DESIGN, DEVELOPMENT AND IMPLEMENTATION OF A BLENDED LEARNING STRATEGY FOR A COMPUTER SCIENCE COURSE AT THE FACULTY OF SCIENCES, OMER AL-MUKHTAR UNIVERSITY, LIBYA

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Copyright statement

Abstract

This research project focuses on the design, development and implementation of a blended learning strategy at the Faculty of Science in Omar Al-Mukhtar University, Libya. The researcher's experience as a lecturer in Computer Science within this university represents a valuable asset which has enabled her to carry out this research project in an effective manner by demonstrating how technological innovation changes the way that universities teach and students learn. The implementation of a blended learning approach in the Computer Science course has enabled students to experience better learning outside of the classroom, and increased lecturers' availability during taught sessions by combining the advantages of digital and in-person pedagogies.

Initially, the structure and characteristics of the Computer Science course are presented alongside the aims, objectives and research questions for this thesis. Then, the conclusions of the literature review, which is related to the theory of teaching and learning, School Based Learning (SBL), Lab Based Learning (LBL), e-learning and blended learning, are described. The assessment of these sources brings to light the powerful connections between lab-based learning, the use of technology for the procedures of teaching and learning, theories and paradigms of learning and structures of information quality. The three questionnaires used in this research project were designed by considering aspects of reliability, validity, bias and triangulation. The results of quantitative and qualitative analysis of the responses have been used to formulate the blended learning approach and to design and evaluate the e-learning package. The quantitative analysis used a statistical technique, while the qualitative analysis was achieved by looking at the answers to open-ended questions. Questionnaire 1 was completed by lecturers and lab instructors in order to identify the skills gap between SBL and LBL. Questionnaire 2 was completed by students in order to determine their preferred learning styles for lab classes. The conclusions from the quantitative and qualitative analysis of the responses were used to design both the LBL skills model and the blended learning approach, whereby students receive theoretical explanations during lectures and then are asked to solve exercises from and e-learning package before attending the face-to-face lab sessions. The design, development and implementation of the e-learning package was achieved by using a user-centred approach comprising the following phases: user analysis, structure and representation, knowledge and communication analysis, and interface and navigation design. Case study 1 contained theoretical concepts and exercises related to the design of a website using the attributes

and main elements of HTML coding. Case study 2 included exercises associated with the design of a simple website using Dreamweaver software and enabling the development of students' 'soft skills', including communication skills and decision-making. Other exercises provided an introduction to methods of improving the look of web pages with a one or two column layout. Case study 3 aimed to enable feasible collaborative learning in groups, in which students developed and designed websites by using HTML links, images, headers and paragraphs. Questionnaire 3 was completed by both students and lecturers to provide an evaluation of the e-learning package using the Technology Acceptance Model (TAM). The conclusions from analysis of the responses provided were used to formulate a set of recommendations for the design of blended learning strategy in the Faculty of Science at Omar Al-Mukhtar University, Libya.

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(46,375 words)

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Dedications and Acknowledgements

I declare that this thesis is my own investigation, and is not being concurrently submitted in candidature for any other degree.

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Academic Biography

Aisha Abdraba Othman Moftah is a PhD candidate in the School of Computing and Engineering at the University of Huddersfield, UK. She studied at the University of Omer AL-mukhtar, Libya, and then obtained an MSc degree in Information Systems Management at the University of Huddersfield, UK. Her research is focused on methods of combining traditional learning and e-learning; intelligent e-learning technology; interactive e-learning systems; e-learning multimedia applications and pedagogical challenges; new trends in learning and training; impact of e-learning on social change; developing an organizational strategy for e-learning; evaluation methods in blended learning environments and intelligent user interfaces.

Chapter 1: Introduction

The fundamental objective of the Computer Science course at Omar Al-Mukhtar University (CSC) is to offer a generalist Computer Science degree that builds on the knowledge provided in secondary education. Graduates will be professionals with an extensive scientific, technological and socio-economic grounding, ready to exercise their skills in the development and application of ICT in the field of Computer Science. With cross-discipline training in Informatics, graduates may join companies in the ICT sector or IT departments in companies of any level requiring the implementation of new technologies. They will be able to fulfil the general functions of designing, developing, maintaining and marketing equipment and systems that incorporate computer and communication subsystems.

The duties to be performed by the graduates may include those of:

- Addressing the development of departments
- Management and organization of IT projects and data processing centres
- Analysis and design of computer systems
- Selection, evaluation and maintenance of IT infrastructures
- Servicing the needs of technical systems, databases, communications and sales engineers
- Technical consulting and IT audit
- Application of artificial intelligence and new technologies
- Design and optimization of methods and means of communication between computers and users
- Training and teaching in the field of ICT.

The course is practical in approach and aims to achieve the following educational objectives:

- To provide a general introduction to programming languages.
- To provide practical training in the major programming languages that a student will use during their university education (Omar Al-Mukhtar University, 2013).

The above targets can be achieved by a two-tier system of education which includes lab-based learning (LBL) and school-based learning (SBL) (Omar Al-Mukhtar University, 2015). SBL provides theoretical knowledge and information in specialised modules in the school environment, giving students the foundations for success in their future careers, while LBL provides them with the strong practical skills that will prepare them for direct access to the labour market or for specialization in any field of IT through a Master’s degree. This chapter aims to present the development process of the Computer Science course at Omar Al-Mukhtar University in Libya, followed by its characteristics and educational structure.

Recently, the Higher Education Ministry indicated that most Computer Science courses in Libya should focus on cognitive skills and hard skills rather than soft skills like speaking, personal communication and problem solving, yet these soft skills are required by the ministry, which employs graduate students in training and teaching in the field of ICT. Without these skills, students will face many problems in their studies and lives. In addition, there is a clear gap between the cognitive and hard skills required during LBL and SBL. The academic staff within the department has recently observed that students display a lack of practical experience and understanding of theoretical subjects that are essential to the success of lab sessions. Internal review reports show a variety of issues concerning the learning processes and traditional teaching methods; limited access to IT; a lack of development processes; poor curriculum review; and limited links between practical tasks and theoretical content (Othman, 2009). Due to large class sizes, especially at undergraduate level, the vast majority of Libyan higher education institutions also face significant challenges in adequately assessing student learning and providing feedback to students. Additionally, there are shortages of proper teaching facilities and of science lecturers who are sufficiently skilled to properly utilize course materials, practical exercises and demonstrations. Some universities have opted to increase the number of faculty members, or to alleviate some of the strain by increasing the number of students who use one computer, but the majority of students still display a lack of practical experience and understanding of theoretical subjects during the computer lab sessions. Moreover, there is no effective strategy in place to reduce this skills gap, and it is this which has prompted the researcher to carry out an in-depth study in the field of computing education in order to improve the performance of the Computer Science course and to contribute to the development of policy regarding such courses in Libya.

1.1 Aim of the Research

The results of this study will cover the knowledge gap in the literature regarding e-learning in Libya and provide a bigger picture of the Computer Science course at Omar Al-Mukhtar University. Adaptive e-learning has been utilised for the first time at Omar Al-Mukhtar University by this study, so the findings will enable the university to define the main factors that can assist the implementation of the e-learning approach in the future. The study implements a blended learning approach by applying web-based learning (LBL) and technology acceptance in a Libyan university. In particularly, the study aims to:

- Analyse the skills gap between school-based learning and lab requirements for the Computer Science course
- Develop a lab skills model and evaluate its application to the Computer Science course
- Define a blended learning approach (including the design, development and implementation of a new e-learning package)
- Evaluate the proposed blended learning approach using the Technology Acceptance Model (TAM)
- Formulate recommendations for a blended learning strategy for the Computer Science course by identifying specific factors of successful web-based learning experiences. This will provide a source of information that can facilitate the design, demonstrate how it can be applied in practice and how it works, and consider the limitations of its application within the existing framework.

1.2 Definition of Terms

The definition of terms used will be explained in detail in the chapters which follow, but some definitions are presented here.

- **The Technology Acceptance Model (TAM):** This model was developed by Davis (1989). It was designed to be a highly effective model to predict the use of information technologies and communications, as well as to predict individual acceptance (Davis, Bagozzi, & Warshaw, 1989).
- **Information and Communication Technology (ICT):** Information and Communication Technology is a term relating to the use of computers connected to the internet, and especially the social aspect of these. The new technologies of information and communication both represent a set of technological innovations, and are also tools that allow a radical redefinition of the functioning of society. ICT refers to those computers and computer tools that process, store, abstract, retrieve and present information represented in a wide variety of forms (Carrillo et al., 2010; Hashim, Alam, & Siraj, 2010).
- **E-learning:** E-learning is a concept that refers to a particular mode of organization, development and evaluation of teaching and learning that materialises or takes place through digitally-created learning spaces (Garrison, 2011).
- **Blended learning:** Blended learning is used as a teaching strategy to select the transmission channels of knowledge and is a type of education that can use an effective range of multi-media presentation and methods of teaching and learning to facilitate the learning process. It is built on the basis of a combination of traditional methods, in which students and lecturers meet face-to-face, and e-learning methods (Bricault,

2015).

1.3 The Structure of Omar Al-Mukhtar University

Omar Al-Mukhtar University was founded in 1961 by King Sanusi. It dates back to Ali Al-Sanusi and a religious group which, in 1835, began to teach the Koran with the assistance of scholars and readers of Al-Azhar. When the university began to take shape in 1961, it was known as Baida Islamic University, and it was not until 1984 that it began to take its current form and changed its name to the University of Omar Al-Mukhtar, named after the Libyan hero Omar Mukhtar.

The university awards degrees at BSc, Masters and PhD level. Four sections were originally founded by the Libyan government: Al-Baida is the control centre of the University, while Derna, Susa and Tobruk are colleges (for more details see Figure 1.1)

1. **Al-Baida,** the central building of the university, houses several faculties including Arts, Agriculture, Natural Resources and Environmental Science, Veterinary Medicine, Computer Science, Engineering, Medicine, Pharmacy, Management, Business, Science, Economics, Accounting, Nursing, Medical Technology, Law and Education.
2. **Darna** has three faculties, namely Economics, Accounting, Science and Nursing.
3. **Goba** has one faculty, which is Education.
4. **Tobruk** has three faculties, namely Law, Literature, Science, Medicine and Technology.
5. **Sousse** is a further college, which houses the faculties of Tourism and Antiquities (Omar Al-Mukhtar University, 2013)

Mission

Omar Al-Mukhtar University is a public university committed to the development of society, and to generating culture and critical, dialectical and propositional thought.

- Its main activities are teaching, research and its links with the community through the provision of services.
- In an era of permanent change in science and technology, it is driven by the generation, adaptation, assimilation and transfer of scientific knowledge; it effectively conjugates tradition and modernity to help meet the developing needs of Libyan society.
- Its primary task is the integral formation of competitive professionals and entrepreneurs who are aware of their national identity, committed to human rights, social justice, democracy and the preservation of the environment, and to provide

the physical resources necessary to fulfil its mission.

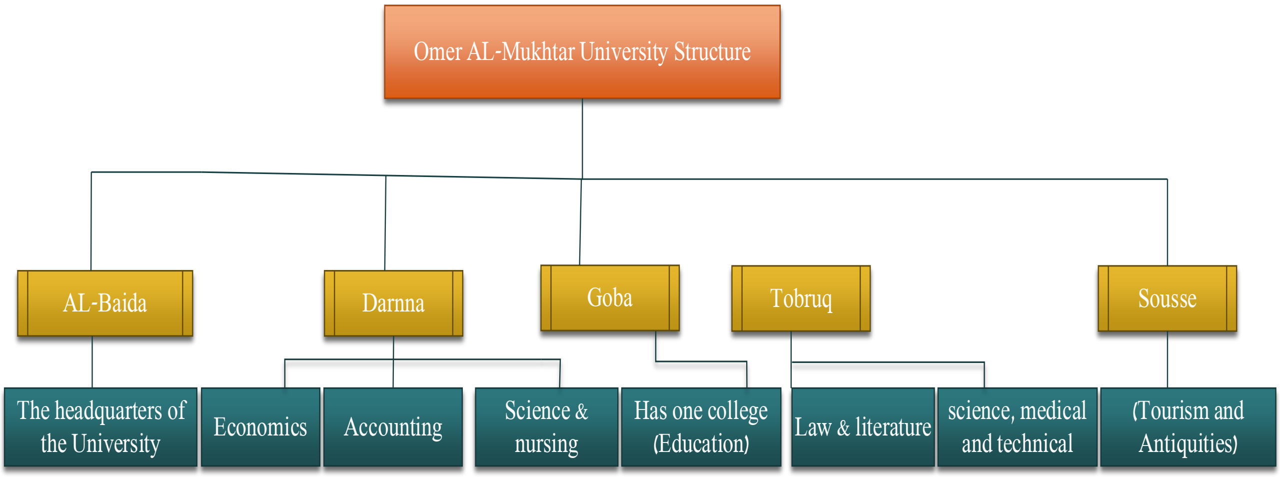


Figure 1-1 Omar Al-Mukhtar University Structure

1.3.1 Computer Science characteristics

In the early 1990s, Omar Al-Mukhtar University established its Department of Computer Learning to provide BSc degrees in Software Engineering and Computer Science. The course material has traditionally been delivered through lectures (also known as school-based learning, or SBL) and reinforced in lab sessions (laboratory-based learning, or LBL). The SBL is based on a lecturer-centred approach in which experienced lecturers provide theoretical knowledge and information via traditional materials (e.g., a blackboard and chalk), and the students receive printed lecture notes and read textbooks. The students later attend lab sessions utilizing a student-centred approach in which they receive hands-on training in the techniques presented in the lectures. Recently, the academic staff within the department have observed that students display a lack of practical experience and understanding of theoretical subjects that are essential to the success of lab sessions. (Omar Al-Mukhtar University, 2013)

1.4 Justifications for the Research

In order to achieve the aims of the lab-based learning, the university regularly reviews the quality of the course system each year. The goal is to improve the quality of performance of the lab sessions in the Computer Science course. A study was recently conducted to determine whether the lab sessions meet the expectations of the university or not (Omar Al-Mukhtar University, 2013). According to the resulting report, the "review showed that there is a gap between the lab and class room sessions"; the students displayed a lack of understanding of theoretical subjects and practical experience that are important to the achievements of the lab sessions, and there was a limited link between the theoretical content and practical tasks. This indicated that modern pedagogical models and increased use of technology should be implemented in both lab and classroom sessions.

The current research study focuses on the improvement of learning and teaching activities in the Computer Science course. The proposed e-learning package will contain online materials and exercises which can be accessed by students in their own time and at their own pace, so they are better prepared when attending the face-to-face lab sessions. With this method, the student will play an important role in the educational process and will learn and train without a lecturer. According to previous studies, further analysis should be carried out to discover the gap between the students' skills during SBL activities and those required by the LBL sessions. There is a need for specific lab needs to be identified based on data analysis and a literature review, in order to develop an LBL skills model comprising the hard and soft skills required for lab sessions.

This proposed model will be used to design and develop supplementary teaching and learning activities and materials which will increase the quality of student learning and satisfaction. In addition to the integration of the soft and hard skills required in SBL modules and existing LBL programmes, students should be prepared by learning a programming language in the SBL and then join the working laboratory programme with the required skills. Therefore, an effective linkage should be available to ensure the success of the transfer from SBL to the lab. To achieve this, effective online learning sites will be created for lecturers at Omar Al-Mukhtar University which will help to close/minimise the existing skills gap between LBL and SBL.

1.5 Identification of Skills Gap between SBL and LBL

The main goal of lab sessions is to allow the students to gain practical experience by using a set of software programs, and to develop knowledge and skills by working in teams. Such skills include the implementation and testing of programmable hardware; programming language; the design and testing of software and supporting tools which can be used to conduct practical work; research; and exploration of various aspects of computing knowledge. The lab can also be used to do homework. The lectures aim to provide students with introductory knowledge of programming languages and computing, which will enable them to solve problems using search methods and by producing rules and algorithms. In LBL, students use computers to solve programming issues which are taught theoretically in SBL. Around 100 students enrol for the Computer Science course each year, but the pass rate is only 50%, and a large number of students behave like ‘ghosts’ (rarely attending lectures or lab sessions). There are several possible reasons for students’ poor performance in the LBL sessions; these include lack of understanding of the theoretical issues necessary to perform exercises and analyse results; lack of experience of practical work; being discouraged by their rate of failure in the laboratory; lack of materials; lack of availability of lecturers and demonstrators; the poor standard of the traditional laboratory facilities; and the conventional nature of the course. Lack of practical experience is quite common in the case of undergraduate students, and there is no easy way to compensate for this. There is a limit to the number of laboratory hours available, and there are rarely extra spaces available for volunteers. Furthermore, the laboratory exercises are usually carried out by students individually. This leads to problems when students are required to design a large software program or system, where they should be able to work as a team, thus allowing them to gain experience quickly. Questionnaire responses revealed that 67% of the students preferred to work as a member of a team. The high rate of failure in the programming tests also discourages students from studying the course. The tests are necessary, but students who are not prepared, and do not know what results to expect, often waste time watching irrelevant signals, such as measuring noise instead of meaningful information. Therefore, it seems that both the subject matter of the programming tests and their level of difficulty should be reviewed.

1.5.1 Laboratory demonstrators’ and lecturers’ observations

Impressions and views regarding students’ performance in LBL and SBL were collected through questionnaires and feedback from observations by the lecturers and laboratory demonstrators. It was observed that the students who did not have the relevant knowledge could not solve exercises related to the higher level of Bloom’s taxonomy, such as the ability to apply, analyse, evaluate or create, thus preventing successful implementation of the laboratory exercises. However, some lecturers felt that basic skills such as writing skills, IT skills, reading, listening and operational skills were taught well during SBL (Omar Al-Mukhtar University, 2013). The laboratory demonstrators noted that some students worked efficiently in the lab and managed to complete tasks quickly, even though their level of preparation before coming to the lab session was not satisfactory. However, it was also noted that there was no means of communication between students and lecturers in terms of asking questions; the teaching activities included theoretical and practical focus on task-related skills and practical skills rather than on social networking and teamwork. The responses of the laboratory demonstrators further indicated that a strong work ethic is highly valued in LBL. They identified students with strong technical and academic skills, and preferred students with skills relevant to specific tasks, including cognitive competencies and lab learning (Othman, Pislaru, & Impes, 2013).

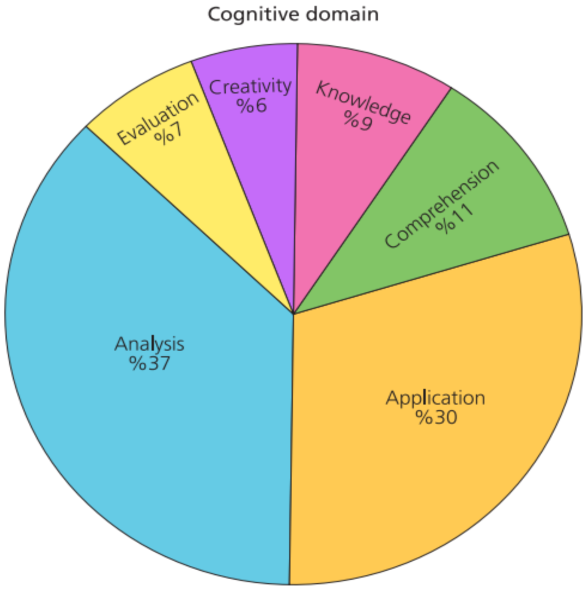


Figure 1-2 Knowledge-based activities (Othman, Pislaru, & Impes, 2014)

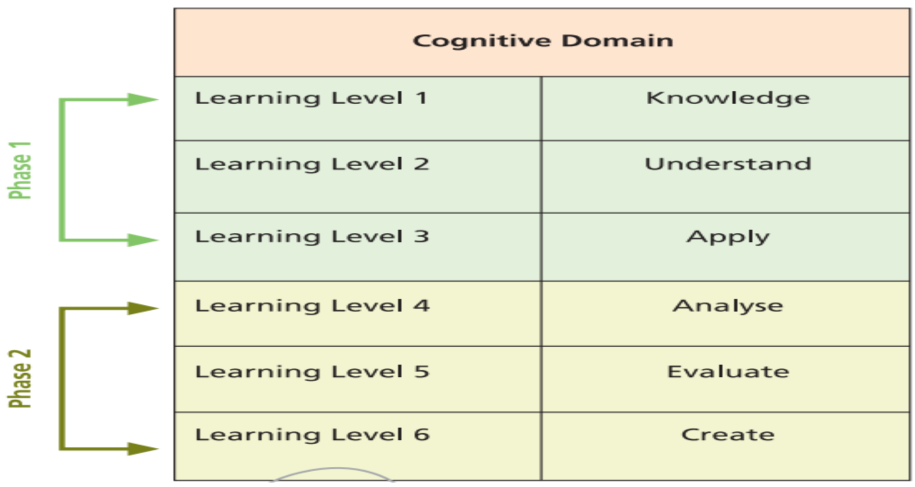


Figure 1-3 Bloom's taxonomy (Anderson, Krathwohl, & Bloom, 2001)

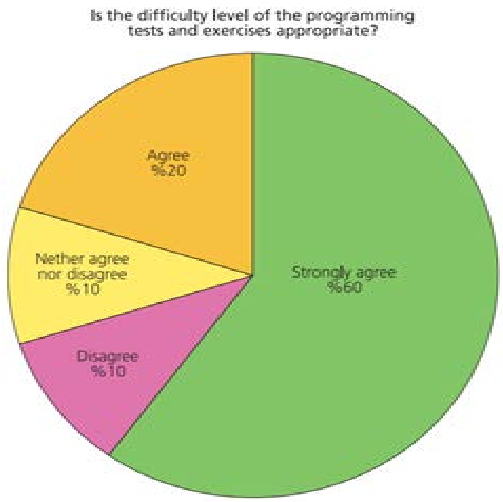


Figure 1-4 Student responses: difficulty level (Othman et al., 2014)

Bloom's classification has been used as a checklist for the analysis of educational materials for LBL and SBL Computer Science Department, Omar Al-Mukhtar University. Unfortunately, it was found that the students did not have the relevant knowledge to enable them to solve software programming issues involving higher level skills (apply, analyse, create). This prevented the successful implementation of lab exercises. In terms of age group, the study indicated that 53% were aged 20-30, 27% were aged 30-38, and only 20% were aged 38+. As expected, most respondents were aged between 20 and 38. In response to the questions related to the cognitive domain, 30% of the respondents agreed that the learning activities covered students' ability to apply theoretical background to practical reality, and 37% agreed that the learning activities covered students' ability to analyse educational materials, as illustrated in Figure 1.2. These abilities fall into the category of lower levels of learning, which are those involved in remembering, understanding and applying simple learning (Othman et al., 2014).

These lower levels are usually suitable for preparing students for comprehension activities, diagnosing the strengths and weaknesses of students, and for reviewing and summarizing the learning content. Higher levels of learning are those that require the application of complex analysis and evaluation, and creative skills. Usually the higher level skills enable students to think more deeply and be independent problem solvers, motivating students to obtain information on their own. The analysis illustrates that exercises within the theoretical (SBL) and practical courses were designed to focus on the higher rather than the lower learning levels within Bloom’s classification (See Figures 1.3 and 1.4).

There are many reasons for the insufficient theoretical knowledge of students attending this course of study. Many students lack a sound mathematical background from high school, while another obvious factor is that many students either fail to attend lectures or do not study enough on their own. Nevertheless, as already stated, some modifications to teaching methods may help to eliminate these barriers. It seems that they need dedicated pre-lab tasks and online material which can help them to gain better knowledge at any time without being reliant on lecturers to verify whether they possess the required knowledge.

1.6 Need for Modern Teaching and Learning Processes for Computer Science Courses

In light of developments in today's world, the Libyan student must ask himself where his position is in the midst of this scientific and industrial revolution. Unfortunately, the Libyan government still depends on traditional teaching methods that do not comply with the modern life and thinking of the student and lecturer in the era of technology development.

The traditional education at the present time does not confer the new educational content of the current generation because it cannot keep up with modern thought; it is clear that the Arab world, where the level of education is very low compared to that of developed countries, needs to adapt to the quantity and type of learning required by students in the twenty first century. These days, there is an increasing demand for technologies and blending learning. Blended learning has been described as interactive education in which the student can access online materials and the lecturers provide feedback to the students. Educational organizations and universities have different strategies for providing this approach, one of which is the employment of e-learning systems.

