a)** focus on details and miss the big picture.

○ **(b)** try to understand the big picture before getting into the details.

29. I more easily remember

○ **(a)** something I have done.

○ **(b)** something I have thought a lot about.

30. When I have to perform a task, I prefer to

○ **(a)** master one way of doing it.

○ **(b)** come up with new ways of doing it.

31. When someone is showing me data, I prefer

○ **(a)** charts or graphs.

○ **(b)** text summarizing the results.

32. When writing a paper, I am more likely to

○ **(a)** work on (think about or write) the beginning of the paper and progress forward.

○ **(b)** work on (think about or write) different parts of the paper and then order them.

33. When I have to work on a group project, I first want to

○ **(a)** have "group brainstorming" where everyone contributes ideas.

○ **(b)** brainstorm individually and then come together as a group to compare ideas.

34. I consider it higher praise to call someone

○ **(a)** sensible.

○ **(b)** imaginative.

35. When I meet people at a party, I am more likely to remember

○ **(a)** what they looked like.

○ **(b)** what they said about themselves.

36. When I am learning a new subject, I prefer to
   - **(a)** stay focused on that subject, learning as much about it as I can.
   - **(b)** try to make connections between that subject and related subjects.
37. I am more likely to be considered
   - **(a)** outgoing.
   - **(b)** reserved.
38. I prefer courses that emphasize
   - **(a)** concrete material (facts, data).
   - **(b)** abstract material (concepts, theories).
39. For entertainment, I would rather
   - **(a)** watch television.
   - **(b)** read a book.
40. Some teachers start their lectures with an outline of what they will cover. Such outlines are
   - **(a)** somewhat helpful to me.
   - **(b)** very helpful to me.
41. The idea of doing homework in groups, with one grade for the entire group,
   - **(a)** appeals to me.
   - **(b)** does not appeal to me.
42. When I am doing long calculations,
   - **(a)** I tend to repeat all my steps and check my work carefully.
   - **(b)** I find checking my work tiresome and have to force myself to do it.
43. I tend to picture places I have been
   - **(a)** easily and fairly accurately.
   - **(b)** with difficulty and without much detail.
44. When solving problems in a group, I would be more likely to
   - **(a)** think of the steps in the solution process.
   - **(b)** think of possible consequences or applications of the solution in a wide range of areas.

Arabic Version (Index of Learning Styles Questionnaire)

النسخة العربية

استبيان مؤشر أساليب التعلم

1) أفهم الشيء بشكل أفضل بعدما:

أ) اجربه

ب) أفكر به بعمق

2) أنا اعتبر أكثر:

أ) واقعي

ب) مبتكر

3) عندما أفكر في شيء عملته بالامس: أنا على الأرجح أسترجع:

أ) صورة

ب) كلمات

4) انا اميل الى:

أ) افهم تفاصيل الموضوع لكني قد اكون مشوش حول الهيكل العام للموضوع

ب) افهم الهيكل العام للموضوع لكني قد اكون مشوش بالتفاصيل

5) عندما اتعلم شيء جديد, يساعدني على فهمه اكثر

أ) التحدث حول الموضوع

ب) التفكير به

6) اذا انا كنت مدرسا, انا افضل ان ادرس كورس

أ) يتعامل مع الحقائق وحالات من الحياة الواقعية

ب) يتعامل مع الافكار والنظريات

7) انا افضل ان احصل على معلومات جديدة من خلال:

أ) الصور, الرسوم البيانية, الاشكال او الخرائط

ب) المواد المكتوبة او المعلومات الشفوية

8) أولا, انا افهم:

أ) جميع الاجزاء, انا افهم كل شيء

ب) كل شيء, انا انظر الى كيفية ارتباط الاجزاء

9) في العمل الجماعي في المواضيع الصعبة, انا اكثر اميل الى:

أ) اقفز واشارك الافكار

ب) اجلس في الخلف واستمع

10) انا اجد سهل

أ) تعلم الحقائق

ب) تعلم المفاهيم

11) في الكتاب الذي يحتوي على العديد من الصور والمخططات, انا على الارجح

أ) انظر الى الصور والمخططات بعناية

ب) اركز على النصوص المكتوبة

12) عندما احل المشاكل الرياضية

أ) انا عادة اعمل على طريقتي الى الحل خطوة واحدة في الوقت

ب) غالبا ما أرى الحلول ولكن بعد ذلك يجب علي أن اناضل من أجل معرفة الخطوات للحصول عليها.

13) في الدروس التي حضرتها

أ) انا عادة تعرفت على الكثير من الطلاب

ب) انا نادرا ما تعرفت على العديد من الطلاب

14) في قراءة قصصية، انا افضل

أ) شيء يعلمني حقائق جديدة أو يقول لي كيفية القيام بشيء ما.

ب) شيء ما يعطيني أفكار جديدة للتفكير حولها.

15) انا افضل التدريسيين

أ) الذين يضعون الكثير من المخططات على اللوحة

ب) الذين يقضون الكثير من الوقت في الشرح

16) عندما احلل قصة او رواية

أ) افكر في الحوادث واحاول وضعها معا لاكتشاف المواضيع.

ب) انا أعلم فقط ما هي المواضيع عندما انتهي من القراءة ومن ثم لا بد لي من العودة وايجاد الحوادث التي توضحها.

17) عندما ابدأ بحل الواجب البيتي, انا على الارجح وغالبا

أ) ابدأ بحل المشكلة مباشرة

ب) احاول فهم المشكلة بشكل كامل في البداية

18) انا افضل فكرة

أ) القطعية

ب) النظرية

19) انا اتذكر افضل

أ) ما اراه

ب) ما اسمعه

20) ان الاكثر أهمية بالنسبة لي هو ان التدريسي:

أ) يعرض المادة في خطوات متسلسلة وواضحة.

ب) أن يعطيني صورة عامة ويربط الموضوع بمواضيع أخرى.

21) انا افضل ان ادرس

أ) مع مجموعة

ب) وحدي

22) انا على الارجح اعتبر

أ) كثير الحرص على تفاصيل عملي

ب) خلاقا حول كيفية فعل عملي

23) عندما احصل على توجيه الى مكان جديد, انا افضل

أ) خارطة

ب) الايعازات المكتوبة

24) انا اتعلم

أ) بوتيرة منتظمة إلى حد ما. إذا أدرس بجد انا سوف "احصل على الفكرة"

ب) في فترات متقطعة وغير منتظمة. سأكون مشوشا تماما فجأة كل شيء يتضح".

25) اود في الواقع اولا

أ) اجرب الاشياء خارجا

ب) افكر كيف سأستطيع القيام بها

26) عندما اقرأ لغرض المتعة, افضل الكتاب الذي

أ) بصورة واضحة يقول المعنى الذي يريده

ب) يقول الافكار بصورة خلاقة وبطرق مشوقة

27) عندما أرى رسم تخطيطي أو رسم في الصف، أنا على الأرجح اتذكر

أ) الصورة

ب) ماذا قال او شرح التدريسي عنها

28) عند النظر الى مجموعة من المعلومات, انا غالبا وعلى الارجح

أ) اركز على التفاصيل وانسى الصورة العامة

ب) احاول فهم الفكرة العامة قبل الحصول على التفاصيل

29) انا اتذكر بسهولة أكثر

أ) شيء ما فعلته

ب) شيء ما فكرت به كثيرا

30) عندما اريد ان انجز وظيفة معينة, انا افضل

أ) اتقن طريقة واحدة للقيام بالعمل

ب) التوصل إلى طرق جديدة للقيام بذلك.

31) عندما شخص ما يريني بيانات, انا افضل

أ) الرسوم والاشكال

ب) نص يلخص النتائج

32) عندما اكتب بحث (او مقالة), انا على الارجح

أ) اعمل على (افكر او اكتب) بداية البحث واتقدم إلى الأمام.

ب) اعمل على (افكر او اكتب) أجزاء مختلفة من البحث ثم ارتبها جميعا.

33) عندما اعمل في مشروع مع مجموعة, انا اولا اريد ان

أ) أن يكون "العصف الذهني للمجموعة" حيث يساهم الجميع في طرح الأفكار.

ب) طرح الأفكار بشكل فردي ومن ثم تقارن الأفكار جميعا.

34) انا اعتبر الاطراء (المديح) لشخص ما:

أ) معقول/مقبول

ب) غير واقعي

35) عندما اقابل الاشخاص في حفلة مثلا, انا على الارجح اتذكر

أ) ما كانت اشكالهم

ب) ما قالوا عن انفسهم

36) عندما اتعلم موضوع جديد, افضل

أ) ابقى مركزا على الموضوع واتعلم الكثير عنه ما استطيع.

ب) احاول الربط بين هذا الموضوع والمواضيع ذات الصلة.

37) انا اكثر ارجح أن اعتبر

أ) ودي

ب) متحفظ

38) افضل الدروس التي تركز على

أ) مادة ملموسة (الحقائق والبيانات)

ب) مادة تجريدية (مفاهيم ونظريات).

39) لغرض الترفيه, انا اكثر

أ) اشاهد التلفزيون

ب) أقرا الكتاب

40) بعض التدريسيين يبدأون المحاضرات بتغطية الخطوط العامة للموضوع, مثل هذه الخطوط العامة:

أ) الى حد ما مفيدة لي

ب) جدا مفيدة بالنسبة لي

41) فكرة عمل الواجب البيتي مع مجموعة باعطاء نفس الدرجة لجميع اعضاء المجموعة

أ) تروق لي

ب) لا تروق لي

42) عندما اقوم بحسابات طويلة

أ) اميل الى اعادة جميع الخطوات وادقق عليها بعناية

ب) أجد فحص عملي ممل واجبر نفسي على القيام بذلك.

43) اميل الى تصور الاماكن التي كنت بها

أ) بسهولة وبدقة الى حد ما

ب) بصعوبة وبدون تفاصيل كثيرة

44) عندما احل المشاكل في فريق عمل (مجموعة), انا على الارجح

أ) افكر في الخطوات لعملية الحل

ب) افكر في النتائج المحتملة أو تطبيق الحل في مجموعة واسعة من المجالات.

Appendix B: The Research Questionnaire

The First Experiment (Arabic and English Versions)

Factor	Question	Reference
Intention to Use (ITU)		
1- Assuming I have access to e-learning (Moodle) in BL, I intend to use it.	1. على فرض إنني لدي الوصول لنظام التعلم الالكتروني (مودل) في التعليم المختلط فإنني أنوي استخدامه	Adapted from Venkatesh & Davis (2000)
2- Given that I have access to e-learning (Moodle), in BL, I predict that I would use it.	2. نظرا إلى أنه لدي الوصول إلى نظام التعلم الالكتروني (مودل) في التعليم المختلط أتوقع أنني سوف استخدمه	
Perceived Usefulness (PU)		
3- Using e-learning (Moodle) improves my performance in BL.	3. استخدام نظام التعلم الالكتروني (مودل) في التعليم المختلط يحسن أدائي	Adapted from Venkatesh & Davis (2000)
4- Using e-learning (Moodle) in BL increases my scientific performance.	4. استخدام نظام التعلم الالكتروني (مودل) في التعليم المختلط يضاعف أدائي العلمي	
5- Using e-learning (Moodle) in BL enhances my learning effectiveness.	5. استخدام نظام التعلم الالكتروني (مودل) في التعليم المختلط يشرفني على الحياة الدراسية	
Perceived Ease of Use (PEOU)		
6- The interaction with e-learning (Moodle) is clear and understandable.	6. التفاعل مع نظام التعلم الالكتروني (مودل) واضح ومفهوم	Adapted from Venkatesh & Davis (2000)
7- Interacting with e-learning (Moodle) in BL does not require a lot of mental effort.	7. التفاعل مع نظام التعلم الالكتروني (مودل) في التعليم المختلط لا يتطلب الكثير من الجهد الذهني	
8- I find e-learning (Moodle) to be easy to use in BL.	8. أجد استخدام نظام التعلم الالكتروني (مودل) في التعليم المختلط سهل.	
9- I find the environment of e-learning (Moodle) to be easy to use.	9. أجد البيئة في نظام التعلم الالكتروني (مودل) سهل.	
E-Learning Self-Efficacy (ELSE)		
10- I can use e-learning (Moodle) in BL, if there is no one around to tell me what to do as I go.	10. يمكنني استخدام نظام التعلم الالكتروني (مودل) في التعليم المختلط حتى اذا لا يوجد أحد يخبرني ماذا يجب ان أفعل	Adapted from Wu et al. (2010)
11- I can use e-learning (Moodle) in BL, if I had never used a system like it before.	11. يمكنني استخدام نظام التعلم الالكتروني (مودل) في التعليم المختلط حتى اذا لم أستخدم نظاما مثله من قبل	
12- I can use e-learning (Moodle) in BL, even if there is no assistant illustration tool with the system.	12. يمكنني استخدام نظام التعلم الالكتروني (مودل) في التعليم المختلط حتى أذا لم تتوفر ألة شرح مساعدة مع النظام	
Perceived Satisfaction (PS)		
13- I am satisfied with the BELS efficiency.	13. انا راض عن كفاءة نظام التعلم الالكتروني المختلط.	Adapted from Chiu et al. (2005)
14- I am satisfied with the BELS effectiveness.	14. انا راض عن فعالية نظام التعلم الالكتروني المختلط.	
15- Overall, I am satisfied with the BELS.	15. بصورة عامة, انا راض عن نظام التعلم الالكتروني المختلط	