The current researcher has had the opportunity to recognize the need for rapid development towards providing an e-learning system within a Libyan university. Furthermore, the researcher 's teaching background in the Computer Science department at a Libyan university has encouraged her to design and implement a strategy of blending learning which will support teaching and learning methods for the Computing course. This research explores the main factors which are indicative of students' satisfaction with online teaching and learning methods. The researcher was asked to explore a variety of areas in the online environment and its role in enhancing teaching and learning in higher education as well as e-learning in Libya, focusing on a blended approach to build recommendations based on facts from research.

The current study provides a conceptual framework to introduce the value of the TAM model in explaining factors of the e-learning process. In order to achieve the purpose of this study, four research questions would need to be investigated. The contribution to knowledge will be addressed after the following research questions have been answered:

1.8 Research Questions

- What are the students’ skills and learning styles, and what is the skills gap between their LBL and SBL?
- Which technologies and pedagogical strategies can be used within the blended learning approach in the Computer Science course?
- How can an e-learning package be implemented in a traditional classroom?
- Does the technology acceptance model help in evaluating the blended learning approach at Omar Al-Mukhtar University?
- What are the factors affecting the adoption of a quality e-learning system in the Computer Science course?

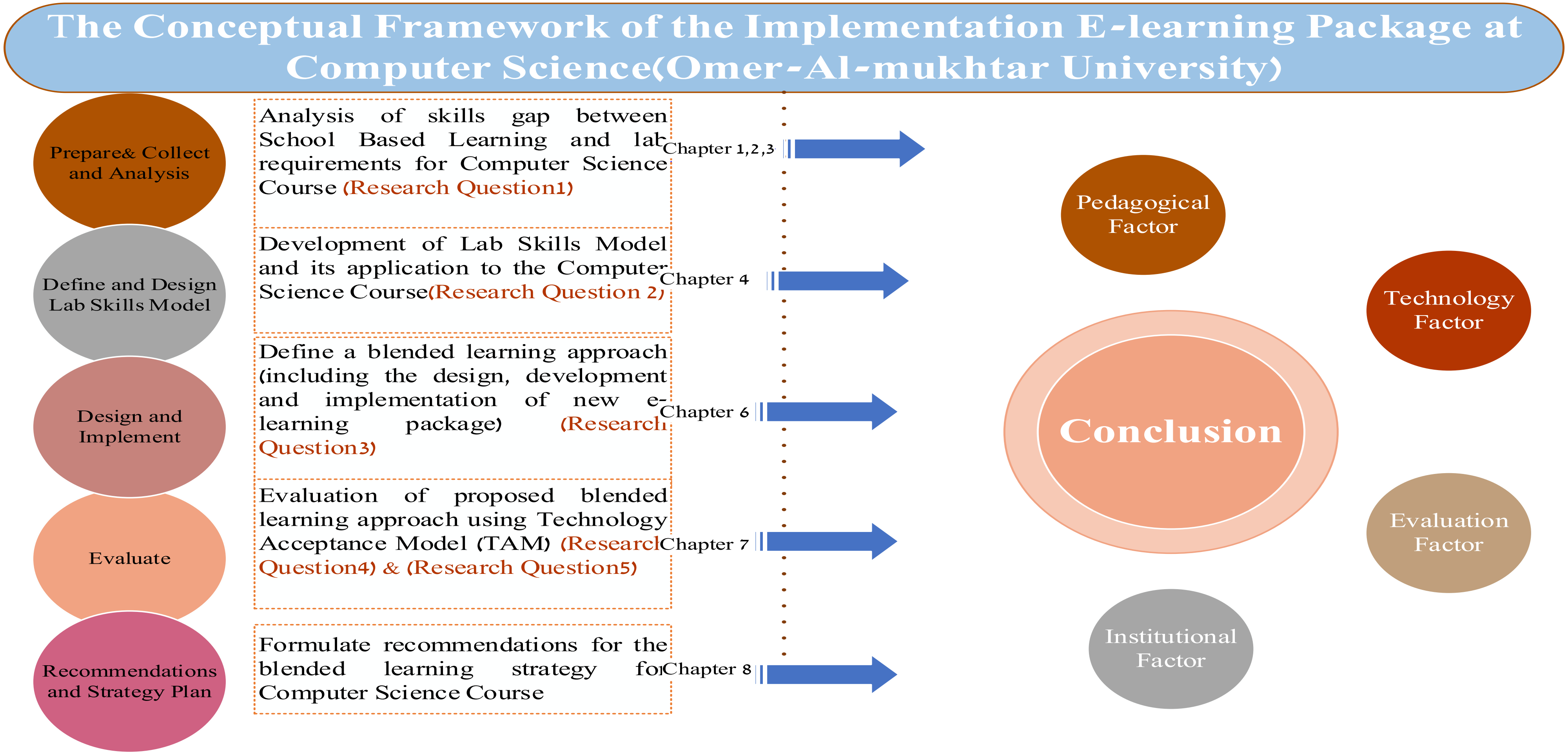
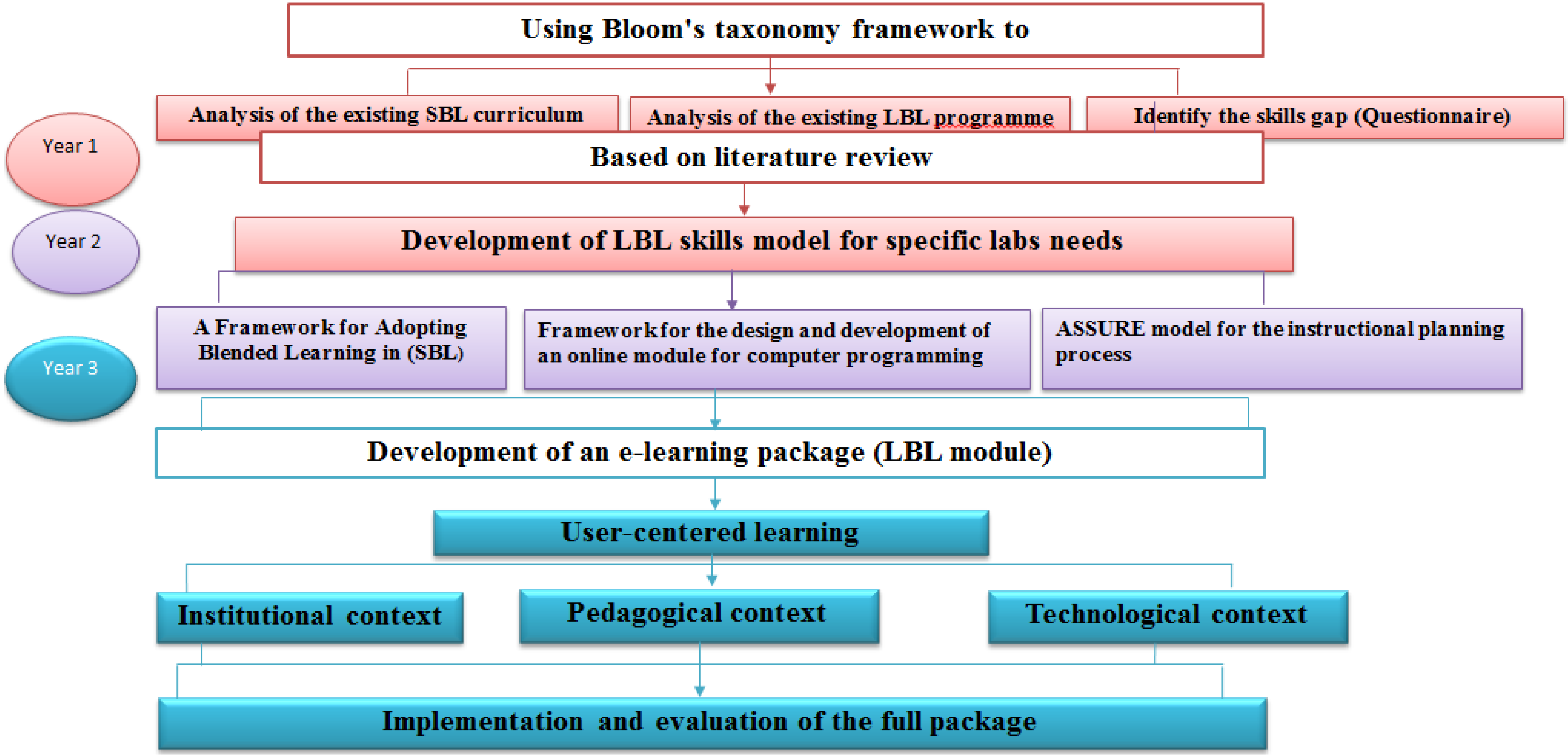


Figure 1-5: Conceptual framework of the research study

Figure 1-6: Project plan framework



1.9 Structure of the Thesis

This section presents a brief outline of the eight chapters of the thesis. Four chapters present the content and background materials relevant to the study, while the remaining chapters provide original contribution to knowledge.

- **Chapter 1** presents the structure and characteristics of the Computer Science course at Omar Al-Mukhtar University. Also it contains the aims, objectives and research questions.
- **Chapter 2** introduces research materials and existing publications related to lab-based learning, with an emphasis on models and theories regarding teaching and learning practice.
- **Chapter 3** describes the research methodology adopted for this project. The researcher designed questionnaires by considering aspects of reliability, validity, bias and triangulation. The results of quantitative and qualitative analysis of the answers have been used to formulate the blended learning approach and design and evaluate the e-learning package.
- **Chapter 4** presents the original contribution of the study regarding the identification of a skills gap between SBL and LBL and describes the proposed LBL skills model.
- **Chapter 5** describes the original contribution of the study to the design, development and implementation of the e-learning package in the proposed blended learning approach.
- **Chapter 6** contains a comprehensive review of present theories related to the technology acceptance model (TAM) with focus on the evaluation of students' acceptance of e-learning systems.
- **Chapter 7** describes the evaluation of the blended learning approach using the TAM model.
- **Chapter 8** presents a set of recommendations for the designed blended learning strategy in the School of Computing at Omar Al-Mukhtar University. These have been derived from analysis of student's skills using a TAM model related to the successful implementation of blended learning in the Computer Science course.
- **Chapter 9** summarises the salient points and draws conclusions. In addition, recommendations for further work are proposed.
- The following chapter provides more detail about previous studies related to learning theories, the TAM model, lab-based learning, blended learning and e-learning in Libya.

Chapter 2: Literature Review

2.1 Introduction

A critical review of publications related to lab-based education is provided at the beginning of this chapter. In the second part, learning-related theories and techniques utilised in research and practice connected with education are appraised. Bloom's taxonomy and Kolb's learning methods are concentrated on.

In the third part of the chapter, there is a review of publications relating to how the two processes of teaching and learning are influenced by the utilisation of technology intended to broaden the scope of channels of educational instruction. In the last part of the chapter, the progress of e-learning in Libya's higher education sector is examined.

Evidence suggests that the application of e-learning in Libya remains in a preliminary phase. Therefore, it is vital that the aspects that have an impact on the progress of online learning are examined. This appraisal is intended to provide enlightenment about the parameters and routes through which aspects influencing the progress of web-based learning in Libya can be investigated. This review also includes an introduction to ICT applications and online learning in developing world nations, a discussion of the difficulties and potential of e-learning in those nations, and a consideration of the key elements of success in the web-based learning process. Based on this review, a framework can be created to examine the aspects that could assist in providing an online learning process that is more efficient and effective in Libya.

2.2 Lab-based Learning Publications

A laboratory is a learning environment that promotes 'learning by doing'. This learning can be seen as strengthening conceptual understanding, and it can be evaluated in terms of the relationship between students' ability to put theory into practice, the development of logic skills, and a high level of efficiency in practical laboratory work (Carnduff & Reid, 2003). It is important to clarify the specific objectives of the laboratory context for learning. A laboratory may aim to give students the experience of tasks involved in the design and construction of a manufacturing system. The objective of this kind of lab is, therefore, to help them gain the skills, knowledge and judgment required to build and design such systems. A lab may also be described as that part of the school allocated to the conduct of scientific experiments, presentations and validation of laws, and to putting theoretical assumptions into practice. With the development of science teaching, the two main functions of a laboratory have become the verification of previous knowledge and the discovery of new knowledge. (Hofstein & Lunetta, 2004)

The effect and role of a lab in both colleges and universities has been a matter of debate (e.g., Lindsay & Good, 2005). The role of the lab may be seen as to strengthen the link between cognitive content and cognitive processes, and to achieve many of the goals of science teaching (building skills, developing deeper understanding, representation of fact, teaching the perceived). It may also be regarded as a means of achieving safety and security, teaching difficult and mysterious concepts, and developing the logical thinking of the student. It enables students to note exact or oriented development, increases their understanding of the work of scientists and the role of the laboratory and experimentation in invention and industry, and expands students' attitudes towards the laboratory and science in general.

The following section presents the rationale for the research on the basis of various reports and studies related to lab-based learning.

With regard to the importance of laboratory practical activities, the Science and Technology Committee and several authors such as Kelly and Finlayson (2007) and Rutto (2012) have indicated that students face difficulty in learning concepts and appreciating them in a meaningful way. This is particularly an issue in traditional laboratory activities due to lack of specialized training, lack of lecturer support and lack of time. These barriers are exacerbated by factors such as cost, old-fashioned experimental techniques and dated equipment. Perhaps one of the most important difficulties faced by the science lecturer lies in enabling each student to conduct experiments in the laboratory. This may be because of the lack of availability of materials and equipment needed to carry out experiments, hardware failure, or lack of sufficient time to prepare for tests because of the large workload experienced by the lecturer.

In fact, without lab sessions, students cannot learn. It is through lab work that the science education student is given the opportunity to 'do science'. The practical work is probably the most important part of the learning process; it is the hallmark of science learning. It engages students in what is going on, raises interest and keeps their attention and, because it is quite relevant to every aspect of daily life, can stimulate the desire for a large-scale experiment to continue. A recent study carried out by UNESCO revealed that most institutes do not do anywhere near as much practical work as they should. It is troubling that there are still a number of qualifications in which students' practical experience is limited. Recent research by Rutto (2012) recommends that lecturers should involve students in practical sessions which can help them to develop their confidence, practise their skills and apply concepts in a practical way, leading to improved performance in all science fields.

There have been some improvements in the efficiency of traditional lab-based learning in recent years. Most of these improvements have been achieved by providing new methods for engaging students in the learning process in the lab, and also by changing the learning style from a lecturer-centred approach to more student-centred learning. Many researchers have proposed various methods and approaches to solving lab-related problems. One of the first examples of a laboratory solution is problem-based learning (PBL), which is described by Bahri, Azli and Samah (2012). Barrows (1986) defines PBL as “a learning method based on the principle of using problems as a starting point for the acquisition and integration of new knowledge”. Since it was proposed by the School of Medicine, University McMaster, PBL has evolved and been adapted to the needs of the different areas in which it has been adopted. This has meant that it has undergone many variations with respect to the original proposal. However, the basic characteristics come from the model developed by Barrows (1996). These characteristics are that learning is student-centred, under the guidance of a tutor, and that students must take responsibility for their own learning by identifying what they need know to have a better understanding, managing the problem they are working on, and determining where to get the necessary information (books, magazines, lecturers, internet etc.). The lecturer’s role becomes that of a consultant for the students. Thus, each student is allowed to personalize their learning, focusing on their areas of knowledge or limited understanding and pursuing their areas of interest. One problem with this approach is that student assessment has to be conducted in relation to the work of a group, rather than of each individual student (Bahri, Azli, & Samah, 2012; Barrows, 1996).

Another method is team-based learning, or TBL (DeAntonio, Sandoval, Dewald, Al-Ta'Ani, & Talla, 2007), which is based on interaction in small groups. TBL is based on three factors, the first of which is that group work is oriented to expose and improve students’ abilities to apply the contents of the course. Secondly, with TBL, most of the teaching time in classes is used for group work and thirdly, courses implemented with TBL typically involve multiple group-work tasks that are designed to improve learning and promote the development of self-managed team learning. The primary learning objective of TBL is to go beyond simple coverage of content and focus on ensuring that students have opportunities to practice and use concepts to solve problems. Thus, TBL is designed to provide students with both conceptual and procedural knowledge. Although part of the time is spent in classroom lectures to ensure that students master the course content, the vast majority of class time in TBL is used to work on group assignments that focus on use of the course content to solve the kinds of problems that the students may face in the future.

A further interesting solution is that of pre-laboratory work, which is proposed by

Limniou, Papadopoulos and & Whitehead (2009). Using pre-laboratory sessions to engage students in preparing their lab work is not new. Hammond, Mohrig and Colby (2007) describe the elements of the process of effective pre-laboratory work, which include the following:

1) Review of theoretical concepts,

2) Planning for the experiment, and

3) Discussion with others.

When combined with the elements of a property and its importance to students, pre-lab work can be very effective in preparing the mind of the student (Johnston, 1998). Also, if students have direct input into a laboratory experiment, for example by determining the actions or techniques to be used, and have a genuine interest in the experiment which relates to their daily lives, they will have greater motivation and personal interest in actually doing the experiment. Johnston et al. (1998) report on the use of pre-labs in Physics: "The purpose of the pre-labs was to prepare students' interest in the experiment by knowing where they were going, why they were going there and how they were going to get there" (Sirhan, Gray, Johnstone, & Reid, 1999). In addition, Sarhan et al. (1999) comment on pre-lectures in Chemistry being a "useful tool to enable students to make more sense of lectures and effort being particularly important for students whose background in chemistry is less than adequate". Allen et al. (1996) describe how problems can be addressed in the pre-lab through small lectures, resembling the form of a session before the lab (Allen, Duch, & Groh, 1996; de Zoete, 2009; Johnstone, Watt, & Zaman, 1998; Lindsay & Good, 2005)

Several authors (e.g., Pollard, Finkelstein, & Lewandowski, 2014) have proposed the use of virtual lab learning to support general labs. This allows the possibility of applying high-cost or dangerous scientific experiments, rather than conducting them in vitro. It also works to solve problems facing the lecturer such as increased numbers of students and the lack of time allotted to conducting experiments in the laboratory. Practical experiments may still be conducted in the traditional laboratory if the necessary equipment is available. Research and studies on this subject are almost consistent on the basic patterns of the use of the virtual lab as an aid to teaching and learning processes. For example, the virtual lab has recently been presented in McFarland (2006) and Othman, Impes, Pislaru and Wilson (2014). However, several practical questions arise when dealing with this approach: 1) it is important to identify the basic patterns of the virtual lab, and 2) how to conduct scientific experiments, especially complex ones, in an easy way. To answer these questions, various different approaches are presented by

Najjar (2002) as follows:

Individual tutoring: In this type of computerized educational program, the virtual lab acts as a lecturer, as students can self-learn without a lecturer's assistance. The lab takes the form of units with examples and applications.

Training and practice mode: In this type of use, the virtual lab offers a number of exercises or questions about a certain topic. The student enters the appropriate answer, and the computer can reinforce the correct answer or correct answer error.

Educational games mode: This kind of educational program is characterized by elements of leisure and entertainment, and works to increase student motivation toward learning. It uses a computer-based games approach to integrate the learning process with playing in a competitive way to earn points. The positive outcome of implementing educational games is that they create an atmosphere of fun, relaxation and interaction, which leads to increased learning. Such activities also allow opportunity for the growth of imagination and innovative thinking during the learning process and, through communication and interaction, can enhance social development and engender respect for others.

Problem-solving mode: Programs that involve solving problems can assist students in developing their mental abilities. They provide opportunities to make repeated attempts to resolve any problem which may be encountered in different learning situations, and the problem may be presented by the computer in more than one way, such as by sound, movement or writing. The student follows a series of steps and actions to reach the correct answer.

Dialogue mode: This type of software provides the opportunity for the student to interact with the computer through the language of a particular dialogue. The student may either pose some questions, or answer questions posed by the computer. This pattern is still in the experimental phase of development.

Simulation mode: Simulation is the process of representing or imitating the events or situations of real life in order to facilitate identification of their nature and characteristics. The need for this type of software may arise when examining a particular embodiment or situation which has, in fact, happened. The simulation allows the pupil to amend the conditions of a component and watch the effects of this amendment on the rest of the system, thus providing students with scientific experience of situations which may be difficult or dangerous to achieve in reality. Simulation programs can be useful when a student needs to make many complex operations, for example, or is working to reduce the cost of materials and tools. Perhaps the most significant advantage of this method is that the student can transfer what he has learned in the simulation and apply it to similar situations in real life; for example, it is easier for the student who uses simulation as well as a book to understand the process of planting roses, and he will have a better awareness of all the requirements than the student who reads the book only. The application of learning transfer helps the student to measure the effectiveness of the knowledge, skills and application of information gained in new situations, as well as helping to increase his development of scientific proficiency. It also reduces the time needed to learn when compared with the time required to learn in a real lab. Since the last years of the last century, and since the advent of educational computer applications, simulation software and educational games computing have been used to improve students' absorption of scientific concepts. By easily converting a large number of practical attributes to computer algorithms, it has become possible to create realistic simulations, both fixed and mobile, using mathematical models and techniques. Such computerized educational software enables the student to conduct scientific experiments that would be difficult to undertake in practice, and through which the student feels thrilled.

Investigation of research from various sciences (Chemistry, Physics, Biology and Computer Science) has shown that there are many difficulties facing the teaching process. A number of these difficulties can be identified as arising from the teaching strategies currently used, which focus on the theoretical side of the science curriculum and can have a negative impact on the quality of learning. Approaches to overcoming these difficulties have focused on the importance of laboratory work and the advantages of its application in the teaching of science. The laboratory is the place that provides opportunities for student learning and experimentation, and this helps the student to retain information longer and to develop scientific skills.

However, in spite of the important role played by laboratory work in science teaching, there are various difficulties that students face in conducting scientific experiments and activities in the laboratory. The reasons for these difficulties may be related to the seriousness of some of the experiments or their lack of validity; the unavailability of materials or tools; lack of sufficient time to prepare the laboratory activities; high costs; the time required to create the laboratory; or the large number of students in the class. Taking into account these constraints faced by laboratory work, and the emergence of modern educational technology based on the use of computer programs as an important element in the teaching of science, the need to use the computer as an aid in both the theoretical and practical side of teaching science has grown significantly. This is primarily because the computer provides the opportunity to conduct experiments that are difficult to undertake in the laboratory (Keller & Naues; Lewandowski, Finkelstein, & Pollard, 2014).

2.3 Models and Theories of Learning for Practice and Educational Research

This study will initially focus on methods of teaching and learning used in current practice. Kolb (1984) formulated the experiential learning theory which relates to learning comprising both practical and academic activities (Kolb & Kolb, 2012; McLeod, 2010), while the theory formulated by Gagne says that the planning process for teaching a subject should consider presenting simple notions gradually so that students can be prepared to perform more complex tasks. Ausubel (1999) notes that the verbal student receives information and links it with existing knowledge and previous experience gained, and in this way, new knowledge, in addition to the previous information, has a special meaning (Ernest, 2010). Biggs (1999) looks at how pedagogical design should link together the course contents, learning environments, teaching and learning styles, assessment methods, learning outcomes, learning processes and learning activities, as shown in Figure 2.1 (Fadeeva, Mochizuki, Brundiers, Wiek, & Redman, 2010).

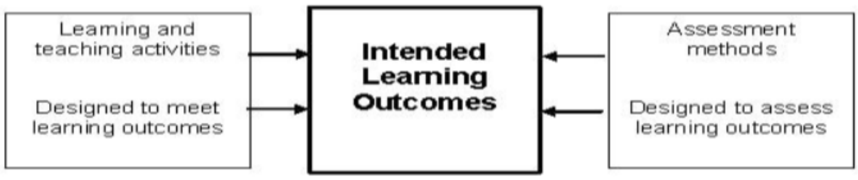


Figure 2-1: Assessment, teaching and learning (from Biggs, 1999)

The learning outcomes (social skills, academic knowledge including planned activities) for a Computer Science course should meet the requirements of the university. According to Schunk (2012), “there are three criteria for learning: learning involves change, learning endures over time, and learning occurs through experience.” This declaration contains all three criteria that he states are required for learning. All these theories indicate that learning involves the development of associations between responses and stimuli. UNESCO published a report in 2006 showing that various techniques can be employed for teaching and learning purposes, including group projects, individual learning and lectures, as well as online learning. Moreover, a Joint Information Systems Committee report (2004) states that that the learning materials must be designed to meet the goals of the external and internal alike (JISC, 2004); for instance, computing courses should be aimed at achieving educational objectives (JISC, 2004) (objectives of the university) and meeting the expectations of the university

(Biggs, 1999b; Schunk, 1996; Schunk & Usher, 2012). In addition to identifying the importance of pedagogy and the meaning of learning, some cognitive psychologists have also examined whether existing learning theories are appropriate for designing Computer Science courses. Schunk (2012) adds new factors to the learning theories:

- Understanding the philosophies of how people learn, and the capability to apply these in the process of learning and teaching, is one of the main requirements for effective teaching sessions.
- Cognitive theories explain learning with elements as interpretations of classroom factor, memory networks, student perceptions and information processing.
- Things that encourage students are self-efficacy, social comparisons, goals, interests and values. Parents and lecturers must be involved in motivating students to learn and using methods to keep them motivated.
- Methods of assessing learning include, for example, oral responses, self-reports, written responses, direct observations and ratings by others.
- Learning theories should be defined as techniques to classify a study of some variables in mental development and learning.
- Understanding the right theories of learning assists lecturers in selecting suitable teaching strategies which could be the most effective way to teach students in school-based learning.