The Second Experiment (Arabic and English Versions)

Part I: The Model Dimensions

Factor	Question	Reference
Intention to Use (ITU)		
1- Assuming I have access to e-learning (Moodle) in BL, I intend to use it.	1. على فرض إمكانية الوصول الى نظام التعلم الالكتروني (مودل) في بيئة التعلم المختلط فأنا أنوي استخدامه	Adapted from Venkatesh & Davis (2000)
2- Given that I have access to e-learning (Moodle), in BL, I predict that I would use it.	2. نظرا إلى أنه بإمكاني الوصول إلى نظام التعلم الالكتروني (مودل) في التعلم المختلط أتوقع أنني سوف استخدمه	
Perceived Usefulness (PU)		
3- Using e-learning (Moodle) improves my performance in BL.	3. استخدام نظام التعلم الالكتروني (مودل) في بيئة التعلم المختلط يحسن أدائي	Adapted from Venkatesh & Davis (2000)
4- Using e-learning (Moodle) in BL increases my scientific performance.	4. استخدام نظام التعلم الالكتروني (مودل) في بيئة التعلم المختلط يرفع من أدائي العلمي	
5- Using e-learning (Moodle) in BL enhances my learning effectiveness.	5. استخدام نظام التعلم الالكتروني (مودل) في بيئة التعلم المختلط يحسن من فعاليتي الدراسية	
Perceived Ease of Use (PEOU)		
6- The interaction with e-learning (Moodle) is clear and understandable.	6. التفاعل مع نظام التعلم الالكتروني (مودل) واضح ومفهوم	Adapted from Venkatesh & Davis (2000)
7- Interacting with e-learning (Moodle) in BL does not require a lot of mental effort.	7. التفاعل مع نظام التعلم الالكتروني (مودل) في بيئة التعلم المختلط لا يتطلب الكثير من الجهد الذهني	
8- I find e-learning (Moodle) to be easy to use in BL.	8. أجد نظام التعلم الالكتروني (مودل) في بيئة التعلم المختلط سهل الاستخدام.	
9- I find the environment of e-learning (Moodle) to be easy to use.	9. بيئة نظام التعلم الالكتروني (مودل) سهلة الاستخدام).	
E-Learning Self-Efficacy (ELSE)		
10- I can use e-learning (Moodle) in BL, if there is no one around to tell me what to do as I go.	10. يمكنني استخدام نظام التعلم الالكتروني (مودل) في بيئة التعلم المختلط حتى اذا لا يوجد أحد يخبرني ماذا يجب ان أفعل	Adapted from Wu et al. (2010)
11- I can use e-learning (Moodle) in BL, if I had never used a system like it before.	11. يمكنني استخدام نظام التعلم الالكتروني (مودل) في بيئة التعلم المختلط حتى اذا لم أستخدم نظاما مثله من قبل	
12- I can use e-learning (Moodle) in BL, even if there is no assistant illustration tool with the system.	12. يمكنني استخدام نظام التعلم الالكتروني (مودل) في بيئة التعلم المختلط حتى أذا لم تتوفر ألة شرح مساعدة مع النظام	
Perceived Satisfaction (PS)		
13- I am satisfied with the BELS efficiency.	13. انا راض عن كفاءة نظام التعلم الالكتروني المختلط.	Adapted from Chiu et al. (2005)
14- I am satisfied with the BELS effectiveness.	14. انا راض عن فعالية نظام التعلم الالكتروني المختلط.	
15- Overall, I am satisfied with the BELS.	15. بصورة عامة, انا راض عن نظام التعلم الالكتروني المختلط	
Multiple Means of Representation (MMR)		
16- I liked the use of video lectures with the included notes and written illustration in this BELS.	18) لقد احببت استخدام محاضرات الفيديو بما تحتويه من ملاحظات وتلخيصات توضيحية في نظام التعلم الالكتروني المختلط هذا	Adapted from Liaw (2008)
17- I liked the use of multiple means to represent and explain learning content in this BELS.	19) لقد احببت استخدام وسائل متعددة لشرح المحتوى التعليمي في نظام التعلم الالكتروني المختلط هذا	
18-I liked the use of multiple means of multimedia instructions (video, PowerPoint, figures, images, texts) in this BELS.	20) لقد احببت استخدام وسائل متعددة من تعليمات الوسائط المتعددة (فيديو, بوربوينت, اشكال, صور, نصوص) في نظام التعلم الالكتروني المختلط هذا	
Multiple means of Action and Expression (MMAE)		
19- The length and content of multiple means of assessments were appropriate in this blended e-learning course.	21) طول ومحتوى مختلف وسائل التقويم كانت مناسبة في كورس التعلم الالكتروني المختلط هذا	Questions 21 and 22 Adapted from:

20- The use of multiple means of assessments gave me better opportunity to express my understanding in this blended e-learning course. 22) إستخدام وسائل متعددة للتقييم أعطاني فرصة أفضل للتعبير عن فهمي في كورس التعلم الالكتروني المختلط هذا	Said et al, (2015).
21- The grading procedures were clear and fair in this blended e-learning course. 23) كانت إجراءات تقييم الدرجات واضحة وعادلة في نظام التعلم الإلكتروني المختلط هذا	
22- I got prompt, helpful and appropriate feedback on class and online works in a timely fashion in this blended e-learning course. 24) لقد حصلت على ملاحظات معززة, مساعدة ومناسبة حول عملي في الصف او عبر الموقع الالكتروني وفي الوقت المناسب في كورس التعلم الالكتروني المختلط هذا	
Multiple Means of Engagement (MME)	
23- The way of designing this blended e-learning course engaged me. 25) طريقة تصميم كورس التعلم الالكتروني المختلط هذا جذبتني	Adapted from Smith (2012).
24- The use of e-learning system engaged me more to interact with learning content in this blended e-learning course. 26) استخدام نظام التعليم الالكتروني حمسني أكثر للتفاعل مع محتويات التعلم في كورس التعليم الالكتروني المختلط هذا	
25- I found that tasks were full of meaning and purpose in this blended e-learning course. 27) لقد وجدت ان المهام تحتوي على الكثير من المعاني في كورس التعليم الالكتروني المختلط هذا.	
26- Overall, I was enthusiastic about this blended e-learning course. 28) بصورة عامة, كنت متحمس حول كورس التعلم الالكتروني المختلط هذا	

Part II: Usefulness of the Course Materials:

Course material	**Accessed**		**Helpful**	
Text version of the course outlines النسخة النصية لملخص عام لمقرر الكورس	Yes	No	Yes	No
Animated PowerPoint version of the course outlines نسخة البوربوينت المتحركة لملخص عام لمقرر الكورس	Yes	No	Yes	No
Video recording of the course outlines تسجيل الفيديو لملخص عام لمقرر الكورس	Yes	No	Yes	No
Text versions (PDF and word) of lectures النسخ النصية بي دي أف و وورد للمحاضرات	Yes	No	Yes	No
PowerPoint versions of lectures outlines نسخ البوربوينت لملخصات عامة للمحاضرات	Yes	No	Yes	No
Video recordings with notes and written illustration that includ overview and goals of every lecture تسجيلات الفيديو والصوت مع ملاحظات وتعليقات توضيحية مكتوبة يتضمن أهداف ونظرة عامة لكل محاضرة	Yes	No	Yes	No
Video recordings with notes and written illustration that explained topics of every lecture تسجيلات الفيديو والصوت مع ملاحظات وتعليقات توضيحية مكتوبة تشرح مواضيع كل محاضرة	Yes	No	Yes	No
Video recordings with notes and written illustration that summarised every lecture تسجيلات الفيديو والصوت مع ملاحظات وتعليقات توضيحية مكتوبة تلخص كل محاضرة	Yes	No	Yes	No
Video recordings with notes and written illustration that reviewed topics of previous lectures تسجيلات الفيديو والصوت مع ملاحظات وتعليقات توضيحية مكتوبة تعرض مراجعة للمحاضرات السابقة	Yes	No	Yes	No
Video recordings with notes and written illustration that demonstrated how to design a full website تسجيلات الفيديو والصوت مع ملاحظات وتعليقات توضيحية مكتوبة تعرض كيفية تصميم موقع متكامل	Yes	No	Yes	No
Web pages that included further information about main topics of every lecture صفحات الويب التي تحتوي على معلومات اضافية حول الموضوع الرئيسي لكل محاضرة	Yes	No	Yes	No
Text-only version of a lecture notes النسخة النصية فقط لملاحظات المحاضرة	Yes	No	Yes	No
Text-only version of the assignment preparation النسخة النصية فقط لاعداد التقرير	Yes	No	Yes	No
Text-only version of project preparation	Yes	No	Yes	No

الن سخة الن صية فقط لاعداد المشروع				
Video recordings with notes and written illustration that demonstrated how to use the e-learning system ن سخ الفيديو المسجلة والتي تحتوي على ملاحظات وتعليقات توضيحية والتي عرضت في قرات خدام ن ظام التعلم الالكتروني				

Of the course materials above that you accessed, which was the MOST helpful and why? من مواد الكورس التي تم الوصول اليها, ما هي الأكثر فائدة ولماذا؟
The most helpful course material:……. الأكثر فائدة من مواد الكورس هو:
This was helpful because…… هذه كانت مفيدة بسبب:

Part III: Helpfulness of the Course Attributes:

Course attributes	**Impact**	
Choices for written one of two reports due dates الاختيار بين تقريرين مكتوبين من اثنين وقت محدد	Positive	Negative
Choices for self-assessments in e-learning الاختيار بين اداة التقييم الذاتي في الموقع	Positive	Negative
Designing web pages project by using the concepts that were explained in this course. تصميم مشروع موقع ويب باستخدام المفاهيم التي تم عرضها في الكورس	Positive	Negative
Quick quizzes during weekly lectures الاختبارات السريعة خلال المحاضرات الاسبوعية	Positive	Negative
Problem-solving in a laboratory حل المشكلة في المختبر	Positive	Negative
Theoretical exam الامتحان النظري	Positive	Negative
Classroom discussion المناقشة داخل الصف	Positive	Negative
Discussion through the e-learning system المناقشة في الموقع الالكتروني	Positive	Negative
Posting of class lectures and explanation prior to the relevant class رفع المحاضرات والشروحات في الموقع قبل موعد المحاضرة داخل الصف	Positive	Negative

Of the attributes listed above, which was the MOST helpful and why? من الخصائص المذكورة أعلاه، ما هي التي كانت الأكثر فائدة ولماذا؟
Most useful course attribute: السمة الأكثر فائدة هي:
This attribute was useful because: هذه السمة كانت مفيدة لأنها:

Appendix C: The First Pilot Study

Appendix D: The Second Pilot Study

Learner Differences in Perceived Satisfaction of an Online Learning: an Extension to the Technology Acceptance Model in an Arabic Sample

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Abstract: Online learning constitutes the most popular distance-learning method, with flexibility, accessibility, visibility, manageability and availability as its core features. However, current research indicates that its efficacy is not consistent across all learners. This study aimed to modify and extend the factors of the Technology Acceptance Model (TAM) to examine perceived satisfaction of an Arabic sample in online learning. The integrated factors in the modified model includes: deep level (learning styles), surface level (gender), and cognitive (online self-efficacy) factors. Learning styles were chosen as a central factor. Hence, the online course was purposefully developed to support one pole in each dimension of Felder and Silverman Learning Styles Model (FSLSM) in order to reveal the pedagogical implications of learning styles on learner satisfaction. A total of 70 learners participated voluntarily in the research. At the end of the online course, they were requested to fill in two questionnaires: the Index of Learning Styles (ILS) and a standard questionnaire. The psychometric properties of the latter were firstly analysed to validate the instrument. Then, Partial Least Squares Structural Equation Modelling (PLS-SEM) was conducted to examine the proposed hypotheses. The model achieves an acceptable fit and explains 44.8% of variance. Perceived usefulness represented the best predictor, whereas online self-efficacy and perceived ease of use failed to show a direct impact on perceived satisfaction. Furthermore, neither learning styles nor gender diversity had direct influence on the dependent factors. Accordingly, the research suggested that other variables may have to be integrated to enhance the power of the model.

Keywords: online learning, learning styles, gender diversity, online self-efficacy, learner satisfaction, Technology Acceptance Model (TAM)

1 Introduction

The rapid development of digital technologies, and most prominently, e-learning, has revolutionised the methods of distance learning. In this vein, a definition of e-learning must first be established and perhaps the most widely-accepted definition is "the delivery of learning with the assistance of interactive, electronic technology, whether offline or online" as cited in Procter (2003). It is noteworthy that 'e-learning' and 'online learning' are not synonymous terminologies. For the purposes of this research, 'e-learning' is used as a general concept encompassing online learning as well.

Although the flexibility, accessibility, visibility, manageability, and availability of e-learning systems have helped to address some of the limitations of traditional learning, this does not mean that traditional methods are to be altogether replaced yet. The examination of e-learners responses to their online learning experience can shed some light on why this is so. According to Bouhnik & Marcus (2006), some common expressions of dissatisfaction are connected with the absence of a 'learning atmosphere', and the lack of direct, for example, face-to-face interaction between 'learner-learner' and 'learner-instructor'. They also stated that in online learning settings, students believe that they do not get enough detail in response to their enquiries, and the needed time to learn a new topic is longer, when compared with apprehending a new topic in a traditional way.

Other personal and environmental factors that may lead to user dissatisfaction entail the absence of 'self-motivation', the difficulty of constructing new knowledge without direct guidance, and the lack of self-efficacy in the use of e-learning (Bouhnik & Marcus, 2006; Dutton, Dutton, & Perry, 2001). Such drawbacks are indicative of the reasons why some users withdraw from their online courses after their first experience or failure to pass it. Thus, in order to accept the conclusion of Sun, Tsai, Finger, Chen, & Yeh (2008) that e-learning is an alternative method to traditional learning, such issues have to be tackled.

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Many models were proposed to examine factors that can help towards the prediction of user intention to accept technologies, or perceived satisfaction, for instance, the Theory of Planned Behaviour (TPB) (Ajzen, 1991), the Consumer Acceptance of Technology (CAT) model (Kulviwat, Bruner, Kumar, & Clark, 2007), the Integrated Conceptual Model (ICM) (Sun et al., 2008), and the Technology Acceptance Model (TAM) (Davis, 1986). According to literature, TAM represents one of the most commonly used models (Bogozzi, 2007; Tarhini, Hassouna, & Abbasi, 2015; Sun et al., 2008). Although it has been widely adopted, few studies have investigated its reliability and validity in developing countries (Tarhini et al., 2015; Teo, 2008). Furthermore, the model was designed for use with a general variety of technologies, and not a particular one.

In Iraq, the Higher Education system is considered the best in the Middle East and, more specifically, in the Arab Gulf region (Kaghed & Dezaye, 2009). However, it was isolated from the environment of scientific research due to the regime of Saddam Hussein and the sanctions imposed by the United Nations (Kaghed & Dezaye, 2009). Until the middle of 2003, Iraqi people did not have access to the internet because its public usage was forbidden by the authorities. After the second Gulf war, the Ministry of Higher Education and Scientific Research (MHESR-I) took serious steps to reconstruct Higher Education albeit in pertinence to the traditional education only; attempts for the adoption of e-learning have been limited. Many reasons can be accounted for this and the prevention of widespread use of online learning in Iraq such as the low internet bandwidth even in public educational institutions; the lack of experience of the internet and web-based learning; poverty and low income. Hence, the present study attempted to examine learner perspectives on this new experience in order to promote quality in learning. In this context, this is unexplored area of research. Learning styles as a psychological factor were integrated in the course design as a core variable that may affect learner perceptions. Although more than 71 learning style models were proposed (Coffield, Moseley, Hall, & Ecclestone, 2004), the FSLSM (Felder & Silverman, 1988) was adopted in this research for several reasons. Firstly, it is the most dominant model in previous studies (Akbulut & Cardak, 2012; Al-Azawei & Badii, 2014). Moreover, it is suitable for Technology Enhanced Learning (TEL) (Graf, 2007; Viola, Graf, & Leo, 2006). Finally, the proposed instrument to diagnose this model was validated (Felder & Brent, 2005; Litzinger, Lee, Wise, & Felder, 2007; Zywno, 2003).

This research aimed to achieve two goals. First, it modified TAM in order to assess perceived satisfaction in online learning instead of attitude to use a technology by incorporating three individual variables of learners: deep level factor (learning styles), surface level factor (gender diversity), and cognitive factor (online self-efficacy). The central factor in this modification was learning styles because studies have not provided conclusive evidence either for or against their pedagogical impacts on perceived satisfaction, or whether mismatching teaching and learning styles can lead to learner dissatisfaction. Accordingly, the investigated learning environment was designed to serve one pole in each dimension of the FSLSM. Second, the study examined the soundness of the modified version of TAM in a developing country in order to contribute to the existing evidence regarding the appropriateness of the model in such learning environment. The rest of the research is structured as follows. In Section 2, the basic concepts are discussed. Section 3 identifies the main factors of the proposed model and hypotheses. Section 4 depicts the adopted methodology. The main findings are presented and discussed in Section 5. Subsequently, Section 6 highlights the implications and limitations of the research. Finally, Section 7 encapsulates the main themes of the study and the possible future work.

2 Basic Concepts

2.1 Online learning

Online learning has been classified into two categories: synchronous and asynchronous. In the former, learners and instructors are geographically separated, but work simultaneously; in the latter, learners and instructors are both geographically and timely separated. In this research, asynchronous category was adopted because it gives learners more flexibility to reflect on the course content and the issue of time zone was addressed. According to Solimeno, Mebane, Tomai, & Francescato (2008), online learning is very suitable for people who have problems of time-management or job-commitment nature. However, the benefits of online learning are subject to other variables of learners, teachers, and learning environments. Accordingly, the reasons underlying learner dissatisfaction have not been investigated out of these dimensions.

On the other hand, the core drawback in an asynchronous learning environment is the absence of direct face-to-face interaction. Sweeney, Ingram, & Swee (2001) compared face-to-face, synchronous, and asynchronous learning modes. From learners' perspective, traditional tutorials were more preferable, effective, helpful, and satisfying, whereas chat room in synchronous tutorials was more enjoyable. Furthermore, whilst ethnicity

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showed to affect learner perception of type of tutorial, gender and internet experience did not. Generally, all participants preferred face-to-face learning over the other two types.

2.2 The Technology Acceptance Model (TAM)

Davis (1986) proposed the Technology Acceptance Model (TAM) to predict the tendency of users to accept technologies. The model was originally developed to explain the behaviour of users towards computer-usage and Information Technology (IT). The main variables in this model are perceived usefulness (PU) and perceived ease of use (PEOU) which can influence users' attitudes towards using a technology (ATU). This model is widely employed in order to assess the acceptance of a particular technology (Bogozzi, 2007; Tarhini et al., 2015). Investigating the integrated factors exhibited how they perfectly linked with user attitude and behavioural intention. Therefore, studies have adopted the model to reveal the acceptance of users towards, for example, e-mail, computer based learning, blended learning, Rich Site Summaries (RSS), and online learning (Gefen & Straub, 1997; Ong & Lai, 2006; Liu, Chen, Sun, Wible, & Kuo, 2010; Tarhini et al., 2015).

On the other hand, perceived usefulness and ease of use factors affecting learner satisfaction, appeared to be the most important parameters in studies aiming to find the causal relationship among different variables and perceived satisfaction (Arbaugh, 2000; Atkinson & Kydd, 1997; Drennan, Kennedy, Pisarski, & Taylor, 2011; Liaw, 2008; Sun et al., 2008). In theory, there is an axiomatic relationship among perceived usefulness, ease of use and satisfaction because compounding increased expectation of outcome improvement with less effort leads to higher level of satisfaction. Consequently, based on the positive results of literature such as these in Liaw (2008) and Sun et al. (2008), we investigated the causal link among these factors and learner satisfaction as the first change in the original TAM.

3 Theoretical Framework and Hypotheses

Although many factors can be incorporated to infer learner satisfaction, the notion that 'simpler is better' was adopted. Therefore, only learner characteristics were used to modify and extend TAM, so as to illustrate the role of such features, more specifically, learning styles. Davis (1986) examined the effect of perceived usefulness (PU) and ease of use (PEOU) with the intention to adopt a technology. The expectation that a particular technology would not assist to enhance performance or it require high mental effort may lead to users' dissatisfaction. As such, we examined the value of PU and PEOU on perceived satisfaction (PS). However, individual differences should be considered because such features and psychological traits may affect learner satisfaction in online learning. Additionally, prior literature that used TAM as a research framework indicated the importance of extending the model to improve its power (Edmunds, Thorpe, & Conole, 2012; Legris, Ingham, & Collerette, 2003; Venkatesh & Davis, 2000); hence, another change in the TAM includes integrating learning styles (deep level factor), gender diversity (surface level factor), and online self-efficacy (OSE) (cognitive factor). Figure 1 depicts the proposed dimensions of the model.

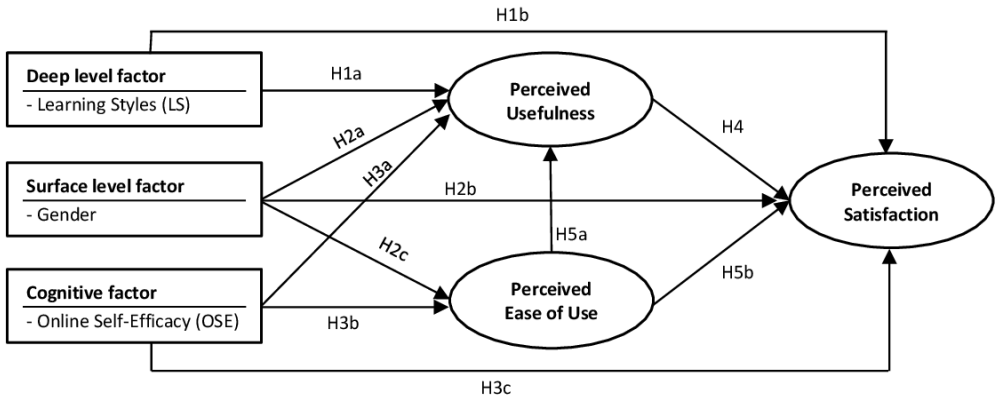

Figure 1: The proposed model

3.1 Deep level factor (Learning styles)

Learning styles represent the main extension of this study as a deep level factor, with potential influences on perceived usefulness and satisfaction. Felder (1996) defined learning styles as the "characteristic strengths and

preferences in the ways they 'learners' take in and process information". The hypothesis of learning styles suggests the importance of matching learning and teaching styles because this trait affects academic achievement, learning time, learning patterns and learner satisfaction (Brown, 2007; Graf, 2007; Klašnja-Milićević, Vesin, Ivanović, & Budimac, 2011; Popescu, 2010). Additionally, as Felder & Brent (2005) stated, neglecting learning styles results in learners to withdrawing from a course or underperforming. Respectively, there seems to be a correlation among these factors as learners will not accept a learning environment if their preferences are ignored. Based on this assumption, perceived usefulness and satisfaction regarding a particular learning technology may rely on the level of accommodating their styles. Contrary, some researchers have disputed the pedagogical implications of learning styles due to the absence of convincing evidence to support such value (Mayer, 2011; Pashler, McDaniel, Rohrer, & Bjork, 2008). According to Mayer (2011, p320), "researchers and practitioners must search long and hard for the educational implications of styles research". Towards this end, this trait was integrated in the modified model by assuming that catering an online course in accordance with a particular style of learners may enhance their perceived usefulness and satisfaction. In the authors' best knowledge, literature did not test the causal link among learning styles, perceived usefulness, and perceived satisfaction by accommodating a learning context as per the particular dichotomies of learning styles in the TAM.