Cognitive Learning Theories: These learning theories focus on the cognitive structure of the student, how to build it, and the introduction of new knowledge to it by many cognitive strategies; examples are as theories by Sawkut, Seetanah, Sanassee, & Lamport (2010). “There are main processes that information has to go through in order to be learned. The mental processing of information includes: construction, acquisition, organisation, coding, rehearsal, memory storage, and the retrieval and no retrieval of information” (Schunk, 2012). Gagne supposes that every learning outcome or part of a learning outcome has a hierarchical structure whose summit includes more topics or complex parts, and is supported by even the simplest part at the base of the hierarchical structure. Topics at each level involve the preparation required to learn the most complex topics, as shown in the hierarchical structure of knowledge (Figure 2.2). In light of this assumption, Gagne states that the student is ready to learn a new topic when he has acquired the preparation necessary to learn the subject. Thus, planning for education should be concerned with identifying and arranging the requirements necessary to learn each topic within the subject and also those that are required to be learned (Smith & Ragan, 1996; Biggs, 1999a)

Learning Outcomes	Learning Conditions (Internal or External)
Verbal Information	•Retrieval of context of meaningful information •Performance of reconstructing new knowledge; feedback
Intellectual Skill	•Retrieval of subordinate (component) skills •Guidance by verbal or other means •Demonstration of application by student; precise feedback
Cognitive	•Retrieval of relevant rules and concepts •Successive presentation (usually over extended time) of novel problem situations •Demonstration of solution by student
Attitude	•Retrieval of information and intellectual skills relevant to targeted personal actions •Establishment of recall of respect for human model •Reinforcement for personal action either by successful direct experience or vicariously by observation of respected person
Motor Skill	•Retrieval of component motor chains •Establishment or recall of executive sub-routines •Practice of total skill; precise feedback

Figure 2-2: Gagné's instructional learning theory (from Smith & Ragan, 2010)

Ausubel (2012) states that every learning outcome has an organisational structure characterised thus: other materials in the structure occupy all the ideas and concepts of the most comprehensive and general subject at the summit; underneath is the least comprehensive and detailed information, and then the minute detail. The cognitive structure of any academic subject consists, in the mind of the student, of the same order from the least to the most comprehensive; Ausubel also sees that there is a similarity between the structure of the information processing in each subject and the knowledge structure, which exists in the mind of the student. Ausubel (2012) assumes that learning happens if it is organised along subject lines similar to those that govern knowledge in the mind of the student, where he sees that the student receives verbal information and links it with knowledge and experience acquired previously, and in this way takes new knowledge in addition to the previous information that now has a special meaning (Ausubel, 2012). Brunner argues that every individual can teach any subject at any age and that this learning should enrich the surrounding environment; thus, the investment power of the individual grows to the fullest extent possible where individual thinking is developed through the individual's interaction with the environment. If everyone has a special vision of the world around him and an interpretation of this vision in relation to himself, and the lecturer understands the way the student perceives the world, then he can teach any subject.

Brunner (2004) believes that the student should be able to formulate problems and the search for alternative solutions rather than looking for only one answer; he cares about the personal development of each individual through his concept of himself and his world. He is therefore interested in learning discoveries and knows that the reorganisation and conversion of data and evidence will allow him to reach beyond available data and information to discover new data or information for the student (Fielding & Moss, 2010). The Swiss psychologist Jean Piaget's theory of cognitive growth, based on a descriptive analytical approach in dealing with mental development, is psychometric input-orientated and knowledge-orientated in addressing mental cognitive activity. It was built by observing his three children in their development. Piaget supposes, in his theory, that anyone can learn any subject, provided that it fits the stage of mental development of the individual, and this notion of innate potential is an important element in the construction of the knowledge of the student.

Learning style: Learning style consists of distinctive behaviour that works as an indicator of how an individual learns about and adapts to his or her environment, and gives hints about how the brain works. Keefe (1979) describes learning styles by means of the "composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a student perceives, interacts with, and responds to the learning environment" (Keefe, 1979; National Association of Secondary School Principals, 1979).

Bloom's Taxonomy: Benjamin Bloom (1913-1999) was an educational psychologist who was interested in improving student learning. In the late 1940s, Bloom and other lecturers worked on a way to classify educational goals and objectives, which resulted in three learning categories or domains and the taxonomy of categories of thinking. Each of the three categories requires students to use different sets of mental processing to achieve stated outcomes within a learning situation. Thus, instructional goals and objectives should be designed to support the different ways that students process information in these domains (Anderson et al., 2001).

- Cognitive domain (knowledge): verbal or visual intellectual capabilities
- Affective domain (attitudes): feelings, values, beliefs
- Psychomotor domain (skills): physical skill capabilities.

Bloom and his colleagues looked at how learning behaviour comes to support the structure of knowledge, orientation and skills in the classic user's education. Bloom's Taxonomy remains the most widely used system of evaluation of its kind in education, especially in industry and group training. It is easy to see why: it forms the simplest and most effective description of each of the processes and explains the application of these to educational goals, methods of education and training, and measures of educational outcomes. Bloom's Taxonomy provides an excellent structure for planning and design, as well as for assessing the effectiveness of all training and education as explained in Figure 2.3 below. The classification serves as an audit list (checklist) to ensure proper planning for the provision of development necessary for students and trainees; it can assess the validity of training and coverage for any education required or planned, including the curriculum or training programme for a large organisation.

	Learning Domain / Learning Level	Cognitive Domain	Affective Domain	Psychomotor Domain
Lower Learning Levels	1	Recall	Receive	Observe
	2	Understand	Respond	Perform
	3	Apply	Value	Demonstrate
Higher Learning Levels	4	Analyse	Organise	Construct
	5	Evaluate	Characterise	Design
	6	Create		

Figure 2-3: The cognitive, affective and psychomotor domains (Alseddiqi, 2012)

The cognitive domain, which is the domain most required at university level (Othman et al., 2013), is not always correctly included within learning outcomes. Shephard (2008) confirms that it is possible for those involved in the design and evaluation of education or training, or the preparation of courses or study plans, to use and benefit from Bloom's cognitive domain model as a tool, framework or simple checklist to ensure the use of the appropriate quality of education in the development of the capacity required (Shephard, 2008). The design and evaluation of education does not need to cover all aspects of Bloom's Taxonomy - just sufficient to be suitable for the required goals. This model enables those in doubt about their training goals to scrutinise their options.

Experiential Learning Theory: Kolb (1984) introduced an experiential learning model incorporating Piaget’s cognitive model and Lewin’s social psychology. Kolb (1999) then developed a model to explain the process of learning to support John Dewey’s theory of the need to build learning on a trial basis. This model also supported the work of Kurt Lewin, which is based on the importance of the person’s activity during the learning process, and on the theory of Jean Piaget, which emphasises that intelligence is the result of the interaction between the person and the environment. It sees learning as having two dimensions. The first is understanding the information, which starts from sensory experiences and ends with abstract concepts; the second dimension is information processing, which starts from contemplative observation and ends with effective experimentation. One of the characteristics of this type of learning is its treatment of information. Learning is based on experience and a dynamic process that works to adapt an individual to the environment surrounding him/her, and that includes going beyond the acts of both the person and the environment. This is done in four successive stages. The 'Learning Cycle' developed by Kolb is a method of showing the process of learning which is based on learning by experience; it does not contain a 'start point' or 'end point' – students can start from any point in the learning cycle, which is illustrated in Figure 2.4.

The first stage, **experiencing,** involves recognising and addressing the information based on sensory experience, and that people learn best through integration with examples. It also involves doing some work or watching what happens. The **reflecting** stage involves individuals relying on perception and processing information through meditation, objectivity and careful observation which places them in the analytical position to learn. The **thinking** stage underlines the theories which have been experienced or can be experienced in the future. The **planning** stage relates to preparing for future action in terms of what the student will do at the next stage (Kolb, 1984). Many studies undertaken by Honey and Mumford in the early 1980s developed the work of Kolb. They indicated that individual students preferred one particular stage of the learning cycle, rather than learning involving all stages. Honey and Mumford (1983) identified four basic stages for learning styles within the Kolb learning cycle (see Figure 2.4). Kolb's (1984) approach is considered as an inventory of individuals' learning styles, which is determined by four stages of learning that require specific learning capabilities (Honey & Mumford, 1983). By combining Kolb's developed theories with their learning styles questionnaire (LSQ), Honey and Mumford (1986) propose four elementary learning styles, including those of activist, reflector, and the pragmatic view. Although everybody has a combination of learning styles, several people have a leading learning style and use other methods much less. Individuals may also find and use different methods in different circumstances. More importantly, there is no right mix. Honey and Mumford's learning styles are widely used in development and management training.

Furthermore, applying a simple procedure of logical analysis to the implications of culture and learning styles leaves little room for doubt that culture can have a powerful effects in improving individual learning preferences. An investigation by Allinson and Hayes (1988) explored whether cultural dissimilarity accounts for learning styles by comparing the methods of British, Indian and African managers using Honey and

Mumford's LSQ. The results indicated that there were significant differences between all three nations (Allinson & Hayes, 1988). In Figure 2.4, the four quadrants refer to the learning styles inventory (LSI) defined by Kolb (1984) and described below.

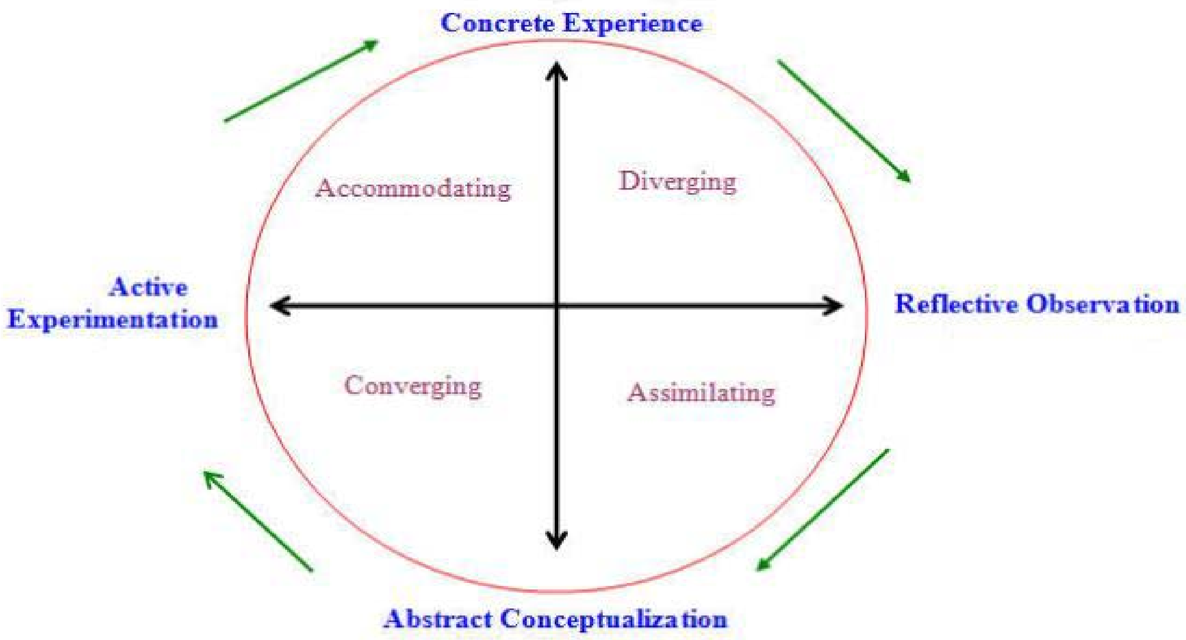


Figure 2-4: Kolb's Learning Cycle (from Kolb, 1984)

Diverging: people with this style are better at hearing many different perspectives, and they approach any case with more control of the application (the act). Also, they could probably be entertained in cases that require generating a lot of ideas, such as brainstorming sessions. Probably because they have wide cultural interests, and they prefer the collection of information, this ability is imaginative and has a high sensitivity to feelings essential for the effectiveness of artworks and service occupations. In cases of formal learning they may prefer to work in a group to collect information, to listen with an open mind, and to receive personal feedback and gather information. They want to know 'Why?' and care about discovering the cause of a situation. They are interested in certain physical aspects and determining what should be provided by the system, and prefer to take the information provided to them in a manner that is detailed, regulatory and logical. They need time to think about the subject and the points that they can imagine, and appropriate teaching methods include a lecture method that focuses on certain things as points of strength and weakness and uses systems, particularly when the system is discovered manually.

Assimilators: people of this style are better at understanding a wide range of information and putting it into a brief, logical model. They are likely to rarely focus on people, but are more interested in concepts and abstract ideas. Generally, people with this style enjoy hard theory that is of more logical than practical value, and this pattern is important for the effectiveness of information and scientific professions. In cases of formal learning they may prefer lectures and reading, exploring analytical models and taking time to think things through. These people care about answering the question, "What do we need to know?" They like thorough and structured information, tend to respect the knowledge of the expert, and concentrate their strengths on their ability to create theoretical models. They do not discover the system randomly, but want to get the right solution to their problem, and suitable teaching methods include lectures (or visual and auditory offers) which are preceded by clarifying or sounding out subjects in the laboratory, accompanied by a guidebook providing adequate responses.

Convergers: people of this pattern are best at finding a special use for ideas and theories. They have the ability to solve problems, and make decisions supported by the capacity to find solutions to questions. They prefer to address technical tasks and issues rather than social and personal ones, and take longer to learn. These are important skills for specialised technical professions. In cases of formal learning they prefer experimentation using new ideas, laboratory tasks and practical applications. These people ask, “How can I apply this in practice?” They understand the detailed working of a system through the application and use of information, and thus they prefer simulations, practical applications and laboratory work.

Accommodators: these people have an ability which enables them to learn primarily from personal experience. They may enjoy the implementation of plans and involving themselves in new experiences notwithstanding the challenge, and perhaps their goal is to gain a sense of courage. In solving problems, they often rely on people having a lot of information rather than on logical, technical analysis. These students are good at complex things and able to observe the relationships between multiple semblances of order. They tend to solve problems intuitively based on the information of others, and there are a variety of approaches that fit this method of education. Such students may acquire new knowledge by solving problems, technical work, learning information from other people and working in groups; they prefer to collect data and watch rather than investigating with practical applications.

2.4 The Impact of Technology on Educational Goals

In the 1990s, digital tools began to be used in the learning process and web-based learning has since become an effective phenomenon in developing the learning and teaching process. Yen et al. (2003) conducted a study on the application of e-learning in the teaching and learning process. They found multiple effects of technology on all aspects of the educational process of student-centred teaching and curricula, as well as on courses that are based on the educational philosophy of the nation and influenced by the lecturer leading the educational process as a whole, which in turn transmits the impact of technology onto teaching methods. Hennessy et al. (2007) describe how "simulations and other ICT tools add value to science lessons in two ways: the first through intrinsic properties of the software; and the second through potential student learning benefits such as clearer understanding" (Hennessy et al., 2007).

Flecknoe (2000) underlines the positive effects of use of technology on the student in multiple fields. It is a form of democratic education that means the student has an area of freedom and space in the specialisation, and even the lecturers want them to achieve independence and a sense of subjectivity which is consistent with their inclinations and abilities. In addition, the use of technology works to raise the motivation of the student through increased interaction in the classroom as well as the development of positive thinking through modern information received via the internet (Flecknoe, 2000).

Johnston and Barker (2002) say that modern technology provides the lecturer with more knowledge and information produced by others, and information technology also draws on a lot of modern teaching methods which enable the lecturer to participate in the preparation of educational materials and work to raise their quality. It also provides assistance with evaluation methods and enables follow-up work to be accessible through short computer lectures which can be seen at any time (Johnston & Baker, 2002). It is important to consider the context of the technological revolution when reviewing the present and future role of the lecturer, as well as the challenges inherent in technological methods. Whilst the technological revolution cannot succeed without being led by the technology, this does not minimise the importance of the lecturer as perceived by some. Reiner and Gilbert (2004) explain that while the learning style of students who prefer to learn using technology is different to that of students who are interested in education by traditional methods, that does not mean that people with certain types of traditional learning style will not benefit from the use of technology in education (Reiner & Gilbert, 2004). However, everyone has certain qualities which give them the ability to learn more or less than others.

Furthermore, it can be said that there are other positive aspects of the technology education curriculum. These include replacing the dispensing of books, which has a traditional image, with the dissemination of valuable knowledge and information by electronic means; another is the emergence of a number of approaches to delivering the curriculum, such as interactive work to raise the motivation of the student and increase concentration (Bruner, 1996, p.93).

There is now a raised awareness of technology in the curriculum, most notably its potential to allow students access to a huge amount of information and to provide material desired by the student. As well as raising the motivation of the student to learn, the nature of interactive work allows them to focus on the development of skills and provides the opportunity for the student to employ knowledge instead of just saving it. It also encourages integration in various fields of knowledge, and supports diversity to make the student able to cope with the rapid changes of society. It is important for the Ministry of Education to keep pace with this constant evolution of the technological revolution and the computerisation of some subjects (Bruner, 1996).

2.5 E-learning in Education

The past two decades have seen countries in the developed world, as well as nations with emerging market economies, embracing ICT in an effort to modernise and improve their various sectors, one of which is education. As a result of this change, curricula have been immensely affected: prospectuses and schoolbooks have been revisited and modernised, and lesson planning and exams have been introduced (Tarkelson, Sinclair, Yook, & Egidio, 2011) The change has also had an impact on pedagogical technique as well as the process of learning itself. The 1980s saw the beginning of the key drastic development of the process of e-learning, which underwent different phases: firstly, separate data processors in labs for computers were used; secondly, access to the internet was made available; and thirdly, combined internet services were utilised and supplied for the two processes of teaching and learning (Albakai, 2010; El Zoghbi, Kumar, & Naidu, n.d.).

2.5.1 E-learning framework

A framework for e-learning was introduced 2001 by Badrul Khan, who built it on the basis of examining the various elements and aspects impacting the development and application of e-learning methods. According to Khan (2001), a number of elements, which can fall in eight categories, influence the progress of e-learning (Khan, 2001). These elements are pedagogical, technological, interface design, evaluation, management, resource support, ethical and institutional, as shown in Figure 2.5

The pedagogical aspect, which is the first category of Khan’s proposed framework, is related to the process of teaching and learning. This category covers elements such as aims and objectives, organisation and methodology of design, as well as techniques, strategies and education tools relevant to online learning settings (Khan, 2001, p.79).

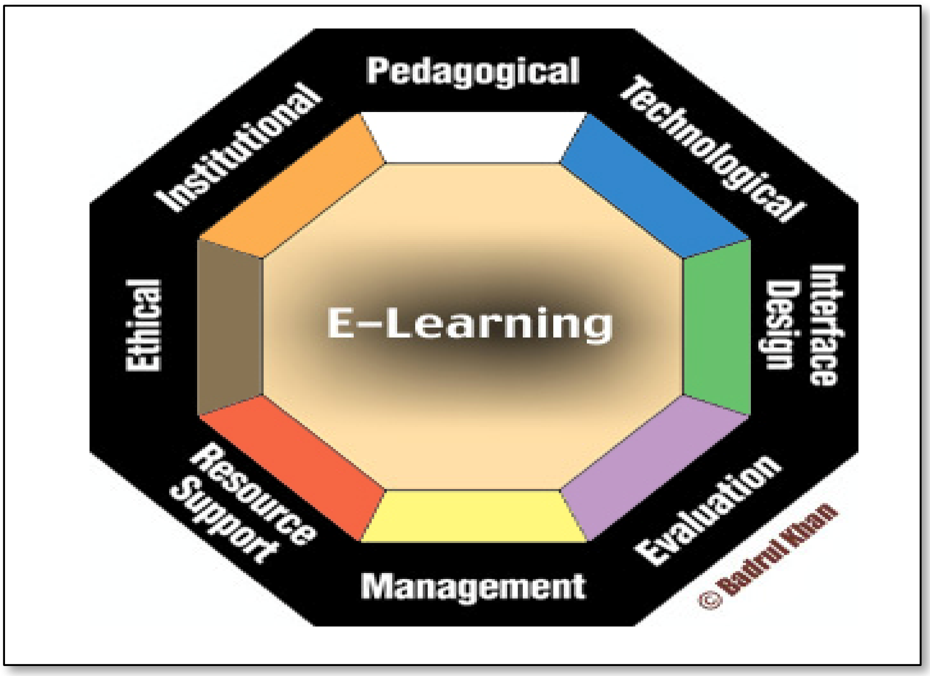


Figure 2-5: Critical success factors of e-learning (Khan, 2001)

Involved in the **pedagogical** category of Khan's framework, then, are five elements that are mainly connected with the teaching of the provided content, as follows:

1. *Aims and Objectives:* This refers to ensuring the student is well informed about the aims and objectives of the course.

2. *Methodology of design:* According to Khan (2001), as far as online learning settings are concerned, the methodology of design depends on the branch of knowledge that is taught through the content of the course (Khan, 2001, p.79). Khan refers to various methodologies of learning, such as instructivist and constructivist ones, and the relevant impact on the entire education philosophy of how the course is laid out. Additionally, the role of the lecturer is likely to be affected by the selected layout of the content. More explicitly, the role played by the lecturer should be a more assistive nature than a pedagogical one, or of a more pedagogical nature than an assistive one, or an amalgamation of the two (Khan, 2001).

3. *Techniques and Strategies:* This refers to a variety of activities that are undertaken with a view to assisting the learning process and aiding students in the accomplishment of the aims of their learning. As suggested by Khan, the online course's philosophical viewpoint will play a partial deciding role in the techniques employed in it. The various assistive educational activities which can be integrated into the process of online learning can be aided by the internet's structural and technical characteristics (Khan, 2001, p.80-

81). Khan cites examples of such activities, including presentations, discussions and case studies, as well as periods of instruction, simulations and games, among other things.

4*. Organisation:* As suggested by Khan (2001), content should be appropriately organised, ordered and sequenced; this is to enable the students to form a structure of the information contained in the course's content (Khan, 2001, p.80). Khan highlights how vital the ordering of content is – in relation to digestibility, style, clarity and optimisation of multimedia.

5. *Medium:* This refers to the identification of the medium to be employed for delivery and distribution, the study its characteristics and the determination of the optimum resources to be employed in the learning process.

The second category in Khan's framework is the **technological** elements, which refer to aspects of the infrastructure of technology in an online learning setting, such as infrastructure-related planning and software, as well as hardware (Khan, 2001, p.83).

1*. Plan of infrastructure:* This refers to planning for IT needs as well as the upkeep, assessment and availability of human resources for ICT support and maintenance.

2. Hardware: This is related to the hardware needed to execute and develop the course being obtainable at the levels of the institution and students, with the purpose of ensuring the student is well-informed about what is needed for course completion in terms of ICT.

3. Software: This refers to the software needed to execute and develop the course being obtainable at the institution, and the software as something that is necessary for the students to complete a course.

Khan links the layout of the **interface**, which constitutes the third set of elements of his framework, to the total layout and feel of online learning programmes. These elements involve the design of content, the layout of page and site, the browsing and examination of ease of use (Khan, 2001, p.84). It is possible to assess these four factors in the development of content as follows:

1. The layout of page and site: This is related to 1) the design of content being compatible with various browsers and software; 2) the course's conformity with the criteria of accessibility, namely if it is accessible to all segments of people, including those with disabilities; and 3) the screen's operability and actual outlook (Khan, 2001, p.84).

2. Design of content: This refers to the way in which the visual introduction of the content is accomplished and the way in which the content's ideas are presented. More explicitly, this is related to whether each paragraph covers one idea; whether different ideas and paragraphs are clearly signposted; and where, when, and how videos and pictures are provided (Khan, 2001).

3. Browsing: This is related to the ease, effectiveness and clarity of the content's browsing technique, as well as the navigation of the course map or the site available, which enables the student to easily access the sections he needs.

4. Ease of use: This is related to the convenience of use and trustworthiness of the content of the course, such as whether the students are able to reach what they are interested in or are able to find relevant links and assistance services.