***H1a**: Learners' learning styles positively affect perceived usefulness (PU) in online learning.*

***H1b**: Learners' learning styles positively affect perceived satisfaction (PS) in online learning.*

3.2 Surface level factor (Gender diversity)

Many studies have investigated the implications of gender diversity on learning experience, for instance, in terms of outcome and satisfaction (Al-Azawei & Lundqvist, 2014; Hong, 2002; Lau & Yuen, 2009). However, the results were inconsistent suggesting further research (Shore et al., 2009). Gefen & Straub (1997) stated that women's responses to certain situations tend to be different than men's. This suggests that IT theories and technology acceptance research should attempt to consider gender differences. Cagiltay, Yildirim, & Aksu (2006) demonstrated that males and females are inclined to adopt different learning methods; women preferred a liner approach, whereas men tend to adopt a non-linear one. Gefen & Straub (1997) extended TAM by adding gender as a one of the fundamental cultural differences. The inspection of the incorporated sample did not show that gender affected e-mail adoption. However, men and women differed in their perceptions. Moreover, Ong & Lai (2006) recommended that researchers should consider gender diversity during the investigations of e-learning theories. Significant dissimilarities were found between men and women with regard to PU, PEOU, computer self-efficacy, and behavioural intention to adopt e-learning (Ong & Lai, 2006). Based on such literature, gender diversity was included to examine the causal relationship among these factors.

***H2a**: Learners' gender diversity positively affects perceived usefulness (PU) in online learning.*

***H2b**: Learners' gender diversity positively affects perceived satisfaction (PS) in online learning.*

***H2c**: Learners' gender diversity positively affects perceived ease of use (PEOU) in online learning.*

3.3 Cognitive factor (online self-efficacy OSE)

Self-efficacy was defined as a learner's cognitive beliefs affecting their behaviour when using a technology (Wu, Tennyson, & Hsia, 2010). In this context, the technology refers to online learning. Some studies identified anxiety and computer skills as parameters influencing the online learning experience (Hong, 2002; Sun et al., 2008). However, we excluded them from our study, as all subjects, except for two, belonged to the computer science field. In addition to perceived usefulness and ease of use as two identified cognitive factors in the TAM, we included online self-efficacy (OSE) as another cognitive construct because e-learning had recently been used in Iraq.

As literature indicates, the effect of OSE on learning experience has been empirically investigated (Johnson et al. 2008; Liaw 2008; Ong & Lai, 2006; Sun et al. 2008). Based on the concept of OSE as a reflection of learners' expectations, it was anticipated to be a significant factor which might influence PU (Ong & Lai, 2006). Investigating the causal link between self-efficacy (SE) and PEOU showed the importance of this factor to predict the latter (Ong & Lai, 2006; Weiyin, James, Wai-Man, & Kar-Yan, 2001) . Additionally, Sun et al. (2008) found that SE was a predictor of PS. Accordingly, we suggest that OSE is an influential factor in online learning.

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***H3a**: Online self-efficacy (OSE) positively affects perceived usefulness (PU) in online learning.*

***H3b**: Online self-efficacy (OSE) positively affects perceived ease of use (PEOU) in online learning.*

***H3c**: Online self-efficacy (OSE) positively affects perceived satisfaction (PS) in online learning.*

3.4 Perceived usefulness (PU)

Perceived usefulness was defined as "the degree to which an individual believes that using a particular system would enhance his or her performance" (Davis, 1986, p26). It was suggested that perceived usefulness (PU) has a significant impact on accepting a technology, and that it can explain a user's attitude (Davis, 1986). As shown in literature, PU was a substantial predictor of perceived satisfaction weather in blended or online learning (Liaw, 2008; Sun et al., 2008). The criteria of Learners when rating the usefulness of a technology rely on their expectation that a technology will aid towards outcome amelioration and goal achievement. Online learning represents a new trend in the developing countries, and more specifically Iraq. Thus, we hoped to investigate learner satisfaction of online learning in accordance with this factor.

***H4**: Perceived usefulness (PU) positively affects perceived satisfaction (PS) in online learning.*

3.5 Perceived ease of use (PEOU)

Perceived ease of use was defined as "the degree to which an individual believes that using a particular system would be free of physical and mental effort" (Davis, 1986, p26). Hence, TAM and the Technology Acceptance Model 2 (TAM2) illustrated PEOU significance in determining PU and users' attitudes towards a technology (Davis, 1986; Venkatesh & Davis, 2000). It directly associates with PS because learners, more specifically in non-mandatory courses, are reluctant to continue using an online system if they face difficulties in employing it and may be prone to dropping a course or to searching for an alternative learning environment. Therefore, literature has linked PEOU with PS (Liaw, 2008; Sun et al., 2008). Grounded on such findings, PEOU was regarded as an influential factor on PU and PS.

***H5a**: Perceived ease of use (PEOU) positively affects perceived usefulness (PU) in online learning.*

***H5b**: Perceived ease of use (PEOU) positively affects perceived satisfaction (PS) in online learning.*

3.6 Perceived satisfaction (PS)

Investigating factors that influence learner satisfaction can play a vital role in understanding the path to success in an e-learning situation and it is hoped that consideration of such variables will contribute to an enhancement of learning experience. Learner satisfaction means

> easily reflects outcomes of reciprocity that occur between students and an instructor instructor…keeps an instructor on his or her toes as a double-check to make sure that material is relevant and current or that students see themselves learning.… (Guolla, 1999 as cited in Thurmond, Wambach, Connors, & Frey, 2002, p176).

Furthermore, Wu, Tennyson, & Hsia (2010) define learner satisfaction as the acquisition of all the advantages a learner aims to receive from learning, as per his behavioural beliefs and attitudes. Based on these definitions, PS is a key factor stemming from the completion of a learning task, where the aimed outcomes derive enjoyably. Bolliger & Wasilik (2009) accounted perceived satisfaction as a vital aspect to continue learning.

Educational institutions should give special consideration to meet learner satisfaction. From a commercial perspective, students are similar to customers. Thus, their learning needs should be met. From a learning point of view, students cannot learn properly if they feel that there are environmental or personal barriers preventing them to achieve their objectives. As a result, Donohue & Wong (1997) indicated that learners level of motivation is affected by their satisfaction.

Many variables can influence perceived satisfaction. Bolliger & Martindale (2004) discussed three factors that represent a central key of learner satisfaction in online learning: instructors, technology, and interactivity. The learner factor, however, is not of less importance than these factors. Table 1 chronologically summarises some studies that examined the impacts of several variables on learner satisfaction.

Table 1: Literature review

Author(s)	sample	Examined variables
Hong (2002)	26	Computer experience, gender, age, scholastic aptitude, learning styles, student–instructor and student–student interactions, perception of the course activities, asynchronous, and time spent on the course.
Bouhnik & Marcus (2006)	-	Interaction (learner-content, learner-teacher, learner-learner and learner-system).
Johnson, Hornik, & Salas (2008)	345	Application-specific computer self-efficacy (AS-CSE), technology usefulness, interaction and social presence.
Sun et al. (2008)	295	Learner dimension (Learner attitude towards computers, Learner computer anxiety and Learner Internet self-efficacy), Instructor dimension (Instructor response timeliness and Instructor attitude towards e-Learning), Course dimension (E-Learning course flexibility and E-Learning course quality), Technology dimension (Technology quality and Internet quality), Design dimension (Perceived usefulness and Perceived ease of use) and Environmental dimension (Diversity in assessment and Learner perceived interaction with others).
Wu, Tennyson, & Hsia (2010)	212	Cognitive variables (self-efficacy and performance expectations), Technological environment (system functionality, content feature) and Social environment (interaction).
Cole, Shelley, & Swartz (2014)	553	Interaction (including communication), convenience, structure (including clarity and instructor's facility with online instruction), learning style, platform, gender, age and the level of study.

4 Research Methodology

4.1 Context

Moodle was installed on the University of Reading server under the name of *Arabic Programming*. It is available on http://arabic-programming.reading.ac.uk/ and offers different courses for Arabic learners who are interested in computer science and programming languages. Anyone can register with the system and have access to all provided courses.

Learners who registered in a web design course in the online learning system were requested to participate in the study. The course was delivered in seven weeks from the middle of October to December 2014 to teach web design using Hypertext Markup Language (HTML) and Cascading Style Sheet (CSS). Every lecture included videos, written text as a pdf file, figures, and examples. The video lectures were divided into small parts because of the low internet bandwidth in Iraq. Each lecture comprised at least two to five videos and lasted between 10 to 15 minutes. Furthermore, four lectures included self-assessment tests. Forums and wiki were activated to discuss course content, and questions were posted that had to be answered by participants. Although the written lectures were in English, the course was taught and explained in the Arabic language.

The course was intentionally designed to serve one pole in each dimension of FSLSM (Felder & Silverman, 1988), more specifically, it considered the characteristics of active, sensing, visual, and sequential learners.

- Processing (active/ reflective): An active learner prefers to do something, self-assessment and group work. These preferences were served by adopting learning-by-doing approach, adding self-assessments to four lectures, and activating interaction tools in the system to allow learners to work with their peers.
- Perception (sensing/ intuitive): A sensing learner tends to prefer facts and no complex concepts. This course was delivered for novice learners who do not have previous knowledge of web design. Therefore, it only entailed general information about web design without any complex concepts and without high level programming that required more thinking. Furthermore, several examples were provided with each lecture to meet the preferences of this style.
- Input (visual/ verbal): A visual learner tends to use pictorial materials rather than written text. Although written lectures were provided, they included only the head points. Therefore, the course

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relied on video lectures and figures to explain the content, and thus served the preferences of a visual learner rather than a verbal one. Overall, the course consisted of 27 short video lectures.

- Understanding (sequential/ global): A sequential learner prefers a step-by-step learning approach and focuses on surface details before getting the whole picture. The course was sequentially presented by providing all details regarding the principles of web design in HTML and CSS, starting from scratch to cover all relevant details, and then to develop learners' knowledge step by step. In the last lecture, all delivered materials were connected by designing a whole website which used all explained content. As such, sequential learners who are patient with details may find the course more suitable for their needs.

The purpose of this design was to quantitatively compare user satisfaction in accordance with their styles and preferences. Furthermore, in order to avoid any bias in the responses to the distributed questionnaires, learners were not informed that the course design served particular preferences. Figures 2 and 3 illustrate the main page of the course and the use of multimedia instructions in teaching and learning.