The **assessment** elements refer to appraisal of students as well as assessment of the setting of the teaching and learning process (Khan, 2001, p.85). Khan (2001) discusses appraisal-related matters from two angles:

1*. Appraisal of students:* This refers to the evaluation of the performance and development of the student.

2. *Assessment of the setting of the teaching and learning process:* This is related to the layout of the course and is derived from student's feedback about the setting of learning, the lecturer, the content and the resources, as well as the design of the course and technical assistance.

The fifth, **management-related** category of the framework proposed by Khan is suggested to involve two key elements:

1. Upkeep of the setting of learning: This refers to matters such as mechanisms of assessment, budgeting, staffing, management of the content of the course and management of the resources of learning, as well as security procedures (Khan, 2001).

2. Information distribution: This is related to how an exchange of feedback and information takes place between the students and lecturers, or administrative staff. This information could be in various forms, such as curricula, courses, announcements, assignments and schedules, as well as grades or results, contact information and feedback, among other things. The exchange and delivery could be achieved through various methods, such as email, mail, telephone or an announcement page.

The sixth, **support resources** category of Khan's framework is mainly connected with the employment of web-based support resources necessary for the promotion of important settings of learning (Khan, 2001, p.86). Khan emphasises online learning support through two elements:

1*. Web-based support:* This refers to how accessible papers, documents and instructions related to technical assistance are.

2. Resources: This is related to access to online services such as email, students' profiles, data on accommodation, and access to library catalogues, research databases and help desk, including a listing of prominent people in the institution's various departments and their positions.

The seventh category, **ethical elements,** is related to aspects connected with geographical, cultural, social and student diversities, legal matters, etiquette and obtainability of information (Khan, 2001, p.88). In this category, the focus is placed on the idea that it is significant that the online students' diversity is examined.

The eighth and last category of Khan's framework, **institutional elements,** is mainly connected with academic links to online learning and administrative matters as well as students' services (Khan, 2001, p.90).

1. Academic links: This is related to institutional assistance to faculty staff to facilitate executing web-based courses, and it can be in the form of education, methodological and technical assistance and strategies.

2. Students' services: This is related to the capacity to provide assistance to students outside the campus. This can take various forms such as bookstore services, financial support, counselling and direction programmes, among other services.

Notably, in relation to his online learning framework, Khan (2001) assesses the factors in terms of student, lecturer and institution. With regard to matters connected with the progression of online learning, it appears to be the case that a number of the essentials examined may sound slightly familiar. This is because Khan investigated around 20 elements of the development of content; these include the layout of interface and content, organisation, support, browsing, ease of use, and more. Additionally, Khan identifies various categories in the process of execution. Dimensions with less significant influence are grouped together into one category of elements pertinent to the development and layout of content.

It can be argued that the author's institution's policy has had an impact on the elements of assessment, management, support and ethics involved in the e-learning framework proposed by Khan. For instance, it is in line with the institution’s criteria and regulations that the strategic approaches and policies related to assessment are produced and executed. The same is applicable to the elements of support, management and ethics. Therefore, it can be argued that all the four sets of elements could be grouped together into one category with a focus on institutional policies in relation to management, ethics, assessment and support matters connected with online learning programmes. It can be generally concluded that Khan (2001) could not address each and every single detail with regard to the development of online learning, with the result possibly being significant overlapping, and sometimes the existence of akin factors that could generate confusion at certain points, especially within the framework of the process of execution.

2.5.2 Online learning in developing countries

Sawahel (2013a) states that, in relation to online learning, Africa now has the most active market globally. Senegal is at the top, and then comes Zambia, followed by Zimbabwe and Kenya (Sawahel, 2013). According to Adkins (2013), in Africa self-paced e-learning reported a total growth rate of more than 15%. Senegal ranks first in terms of growth rate, in the African continent, with 30%; it is followed by Zambia, Zimbabwe and Kenya, each of which reported a growth rate of just above 25%. Globally, Africa ranks first in terms of growth rates in the areas of services of custom content development, packaged content, installed authoring tools, cloud-based authoring tools, installed learning platforms and learning platform services (Adkins, 2013).

As suggested by Tagoe (2012), although some headway has been made, the majority of universities in the African continent continue to have difficulty incorporating online learning into their educational process (Tagoe, 2012). According to UNESCO, a survey conducted on online learning in the continent unveiled the fact that throughout most of Africa, online learning remains in its very early stages (Macharia & Nyakwende, 2010). In a number of countries, no trustworthy and even-handed system for online learning has yet been created, and online learning is still not being treated as a vital item on governments’ agendas (Akbar, 2005). Similarly, there has not been a complete grasp and investigation of either the educational, economic, social and technological parameters, or the capacity to utilise the advantages of ICT to achiever a better life quality (Duan, He, Feng, Li, & Fu, 2010; Rossiter & Crock, 2006)

A study with confirmatory factor models involving 538 participants from various courses was conducted by Selim (2007) at the University of the Arab Emirates. This examined four types of critical success elements from the perspective of the students. The elements examined included qualities of lecturer (related to stance on and control of technology and pedagogical technique); qualities of student (related to technological skill and interactive cooperation); and technology (related to accessibility, infrastructure and layout); as well as assistance from the university through the institution's policies which are aimed at the facilitation of courses on web-based learning (Selim, 2007).

For the purpose of testing these elements, Selim (2007) categorised them into 53 assessable aspects that could elicit an interaction from the students. There were 13 lecturer-related aspects; 22 student-related aspects; 13 technology-related aspects factors; and 5 aspects related to university assistance.

As shown in Figure 2.6, these elements have been examined as critical for success in the area of online learning, based on the case studies presented by Selim.

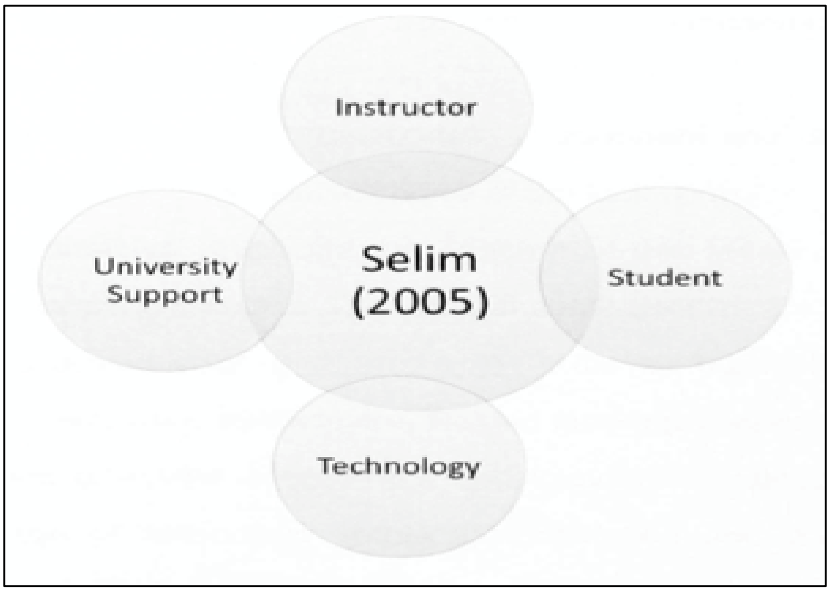


Figure 2-6: Critical success elements of online learning (Selim, 2007)

Based on the findings of his research work, Selim (2007) refers to a highly critical level shown by the elements related to the control of technology and the stance of the lecturers. Providing additional explanation, Selim notes that the stance on interactive learning and pedagogical technique constituted the most critical element in the segment relating to the qualities of the lecturer.

Based on the findings related to the segment of the qualities of the student, Selim concludes that the student's technical knowledge, as well as self-incentive, constituted critical elements, explaining that a high validity level was shown by the assessments of both (Selim, 2007). According to him, the student's past technological skill was the most critical element in this segment.

With regard to the segment of technology, Selim found that the most critical element was content usability, which was followed by the layout of screen and efficiency of browser (Selim, 2007). A highly critical level was shown by the majority of the technology-related assessable aspects, including computer networks and labs being available and infrastructure being reliable.

In relation to the category of assistance from the university, Selim highlights a consensus that university assistance should not be restricted to technical support, but should also involve resources and information facilities as well as library services. It should be noted that the findings have a reasonable level of validity, given the range of the sample of the study – 538 students from 37 different courses. In the meantime, one discernible potential limitation is that the assessments utilised in the survey and the analytical examination of group course design and technology in one element might affect the findings of the analytical examination of data and generate some imprecision in the analytical examination.

2.5.3 Online learning in Libyan higher education

As is the case in the majority of countries in the developing world, ICT utilisation and online learning application in Libya remain in their infancy. A number of Libyan universities, for instance Garyounis University, Academy of Postgraduate Studies and Economic Research, and Alfateh University, possess basic ICT infrastructure (for example, computer machines, access to the web, and a LAN). However, these academic institutions continue to apply a conventional educational method that relies on direct interaction as well as learning activities provided on campus only. Although Libyan Open Universities (LOPs) provide students with opportunities for home-based study as part of accommodating the needs of students who have work and family responsibilities or who live in remote locations, the learning experiences are often conventional, with academic institutions widely depending on printed learning content. However, this is starting to change, with many institutions recently introducing web-based libraries and repositories of online resources (Rhema & Miliszewska, 2010). The year 2005 saw the roll-out, in Libya, of an ICT national policy in the field of education, which was run by the Ministry of Education and the Ministry of Vocational Training, assisted by other parties including the main telecommunication providers in Libya, Libya Telecom and Technology and the General Postal and Telecommunication Company. The goal of the collaboration that involved the private sector and the government was to enhance the ability of Libya to execute wide-ranging ICT initiatives. As part of the efforts towards modernisation, the aim of this national policy was to facilitate the obtainability of ICT access and create ICT infrastructure and instruments, as well as assist in an expansive development of ICT abilities in all parts of the community. However, the policy was chiefly aimed at the employment of ICT and web-based learning as tools with which to achieve a better quality education in Libya through:

- The embracing of up-to-date and technology-assisted pedagogical means and approaches;
- Encouraging and assisting the scientific community to undertake research within the general public in Libya;
- Urging the private sector to financially support advanced and specialist education;
- Enhancing distance learning and open learning.
- Raising the profile of Libya’s higher learning.

The authorities in Libya have engaged in join collaboration with the UNDP and UNESCO to make sure the policy of ICT is executed in a suitable and timely manner. This assistance has paved the way for investments in and international partnerships with Libya.

2.5.4 ICT initiatives and projects

The year 2005 saw the roll-out of a key project which was jointly sponsored by UNESCO and the Libyan government: the creation of the Libyan Higher Education and Research Network (LHERN). Under the project, LANs were installed in a total of 149 faculties in different universities, along with a Wide Area Network (WAN) to connect them together. As part of the project, a national centre for ICT resources was set up for lecturers, and management systems of universities management, which involve those related to student information and university procedures, as well as financial operations which were automated through ICT (Haddad & Rennie, 2005). As part of this project, digital libraries and websites for learning resources were set up, and ICT-assisted educational solutions, for instance web-based learning and distance education, were created. Additionally, this major project involved the provision of training in digital knowledge, essential ICT abilities, the employment of ICT in the process of teaching and the creation of course content, and system management in addition to the running of media centres.

Another key step was the supervision by the Department of Computers and Networks of the execution of the National Computer Project, the purpose of which was to provide and install over 150,000 computers in about 5,000 computer laboratories at learning institutions, including higher education ones. Employing satellite and telephone lines, as well as wireless communications, the project connected all learning institutions together through a sophisticated network of telecommunications (Rhema, 2013). Aided by this project, the system of e-examination in Libya saw significant expansion and enhancement; through this system, the results of final secondary school students' examinations are managed, and according to those results, the system decides which university they will join (Rhema & Miliszewska, 2010).

The year 2013 saw the roll-out of many fresh initiatives in Libya. With the purpose of reforming Libyan universities, these initiatives would see the creation of ICT infrastructure and the linking of universities through an advanced network of communications, as well as establishing virtual higher learning. The unveiling of those initiatives came through the then Libyan Deputy Minister of Higher Education and Scientific Research at the Arab Education Summit in May 2013, which was held in the Jordanian capital, Amman. The summit, the topic of which was 'ICT, Learning, Infrastructure, Procurement and Investment', was hosted by Arab Brains; this is a networking institution that specialises in connecting leaders from the public and private sectors involved in innovative learning (Sawahel, 2013b).

2.5.5 Increase in mobile telecommunication

Libya has seen a drastic growth in mobile phone penetration; it went up from 1% in 2001 to 171% in 2010, which suggests individuals have several subscriptions (International Telecommunication Union [ITU], 2012). By way of making up for the deficient fixed infrastructure, the government of Libya use mobile broadband technology to maximum advantage. Approximately 11 million mobile phone subscriptions were reported in 2010, along with 2.7 million active mobile broadband subscriptions (ITU, 2012).

The headway made by Libya was terminated by the outbreak of the armed conflict in 2011 which reversed the developments achieved over the years in education, housing, employment, health and nutrition sectors (Rhema & Miliszewska, 2012). As a result of the armed conflict, communication services have been significantly impacted. However, even before the outbreak of the conflict, despite its rather high level of income, Libya had ICT networks and projects that were worse than those of other, similar nations. This was blamed on the political climate where the ICT market was exclusively monopolised by the state, including mobile cellular (voice) services, which saw competition between two rival state-owned operators. It was not until October 2011 that Libya Telecom and Technology (LTT) initiated rebuilding and maintenance works, as well as technical activities with the purpose of restoring its services in the region impacted by the conflicts, for instance Bani Waleed and Misurata. LTT pledged that by February 2012 at the latest the service would be restored to its pre-conflict status (ITU, 2012; Rhema, 2013).

2.5.6 Implementation of e-learning in education

The motive for the introduction of online learning in Libya is the fact that the country is eager to achieve further development and enhancement of its system of education. In 2008, for example, an electronic system for taking specialist secondary education examinations online was adopted and turned out to be successful, which led the General People's Committee of Education to seeking to apply it to other areas of learning.

Additionally, primary schools witnessed the beginning of more pilot initiatives aimed at the introduction of web-based learning. Jointly with its Ireland-based partner Riverdeep, MCIT, a Libyan learning technology solutions provider, created a fruitful pilot project for online learning, involving six Tripoli schools. As part of this project, MCIT fully designed and supplied the IT network as well as power infrastructure for the schools; it also supported the applications and systems as per the Riverdeep-created criteria (Clark, 2004). The year 2009 saw the roll-out by the government of Libya of a project worth $72 million for the utilisation of ICT in the area of Libya's higher education as well as scientific research systems (NationalReportLibya, 2008).

2.5.7 Elements relevant to online learning introduction, development and assessment

The goal of this thesis is to create an appropriate strategic approach to better introduce, apply and enhance online learning in Libya's HEIs. As suggested by Hamdy (2007), it is not possible for a strategic approach to be created without the identification of its variables. Therefore, it is important that this broad review of literature is organised so that the elements or CSFs that impact the progress of web-based learning can be categorised and recognised, and so that the conceptualisation of those elements in a framework or model can be attempted. Discussion in previous literature reviews has primarily revolved around various elements related to progress in levels of web-learning introduction, application, enhancement and assessment. However, this review has also included discussion of many other elements. Evidence suggests that these research works agree that influencing factors exist and play a significant role. The following section includes a summary of examples of these elements within the research studies examined.

- In many research studies, the institution's policy and strategic approach to online learning introduction and application, including all assistance and motivation elements at different levels, were evidently noticeable (Fresen, 2005; Kenan, Pislaru, & Elzawi, 2014; Badrul Huda Khan, 2005). In all these research studies, there is emphasis on the significant role played by the institution in web-based learning in relation to several aspects, including student, course and faculty support, resources, course management and assessment.

- Many research studies have also shown a consensus on educational elements in relation to presentation and layout of content, management of feedback and student interaction, among other things (Bhalalusesa, Lukwaro, & Clemence, 2013; Fresen, 2005; Rhema & Miliszewska, 2010).

-Technological factors have the greatest concurrence according to all research conducted in this field. If it is indicated that web-based programmes cannot occur without acceptable technological infrastructure, then this concurrence might be upheld in a basic way.

-Additionally, in the greater part of the assessed literature, there is a focus on the planning and delivery of the programme of the e-learning course (Beetham, 2005; Fresen, 2005; Phipps & Merisotis, 2000; Selim, 2007). It is necessary that an attainable concluding result accentuates the significance and crucial nature of the planning and delivery factors, despite the fact that this research has addressed the planning factors from a variety of aspects.

-Within this literature assessment, the cultural structure which has an impact and effect on the execution and achievement of e-learning has been considered from many aspects and at a variety of stages

-Kenan et al. (2014) address cultural matters from the point of view of the individual, and in contrast, they also concentrate on the value of knowing the aptitude, capability and disposition of the student, lecturer and technician regarding the use of technology in a learning environment. Their study concerning their attributes is combined with a consideration of how these attributes are portrayed in the application of the system. From a different aspect, Bhalalusesa et al. (2013), Boezerooij (2006) and Selim (2007) examined all the cultural variables together, with regard to the programme users' demographical attributes and how success is thereby influenced. It is possible that this method may engender a scheme which allows the lecturer, student, technician and demographical factors to be considered, in a general sense, in terms of the effect of cultural variables on the success rate of e-learning.

2.6 Conclusions

The assessment of this literature has brought to light the powerful connections between lab-based learning, technology for procedures of teaching and learning, theories and paradigms of learning and structures of information quality. We can deduce the following results:

- Bloom's taxonomy is integrated with three domains, cognitive, affective and psychomotor.
- An experiential learning theory and paradigm on the basis of Dewey's philosophical expediency and Piaget's cognitive paradigm was created by Kolb (1984).
- Four learning techniques with regard to the specific needs of each student are embodied in Kolb's inventory of learning styles.
- In order to satisfy the specific and evident needs of each student, technology must be integrated with the learning and teaching procedures.
- A framework for e-Learning was introduced in 2001 by Badrul Khan, who built it on the basis of examining the various elements and aspects impacting the development and application of e-learning methods.
- A study with confirmatory factor models involving 538 participants from various courses, which was conducted by Selim (2007) at the University of the Arab Emirates, examined four types of critical success elements from the perspective of the students.

Considerable research has concentrated on deciding the effects on individuals and the course, and the problems (technological and contextual) of adjusting to online learning and ICT within developing nations. It has been made known by literature sources concerning the e-learning experiences of lecturers and students that an acceptable standard of teaching and learning has been achieved for both. Studies regarding the conceptions of lecturers and students have concentrated on the establishment of their degree of satisfaction and their disposition. It has been advocated that the principal features which promote the productiveness of web-based learning are frequently thought to be highly positive among every party involved with online learning and ICT.

Chapter 3: Research Methodology

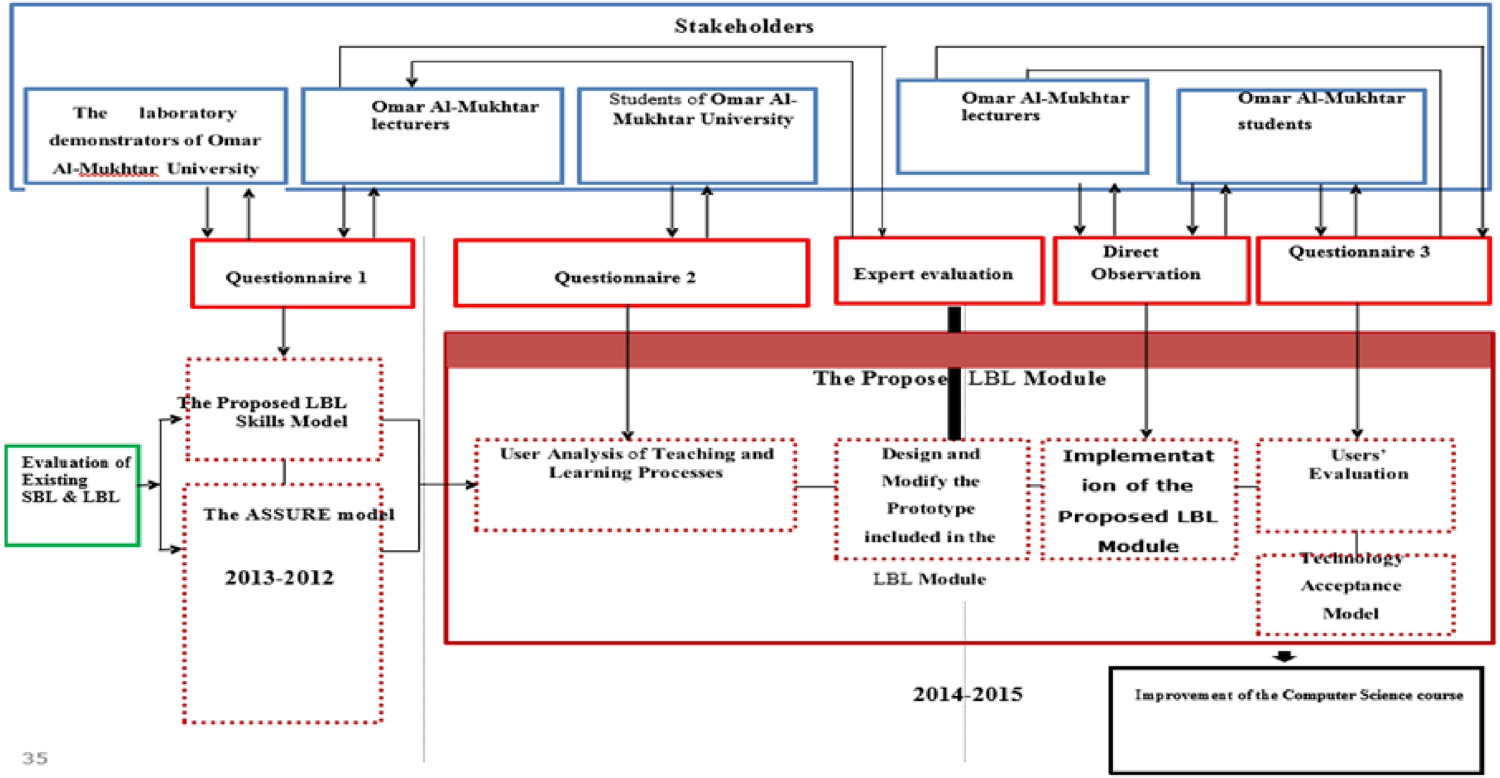
3.1 Introduction

The choice of an appropriate research methodology to carry out the research process is not an easy task. Given the large variety of methods, and the increasing complexity of research topics, the selection of an appropriate method requires reflection on an approach, and this will affect the choice of method. This chapter explains the methodology of this study, introduces the research approach and expounds on the measurement tool, including the research planning adopted, to achieve the research aim, answer the research questions and collect data. The research plan adopted for this study can be divided into three stages:

In stage 1, the research would describe the skills gap based on the quantitative and qualitative analysis of answers to Questionnaire 1, completed by lecturers and lab administrators, and provide a plan to address this problem; more explanation will be presented in Chapter 4.

In stage 2, the conclusions of the study regarding preferred learning styles would be used to develop the blended learning strategy for the Computer Science course. This would involve consideration of the answers to Questionnaire 2, completed by students (see Chapter 4).

In stage 3, Questionnaire 3 would be designed to evaluate students' acceptance of the blended learning approach using the TAM model. It would also present how the external variables and internal variables for the research model were identified and consider the issues of reliability, validity, bias and triangulation during all stages (see Chapter 7).


Stakeholders
The laboratory demonstrators of Omar Al-Mukhtar University
Omar Al-Mukhtar lecturers
Students of Omar Al-Mukhtar University
Omar Al-Mukhtar lecturers
Omar Al-Mukhtar students
Questionnaire 1
Questionnaire 2
Expert evaluation
Direct Observation
Questionnaire 3
The Proposed LBL Skills Model
Evaluation of Existing SBL & LBL
The ASSURE model
2013-2012
The Propose LBL Module
User Analysis of Teaching and Learning Processes
Design and Modify the Prototype included in the LBL Module
Implementation of the Proposed LBL Module
Users' Evaluation
Technology Acceptance Model
2014-2015
Improvement of the Computer Science course
35

3.2 Research Methodology

A research methodology is designed to give the researcher a methodological guide and should contain the main elements of the development of the research process. The purpose of this guide is to facilitate the work of researchers in a simple and concrete way. The methodology suggested by Saunders et al. (2003) looks very logical, and describes the different stages as categories within successive parts. This framework was used by the researcher in this study (Lewis, Thornhill, & Saunders, 2003).

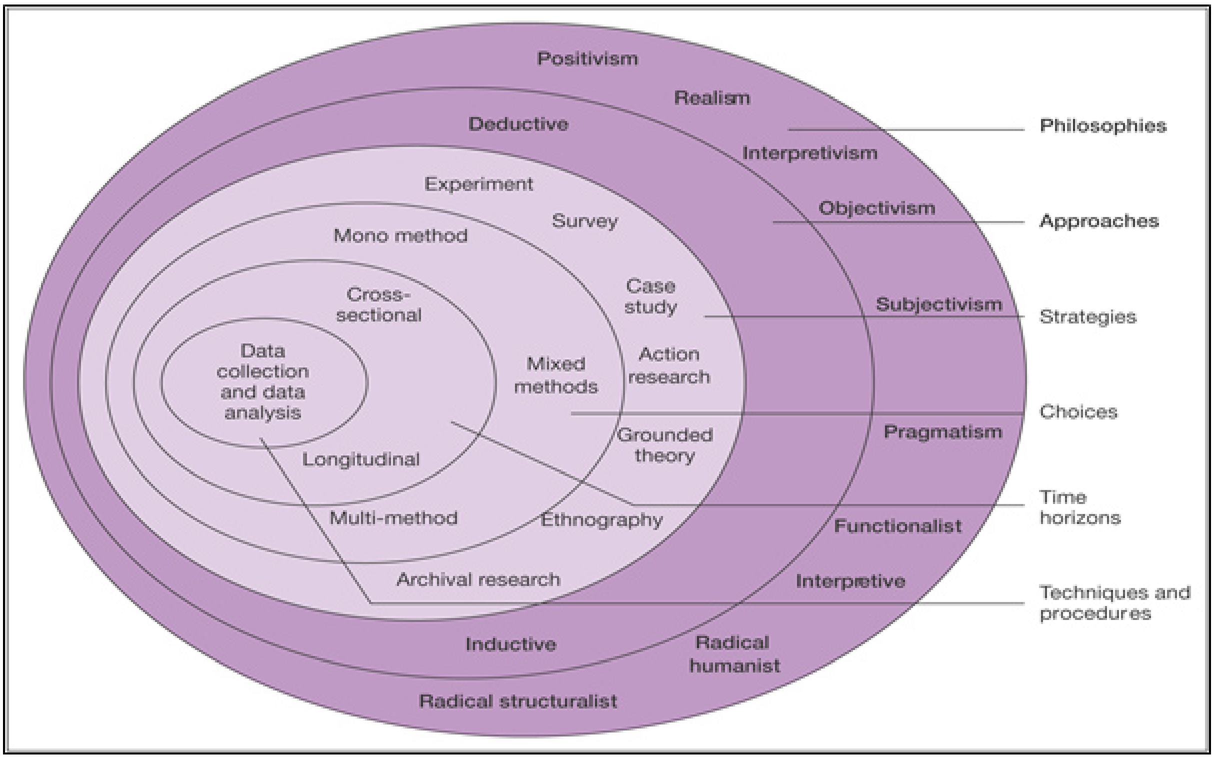


Figure 3-1: The 'onion' research process (source: adapted from Saunders et al., 2003)

The result of a pure or basic research study is the improvement of an existing situation by providing a strategy plan. Here, the focus is on discovering the main factors that can influence the adoption of quality blended learning in the Computer Science course, both in the lab and in the classroom, and how the course can be improved to meet the requirements of the Education Ministry. ***Theoretically:*** According to the literature review, this is the first study which has examined the factors that affect Computer Science students' acceptance of the use of an e-learning system in a Libyan University. Also, the researcher has not found the existence of any Libyan study which has implemented the technology acceptance model (TAM).***In practical terms:*** The researcher has conducted an analytical study that can help in future policies for the development of an e-learning system, by taking into account factors that will affect the extent of the use of these sources.

3.3 Research Paradigm and Philosophy

If information is to be acquired in a suitable and efficient way, then the research study paradigm and philosophy must form a major portion of the method of the study. A research paradigm is defined by Johnson and Christensen (2004) and Johnson andOnwuegbuzie (2004) as a viewpoint on the basis of a group of shared presuppositions, ideas, principles and procedures. This means that it is possible to describe a paradigm as an application of the way in which a student reasons concerning the growth of learning. The amalgamation of two linked ideas, namely the attributes of the planet, and the purpose of the student define the meaning of a research paradigm. This is of great benefit if the student undertakes the study efficiently. Positivism is the name which may be given to the philosophy of this research work, as it is grounded on a method which is highly constructed to allow quantitative measurement, monitoring and universality, and calculates the outcome with the aid of statistical techniques. Positivist philosophy is a crucial and objective foundational technique and is frequently utilised in natural sciences. According to Bessant et al. (2003), this method is inclusive of different reasoning in the field of natural science, for example the philosophy of unchanging universal laws and the observation that all things happen in nature. The student is able to accumulate, through common sources, every detail of information that is linked with the subject being studied, with the aid of positivist philosophy. The task of the student in the study of reasoning is of great significance regarding that study (Bessant et al., 2003).

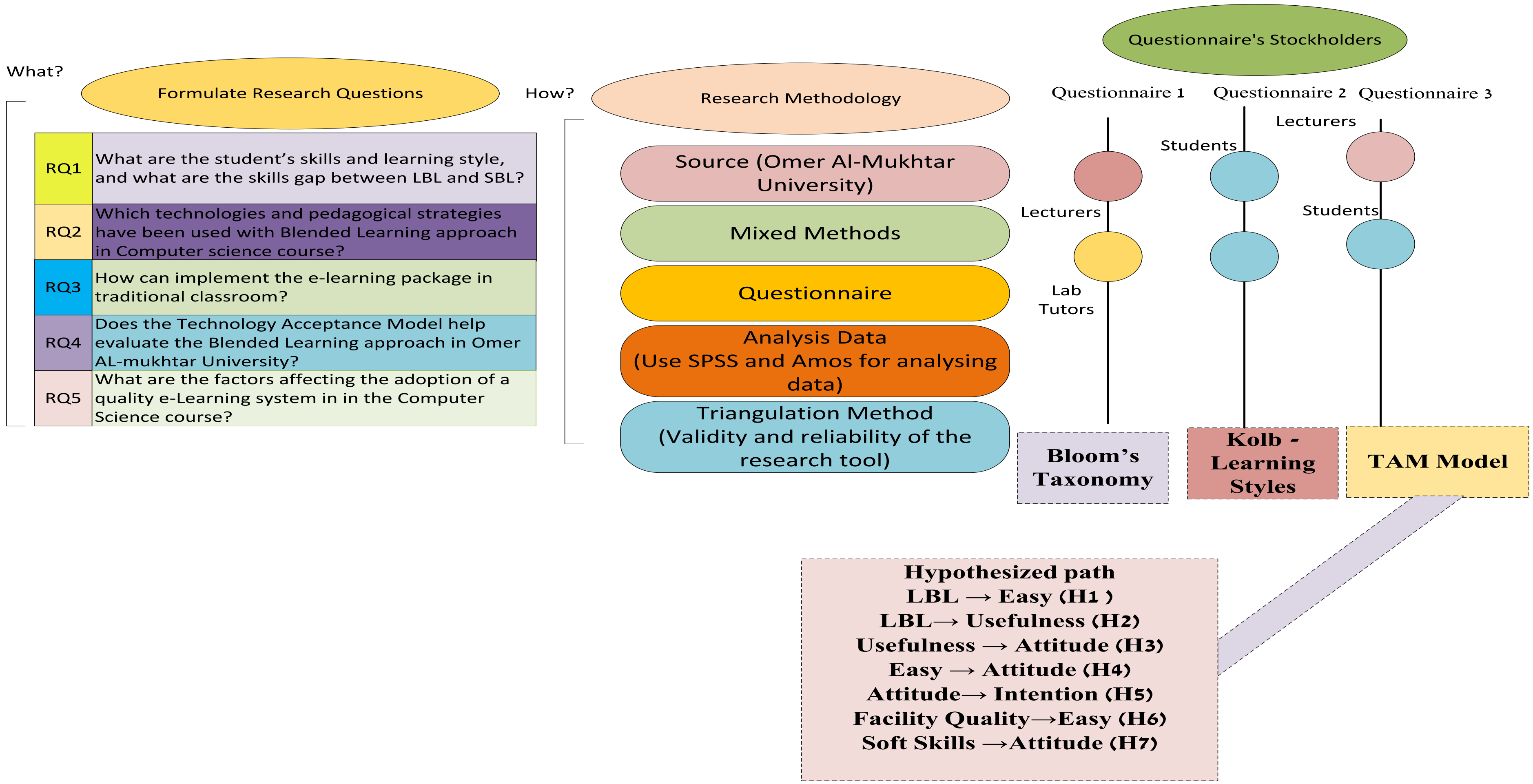


Figure 3-2: Research design

3.5 The Research Process

The two procedures for logical thinking in research work are the inductive and the deductive. An inductive procedure can be described as the means by which particular phenomena are monitored and which lead to obtaining of answers (Sekaran & Bougie, 2011). The commencement of the investigation of inductive research is a monitoring of a phenomenon followed by an attempt to elucidate it by the formation of a presupposition or a theory (Crowther & Lancaster, 2012). One purpose of the inductive method is to seek an improved comprehension of the essence of the issue by monitoring the phenomena, and then on the basis of the monitoring to develop presuppositions or theories to elucidate the phenomena. This study's procedure has been outlined by these sequences (Donnelly & Trochim, 2005). Firstly, observations are performed to identify arrangements and consistency within the surroundings. Secondly, following the monitoring of the arrangements, presuppositions and theories can be developed. Also, Crowther and Lancaster (2012) indicate that the inductive method is suitable for the utilisation and interpretation of measurable qualitative information. According to Teddlie and Tashakkori (2003), qualitative study is mainly concerned with inductive research, while measurable quantitative research for the testing of presuppositions is the concern of deductive research (Teddlie & Tashakkori, 2003). Burney (2008) claims that the term 'deductive' alludes to a group of methods for the application of testing, assessing and validating theories in real situations. The theories that are formulated in deductive research may be either acknowledged or discarded by experiential monitoring, being an approach that moves from the common to the specific. According to Ali and Birley (1999), deductive research can be defined as the formulation of a theory which is subject to a meticulous examination (Ali & Birley, 1999; Spens & Kovács, 2006; Burney, 2008). The goal of this study is to create a technology acceptance model in order to clarify the researchers' acknowledgement of LMSs; therefore, this study adheres to a deductive research method. Also, authentication and experiential investigation by means of meticulous examination will be applied to the model which has been created.

3.6 Research Approach

The research conducted a mixed method approach for gathering data. This is a mixed type of data which includes quantitative and qualitative data. This approach involves a research design that uses mixed data (triangulation) and additional means (statistics and analysis of the text). A mixed method uses multiple forms to collect data and produce reports (Maxwell, 2012; Ritchie, Lewis, Nicholls, & Ormston, 2013; Creswell, Klassen, Plano Clark, & Smith, 2011). In this study, the researcher utilised both research questions to collect the qualitative data and hypotheses to collect quantitative data in order to find the relationship between variables which will be presented in Chapters 6 and 7.

The use of mixed methods in a study helps the process of researching the problem in all its aspects; the quantitative element is expected to use deductive scientific methods, while the qualitative component is expected to use inductive scientific methods. Moreover, the quantitative approach to collecting quantitative data on the basis of accurate measurement applies structure to information gathering and aids validity. When the researcher uses several methods in the process of a study, then he or she can use the strengths of each type of information gathering and reduce the weaknesses in each of the two approaches. A mixed method approach of collecting and evaluating increases the validity and accuracy of information.

3.7 Research Strategy

The aim of a research study can be confirmatory or exploratory. Firstly, if there is not much detail concerning the phenomenon, the exploratory method is used because this permits there to be an improved comprehension of the issue being studied. According to Gerring (2001), ideas and theories ought to be amended in relevance to the current conclusions, which indicate that the exploratory planning method is a procedure of reciprocal amendment (Gerring, 2001). Since all that is needed by the presuppositions is that the acquired information is maintained, the investigative method can be regarded as inductive research work that presents adaptability in the development of presuppositions. Furthermore, it is usual for the investigative method to make use of qualitative measuring for the gathering of information, for example in monitoring and in dialogue.

Secondly, if a study is attempting to examine the suggested presupposition or connection, then the substantiating method is performed. The experiential testing of the conceptual facets of this study is the plan of action in this method, and therefore students can choose either to acknowledge or to discard these facets. Moreover, according to Meyers et al. (2006), the confirmatory study is predominantly deductive and is dependent on computational means to address queries in that study. This study seeks to verify the statistical importance of the generated model and of presuppositions in the e-learning context by the use of a quantitative measuring methodology (Meyers, Gamst, & Guarino, 2006).

3.8 Data Collection

The selection of a relevant means of gathering and sorting information is a major factor in planning research work (Saunders et al., 2009). Questionnaires are a means of gathering information whereby each participant is requested to answer an identical group of questions which are in a prearranged sequence. It is normally brief, geographically spread and it is cheap to use the questionnaire method in a survey; furthermore, it permits each contributor to reply with no inhibitions (Bryman & Bell, 2015; Liamputtong & Ezzy, 2005). Moreover, two foremost kinds of questionnaire exist, namely, those which are filled in by the interviewer and those which are filled in by the participant. The following five benchmarks to choose a relevant method are advocated by Saunders et al. (2011): participants' attributes, respondents' prestige, misleading respondents, representative size, representative category and how many questions are asked. It was decided to use the method whereby participants fill in the questionnaire themselves, on the basis of the benchmarks indicated above; since the participants are students, the necessary size of the sample is big, a Likert-scale is utilised for the kind of questions asked, and there is a comparatively large number of questions. Also, it is usual to use this method of completion of the questionnaire (namely, filled in by the participant) as the principal means of gathering information in the field of technological acceptability.

3.9 Questionnaire Development

The way in which the questionnaire is designed is critical to the process of gathering information, since it has an impact on the rate of response, the internal cogency of the information and the dependability (Saunders et al., 2011). Foddy (1993) affirmed that it is essential that the way in which the participant understands the question is the same as that in which the questioner intends it to be understood, and also that the questioner understands the reply as the participant intends it (Foddy, 1994).The preparation of the questionnaire has, in this study, undergone many changes in its progression. When each of the external variables was measured, the items were recognised and modified. According to Hair et al. (2010), there ought to be a minimum of two measured elements for every variable within the model, when the substantiating method of research work is employed. A total of thirty-four measured items was distinguished by the study, the goal of which was to measure the model variables which have been developed. The measurement items which had been adapted were subsequently adjusted in line with the context of the study (Hair, 2010). The selection of the relevant kind of question is the second step. The kind of direct question in the technological acceptance study utilised the Likert-scale to measure users' understanding. Scale measurements of components have dissimilar designs and the right form should be chosen to get effective reliability in the study result. Multi scale format measurements are typically selected to show the satisfaction level of the user (Davis, 1986). Furthermore, most studies usually select Likert scale measurements, so they have also been used in this thesis. The 5-point Likert scale is one of the best methods of measuring trends. Table 3.1 displays the Likert scale design which was utilised as a format for the multi-scale measurement; the questionnaire was also based on the TAM model questionnaire format.

Table 3.1: The Likert scale design

Strongly agree	*Agree*	*Neither agree nor disagree*	*Disagree*	*Strongly disagree*
1	2	3	4	5

The format of the TAM questionnaire was designed based on that of Davis (1986). This questionnaire has a multi-scale format with a 5- point rating scale measurement. Both DeCoster (2000) and Davis (1989) indicate that a 5-point scale is the most reliable assessment scale, as cited by Danesh Sedigh (2013). The questionnaire has used the relevant theory in this study; the type and quantity of questions are related to the factors in the TAM model and then the components are created to fit the hypotheses of this thesis. The pre-test of the questions indicated that the data were suitable to gain the right type of information, and Cronbach's Alpha was used for a reliability test, as shown in Table 3.2.

The questionnaire was used to find and validate the main factors of TAM. The study tested the reliability of the questions and the reliability of the TAM factors, and the data were analysed using a structural equation modelling (SEM) method based on the AMOS application. In this study the researcher adopted the questionnaire as a key tool for the collection of data. The questionnaire discussed the factors that affect the accepted use of an e-learning system, which were divided into key themes: expected ease of use, perceived usefulness, attitude toward using and behavioural intention to Use. The aim of a questionnaire is to give information to a study as proof to support the researcher's claims and hypotheses. When creating a questionnaire there are should be a process (Diem, 2004). The aim of this study was to give reliable information that would enable the hypotheses to be measured and answered, so the questions needed to be designed to fit the hypotheses and the research aim (Diem, 2004). In TAM theory, there are certain elements or components that are described for each factor, so the questions needed to be related to these components (for more detail, see Chapter 6).

3.10 Data Analysis

The Structural Equation Modelling (SEM) method was employed to evaluate the data gathered in the study. This is a continuation of a number of multivariate methods, for example multiple regression, substantiating factor investigation and multivariate investigation of variance, that permit the simultaneous analysis of a sequence of interrelated dependant connections amidst the calculated variables and hidden constructs (variants) in addition to being between a number of hidden constructs (Hair et al., 2010). The origins of structural equation modelling (SEM) are in the techniques that give consideration to a set of relationships between one or more independent variables, be they continuous or discrete; the techniques are developed in such a way as to reveal the observed correlations in a system of mathematical equations describing hypotheses about causal relationships. These relationships between variables are performed on a 'path diagram', a method known as 'path analysis' (Byrne, 2013). The aim of this approach is to create structural equations, and within the structural equation model two main components can be identified: (a) a measurement model that represents the relationships between latent variables (or constructs) with indicators (or empirical variables), and (b) the model where the structural relationship between the constructs is described. The measurement model allows the investigator to use several variables (indicators) for a single latent dependent or independent variable. The main objective of the measurement model is to corroborate the suitability of the selected indicators in measuring the constructs of interest; i.e., the researcher evaluates how well the variables observed combine (or could be correlated) to identify the construct hypothesized. The discussion results and a measurement model will be presented in Chapter 7 (Schreiber, Nora, Stage, Barlow, & King, 2006).

SEM, analysis of moment structures (AMOS) and linear structural relations (LISREL) are activated by two widely known computational software packages. In this study, AMOS has been used to perform the substantiating factor investigation and the multiple regression investigation. The software has a set technique such as using graphical shapes to represent variables and regression paths which occur between the dependent and independent variables. Graphical figures are used by the software to symbolise variables, and regression routes are portrayed between the variables (dependent and independent).

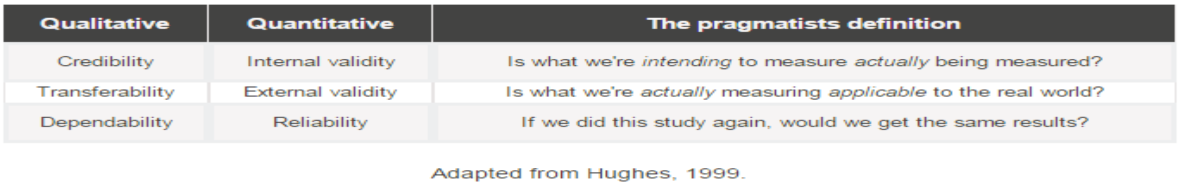
3.11 Questionnaire Reliability and Validity

Cooper and Schindler (2006) define reliability as the mean amount of stability in the reliability test; this means that the results given should always be the same, and repeated testing should give the same results without variation or fluctuation over time. Verification of consistency is generally easier to verify than truthfulness and so we can interpret that the reliability coefficient is more useful as it refers to consistency and getting the same results when the questionnaire is applied a second time (Cooper & Schindler, 2003).

Table 3.2: Application of triangulation – design guidelines

Credibility *(internal validity)*	Is what we're intending to measure actually being measured? • Selected a number of specialists such as Dr Crinela Pislarue and Dr. David Wilson in the field of the study, and ask them to correct the questions and the statements if there are any mistakes. • Conducted a pilot study with computer science students – and write a set of questions and statements related the feedback that collected from the pilot study. • Consider to a set element to validate of the questionnaire such as feasibility, readability, and layout and style clarity of wording. • Conducted structural equation modelling because it is an important tool and generally accepted to test hypotheses to gain number of test for example set comparisons which require a big number of contributors. • After collecting the data, to achieve the objectives of the study and analysis of the data collected, the researcher using a number of methods with the adoption of appropriate statistical methods using the Statistical Package for Social Sciences (SPSS) and AMOS application.
Transferability *(external validity)*	Is what we're actually measuring applicable to the broader real world? • Tried to understand the participants' views and their thoughts and their feelings and experiences wrote as questions. • Determine the required objectives of the survey work in the light of the research topic and problem, and then determine the data and information required to be collected. Translation and conversion of goals into a series of questions and enquiries. • Selection of the questionnaire and experience on a limited group of individuals identified in the research sample to give their opinion on the quality in terms of understanding and inclusiveness and significance as well as the quantity and adequacy to collect the required information on the subject of research and problem in the light of the observations obtained, it can modify the questions in such a way that gives good returns.
Dependability *(reliability)*	If we did this study again, would we get the same results? • The researcher consider a set of methods that aimed for any combination of more than one way to collect the data (close and open questions), combine more than one group of participants(Lecturer and Lab Tutors), or combine theories (such as Bloom Taxonomy, Kolb and TAM model) also used two software to analyse the data. • The testing reliability was measured by reliability(suitable if Cronbach's > 0.70) • Composite reliability (CR) was tested to estimate internal consistency for measurement model.(see chapter 7)

- Factor loadings (acceptable if FL >0.50).The testing reliability of the factors was presented to evaluate the internal reliability of the proposed model. (See chapter 7).



Qualitative	Quantitative	The pragmatists definition
Credibility	Internal validity	Is what we're *intending* to measure *actually* being measured?
Transferability	External validity	Is what we're *actually* measuring *applicable* to the real world?
Dependability	Reliability	If we did this study again, would we get the same results?

Adapted from Hughes, 1999.

Figure 3-3: Questionnaire reliability and validity

"Triangulation' is a process of verification that increases validity by incorporating several viewpoints and methods...it refers to the combination of two or more theories, data sources, methods or investigators in one study of a single phenomenon to converge on a single construct, and can be employed in both quantitative (validation) and qualitative (inquiry) studies'' (Yeasmin & Rahman, 2012; Olsen, 2004). Dean (2013) suggests design guidelines to help build triangulation into research (see Table 3.3 for more detail), so the researcher has followed this design in this study (Dean, 2013).

3.11.1 Questionnaire administration and ethical considerations

Omar Al-Mukhtar University organised the administration of this questionnaire. Furthermore, the university was given a copy to seek acceptance. Following the acceptance of the questionnaire by the university, every undergraduate student in the email directory of the university was subsequently sent an email. A message was included in the email asking the students if they would be prepared to participate in the study. Furthermore, details of the goal of the research study, together with the need to find volunteers were included in the message, together with the hyperlink to the questionnaire, which had been sent by email. The process of gathering the information was carried out over a period of six weeks, and was analysed following that time period. The gathering of the information from every participant was anonymous, and no request was made for personal information such as email address or name. Those who filled in the questionnaire, in this voluntary project, were told that their completion of the questionnaire implied their permission to participate. Finally, all the information that was supplied by those who took part was treated with confidence and used for no other purpose than for this study.

3.12 Conclusion

The following summarizes the most important aspects presented in this chapter. The chapter has presented an architecture for implementing a research methodology based on mixed methods and triangulation, an approach which aims to increase validity by incorporating several viewpoints and methods. This approach involves a research design that uses mixed data (triangulation) and additional means (statistics and analysis of text). The researcher has used questionnaires to collect data. In accordance with the methodology of the Computer Science course, it has modularized the research planning to create a research strategy, having identified that for studies with a mixed methods approach this process is essential. Also, to achieve the aim of the research, collect data and answer the research questions, the research plan was divided into three stages which have been explained in this chapter.