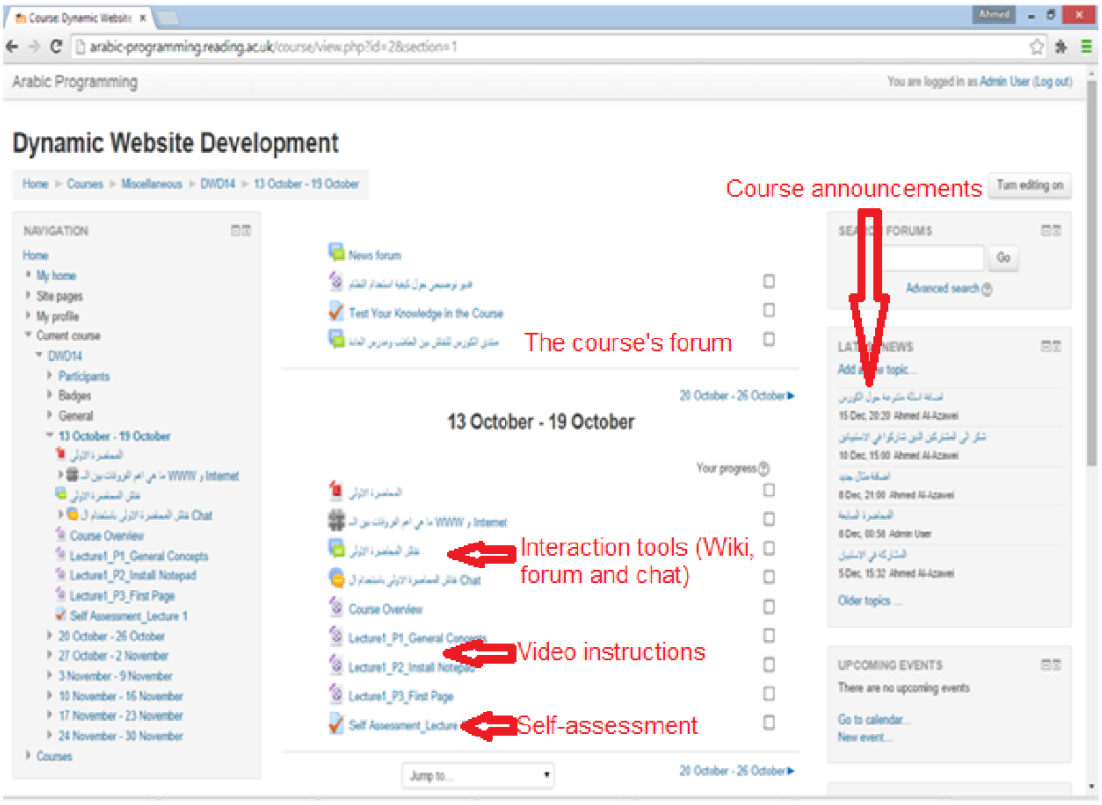

Figure 2: The course's main page.

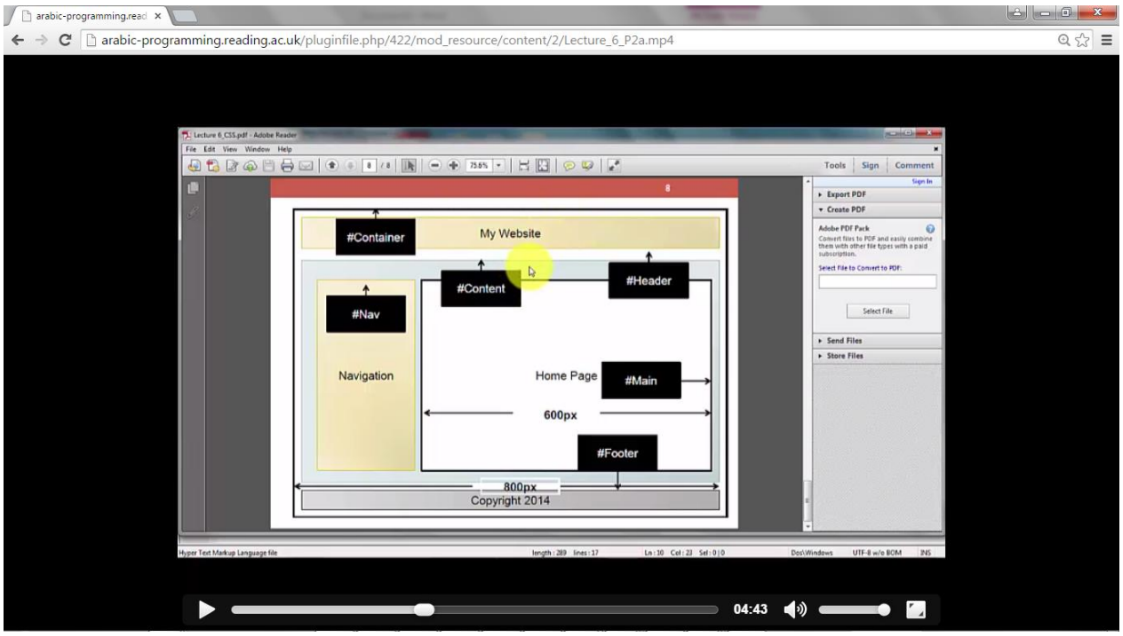

Figure 3: The multimedia instructions.

4.2 Participants

A short video was posted on Facebook to introduce the course and show users how to self-enrol. In addition, many lecturers in different computer science colleges in Iraq were contacted to encourage their students to participate. A total of 144 learners registered on the course. In total, 88 (61.11%) learners filled in the distributed questionnaires. However, 18 users who filled out either the learning styles questionnaire or the standard survey were excluded from this investigation. As such, 70 (48.61) learners represented the total subjects of this study. The demographic features of participants are presented in Table 2. The area of study of all participants was IT or computer science, except for two. However, these two cases were not excluded from the analysis because the overall findings would not be affected by such small rate (2.8%).

Table 2: Demographic features (N=70)

Item	N (%)	Item	N (%)
Gender:		**Area of Study:**	
Male	27 (38.6)	Computer Science or Information Technology	68 (97.1)
Female	43 (61.4)	To some Extent Relate to Computer Science	1 (1.4)
		Others	1 (1.4)
Level of Study:		**Age Group:**	
Undergraduate	59 (84.3)	18-21	57 (81.4)
BSc	7 (10)	22-25	7 (10)
MSc	1 (1.4)	26-29	1 (1.4)
Postgraduate	3 (4.3)	30-33	2 (2.9)
		34-37	1 (1.4)
		38-41	2 (2.9)

4.3 Data collection

In order to gather data, online-based surveys were used. This comprised two questionnaires to identify the demographic features of participants, learning styles, and the identified factors. The questionnaires included a brief explanation about the objective of carrying out this research, also guaranteeing confidential manipulation of all data.

During week six, subjects were requested to participate in the video lectures, using the announcement page of the Moodle system and sending an email to all learners. After ten days, the URLs of both instruments were

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announced again on the Moodle and a reminder email was sent to all participants. The questionnaires were administrated in December 2014 and for approximately a month. All questions in both instruments were translated into the Arabic language. Two PhD students at two different universities in the UK who speak Arabic as a mother language checked the translation in order to verify it. According to their feedback, some questions were modified.

4.3.1 The Index of Learning Styles (ILS)

This psychometric instrument was proposed in order to infer learning styles in accordance with FSLSM (Felder & Silverman, 1988). The questionnaire comprised 44 forced-choice questions. Eleven questions were asked to identify each of the four dimensions (active/ reflective, sensing/ intuitive, visual/ verbal, and sequential/ global) of FSLSM (Felder & Soloman, n.d.). For each question users could choose either 'a' or 'b'. The two options corresponded to one or the other pole in each dimension for instance, 'a' for active style and 'b' for reflective one. This design allowed for the identification of mild, moderate, and strong preferences in each dimension. In order to carry out the statistical analysis with regard to learning style dimensions, the following procedure was followed. Initially, 1 was assigned to all 'a' options and 0 to all 'b' options. This produced integer values ranging from 0 to 11. Then, Felder & Spurlin (2005) suggested defining, for example, for the processing (active/ reflective) dimension, a score of 0-1 as a 'strong-reflective', 2-3 as a 'moderate-reflective', 4-5 as a 'mild-reflective', 6-7 as a 'mild-active', 8-9 as a 'moderate-active', and 10-11 as a 'strong-active'. Figure 4 illustrates the scores distribution of learning styles. The main tendencies of students were towards active (68.5%), sensing (72.8%), visual (75.7%), and sequential (65.7%) styles (including those with mild preferences).

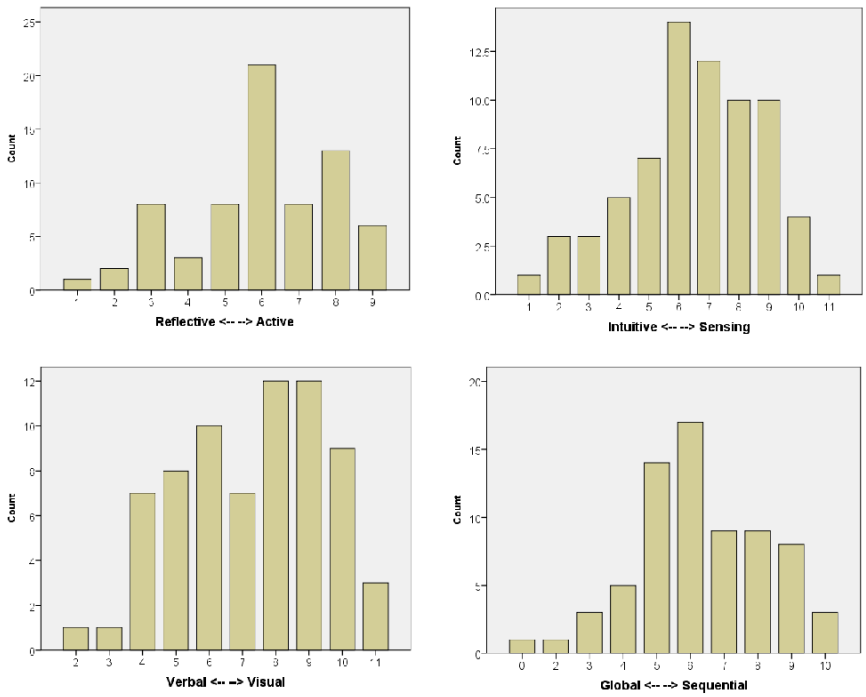

Figure 4: Distribution of learning style scores

4.3.2 A standard questionnaire

To begin with, three e-learning experts examined the questionnaire in order to improve its face-structure. As a result, some questions were excluded, while others were modified. The questionnaire included the following parts:

- *Demographic data*: gender, age group, level of study, area of study, internet, and e-learning experience. The last two features were identified by using a 7-point Likert scale ranging from 1 for 'strongly disagree' to 7 for 'strongly agree'.

- *The closed-ended questions*: sixteen questions were used to identify the four factors: OSE (5 indicators), PU (3 indicators), PEOU (3 indicators), and PS (5 indicators). A 7-point Likert scale ranging from 1 for 'strongly disagree' to 7 for 'strongly agree' was used. This scale was adopted in order to give learners more flexibility to express their preferences. The questions were self-developed and adapted from literature (Johnson et al., 2008; Liaw, 2008; Sun et al., 2008; Piccoli et al., 2001; Wu et al., 2010). Appendix A presents the items of each construct in the proposed model.

- *An open-ended question*: this was an optional question that learners can answer or ignore. It aimed to qualitatively identify learners' perspectives with regard to the advantages and disadvantages of online learning and attending this course via internet. Although all comments of the nine participants who answered this question were positive, the qualitative analysis was excluded due to the small number of responses.

4.4 Analysis techniques

In order to investigate the proposed hypotheses, the software SPSS (Statistical Package for the Social Sciences) version 22 and SmartPLS version 3.0 for Windows 7 were used. Different descriptive and inferential statistics were conducted. This included the computing of mean (M), frequency, standard deviation (SD), Cronbach's α, Pearson's correlation, factor analysis, and PLS method. The p value at 0.05 was adopted to investigate the significant correlation between variables.

5 Results and discussion

The participants demonstrated good knowledge of the internet, and familiarisation with online learning. This was unsurprising because, except for two, all were studying or have graduated from computer science or information technology schools. However, they were not very experienced at using the internet (*M*=4.90, *SD*=1.571) and e-learning (*M*=4.70, *SD*=1.662). This result was compatible to our initial expectations because the use of such technologies, particularly online learning is still in its infancy in Iraq. Pearson's coefficient showed a mild, but significant correlation among internet, e-learning experience, and PS (*r*=0.28, *P*=0.018 and *r*=0.24, *P*=0.041) for both variables respectively.

5.1 Differences between groups

Pearson correlation coefficient of gender diversity among PU, PEOU, and PS was also computed before conducting the PLS model. This was essential prerequisite to understand the level of correlation between independent and dependent factors. The results did not demonstrate any significant correlation (r=-0.098, P=0.41), (r=-0.076, P=0.53), and (r=-0.074, P=0.54), for the three factors respectively. In order to reveal any significant differences among learning styles, PU, and PS, one-way ANOVA was conducted. The results are reported in Table 3. It is clear that there are no significant differences between learning style groups and the dependent factors (PU and PS).

Table 3: One way ANOVA findings examining variation in PS and PU for learning style groups

Perceived Satisfaction (PS)						Perceived Usefulness (PU)					
Learning style	**M**	**SD**	**F**	**df**	**P**	**Learning style**	**M**	**SD**	**F**	**df**	**P**
Active	5.75	0.99	1.522	1,68	0.22	**Active**	5.97	1.0	2.744	1,68	0.102
Reflective	6.03	0.58				**Reflective**	6.36	0.68			
Sensing	5.91	0.83	1.32	1,68	0.25	**Sensing**	6.08	0.99	0.023	1,68	0.88
Intuitive	5.64	1.03				**Intuitive**	6.12	0.73			
Visual	5.84	0.82	0.002	1,68	0.96	**Visual**	6.05	0.96	0.506	1,68	0.47
Verbal	5.83	1.10				**Verbal**	6.23	0.81			
Sequential	5.79	0.99	0.373	1,68	0.54	**Sequential**	6.13	0.99	0.190	1,68	0.66
Global	5.93	0.66				**Global**	6.09	0.92			

5.2 Instrument properties

Pallant (2013) indicated that Cronbach's coefficient alpha is a widely used indicator to measure the construct-internal consistency of a measurement. The overall result indicated high-consistency reliability (α=0.90). The αs, as presented in Table 6, showed that all factors were at a good level of reliability. For further investigation, Pearson coefficient correlation was used to conduct the inter-scale and total items correlation. There is a significant correlation between all scales and most items as presented in Tables 4 and 5. However, the highest correlation among scales is 0.585 between perceived usefulness and perceived satisfaction. The

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multicollinearity assumption was not violated as the results of tolerance and VIF (Variance Inflation Factor) revealed (Table 4).

Table 4: Pearson correlation coefficient (Inter-scales correlation)

	PU	PEOU	PS	Tolerance	VIF
OSE	0.488**	0.558**	0.410**	0.634	1.578
PU		0.515**	0.585**	0.677	1.478
PEOU			0.418**	0.612	1.635

* *Correlation is significant at the 0.01 level (2-tailed).

According to Pallant (2013), in order to carry out the factor analysis test, the correlation matrix should reveal a correlation of at least 0.3 among some items. Furthermore, Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) as commonly used measures to check whether the factorability of data achieves less or equal to 0.05 and 0.6 as a minimum value for both tests respectively. These criteria were matched in this analysis. The KMO was 0.815 and the Bartlett's test of sphericity was significant at p less than 0.001. As such, the results support the factorability of the correlation matrix.

The Principle Components Analysis (PCA) extracted the presence of 4 factors to explain 69.5% of variance. Factors 1, 2, 3, and 4 loaded all items of the four scales as illustrated in Appendix B. The "scree plot" of eigenvalues (Figure 5) also showed a smooth decrease in eigenvalues after factor 4. The four-factor model perfectly identified the four constructs and strongly loaded all items. For further analysis, Wixom & Todd (2005) stated that the convergent and discriminant validity can be proven if the items' load on their associated constructs is above 0.5 and higher than their loaded across factors (Appendix B). Hair, Black, Babin, Anderson, & Tatham (2006) stated that the convergent validity can be established when the values of average variance extracted (AVE) and composite reliability (CR) are higher than the acceptable level of 0.5 and 0.7. Furthermore, if the variance shared between any variable and other factors in the tested model is less than the variance that a variable shares with its own factors, discriminant validity can be supported (Fornell & Larcker, 1981). Table 6 illustrates that AVE and CR exceeded the thresholds to support the convergent validity and the discriminant validity was advocated as well.

Table 5: Pearson correlation coefficient (Inter-items correlation)

	OSE					PU			PEOU			PS			
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**4**
OSE2	.612**	1													
OSE3	.269*	.362**	1												
OSE4	.478**	.619**	.513**	1											
OSE5	.521**	.517**	.526**	.530**	1										
PEOU1	.301*	.402**	.316**	.525**	.326**	1									
PEOU2	.357**	.359**	.268*	.418**	.217	.541**	1								
PEOU3	.397**	.333**	.390**	.440**	.323**	.444**	.496**	1							
PU1	.440**	.355**	.268*	.318**	.404**	.234	.509**	.464**	1						
PU2	.262*	.341**	.201	.320**	.207	.229	.400**	.349**	.599**	1					
PU3	.318**	.374**	.281*	.409**	.425**	.301*	.400**	.334**	.601**	.669**	1				
PS1	.175	.310**	.298*	.337**	.265*	.201	.254*	.423**	.503**	.509**	.409**	1			
PS2	.246*	.283*	.251*	.374**	.289*	.214	.245*	.451**	.487**	.484**	.537**	.698**	1		
PS3	.232	.226	.184	.468**	.410**	.323**	.340**	.316**	.509**	.420**	.448**	.698**	.556**	1	
PS4	-.029	.199	.115	.177	.159	.071	.159	.240*	.305*	.302*	.203	.652**	.508**	.515**	1
PS5	.116	.365**	.230	.451**	.413**	.355**	.252*	.414**	.397**	.337**	.421**	.650**	.536**	.733**	.663**

* *Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

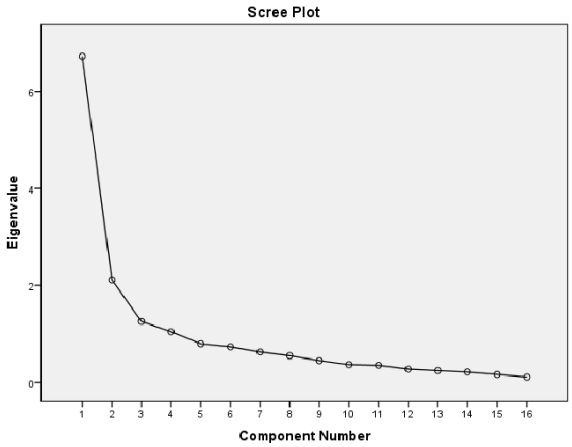

Figure 5: Scree plot for factor analysis of the questionnaire (n=70)

Table 6: Findings of the measurement model

Latent factor	AVE (>0.5)	CR (>0.7)	Cronbach's α	Discriminant validity			
				OSE	PEOU	PS	PU
OSE	0.598	0.881	0.830	0.773			
PEOU	0.661	0.854	0.745	0.575	0.813		
PS	0.696	0.920	0.891	0.433	0.440	0.834	
PU	0.748	0.899	0.832	0.496	0.518	0.600	0.865

5.3 Hypotheses investigation

PLS-SEM was used to test the path associated in the proposed model. This is due to many reasons: it is applied to reveal the relationship between independent and dependent variables, specifically, when a dependent factor is used as an independent one in a model (PEOU and PU in this study) (Tarhini et al., 2015), it is adequate for small sample size (Barrio-garcía, Arquero, & Romero-frías, 2015; Chin, 1998; Yi & Hwang, 2003), and it was predominant in prior TAM related work (Barrio-García et al., 2015; Yi & Hwang, 2003).

The study aimed to modify the TAM by integrating several learner factors to evaluate learner satisfaction in online learning instead of attitude to use a technology. Generally, four hypotheses were retained and seven were rejected. Table 7 depicts that neither learning styles nor gender diversity showed any direct significant effect on PU, PEOU, and PS, OSE had direct significant influences on PU and PEOU, PEOU had direct significant effect on PU, and PU was the best predictor of PS. In Figure 6, the path associated between variables after carrying out the PLS modelling is presented. The four dimensions of learning styles were abbreviated to β_{Proc}, β_{Per}, β_{Inp}, and β_{Und} for Processing, Perception, Input, and Understanding respectively. The independent factors explained 44.8% of variance where PU was the strongest predictor.

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Table 7: Hypotheses analysis

Hypotheses	R^2	Standardised estimate						
		Direct effect	*t*	*P*	*Indirect effect*	*t*	*Total effect*	Finding
Dependent PU	**0.340**							
H5a: PEOU→ PU		0.366	2.277	0.019			0.366	Supported
H3a: OSE → PU		0.268	2.010	0.037	0.213	2.016	0.481	Supported
H2a: Gender → PU		0.001	0.008	0.99	0.011	0.308	0.0122	Rejected
H1a: LS → PU								
Processing		-0.069	0.596	0.53			-0.069	
Perception		-0.079	0.568	0.58			-0.079	Rejected
Input		0.069	0.673	0.51			0.069	
Understanding		-0.009	0.067	0.95			-0.009	
Dependent PEOU	**0.331**							
H3b: OSE → PEOU		0.581	4.185	<0.001			0.581	Supported
H2c: Gender → PEOU		0.030	0.313	0.74			0.030	Rejected
Dependent PS	**0.448**							
H5b: PEOU → PS		0.069	0.435	0.65	0.171	1.836	0.240	Rejected
H4: PU → PS		0.467	3.210	0.002			0.467	Supported
H3c: OSE → PS		0.245	1.214	0.22	0.265	2.107	0.510	Rejected
H1b: LS → PS								
Processing		-0.076	0.637	0.48	-0.032	0.609	-0.108	
Perception		0.259	1.759	0.067	-0.037	0.548	0.222	Rejected
Input		0.087	0.910	0.35	0.032	0.680	0.119	
Understanding		-0.227	1.826	0.076	-0.004	0.070	-0.231	
H2b: Gender→ PS		-0.033	0.288	0.76	0.007	0.155	-0.025	Rejected

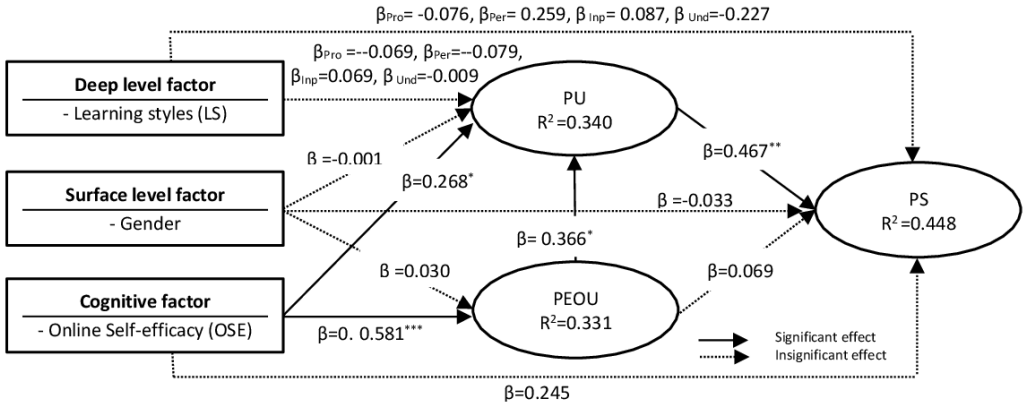

Figure 6: The results of the proposed hypotheses

As presented in this analysis, learning styles did not seem to predict PU (H1a) and PS (H1b). Although literature did not investigate the effects of learning styles on PU in an adaptable learning setting, we suggested such influence based on learning styles hypothesis. Contrary to our assumption, H1a was rejected because learning style dimensions were not predictors of PU as shown in Table 7. With regard to H1b, our result is in agreement with the findings of Hong (2002) that learning styles did not significantly influence PS. Cheng & Chau (2014) argued that learning styles are significantly associated with online participation and the latter, in turn, is associated with learner satisfaction. This result indirectly relates learning styles with PS. However, we deliberately designed the online learning environment to match the preferences of particular poles in the FSLSM. This adaptation presented an insignificant effect among the four dimensions and PS (Table 7), whereas Cheng & Chau (2014) did not explore this point. Accordingly, this research indicates that other factors are more likely to affect learner satisfaction than learning styles. It could be argued that the online environment matched the preferences of the majority of participants because most of them were tend to active, sensing,

visual, and sequential. Nevertheless, the mean differences of PS for the dichotomies were not substantial enough to confirm our conclusion. This discussion was also supported by the findings of ANOVA test (Table 4). This means that regardless of matching or mismatching groups, learning styles as a factor cannot predict PU and PS. In addition to the theoretical critique regarding learning styles (Mayer, 2011; Pashler et al., 2008), this analysis adds more empirical debate with aspect to the implications of this trait.