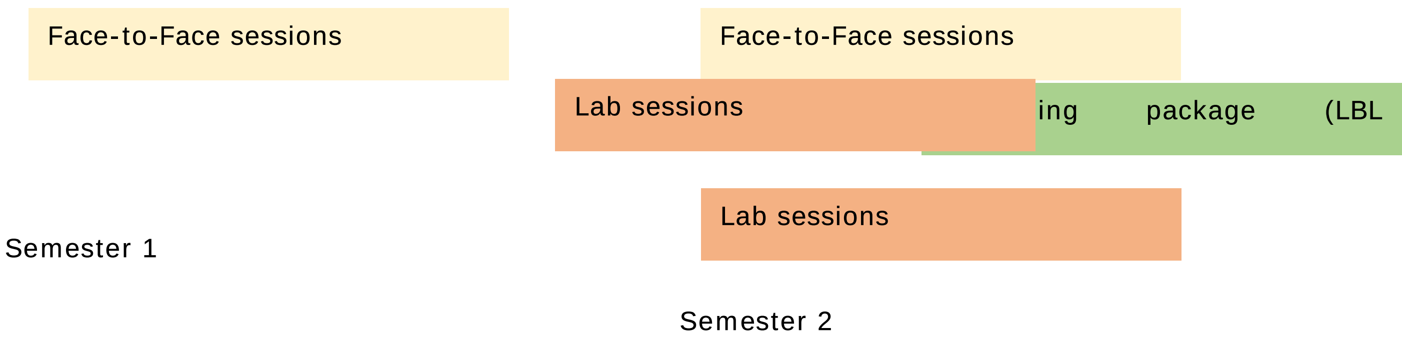
Chapter 4: An Improved Lab Skills Model and Using a Blended Learning approach

4.1 Introduction

This chapter provides an identification of the existing skills gap between school-based learning (SBL) and laboratory-based learning (LBL) in the Computing Department within the Faculty of Science at Omar Al-Mukhtar University in Libya. The structure of the Computer Science curriculum for Year 2 is as follows:

Semester 1 has duration of three months, with each month comprising three weeks of teaching (SBL) and one week of practical work before implementing the e-learning package.

Semester 2 also lasts for three months and, as Semester 1, includes both teaching (SBL) and practical work (LBL). The students are requested to use the e-learning package before they attend every lab session. The Computer Science students currently go to the lab one day each week. Also, the students attend a one-day induction seminar, which presents fundamental knowledge related to the practical work.



The researcher developed an initial questionnaire (Questionnaire 1) which was completed by lecturers and laboratory demonstrators. The aim was to discover these stakeholders' perceptions about the gap between the students' skills during SBL activities and those required by LBL sessions. The questions referred to skills related to three learning domains: cognitive, soft and hard skills. The second questionnaire was completed by students and was designed to define the students' preferred learning styles; these would be used to develop a blended learning strategy, based on Kolb theory, for the Computer Science course. The results of quantitative and qualitative analysis of the responses were used to design a novel LBL skills model which would be used in a blended learning approach. The proposed model would be used to design and develop supplementary teaching and learning activities and materials to increase the quality of student learning and satisfaction, as well as to implement the blended learning approach when students start using the e-learning package.

4.2 Blended Learning Approach

Today almost all universities have virtual campus and support tools based on the internet. This has enabled the emergence of an interesting educational offer of distance learning or e-learning, and more recently of combined modality or b-learning (face / virtual). In this context, it is suggested that such a combination passes for a good teaching approach and a good use of technology to support the academic project and enable not only its development, but also its expansion. In simple terms, combined learning aims to provide a way to learn which combines teaching and face-to-face learning with an alternative teaching mode, and virtual learning is more precisely the technological component, through a virtual campus, which brings novelty to this mode. It is a hybrid model, through which tutors can make use of their classroom methodologies for a classroom session and at the same time promote thematic development through a virtual platform (for more detail see Figure 4.1 below).

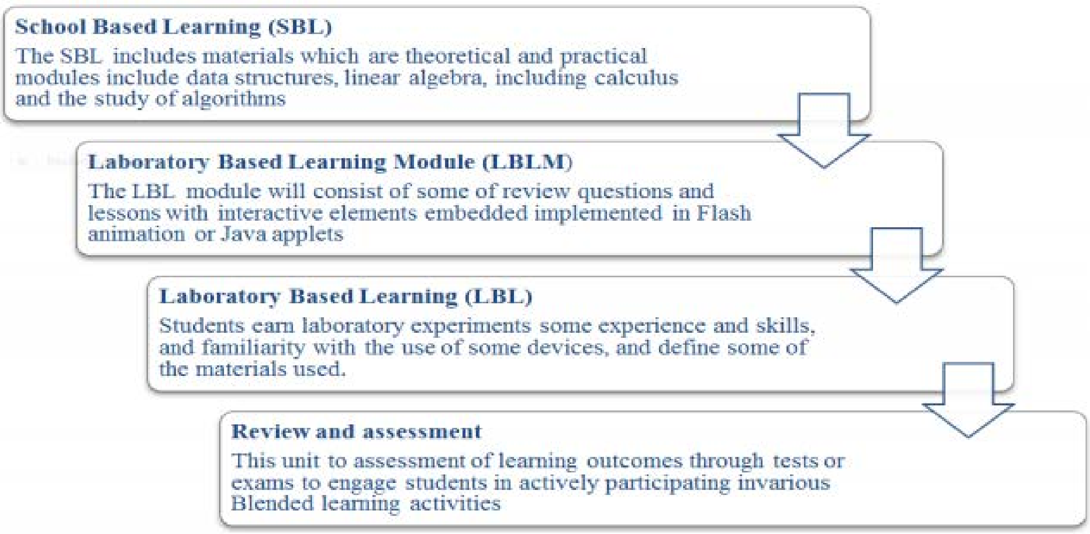


Figure 4-1: Process model of the blended LBL module (Othman, 2013)

The Computer Science department will benefit from adopting blended learning. Here is a list of anticipated advantages when the blended learning strategy is implemented at Omar Al-Mukhtar University:

1- Cost savings – when e-learning systems are used to complement or replace the traditional delivery of lectures and seminars.
2- In the blended learning environment, students and lecturers are requested to be present for learning in a classroom face-to-face during 25% of academic time. Blended learning can reduce the seated time of courses from 75% to 25% of the

total academic period. Therefore, adopting blended e-learning may assist the diverse needs of an increasing student population by decreasing the time of seated study. Every course provided by blended e-learning will decrease the seated time by half and, as a result, if Omar Al-Mukhtar University provides courses via blended learning, it may be able to raise its capacity without needing to build classrooms, buildings and laboratories.

4.3 Questionnaire 1: Identification of Skills Gap between SBL and LBL

Saunders et al. (2011) state that the size of a sample must be appropriate to the study, and that the best sampling method must be adopted to answer the research questions and meet the research objectives (Saunders, 2011).

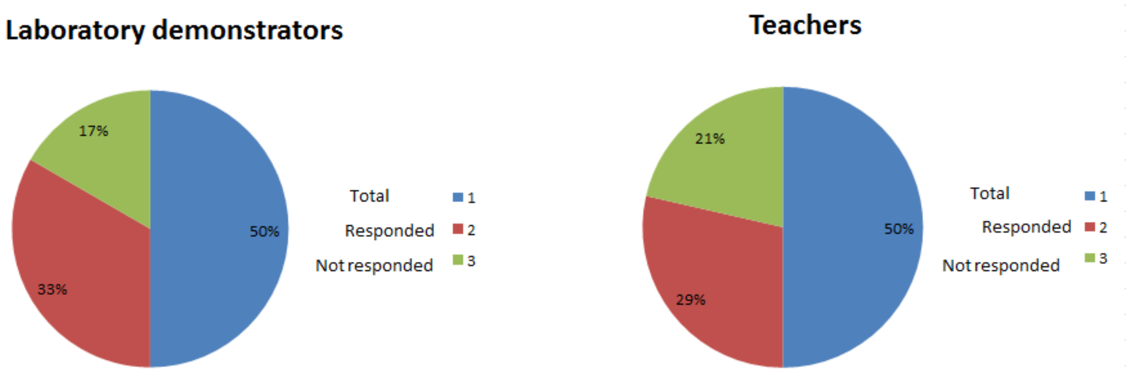


Figure 4-2: Answer rate for the questionnaire

Of the lecturers who deliver theoretical modules within school-based learning (SBL) in Years 3 and 4, only 30 people responded to the questionnaire. The key aims were to obtain the opinion of the lecturers regarding students' skills during their study in SBL. Of the laboratory demonstrators, who help students during their lab work, there were 20 who responded to the questionnaire. The main reason for asking these people was to provide a better idea about hard skills and soft skills, and to evaluate the practical work during LBL. After confirming the validity and integrity of the test, the survey was distributed to 100 people. From those who responded to the 2 questionnaires, therefore, a study sample of 50 was obtained. Overall, the 50 respondents involved in this study were of different demographics. According to Uma Sekaran (2003), a sample of 30-500 individuals is appropriate for most research and studies. In this aspect of the research, the researcher will concentrate only on the students' skills and how these skills varied between the classroom and operational performance in the lab. The researcher used a Likert scale to measure the questionnaire responses in the format of a typical five-level

Likert item as follows:

Strongly agree	*Agree*	*Neither agree nor disagree*	*Disagree*	*Strongly disagree*
1	2	3	4	5

Validity and Reliability

The reliability of the questionnaire was estimated using Cronbach's Alpha. The table below shows the calculated reliability of the transactions. It can be seen from the above table that the overall reliability coefficient is more than 0.70, and this shows that the resolution has a good degree of reliability in relation to the study sample. Reliability refers to the ability of the measurement instrument to obtain the same results on different tests. It depends on technical research and the mode of application of the measuring instrument. If the instrument is unreliable, random errors will occur (Al-Zahrani, 2010; Read, 2013).

Table 4.1: Cronbach's Alpha Results

statements/ Constructs	*N of items*	*Cronbach's alpha >(0.70)*
Cognitive skills –lecturer's statements	(Q1:Q9)	0.960
Soft Skills –lecturer's statements	(Q 10:Q21)	0.922
Hard Skills–lecturer's statements	(Q 22:Q31)	0.786
Cognitive skills –Laboratories' statements	(Q1:Q9)	0.74
Soft skills –Laboratories' statements	(Q10:Q21)	0.87
Hard Skills –Laboratories'	(Q22:Q31)	0.76

statements

4.3.1 Data analysis

This section provides an overview of the findings of the research after the construction and application of the research tool (questionnaire) to determine the skills gap for students. To analyse the data, Statistical Package (SPSS) version 20 was used. The number of the actual sample comprised 30 respondents who were faculty lecturers, and 15 laboratory demonstrators. The following section presents the analysis of the results that were obtained. The average responses to the cognitive, soft and hard skills statements will be evaluated in Part 2. Table 4.2 below shows that the vast majority of the lecturers involved in the study were female, with a rate of 83%, and the rest were male. This is unsurprising because Computer Science lecturers in Libya are commonly female.

The table shows that 50 % of the lecturers involved in the study were within the age group 30-39 years, while 33% of the total were in the age group 40-49 years and 17% were aged 50 years and over. This indicates that there is a mix of old and young lecturers in Omar Al-Mukhtar University.

The following table shows that a large percentage of the lecturers involved in the study population had 1-4 years of experience (50%), while the proportion of those who had 4-10 years' experience was 33%, and 14% had 11 years of experience and over.

Table 4.2: Data analysis part 1

Staff of Respondents	**Variables**	**Characteristics**	**Percent %**
Lecturer respondents	Gender	Male	**17 %**
		Female	**83%**
	Age	30-39	**50%**
		40-49	**33%**
		50-59	**17%**
	years of experience	1-4	**53%**

		5-10	**33%**
		11-20	**7%**
		More than 20	**7%**
Lab- demonstrator respondents	Gender	Male	**25%**
		Female	**75%**
	Age	20-25	**70%**
		26-30	**30%**

The above table (4.2) shows that the vast majority of the lab demonstrators involved in the study population were female (75%), while only 25% were male. It also shows that the majority of the lab demonstrators were within the age group 20-25 years (70%), and 30% were from the 26-30 age group. This is because the university requires graduates for this job role and they often choose young people. After being analysed and reviewed by researcher, the findings were categorized and integrated according to the perceptions of students' skills in order to answer the research question. The researcher also wanted to discover the human factors that might have an impact on the introduction of e-learning. The descriptive statistics, which were determined by using averages, standard deviations and the percentages of responses for each statement, show averages for all variables and the number of participants who responded to Questionnaire 1. The descriptive statistics (including questions, averages and standard deviation) are given in the Appendix.

The findings can be presented using three domains, which were used as a checklist to identify the students' levels in the following skills:

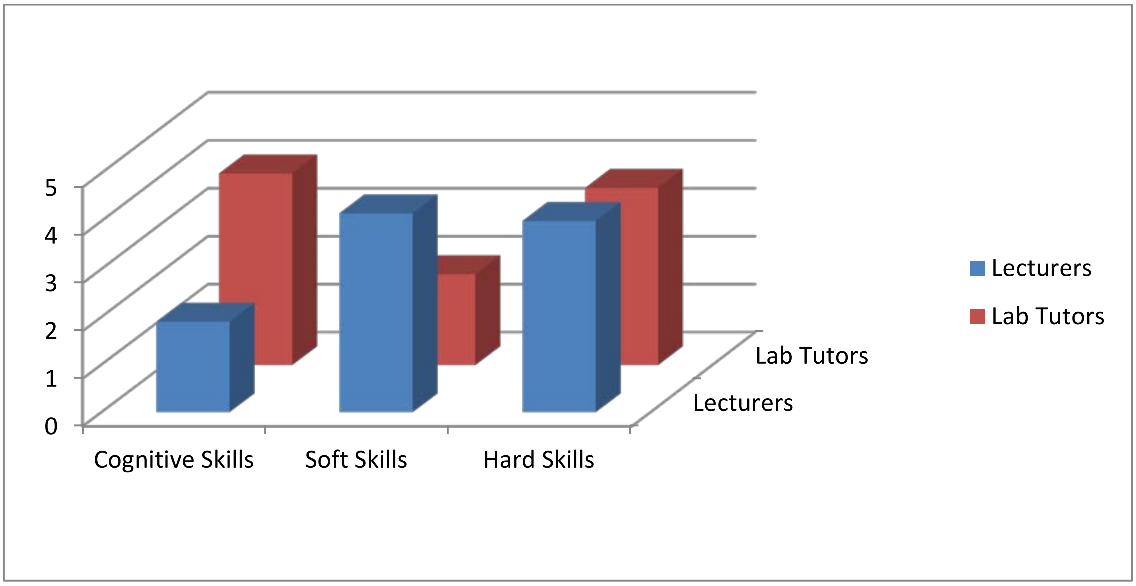


Figure 4-3: Averages for part 2

Cognitive domain – Figure 4.3 shows that the average for the lab tutors (red bar) is greater than the average for the lecturers (blue bar). This is clear evidence that the lab tutors were unhappy about the basic knowledge level of the students in applying practical programs. In Computer Science education, the laboratory programme is integrated with materials that are given in the classroom to prepare students for practical work. Laboratory work gives students both practical and cognitive skills, and exposes students to the relevant Computer Science field.

Soft domain – Figure 4.3 displays that the average for the lecturers (blue bar) is greater than the average for the lab tutors (red bar). The lecturers classified soft skills as a more important factor than cognitive skills. It was clear that the lecturers taught students by asking them to perform the work that they had achieved in the lab. Thus, by working in the lab, students can learn practical skills that they cannot learn theoretically. Computer use is becoming increasingly common among students, and the majority use computers not only to learn about Computer Science, but also as a tool to research, publish, complete homework and engage in recreational activities. In addition, some lecturers said that students access the internet for information and, even without knowing what information they search for, it is important to consider this an advantage. Research on the network should be promoted as a means of supporting academic training, so there is a need for greater dissemination of search engines, sites, electronic magazines, etc.

Hard domain – The average for the lab tutors (red bar) is equal to that of the lecturers (blue bar). However, the data show that the computer is most widely used as a means of communication, especially e-mail. Most respondents reported having at least one email account, though a significant number of students also use alternatives such as Viper, Skype and Facebook. The respondents indicated that students used mobile phones for social networking, which gives them better computer skills. On this basis, it is necessary to promote good use of these tools. The advantage is that students already know how to use them, so it is only a matter of incorporating them into the processes of teaching and learning, since web-based learning is an effective means of communication and education in general. This speaks of the need to seek alternatives and offer more opportunities for computer and internet access outside the students' homes.

The findings of the research show that fundamental knowledge is an essential factor for working effectively on lab experiments. These results are confirmed by other studies, such as that by Salim, Puteh, & Daud (2012), which demonstrate the significance of cognitive knowledge in practical work.

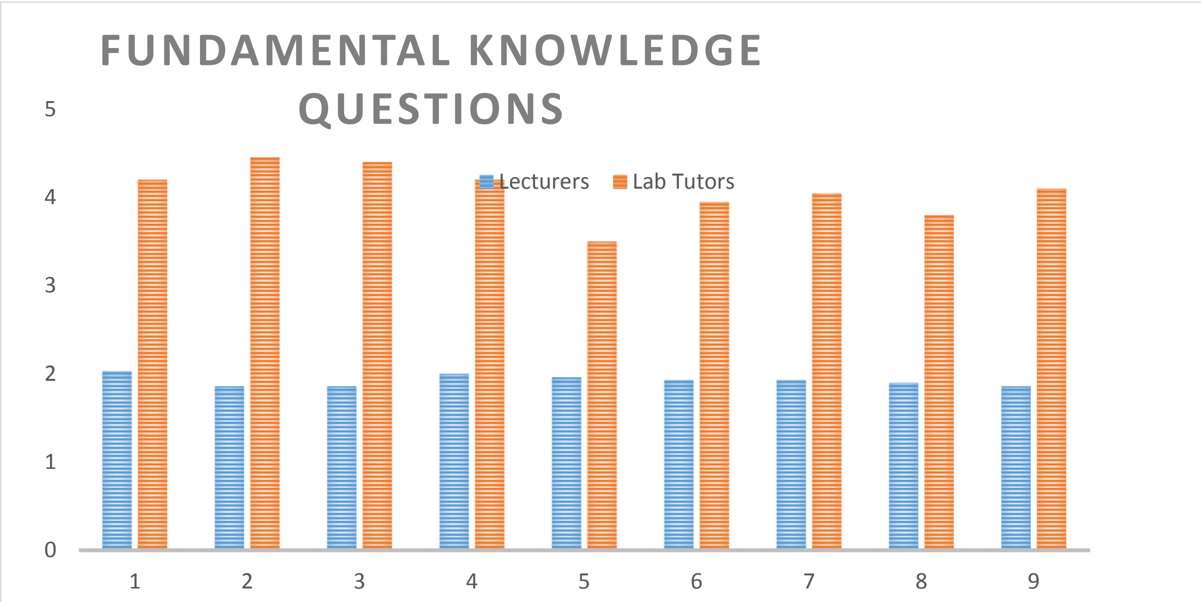


Figure 4-4: The fundamental knowledge questions

The results show that the majority of lecturers felt students did not know how to program. This may be caused by them coming from different training options at upper secondary level, most of which do not consider it an essential skill for the Computer Science training selected. Currently, the e-learning application is regarded as a good tool for studying and performing homework, and some lecturers even set it as a condition for the presentation and reception thereof. This implies that there is a greater momentum within educational institutions for encouraging study and education through the use of network resources that are accessible and affordable for students. International standards require that professionals of this century should be able to use the internet as a means of dissemination, either by developing personal pages or discussion forums implemented independently, or as management tools for collaborative work, so the ability to use predefined formats for publishing information on the net is an activity that must be developed. Lecturers should encourage students to design their own personal pages, to use electronic portfolios, online bulletin boards and discussion forums, and to work collaboratively. The Computer Science course can therefore be developed by introducing new methods for teaching which support the improvement of students' basic fundamental knowledge.

The results from the lecturers indicated that the level of fundamental knowledge delivered in the classroom is very low. The areas where knowledge was thought to be lacking include gathering information, reading, understanding hardware concepts and mathematics skills. Furthermore, the lecturers had similar beliefs regarding the Computer Science students' understanding of fundamental project management (Q7), collection and interpretation of data (Q9) and knowledge about operating systems (Q3). The lecturers also indicated that the Computer Science students achieved better in the classroom than in lab-based learning with regard to their ability to apply knowledge of Computer Science (Q5), understand problems solved by using an example (Q1) and apply web design skills. On the other hand, the lab demonstrators stated that the students had a low level of knowledge regarding the use of applications which differed from the programming languages that they had already studied on the course. The program most used by students is Word, and less than half said that they used PowerPoint, Excel or Publisher regularly. The above can be explained by the fact that lecturers usually set students activities involving the use of simple programs like Word. Therefore, it would be desirable to design and implement courses that enable the management of tools for producing visual presentations, animations and conceptual maps (Flash, Hyperstudio, Inspiration, etc.) to support academic work. To sum up, there is a fundamental skills gap concerning the skills offered in the SBL and LBL programmes. The following figure 4.5 illustrates the responses to questions regarding the soft skills domain.

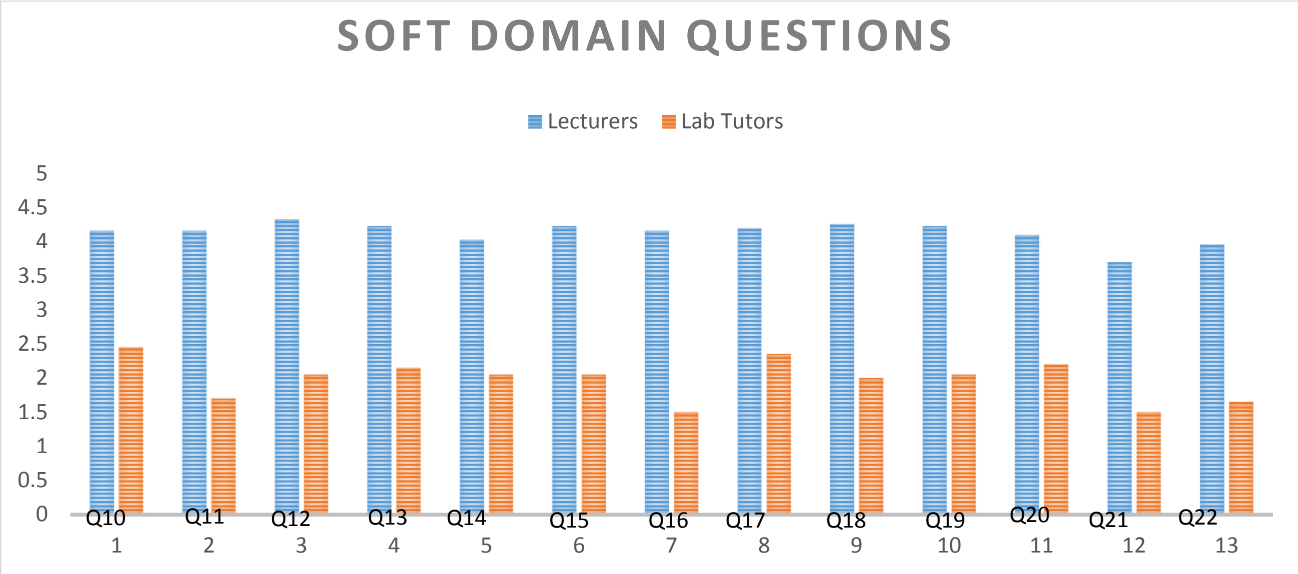


Figure 4-5: Soft domain questions

The lab tutors also emphasised the need to design and develop collaborative projects that incorporate the use of ICT, and to develop and incorporate curricular activities using educational programs through the web. They felt that this would improve the teaching and learning process in both the lab and the classroom.

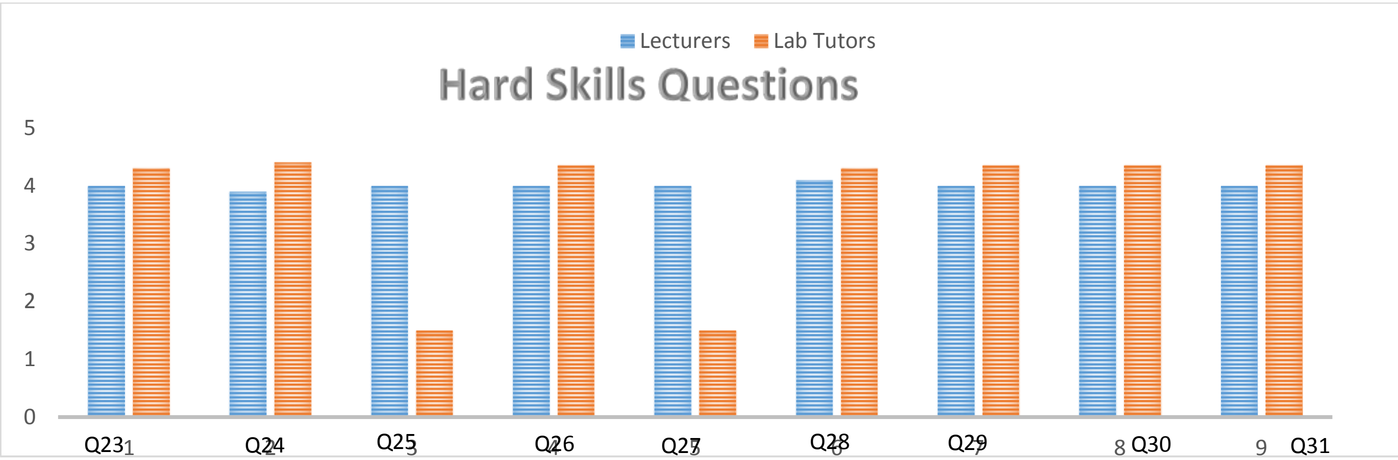


Figure 4-6: Hard domain questions

The lab tutors said that the CS students' progress improved in the lab. For example, the laboratory offered better opportunities for students to formulate, identify and solve computer problems (Q25), and to implement practical tasks individually. They confirmed that LBL also gave students the chance to practice their programming projects and develop hands-on skills. The lecturers, however, indicated that the CS students did not achieve well in terms of hard skills, such as the ability to write programs in different programming languages and solve problems using mathematical models (Q23, Q24).