Pertaining to gender diversity hypotheses, Ong & Lai (2006) integrated gender diversity in TAM to investigate e-learning acceptance. The study indicated the significance of gender differences. Male perceptions of computer self-efficacy, PU, and PEOU were significantly higher than female ones, and then the intention to use e-learning was different. In contrast, Gefen & Straub (1997) indicated that PU and PEOU for women was significantly higher than men. Such results were inconsistent with our findings, as gender was neither a predictive of PU ($\beta_{Gender \rightarrow PU}$= -0.001, P=0.994) nor PEOU ($\beta_{Gender \rightarrow PEOU}$= -0.030, P=0.754). Based on this analysis, H2a and H2c were rejected. Furthermore, H2b suggested that PS was significantly affected by gender diversity. Contrary, PLS did not show such significant relationship ($\beta_{Gender \rightarrow PS}$=-0.033, P=0.774). This result is in accordance with studies that pointed out gender was not an affective factor to predict learner satisfaction (Hong, 2002; Vanderheyden & De Baets, 2015). To conclude, literature has produced inconsistent results concerning the value of gender diversity. This might be explained by cultural differences because gender was accounted as one of the aspects of cross-cultural differences (Gefen & Straub, 1997).

Following online self-efficacy (OSE) hypotheses, this factor was a predictive of PU (H3a) and it was a strong predictor of PEOU (H3b) where the results were ($\beta_{OSE \rightarrow PU}$= 0.268, P=0.045) and ($\beta_{OSE \rightarrow PEOU}$= 0.581, P<0.001) for both hypotheses respectively. These results are consistent with other studies, for instance, Ong & Lai (2006). We also assumed a causal link between OSE and PS, as learners may be unsatisfied if they were not confident enough to use this technology and it represented new experience for them (H3c). However, this hypothesis was not confirmed ($\beta_{OSE \rightarrow PS}$= 0.245, P=0.225) to support the finding of Liaw (2008), whereas Sun et al. (2008) found that it was a predictor of PS. However, as mentioned previously, the sample included current students or graduates of computer science. Therefore, to some extent their OSE was over the expected level, as such other factors were more likely to predict learner satisfaction.

With regard to PU hypothesis (H4), this research supported the findings of Barrio-garcía, Arquero, & Romero-frías (2015), Davis (1986), Drennan et al. (2005), Venkatesh & Davis (2000), and Sun et al. (2008) to indicate that PU was the strongest predictor of technology acceptance or learner satisfaction ($\beta_{PU \rightarrow PS}$= 0.467, P<0.001). This means that participants found online learning to be a useful technology to achieve their goals and improve learning outcomes and this, in turn, undoubtedly affects their satisfaction. Specifically, it represents new experience for Iraqi students. Thus, in order to ensure continuous use of a learning technology, useful and interactive teaching methods that can promote academic achievement should be used.

Following PEOU hypotheses, as assumed in the TAM and TAM2, PEOU was a direct determinant of PU (Davis, 1986; Venkatesh & Davis, 2000). Our analysis of H5a verified this assumption ($\beta_{PEOU \rightarrow PU}$= 0.366, P=0.023). Such result supported the previous literature (Davis, 1986; Ong & Lai, 2006; Venkatesh & Davis, 2000). Tarhini et al. (2015), on the other hand, found that these factors are uncorrelated. Furthermore, contrary to our assumption that PEOU will significantly affect PS (H5b), the analysis rejected this hypothesis ($\beta_{PEOU \rightarrow PS}$= 0.069, P=0.664). Similarly, Drennan et al. (2005) and Tarhini et al. (2015) revealed that PU was a determinant of PS or attitude to use a technology, whereas PEOU was not. On the other hand, Sun et al. (2008) pointed out the significance of PEOU to determine learner satisfaction . Our finding can be interpreted according to the experience level of participants in online learning because all, but two, came from Information Technology and Computer Science majors. Therefore, they did not face any difficulty to work in that environment due to their individual skills. This justification can also be advocated by the interpretation of Tarhini et al. (2015) that PEOU is a critical factor in the early stage of adoption. Additionally, the significance of PEOU on e-learning or e-mail technologies was shown in the prematurity era of such technologies (Gefen & Straub, 1997; Ong & Lai, 2006; Venkatesh & Davis, 2000). Therefore, the maturity of current e-learning technologies may help learners to use them even if they are less experienced. In other words, this does not mean that PEOU is not a significant factor, however, it may mean that the use of superior and usable learning technologies supports delivering e-learning more easily.

In summary, the modified model explained 44.8% of variance. PU was the best predictor, whereas all other integrated factors did not show a direct significant contribution. In general terms, the overall results slightly enhanced the findings of the original TAM where the model typically explained 40% of variance (Venkatesh & Davis, 2000).

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6 Implications and limitations

The overall results are promising because they are indicative of the high degree of satisfaction and perceived usefulness of Iraqi learners with regard to online learning. This should encourage the MHESR-I to establish an integrated infrastructure to extend the use of online learning or blended learning in public universities in order to improve learning quality and motivate students towards new learning technologies. Specifically, the contributions of the research are fourfold. To begin with, although it modified TAM to predict satisfaction instead of technology adoption, it moderately supported the original factors of the TAM in an Arabic population sample. On the other hand, all extended factors were not direct predictors of learner satisfaction. Moreover, the study contributed to the existing debate by pointing out the modest effect of learning styles on educational practice as indicated in other works (Mayer, 2011; Pashler et al., 2008). Some reported studies such as Brown (2007) qualitatively analysed the implications of learning styles on perceived satisfaction in an adaptive learning environment to indicate that this adaptation improved learner satisfaction albeit this trait did not influence academic performance. However, in order to investigate the effectiveness of learning styles on such factors, it is essential that learners are unaware that an online course is designed according to their individual preferences so that a placebo effect scenario is prevented. Our result may suggest that there is no need to personalise educational hypermedia systems (EHSs) according to this trait because students can easily adapt to different learning circumstances even if such environments do not address their individual preferences. Furthermore, the surface level factor (gender) is influenced by several cultural and environmental variables (Gefen & Straub, 1997). Therefore, we recommend further investigation to reveal the effectiveness of gender diversity in developing countries not least in regions were cultural customs impose restrictions on female education. Mixing quantitative and qualitative analysis can provide more in-depth understanding about the role of gender in such cultures. Finally, the cognitive factor (OSE) is directly linked with PU and PEOU, but its effect on PS may also depend on other variables such as individual skills, user experience, and the maturity of a particular technology.

It is worth mentioning that this study is subject to many limitations. First, the sample size is quite small and homogeneous. Investigating larger and heterogeneous population can provide more reliable results. Thus, the findings of the study should be interpreted cautiously. Second, the data were collected from subjects who attended one online course. Hence, this may represent their subjective opinion regarding that individual course. Collecting data from different courses could allow for more encompassing interpretations.

7 Conclusion

Meeting user satisfaction represents a key factor for success in online learning. This study modified TAM to achieve this goal. The results showed that not all identified factors can predict perceived satisfaction. However, the perceived usefulness as an original factor in TAM represents the best predictor. Although online self-efficacy and perceived ease of use did not directly affect perceived satisfaction, this was explained according to the individual experience of learners and the maturity of a particular technology.

The study focused on the role of learning styles to determine learner satisfaction. Some of the learning tendencies were intentionally mismatched to serve only other styles. However, the results did not show any statistical significance among perceived satisfaction and the matched or mismatched groups. This means that variables other than learning styles may significantly affect learner satisfaction. Based on this result, it should be recommended that when researchers aim to investigate the pedagogical implications of learning styles, students should not be aware that an online course is designed in accordance with their styles, so that the placebo effect is prevented. In other words, if learners are informed that the course is adapted as per their individual preferences and styles, this might psychologically predispose them to positively respond to qualitative or quantitative questions. This may explain the contradictory findings regarding the implications of learning styles on learner satisfaction. In future work, a larger sample will be used to substantiate the findings. Additionally, it would be more feasible to collect data from a heterogeneous sample in order to avoid any bias that could be emerged in a homogeneous one. Other independent factors can be incorporated in order to enhance the model.

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Appendix A: The questionnaire items, mean, and standard deviation

Factors	M	SD
Online Self-efficacy (OSE):	5.08	1.12
1) I believe that I have the ability to post comments and respond to comments posted in the course discussion forum.	5.06	1.30
2) I believe that I have the ability to locate information on the course website.	5.43	1.29
3) I believe that I have the ability to use all Moodle features.	4.69	1.78
4) I feel confident using online learning systems after participating in this course.	5.44	1.28
5) I feel confident using online learning systems before participating in this course.	4.79	1.65
Perceived Ease of Use (PEOU):	5.44	1.00
6) I found that all functions can be used easily even with less experience in online learning.	5.53	1.17
7) I found that the online learning system can be used easily.	5.43	1.34
8) I found it is ease to do what I want in the online learning system.	5.39	1.15
Perceived Usefulness (PU):	6.09	0.92
9) I believe online learning is a useful learning tool.	6.09	1.15
10) I believe online learning is useful.	6.16	1.03
11) I believe online learning improves learning outcomes.	6.04	1.04
Perceived Satisfaction (PS):	5.84	0.89
12) I am satisfied with using online learning as a learning assisted tool.	5.77	1.01
13) I am satisfied with using online learning functions.	5.63	1.19
14) I am satisfied with my decision to take this course via Internet.	5.80	1.04
15) If I have an opportunity to take another course via Internet, I would gladly do so.	6.14	0.99
16) I feel that online learning served my needs well.	5.87	1.102

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Appendix B: Principle component analysis and factor loading

			Factors			
		Factor loading (>0.7)	1	2	3	4
OSE	OSE1	0.739		***0.687***	0.389	
	OSE2	0.815		***0.725***		
	OSE3	0.670		***0.638***		
	OSE4	0.838		***0.685***		0.409
	OSE5	0.793		***0.824***		
PEOU	PEOU1	0.788		0.309		***0.805***
	PEOU2	0.833			0.395	***0.777***
	PEOU3	0.819				***0.591***
PU	PU1	0.863			***0.752***	
	PU2	0.861			***0.797***	
	PU3	0.870			***0.735***	
PS	PS1	0.892	***0.801***		0.341	
	PS2	0.806	***0.639***		0.455	
	PS3	0.851	***0.738***			
	PS4	0.766	***0.847***			
	PS5	0.852	***0.832***			
	Variance %		21.6	18.8	16.2	12.8

Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.
Loading less than 0.3 was omitted.

Appendix E: The First Ethics Approval

Research Ethics Committee

University of Reading

Project Submission Form

Note All sections of this form should be completed.
Please continue on separate sheets if necessary.

Principal Investigator: Dr. Karsten Oster Lundqvist

School: School of Systems Engineering

Email: a.al-azawei@student.reading.ac.uk

Title of Project: **Investigating the Feasibility of Adaptive Educational Hypermedia Systems Focusing on Learning Styles.**

Proposed starting date: 15 December 2014

Brief description of Project:

Background:
It could be obvious that learners differ in their individual preferences and attitudes. Such characteristics can affect the design of instructional settings. Adapting teaching styles in accordance with learners' characteristics can be a time consuming process in a large courses. Hence, personalising courses have been widely developed with the great revolution of e-learning mode. This mode offers a wide range of pedagogical resources to give learners the opportunity to choose the most suitable materials for them. This, on the other hand, can disrupt students to find a right learning pathway. As such, designing an educational course which responds to individual learner's needs can promote learning process. However, the most controversial issue is to which users' characteristics such courses should be tailored. Recently, studies have shown that learning styles attracted a significant consideration in order to accommodate educational hypermedia systems to learners' needs. Towards this end, this research is going to investigate all potential impacts of learning styles on learning process. A case study will be chosen from the University of Babylon in Iraq.