They confirmed that LBL students needed improvement in their understanding of the basic concepts of Computer Science and software engineering.

In conclusion, it can be noted that there is gap between the skills provided in the classroom and those provided in the lab. Overall, the participants agreed that the Libyan Higher Education faces a set of challenges, for example, lack of background knowledge and shortage of students' hard and soft skills. Figure 4.6 illustrates that graduates of Computer Science should have a full understanding of programming skills and knowledge in mathematics to improve their technical knowledge in each area of hardware or software. In order to ensure students are well-prepared to graduate from a Computer Science course, these elements of knowledge, blended with various soft skills, are vitally important; they are also essential for pursuing a job as a Computer Science professional.

4.5 Questionnaire 2 (Analysis of Student User Perspectives)

This questionnaire was formulated to enable students to choose suitable learning styles for learning experiences in the future, and their learning preferences in terms of the 20 typical learning activities according to Kolb's learning styles inventory (LSI) (Kolb, 1984).The learning activities are included in the rows of the questionnaire (see Table 1). (See also the columns containing the four learning styles, A, B, C and D, in the Appendices.)

A. To participate positively in the class **(Accommodating)**

B. To offer the time for students to listen and then observe **(Diverging)**

C. To give instructions for thinking to get solutions to questions and problems **(Assimilating)**

D. Tasks and applications **(Converging)**

Despite the fact that there is a difference in how to understand and identify learning styles, Duckett and Tatarkowski (2011) recommended that students learn better when their favourite learning styles are compatible with the teaching methods used, and this is what makes the understanding of what is the favourite learning style among students extremely important for teachers. The success of the lecturer in the application of the style of education which corresponds to the learning style preferred by the students makes it easier for him, as his mission is determined more by educational attainment than upgrading to a better level of education (Zimmerman, 2004).

4.5.1 Data analysis

The data were analysed using a statistical software package (SPSS IBM Statics 20) and the researcher followed the following strategy in the presentation of the research results. Table 5 in the Appendices shows descriptive statistics for the sample as a whole (60 students). It was noted that the highest mean was for the assimilating learning style, with a value of 3, while the mean for the diverging learning style presented a value of 2 and the lowest average learning style was accommodating with a value of 1. The mean of the converging learning style was not available. This seems to be consistent with the observations of researchers on the nature of computer science students, that they have a greater tendency to watch and then assimilate directly to work, which is reflected in the higher average of the assimilating learner style. It was also noted that there was a consistency between the group as a whole (60). Figure 4.7 presents the average value distribution for the students' responses. 44% of the learners were assimilators, which were the highest proportion, 37% were divergers, whilst 10% were accommodators and 9% were converters, which had the lowest score.

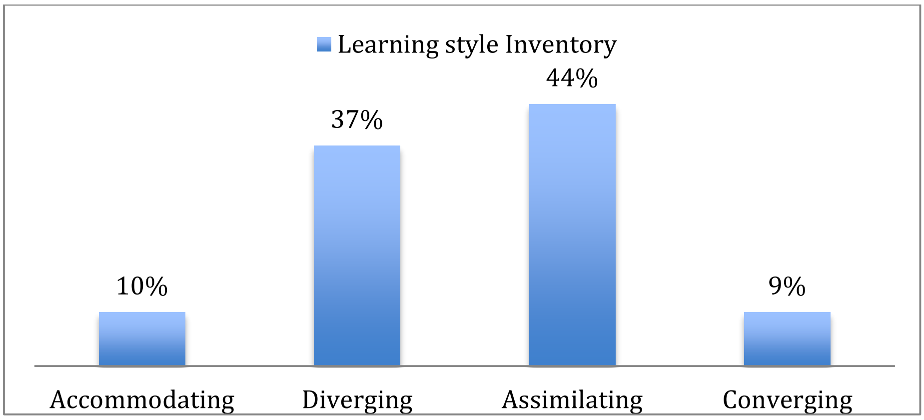


Figure 4-7: Average responses of students

These data support and expand those of the study conducted by Kolb (1981b; 1984) which, as shown in the figure 4.8 below, demonstrated that Computer Science is characterised by the assimilating learning style.

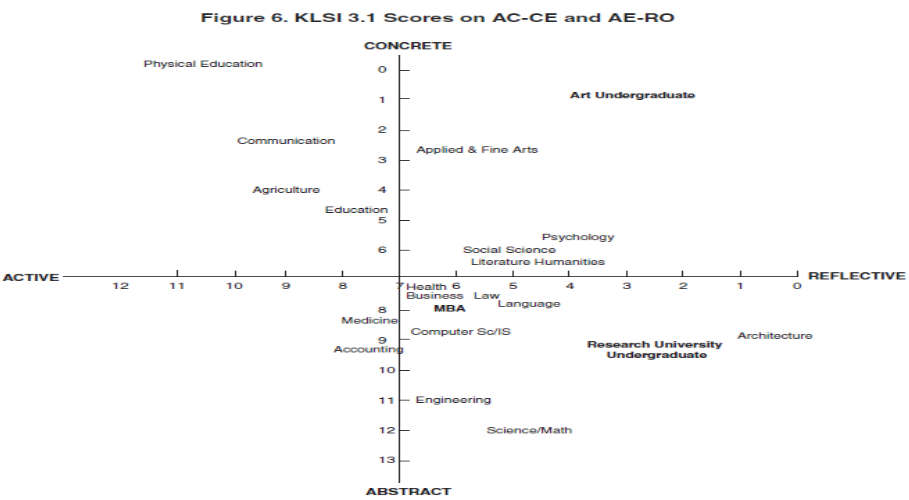


Figure 4-8: the study conducted by Kolb (1981b; 1984)

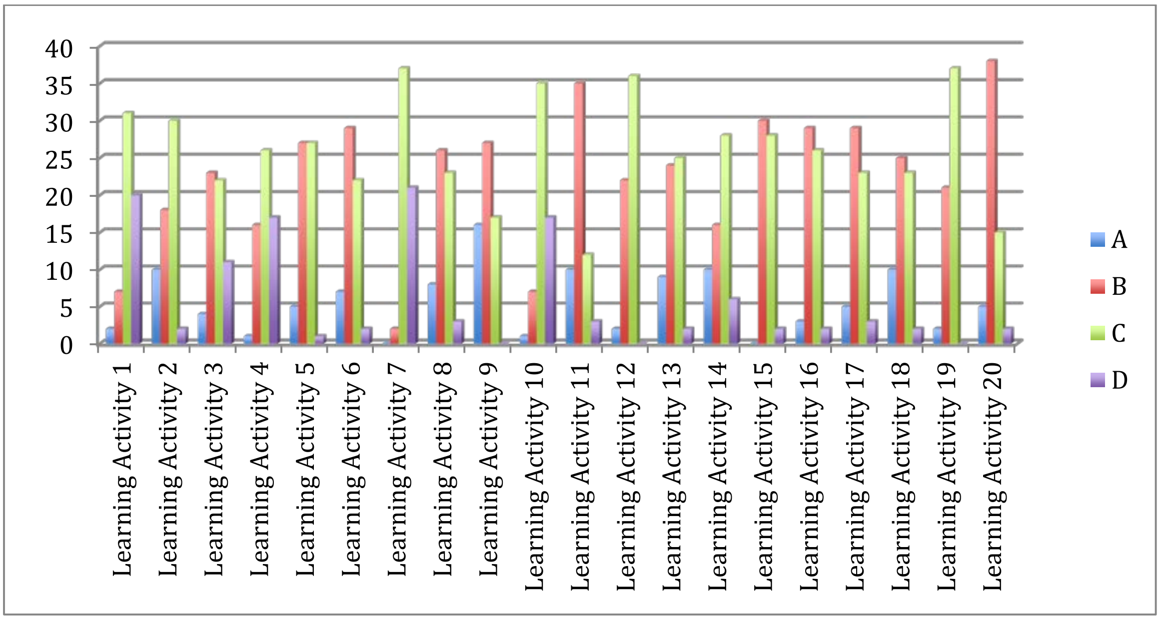
For instance, the distribution of students' learning styles for Learning Activity 14 (when students were studying some new things) showed that:

6 Students (10.0%) preferred the converging learning style, involving practical learning activities.

28 students (46.7% of the respondents) preferred examples and ideas to increase theoretical knowledge – consistent with the assimilating learning style.

16 students (26.7%) preferred thinking immediately how it would work in practice (diverging).

10 students (16.7%) preferred performing experiments and carrying out plans in the real world (accommodating).



4-9: Distribution of students' preferred learning approaches

4.5.2 The open-ended question

The main advantage of the open question is the freedom offered by this type of question. The responder can allow his ideas to flow freely, which enables the researcher to identify their ideas as expressed in their own language in an automatic manner, and this can serve as a basis for new hypotheses. With regard to the fundamental knowledge skills level of Computer Science students, some lecturers and lab tutors indicated, through the open-ended questions that the students should prepare and study fundamental knowledge (concepts of algorithms, coding and software development methods) and apply these concepts in practice before they go to the lab. Hence, introducing the fundamental knowledge required for operational learning in Computer Science should become an important stage that can support students and improve their understanding of basic knowledge. It is essential to offer this method of work experience to Computer Science students before they go to laboratory-based learning, as this will provide improvement in outcomes through the provision of a better correlation between the needs of the students and the learning programme. Such an approach should include a variety of educational resources and stimulating learning methods.

Justification for the use of e-learning in the future

The lab tutors indicated that a blended learning approach can improve communication and facilitate student learning:

> "I am very interested to apply new method in my teaching as e-learning package because many of the Computer Science issues is extremely difficult to be taught entirely theoretically, and, in particular, such as highly skilled, and use the e-learning represents one proposed to solve such problems solutions"
>
> "Yes, I am interesting use e-learning package because it can find solutions to the problem of large numbers of student's solutions."
>
> "Yes, because it can help for the multiplicity of sources of knowledge as a result of contact of different sites on the Internet"
>
> "Possibility of contact between the student and the teacher with each other: This is done through the chat, dialogue and e-mail applications and social networking rooms"
>
> "the possibility of putting the various destinations for students or debate: through comments on the issues raised in the forums and blogs, which makes the student more daring to put his ideas and express his opinion more than if they were in a traditional classroom"
>
> "Access to the teacher any time, any place: where the student can easily communicate with the teacher and with minimal effort and faster time outside of work hours through e-mail and social communication media and others"

> “The possibility of receiving methods and different ways of education suited to the learners: Some of the visual is aligned way, including audio or print and others is aligned practical way”

> “Provide the curriculum all the time, and throughout the week: the learner can learn to fit in at any time in the morning or in the evening. It can repeat and review what has studied it at any time and it is preparing for the tests”

The above comments take as their starting point the fact that students can arrive with a basic level of management of the practical skills by using an e-learning package to enhance their learning abilities. The comments summarised important elements that are essential for Computer Science students.

The lecturers indicated that the course materials should operate in tandem with the lab programmes in order to increase students’ ability to function in the technical competencies of ICT, such as in terms of using the internet, commercial software packages and emails. They also agreed that students should have a good ability to take projects through the phases of research action by using the stages of analysis, design and evaluation. They emphasised the significance of commitment to solving problems through IT knowledge, and working as team to achieve goals through communication. They confirmed that LBL students need improvement in their understanding of basic concepts in Computer Science and software engineering. All the comments raised should be addressed within the Computer Science course in both classroom and lab-based learning; effective learning methods in appropriate learning settings should also be ensured. With regard to soft skills, the lecturers agreed that the course should include more of the soft skills that help students to answer complicated problems, such as critical thinking and creativity. They also agreed that projects and courses should include activities such as a puzzle to get the students thinking about the idea or the key to solving the puzzle. Critical thinking assists students to identify possibilities and analyse the main stages to obtaining solutions. Furthermore, other skills beneficial to lab majors include verbal and written communication, decision making, and working well under pressure. The focus of blended learning is to use such skills to support traditional classroom experiences.

Another idea is that teachers can take the more difficult mathematics content, use interactive whiteboard captures with video and narration, and then post the resource for anytime student viewing. Students can also capture their whiteboard work and submit that presentation for assessment.

4.6 Lab Skills Model

The proposed LBL skills model has been generated based on the qualitative and quantitative analysis of the questionnaire answers. It contains both soft skills and hard skills (see Figure 4.9). The respondents from the Computing Department at Omar Al-Mukhtar University agreed that, in order to be successful, students must develop a combination of behaviours, attitudes and skills. The proposed model is based on the quantitative and qualitative data and also on other skills models (Hiermann & Höfferer, 2003; Kearns, 2001).

This model considers the framework of e- Learning which introduced in 2001 by Badrul Khan who built it on the basis of examining the various elements and aspects impacting the development and application of e-learning methods.

The proposed LBL skills model takes into consideration the results of another study with confirmatory factor models involved 538 participants from various courses; that was conducted by Selim (2007) at the University of the Arab Emirates, and examined four types of critical success elements from the perspective of the students.This model is designed to improve the soft and hard skills needed for relevant qualifications and subsequently in the workplace; it aims to strengthen the students' skills by motivating them to study, apply practical skills and discover their own creativity. According to the definition by Hiermann and Höfferer (2003), sets of skills should relate to qualifications and/or experience. This study focuses on the strengthening of skills required for qualifications, and those necessary for undergraduate study. The first half of the skills addressed are based on a particular university degree, and this model aims to address their needs by developing the students' skills in the right direction.

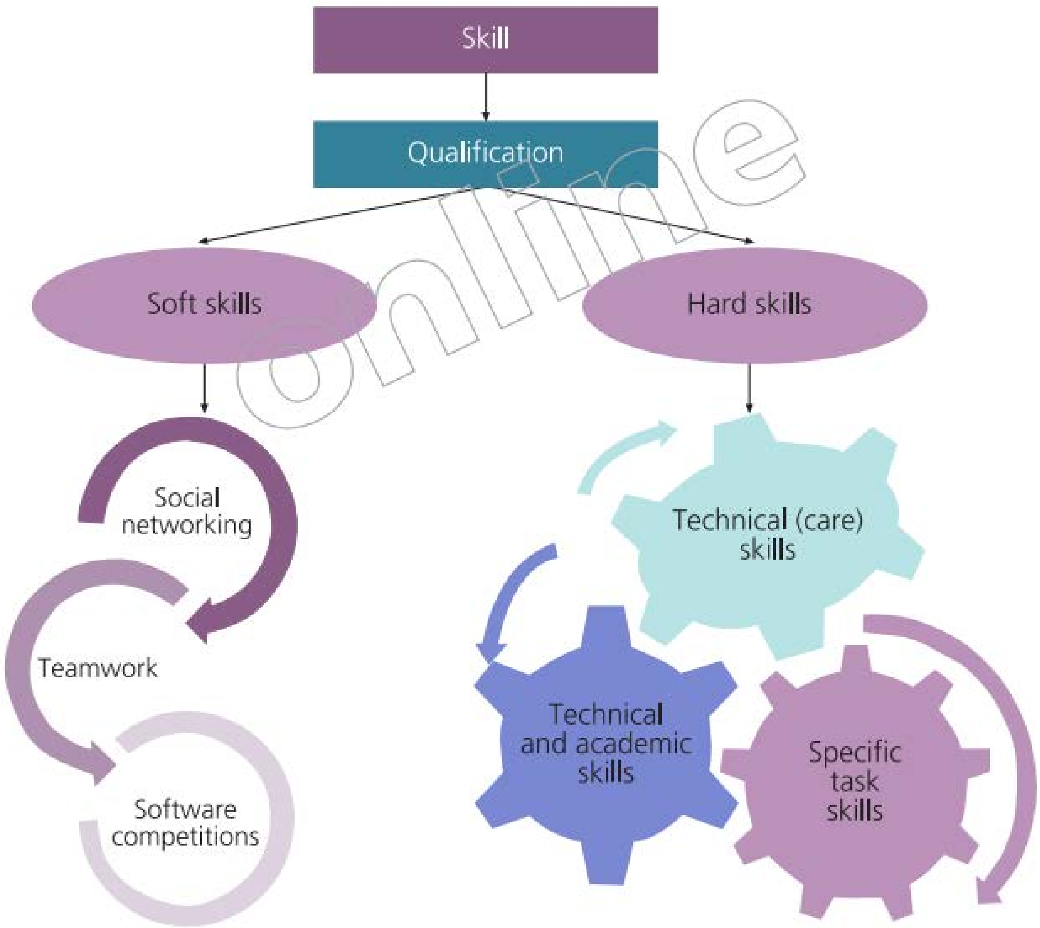
Soft Skills: These skills are the core competencies essential for high-level task performance. Soft skills are a set of personality traits, including social graces, ability to communicate, language, personal habits, friendliness and optimism, that characterize relationships with others. They are interpersonal skills that complement the fixed intelligence of the person, and techniques required in work and many other activities (Iyer, 2014). Improving soft skills can assist Computer Science students in the development of their ICT skills, reading, listening and overall communication skills, for example by enabling them to become involved in a dialogue, provide feedback, work as a group and understand how to solve problems.

Soft Skills Required for Dealing with Others: Examples of these soft skills include the ability to participate in teamwork and teach others, provide services, lead a team, negotiate and unify the ranks of a team in the light of cultural differences. They also include the ability to motivate and to use decision-making skills and problem-solving skills in dealing with others. People with such skills are able to maintain conversation through both small talk and meaningful debate, to neutralize arguments with insight, give polite instructions and talk intelligently about any topic (Iyer, 2014) Soft skills can also be applied to the following functional and technical abilities:

- Analysing the requirements to produce a design.
- Using mathematical methods and scientific rules to solve problems.
- Identifying the reasons for operating faults and determining what to do about it.
- Writing computer programs for different aims.
- Talking with others to convey information effectively.
- Understanding written paragraphs and sentences which relate to their documentation.
- Using reasoning and logic to classify the strengths and weaknesses of conclusions and find alternative solutions to problems.

Social networking between programmers is very important on several fronts, because it allows students to communicate with programmers who have experience of advising students about how to use new technologies. This networking can take several forms, be it through personal contact, or communication via chat rooms or other programs which enable communication; thus, it is important for programmers to maintain their pages on social networking sites or personal blogs. The advantage of access through the university is that students will be alongside people who have the same desires and inclinations regarding programming (Broughton, Higgins, Hicks, & Cox, 2009). It is therefore important to configure the network so that individuals can build relationships with colleagues, and select others who have a promising future and keep in touch with them.

Teamwork and Problem Solving: Students must work on their software projects with other programmers, and should seek either to take the lead, in the best scenario, or at least to gain experience. Problem-solving skills will be enhanced as the result of detailed procedures followed by the teacher in teaching, educating and training students in the skills of scientific and logical thinking by introducing issues from an unfamiliar perspective in order to challenge ideas (Alseddiqi, 2012). This is a cultural change, and requires the student to reflect, think about and discuss issues to find an appropriate solution under the supervision of a teacher by a specific time during class. The role of the teacher is to develop the use of problem-solving strategies by:



4-10: Lab skills model (Othman et al., 2014)

- Identifying the knowledge and skills that students need to conduct research, such as survey and reconnaissance.
- Determining preliminary results or concepts to be acquired by students as a result of their research and surveys.
- Teaching students models of ways to research and solve problems which will benefit them in the future.
- Helping students identify references required to perform research.
- Providing models for research skills, such as persistence, and guidance in the process of conducting research.
- Monitoring student progress and intervening to support them whenever necessary.

Software Competitions: Students' participation in programming competitions via the internet helps them to cope with more complicated software solutions whilst, of course, creating a competitive atmosphere between themselves and members of other universities.

Hard Skills:

Technical (Core) Skills: Computer Science students transfer their knowledge into practice using mathematical and programming language skills. Students must know about the process, safety standards, computer applications and use of the device, etc. These skills are usually easy to monitor, measure and identify through SBL. Students must show a high level of competence in specific technical skills within the LBL programme in order to increase their chances of getting a job in the future (Alseddiqi, 2012).

Technical and Academic Skills: The students establish core competencies through theoretical modules, and these are converted into practical competencies through the practical modules in LBL.

Specific Task-Related Skills: These are, in fact, entirely linked to the skills previously used in SBL, and the students need to feel that these skills can be characterized and mastered. Proficiency in such skills can be analysed by giving the student a specific task related to a skill mastered during lab sessions. These skills focus on the Computer Science students' ability to be creative and add value to a task by proposing new practical methods for future development. They can also be used to determine areas of specialization, as it is better for students to be specific in their choices. Selection for such specialization is by inclination, because the students must decide what kind of discipline they want to study (for more detail see Alseddiqi, 2012; Othman et al., 2014).

4.5 Conclusion

In conclusion, it can be noted that there is gap between the skills gained in the classroom and those gained in the lab. Overall, the participants agreed that Libyan higher education faces a set of challenges, for example students' lack of background knowledge and their shortage of both hard and soft skills. The results illustrate that graduates of Computer Science should have a fuller understanding of programming skills and knowledge of mathematics in order to improve their technical knowledge of both hardware and software areas. The development of these elements of knowledge, blended with various soft skills, is important to prepare students for pursuing a job as a Computer Science professional or for higher level study of Computer Science.

Chapter 5: Design, Development and Implementation of the E-learning Package

5.1 Introduction

This chapter aims to shed light on the development of the LBL module along with a set of pedagogical strategies and technologies to help in achieving the objectives of a Computer Science course at Omar Al-Mukhtar University. This chapter discusses usable and accessible web applications that can be designed through implementation of the set of techniques and procedures included under the methodological framework known as 'user-centred design', the phases of which include user analysis, structure and representation, knowledge and communication analysis, and interface and navigation design. The materials were prepared and applied in three case studies.

Case study 1- presented fundamental knowledge for basic HTML coding, and how to code it.

Case study 2 - included soft and hard skills for studying the HTML elements and the design of a simple website by Dreamweaver software.

Case study 3 – presented feasible collaborative learning in groups that aimed to develop and design a website. This included practical competencies related to the development and design of a website in an integrated LBL module.

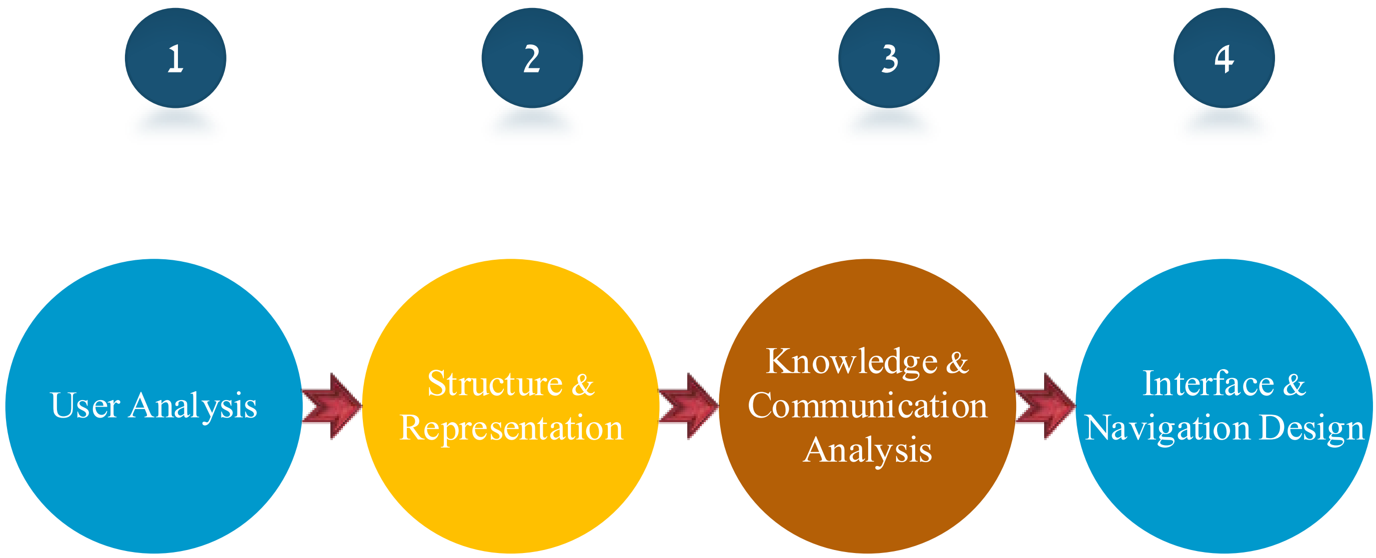


Figure 5-1: User-centred design

The aim of the module is to deliver important materials to ensure that computer science students have the required training before they go to the lab. The first section of this chapter will present the main stages of development of the LBL module, which is designed as an e-learning package. The phases include user analysis, structure and representation, knowledge and communication analysis, and interface and navigation design. It is a process that runs continuously and systematically, generating instructional specifications through the use of phases designed to ensure that the objectives are achieved. The user-centred design model includes a complete analysis of the needs and educational goals to be met, followed by the design and implementation of a mechanism to achieve those objectives. This process also involves the development of instructional materials and activities, and then the testing and evaluation of student activities (Brandt & Grunnet, 2000; Haklay & Nivala, 2010). The second section will present three case studies which were undertaken as part of the development of the LBL module.