Research Objectives:
The main goal of conducting this research is to investigate the importance of integrating learning styles with e-learning modality and highlight the pros and cons of using such traits in designing and adapting e-learning courses.
The research will take into account the effect of this trait on learning process, learners and teachers to get insight about all potential impacts.

Research Methodology:
Integrated research methods will be used in this study in order to collect data. This will include quantitative and qualitative methods and data will be analysed statistically to measure the significance of considering the incorporated factors on learning outcome. It is noteworthy that all study's subjects will be undergraduate students over 18 years old.

Version – September 2012

I confirm that to the best of my knowledge I have made known all information relevant to the Research Ethics Committee and I undertake to inform the Committee of any such information which subsequently becomes available whether before or after the research has begun.

I confirm that I have given due consideration to equality and diversity in the management, design and conduct of the research project.

I confirm that if this project is an interventional study, a list of names and contact details of the subjects in this project will be compiled and that this, together with a copy of the Consent Form, will be retained within the School for a minimum of five years after the date that the project is completed.

Signed:

..... Date: 24/11/14
(Investigator)

..... Date: 15/12/2014
(Head of School or
authorised Head of Department)

..... Date: 24/11/2014
(Student -where applicable)

Checklist

1.	This form is signed by my Head of School (or authorised Head of Department)	■
2.	The Consent form includes a statement to the effect that the project has been reviewed by the University Research Ethics Committee and has been given a favourable ethical opinion for conduct	☐
3.	I have made, and explained within this application, arrangements for any confidential material generated by the research to be stored securely within the University and, where appropriate, subsequently disposed of securely.	☐
4.	I have made arrangements for expenses to be paid to participants in the research, if any, OR, if not, I have explained why not.	☐
5.	EITHER	
	(a) The proposed research does not involve the taking of blood samples;	■
	OR	

(b) For anyone whose proximity to the blood samples brings a risk of Hepatitis B, documentary evidence of immunity prior to the risk of exposure will be retained by the Head of School or authorized Head of Department. ☐

Signed:

..... Date.....
(Head of School or
authorised Head of Department)

6. EITHER

(a) The proposed research does not involve the storage of human tissue, as defined by the Human Tissue Act 2004; ■

OR

(b) I have explained within the application how the requirements of the Human Tissue Act 2004 will be met. ☐

7. EITHER

(a) The proposed research will not generate any information about the health of participants; ■

OR

(b) If the research could reveal adverse information regarding the health of participants, their consent to pass information on to their GP will be included in the consent form and in this circumstance I will inform the participant and their GP, providing a copy of the relevant details to each and identifying by date of birth ☐

OR

(c) I have explained within the application why (b) above is not appropriate. ☐

8. EITHER

(a) the proposed research does not involve children under the age of 5; ■

OR

(b) My Head of School (or authorised Head of Department) has given details of the proposed research to the University's insurance officer, and the research will not proceed until I have confirmation that insurance cover is in place. ☐

Appendix F: The Second Ethics Approval

Research Ethics Committee

University of Reading

Project Submission Form

Principal Investigator: **Dr. Karsten Oster Lundqvist**
School: **School of Systems Engineering**
Email: **a.al-azawei@pgr.reading.ac.uk**
Title of Project: **Designing Accessible Online Learning Focusing on Learning Styles and Universal Design for Learning (UDL)**
Proposed starting date: **25 June 2015**
Brief description of Project:

Background:

It could be obvious that learners have different preferences, abilities, and characteristics. Such differences can affect the method that should be used to design instructional settings. Hence, learning should be accessible by all learners irrespective of individual abilities and differences. This can enhance learner experience in terms of performance and satisfaction. However, the most controversial issue is how to accommodate online learning to meet all learners' needs. Towards this end, this research is going to investigate the possible solutions to address this problem. A sample will be chosen from Iraqi lecturers and students.

Research Objectives:

The main aims of this research are

- To investigate designing online courses in different ways in order to meet needs of learners with different abilities and preferences.
- To propose a teaching-collaboration framework to be implemented for Arabic instructors to help them developing their teaching experience.

The study will take into account the impacts of such design on teachers' performance and learner experience.

Research Methodology:

Integrated research methods will be used in this study in order to collect data. This includes using quantitative (surveys and learning patterns) and qualitative (interviews and/ or focus group) approaches. Many surveys and maybe interviews will be used to measure learner and instructor experience in terms of performance and perceptions such as satisfaction, perceived usefulness, and perceived ease of use. The questionnaires will be used before and after developing our courses and learning tool, whereas learning patterns will be used to assess the correlation between learner preferences and their actual behaviour in the online courses.

It is noteworthy that all participants will be lecturers or a university's students and all of them are 18 years old or over.

Consent Form, will be retained within the School for a minimum of five years after the date that the project is completed.

Signed:

..... Date: 17/6/2015

(Investigator)

..... Date: 17/6/2015

(Head of School or authorised Head of Department)

..... Date: 17/6/2015

(Student -where applicable)

rec_application_template_july_2012

Checklist

1. This form is signed by my Head of School (or authorised Head of Department) ■

2. The Consent form includes a statement to the effect that the project has been reviewed by the University Research Ethics Committee and has been given a favourable ethical opinion for conduct ☐

3. I have made, and explained within this application, arrangements for any confidential material generated by the research to be stored securely within the University and, where appropriate, subsequently disposed of securely. ☐

4. I have made arrangements for expenses to be paid to participants in the research, if any, OR, if not, I have explained why not. ☐

5. EITHER

   (a) The proposed research does not involve the taking of blood samples; ■

   OR

   (b) For anyone whose proximity to the blood samples brings a risk of Hepatitis B, documentary evidence of immunity prior to the risk of exposure will be retained by the Head of School or authorized Head of Department. ☐

   Signed:

   ..... Date.....

   (Head of School or

   authorised Head of Department)

6. EITHER

   (a) The proposed research does not involve the storage of human tissue, as defined by the Human Tissue Act 2004; ■

   OR

   (b) I have explained within the application how the requirements of the Human Tissue Act 2004 will be met. ☐

7. EITHER

(a) The proposed research will not generate any information about the health of participants; ■

OR

(b) If the research could reveal adverse information regarding the health of participants, their consent to pass information on to their GP will be included in the consent form and in this circumstance I will inform the participant and their GP, providing a copy of the relevant details to each and identifying by date of birth ☐

OR

(c) I have explained within the application why (b) above is not appropriate. ☐

8. EITHER

(a) the proposed research does not involve children under the age of 5; ■

OR

(b) My Head of School (or authorised Head of Department) has given details of the proposed research to the University's insurance officer, and the research will not proceed until I have confirmation that insurance cover is in place. ☐

Signed:

…….. Date……..…

(Head of School or authorised Head of Department)

This form and further relevant information (see Sections 5 (b)-(e) of the Notes for Guidance) should be returned, both electronically and in hard copy, to:

Dr Mike Proven
Coordinator for Quality Assurance in Research
Whiteknights House
Email: m.j.proven@reading.ac.uk

You will be notified of the Committee's decision as quickly as possible, and you should not proceed with the project until a favourable ethical opinion has been passed.

Appendix G: The Permission Letter from the Head of the Department

Ministry of Higher Education and
Scientific Research
University of Babylon
College of Information Technology
Iraq

To Whom It May Concern

Consent Letter

Dear Sir/ Madam,

I would like to confirm that **Mr. Ahmed Habeeb Said Al-Azawei** who is a PhD student at the University of Reading/ UK and a staff member at the University of Babylon/ Iraq has contacted me in order to distribute online questionnaires and conduct some experiments related to his PhD research with our undergraduate students. **Mr. Al-Azawei** has explained that the main aim of his study is to investigate the effect of **learning styles** and **inclusive learning** on student performance, perceptions, and e-learning adoption.

I gave **Mr. Al-Azawei** my consent in order to conduct the experiments and encouraged our students to voluntarily participate in this research. I think that this study can help to improve e-learning implementation in Iraqi universities.

Please, if you have any question do not hesitate to contact me.

Prof. Dr. Wesam S. Bhaya,
Head of Information Networks Dep.,
College of Information Technology, University of Babylon,
Hilla, Babil, Iraq,
009647813589831,
wesambhaya@itnet.uobabylon.edu.iq.

Appendix H: Skewness and Kurtosis of the First Experiment

Statistics

		ITU1	ITU2	PU1	PU2	PU3	PEOU1	PEOU2	PEOU3	PEOU4
N	Valid	210	210	210	210	210	210	210	210	210
	Missing	0	0	0	0	0	0	0	0	0
Skewness		-1.380	-1.506	-1.176	-.647	-.881	-1.121	-.703	-1.465	-1.623
Std. Error of Skewness		.168	.168	.168	.168	.168	.168	.168	.168	.168
Kurtosis		1.851	1.909	.578	-.663	.163	.603	-.838	1.984	2.259
Std. Error of Kurtosis		.334	.334	.334	.334	.334	.334	.334	.334	.334

Statistics

		ELSE1	ELSE2	ELSE3	PS1	PS2	PS3
N	Valid	210	210	210	210	210	210
	Missing	0	0	0	0	0	0
Skewness		-.987	-1.278	-.664	-1.048	-1.197	-1.304
Std. Error of Skewness		.168	.168	.168	.168	.168	.168
Kurtosis		.187	.906	-.571	.244	.960	1.395
Std. Error of Kurtosis		.334	.334	.334	.334	.334	.334

Appendix I: Skewness and Kurtosis of the Second Experiment

	ITU1	ITU2	PU1	PU2	PU3	PEOU1	PEOU2	PEOU3	PEOU4
N Valid	92	92	92	92	92	92	92	92	92
N Missing	0	0	0	0	0	0	0	0	0
Mean	6.13	5.97	5.97	5.64	5.89	5.78	5.37	5.78	5.77
Median	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Std. Deviation	.714	.733	.831	1.297	1.021	1.147	1.495	1.127	1.017
Skewness	-.566	-.462	-.173	-1.337	-1.296	-1.393	-1.204	-1.393	-1.572
Std. Error of Skewness	.251	.251	.251	.251	.251	.251	.251	.251	.251
Kurtosis	.362	.255	-1.002	1.905	2.464	2.026	1.044	2.600	4.858
Std. Error of Kurtosis	.498	.498	.498	.498	.498	.498	.498	.498	.498

	ELSE1	ELSE2	ELSE3	PS1	PS2	PS3
N Valid	92	92	92	92	92	92
N Missing	0	0	0	0	0	0
Mean	5.48	5.42	4.99	5.86	5.85	6.00
Median	6.00	6.00	5.00	6.00	6.00	6.00
Std. Deviation	1.271	1.303	1.558	1.001	.710	.711
Skewness	-1.231	-1.384	-1.015	-2.062	-.714	-.375
Std. Error of Skewness	.251	.251	.251	.251	.251	.251
Kurtosis	1.254	2.013	.222	7.448	2.061	.114
Std. Error of Kurtosis	.498	.498	.498	.498	.498	.498

	MMR1	MMR2	MMR3	MMAE1	MMAE2	MMAE3	MMAE4	MME1	MME2	MME3	MME4
N Valid	92	92	92	92	92	92	92	92	92	92	92
N Missing	0	0	0	0	0	0	0	0	0	0	0
Mean	6.38	6.23	6.32	5.85	5.96	5.52	5.78	5.84	5.87	5.90	5.87
Median	7.00	6.00	6.50	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Std. Deviation	.900	.939	.864	1.058	.876	1.134	1.004	1.019	.952	.826	1.071
Skewness	-2.038	-2.267	-1.815	-1.737	-.717	-1.373	-1.948	-1.255	-1.375	-.890	-1.763
Std. Error of Skewness	.251	.251	.251	.251	.251	.251	.251	.251	.251	.251	.251
Kurtosis	5.818	9.533	5.740	5.463	.043	2.810	6.774	2.037	3.199	1.280	4.230
Std. Error of Kurtosis	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498