The main points, which were the development of students' fundamental knowledge and the requirement for effective teaching and learning activities, were considered while developing the modes of delivery and learning activities. The proposed LBL module was presented as a pilot with the Computer Science students in the academic year 2015 and the user evaluation of the revised package was conducted by TAM Model (see Chapter 7).

Figure 5-2: Course structure used with LBL module

5.2 The Design of the E-learning Package for the LBL Module

The proposed materials to be included in the LBL module were converted into three case studies. These materials were included in the website during the prototype stage.

The above figure presents the process of converting the hard materials into the online module. As mentioned above, the design of the application included aspects such as user analysis, structure and representation, knowledge and communication analysis and interface and navigation design. The first aspect of developing the e-learning package, i.e. user analysis, focused on the Computer Science stakeholders and the technological, pedagogical and institutional context. The structure of materials needed to concentrate on fundamental knowledge related to programming languages. The LBL module contents were therefore developed based on practical materials associated with the lab sessions and available communication systems. The students would be able to engage themselves in the construction of knowledge, based on their experience, with the help of videos and online materials represented in the e-learning process. This process of learning provides an excellent experimental approach.

5.2.1 User analysis

Hussein (2005) recommends that the user-centred design of e-learning packages should take into consideration the institutional, technological and pedagogical contexts of the products' implementation, as well as the profiles of stakeholders (Hussain, 2005). The stakeholders of the LBL module are the lab tutors, lecturers and students. Questionnaire 1 was designed to measure the skills of the students on the Computer Science course (CS). The association between the existing approaches to learning and teaching, including the preferred learning styles of students on the Computer Science course, is reflected in the outcome of Questionnaire 2 (see Chapter 4).

Institutional analysis

Computer Science (CS) students - Based on their capabilities and career preferences, students are admitted to Computer Science institutions at the age of 23. The researcher, in her role as a Computer Science lecturer, had observed that the students who were enrolled at the institution in the first year had varied skills and knowledge sets, and came from different backgrounds. It is therefore essential for Computer Science institutions to build a culture where everyone is treated equally in relation to their race, ethnic origin and religion/beliefs. Based on their learning capabilities and preferences, students must obtain the secondary school certificate. The degree which they can get from the faculty is the Bachelor's degree which needs four years of study on most courses.

Computer Science lecturers – As well as delivering the modules (Computer Science), the lecturers also oversee practical sessions which are conducted in the institute's workshops. Direct instruction was provided by two lecturers from the Computer Science institute and they also supervised online theoretical learning activities (conducted within both the classroom and the laboratory). The remaining practical learning activities were taken care of by three lab tutors within the institute labs. The lecturers, who deliver practical and theoretical modules during SBL, are required to hold a PhD or Master's degree. The curriculum is delivered via hard copy sheets and students notes recorded in a textbook. Three lecturers from the Computer Science course have assisted by putting their own materials into online materials to be used within the laboratory and classroom.

Faculty science Demonstrators: The demonstrator who works in the lab enables students to understand theoretical subjects during SBL and prepare students for the lab exercises. Demonstrators write programmes and solve the most difficult problems. Demonstrators also observe students during their LBL programmes.

Institutional context

Strategy and policy - Omar Al-Mukhtar University demands a clear mission and well-designed academic programmes. The mission of the Department of Computer Science is to prepare graduate and undergraduate students for productive careers in government, acadaemia and industry by offering an outstanding environment for learning, teaching and research in applications of computing and the associated theory. The department provides theoretical and practical educational services to colleges and departments that need this specialization, implementation of training courses in the use of computers for staff and students at the university, and supervision, follow-up and maintenance of the computers at the university. The department performs research, scientific studies and practical work in the field of computers, as well as in the relationship of this discipline to other academic areas.

Form and assessment - Students attend obligatory schoolroom laboratory exercises and tutorials. To get an acceptable final mark students must pass the written test at the end of the schoolroom lectures, achieve all the exercises in the LBL and pass the final examination. Undergraduates are not allowed to sit the final examination unless they finish the laboratory exercises which are based in LBL, and classroom tutorials which are based on SBL. The students have classes and lectures (SBL) every week.

The computing course is a hard course, with an average exam pass rate of 50%. In order to develop the computing course to support the establishment of more effective learning activities, it is necessary to review the institutional context currently available to support the implementation of the e-learning package

Pedagogical context

The Computer Science course is based on three main axes, namely, the lecturer, the lab tutors and the materials. The department still uses traditional methods to deliver the materials. Traditional education, in which the lecturer meets with the student face-to face, has continued from ancient times up to the present, as it is well known as a means of communication and this is the most powerful way to communicate and transfer information between two people. However, the pedagogical context must make sure that the design of activities, learning outcomes, teaching, learning processes, environments and assessment techniques are successfully connected together.

This research conducted three models that have been employed to design the proposed

LBL module. The researcher has also produced models that can be useful for teaching and learning on the Computer Science course. The learning models are designed to help the learning cycle for Computer Science students by supporting them with an e-learning package. They can be for a set of modules or for one specific target.

The first model presents the components of the learning process for the learning activities developed by Mayer (1989), with the addition of new components regarding student characteristics and the objective of the online module (LBL). The researcher used this model when designing the learning activities for the online interactive LBL module. The model is based on the personal experience of the main author as a lecturer in the Department of Computer Science. This could be used for the development of the curriculum and learning modules which will raise the quality of educational attainment for all students. The framework is based on Mayer's model of learning (1989) and the three dimensions which will be presented within this framework are material to be learned, presentation method and learning strategy. Mayer's learning model contains six elements; the learning model provides the main elements of the framework, in which the characteristics of the student, learning material and presentation method are initial elements of the learning process. The other three elements identify the learning performance, learning outcomes and learning process. These will be presented in more detail below, as demonstrated in Othman (2013).

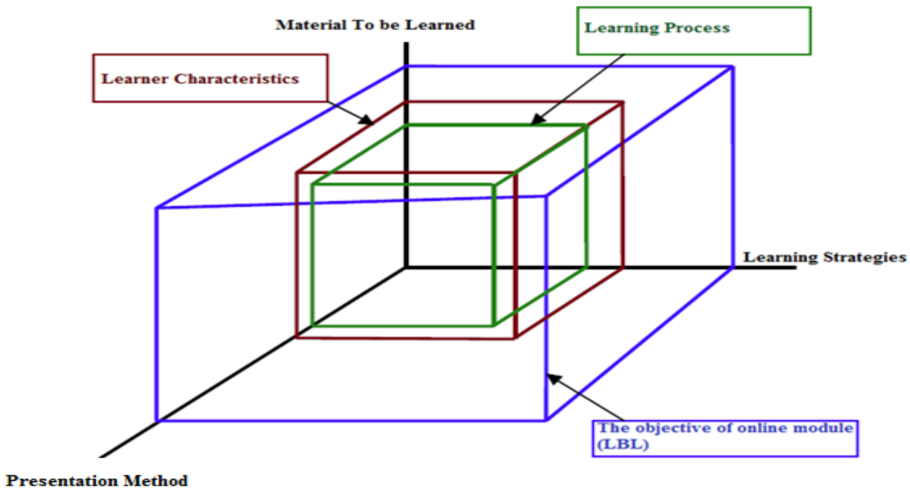


Figure 5-3: Components of the learning process

The second model presents the Assure model, which can work as guidance for planning and conducting lessons, and aims to include media and technology; this can therefore be used in the development of learning activities for the LBL module inn order to focus on the students' needs. Heinich et. al (1999) proposed the use of the Assure model for planning and delivering teaching sessions that integrate technology and media, and for providing authentic assessment of student learning. "The Assure model allows for the possibility of incorporating out-of-class resources and technology into the course materials. This model will be especially helpful for instructors designing online courses."

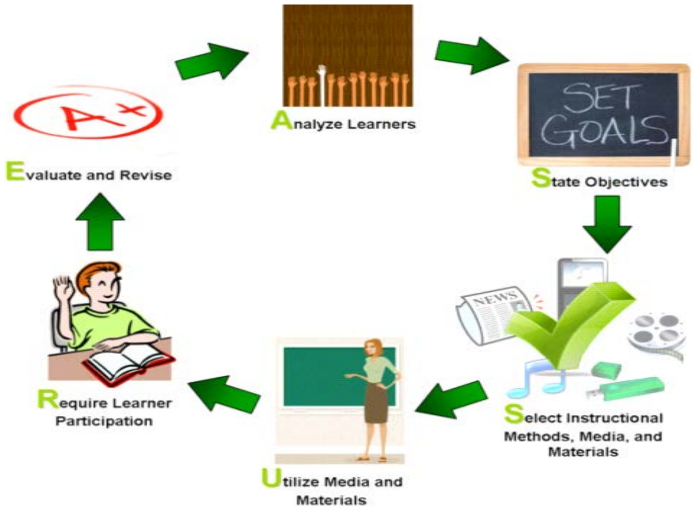


Figure 5.4: The six steps of the Assure model

This process or template for planning can help students make better usage of technology, in order to facilitate the learning process and the completion of further progress to achieve their goals. It provides opportunities to use digital tools instead of standard paper copy templates and evidence submitted by lecturers. These digital tools can be accessed and stored anywhere with the proper connection (whereas papers may be lost or left behind), and can improve cooperation between students. A well-designed lesson attracts the attention of the student, illustrating the goals to be achieved and providing new material. The student participates in practice, and the instructor assesses comprehension, delivers advice and is responsible for follow-up activities. It is a logical design and a simple guide for planning and implementing instructions that include media and technology. Othman refers to these phases as "events of instruction." It has been shared in Othman et al. (2014).

The third model (lab skills model) presents the main elements of the soft skills and hard skills; these include the keys to emotional intelligence and personal qualities which can motivate and assist in the intellectual development of the students. For more detail, see Chapter 4.

Student-centred approach – The educational approach cantred on the students considers their individuality in the learning process, building new knowledge from previous information and improving cognitive skills by the interaction with the new environment. This provides the opportunity for students to learn to self-educate and motivates a definite desire within them to learn from their choice of subjects, at a time that is appropriate for their circumstances and their needs and preferences, and which allows unlimited opportunities to discover through experimentation and trial and error. This is unlike its equivalent in the traditional system of learning, which does not take into account students' individual inclinations and needs. Moreover, learning theories (for example Kolb's models, collaborative learning theory and Bloom's taxonomy) should be taken into consideration while developing course content. Consequently, it is essential that the university changes its strategy to achieve an effective balance between practical applications and theoretical modules, and applies a student-centred learning approach.

Technological context

The Ministry of Education (MOE) in Libya introduced technology in the mid-2000s for general institutions, starting by providing computer laboratories in schools and delivering lecturers' training programmes. Later, learning resource centres were opened in various schools, with personal computers linked to the World Wide Web. In 2011 the university established the new institute which is fully equipped with practical laboratories containing up-to-date equipment and software packages for assisting the teaching and learning processes. Currently the software packages are mostly used in core (theoretical) SBL modules such as Mathematics, Science and English Language. The researcher suggests there should be increased use of technology in the specialised SBL modules, such as including online content for engineering courses, animations for explaining engineering experiments, videos for practical work guidelines, pictures of real work environment, and scenarios of engineering problems to be discussed online.

5.2.2 Structure and representation

Dreamweaver can be used to create website pages as well as all content pages (Tomei, 2007). Its use usually starts with a generic HTML and CSS coding. The homepage was the first to be developed along with the main code of the website. When the homepage was created, it started adding content to each of the pages. Finally, the complete web developer implemented the process of the website in programming languages. PHP language was also used to access and add data in the database. The designer selected the SQL server that was intended to be presented to students studying the Computer Science course, which can add courses, send emails to students and receive enquires for students. The site was designed from static to dynamic, and allowed query databases and the facility to contact managers through forms. The representations and structure of assessments and learning activities should take into consideration a set of functionality, e.g. live hyperlinks, buttons, icons and videos which should be added to give the application an effective structure of the application, in addition to ensuring that the site meets the required levels of usability.

[redacted]

Home Welcome to LBL module

Login

- About The Module
  - Introduction
  - Outline
  - Learning Outcomes
  - Teaching and Learning
  - Assessment Strategy

Case Study One: About the Case Study

Outline

Objectives

Learning outcomes

- Study Week 1
- Study Week2
- Study Week 3
- Assessment

Case Study Two: About the Case Study

Outline

Objectives

Learning outcomes

- Study Week 4
- Study Week5
- Study Week 6

Case Study Three: About the Case Study

Outline

Objectives

Learning outcomes

- Study Week 7
- Study Week8
- Study Week 9
- Assessment

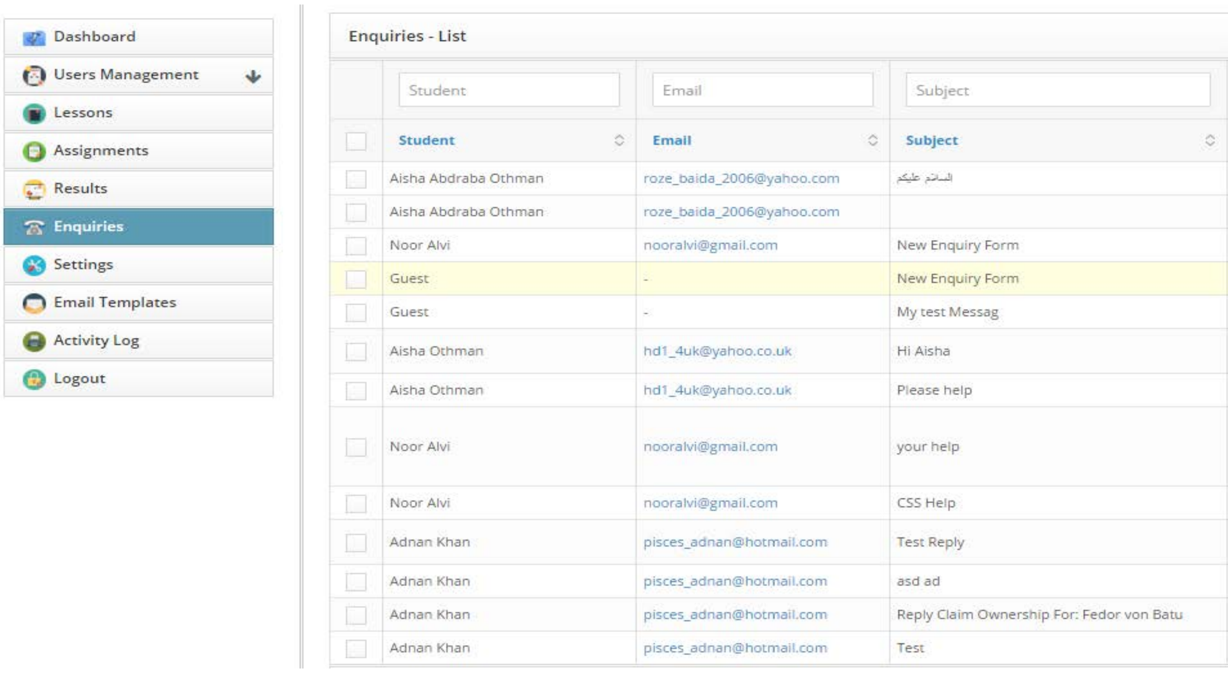


Figure 5-5: Knowledge and communication analysis example 1

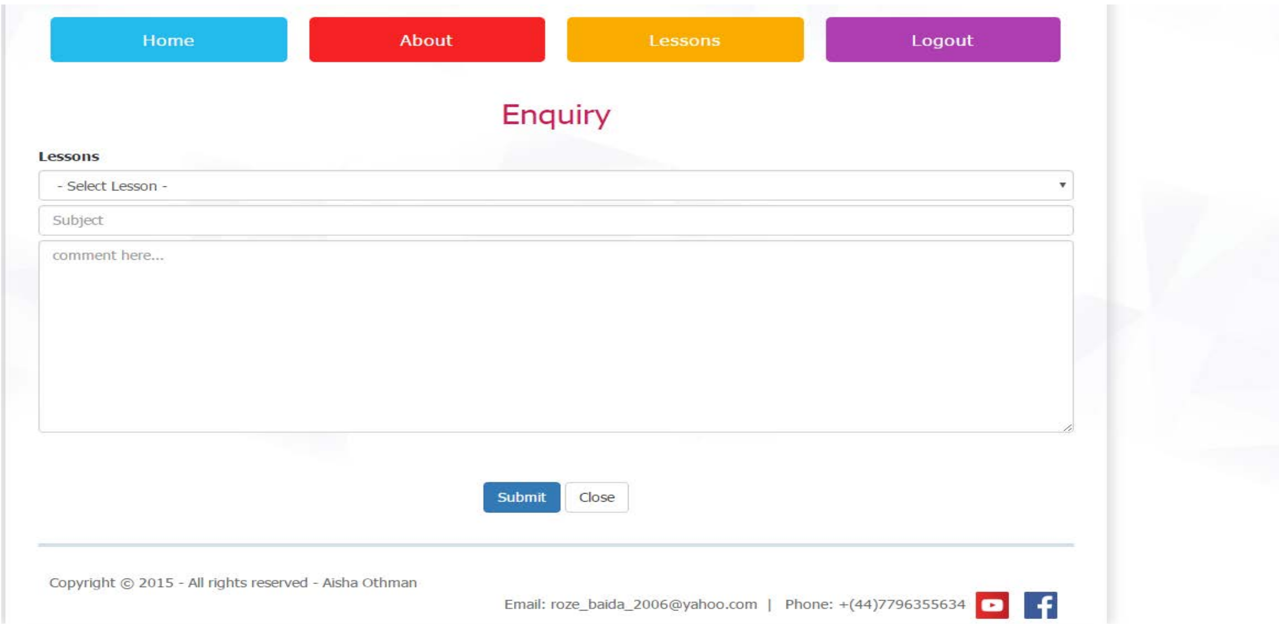


Figure 5-6: Knowledge and communication analysis example 2

5.2.4. Interface and navigation design

The prototyping stage is based on the development of models or prototypes of the site interface. Its appearance may not exactly correspond to what the site will look like once finalized, but it can be used to assess the usability of the site without waiting for its implementation. In the early stages of development of the website, low-cost paper prototyping was used to replicate the basics of the interface of the site on paper. The LBL module included collaborating materials (including videos, pictures and online assessment).

Also, the students can simply change from one page to another using the buttons and attached links in the list in the lesson page, so this website has elements suitable for students with different learning styles in order to motivate them with the learning materials. The development of the proposed LBL Module, which was based on the lab skills model and the Assure model, has been shared in Othman et al. (2014). The first opportunity for the course to use the system as a reinforcement of classroom activities was in September 2015. This system was geared to individual student work and applied to a section of the course of 200 students. At that time the students had positive comments regarding the tool.

The technologies used covered issues ranging from the support of the administrative aspects of the course to applications oriented to produce active classes and support activities in parallel with the course. In particular, the LBL module aimed to help Computer Science students to get the required preparation in advance before they go to lab based learning.

To achieve this competence, a blended learning strategy was followed, in which the following activities and supporting technologies were combined:

1) Web-based learning for course intranet supporting the administration of the course;
2) The use of mobile technology-based activities to support collaborative learning face –face in the classroom; and
3) Use of computer labs to support learning in practice.

5.3 Implementation of the E-learning Package

The materials were prepared and included three case studies. The online materials allowed the students to apply practical computing programs, get knowledge regarding solutions and improve their fundamental knowledge in terms of the soft and hard skills required by the lab. The case studies were developed after revising the current skills gap between classroom and lab-based learning. The online module (LBL) is accessible at

< http://alvipixelsdesign.co.uk/elearning/ >.

The application was securely protected so the lecturer had to register the students and collect the personal information, record it in a special profile for each student who enrolled in Semester 1 and send the password and usernames to them. The lecturer who was responsible for accessing the module put in the materials and lessons plan as case studies.

Table 5.1: Guidelines of the LBL module case studies

Study Week	Case Studies	The aim and objectives (learning outcomes)
1	Introduction to HTML Language	Cover the effective knowledge and information about the LBL module.
2		Design Website using attributes and main elements introduced in HTML.
3		Learn basic HTML coding, including what this is and how to code it.
4	Introduction to Cascading Style Sheets (CSS)	Design simple website by Dreamweaver software. Develop students' soft skills, including communication skills and decision making.
5		Introduction to cascading style sheets - to improve the look of your web pages by adding CSS to enhance them.
6		How to design a two column layout for your website using CSS.
7	Design Website	Define and use variables, perform looping and branching, develop user interfaces, capture and validate user input, store data and create well-structured applications.
8		Design the website in interactive form and make pretty things for interface design. Improve students' hard skills.
9		Understanding the main steps to create a website such as HTML links, images, header and paragraphs. Contribute to decision making and solving problems during the lab work. Write a report evaluation their experience. Divide students into two teams: Team one: collect the content of the website and draw up the site map Team two: design the website and select the appropriate elements required to design the website.
10	Assessment	Online quiz at the end of the module.

Case Study 1: Introduction to HTML languages (Lectures 1-3)

The case study was divided into two aspects: activities for learning that is based on theory (for comprehension of knowledge and gaining of attitude) and application of hands-on learning (for transforming knowledge and attitude into uses of technical abilities). Accessible to the students were various sources of information and instruments of communication (including direct guidelines, online learning and instances of hands-on applications), whilst the activities of theory-based learning were provided through the multimedia laboratory.

1st week of study - The case study’s framework and goals, as well as learning results, were supplied by the lecturers. The next step they made was the presentation of background information about the materials intended for online learning, and about the settings of the workshop at the institute. Directly asked to do so by the lecturers, the students accessed the case study’s web pages in the multimedia laboratory. In the lecturers’ view, the students demonstrated a good level of experience in accessing learning materials available on the internet.

In the students’ view, the case study’s explications were interesting, particularly the drawings employed to illustrate the operational procedures for the documents which are described by HTML tags and learning basic HTML coding.

The lecturers delivered the case study in three weeks; they activated the fundamental knowledge in the first week to let students prepare for the next training work and access the module using their passwords and user names. The topics of the first weeks 1-2-3 included:

- What is the HTML language?
- HTML example and example explained
- HTML documents described by HTML tags
- Each HTML tag describes different document content and students learn basic HTML coding, what this is and how to code it.

The aim was for the students to understanding the phases of website design and how to code it to be linked to a real-world instance.

Evidently, the introduction to HTML languages case study enabled the students to know better what HTML coding language is like. The students were additionally tasked with engaging in discussions on the web-based forum in order to achieve a better level of knowledge and understanding through the process of peer learning.

2nd week of study – A lecturer-supplied tutorial providing hands-on operational instructions was displayed on the multimedia laboratory's projector. The students were then required to watch the tutorial, separately, on the lab-based learning. A set of questions were asked by a number of students as to whether constituent parts were available at the institute workshop's store. There was a consensus among a number of students that the online tutorial explained the main steps of the write code by HTML and highlighted the abilities they are recommended to gain. The video also aroused their interest in a real-life work environment. Additionally, in the lecturers' view, the students found the videos contained the steps and stages to write codes easily comprehensible, and using them was a suitable measure.

The students were tasked to print out the hands-on instructions and appraisal from the webpage. After completing the reading of the instructions, the students noted that the information supplied was organised and easily comprehensible and applicable.

3th week of study - under the oversight of lecturers, the students were required to complete online quiz appraisals on the website. The purpose of the online assessment was to gauge the knowledge and comprehension of the students about theory-based ideas. The lecturers clarified that the appraisal's purpose was to promote the learning perceptions of the students and introduce fresh competencies connected with a real-life situation, as well as assist them in transitioning to the fresh experience. The students had access to the learning materials online and to internet search engines. Therefore, they had the opportunity to show their skill in utilising learning materials available on the internet to solve practical problematic issues.

Therefore, this appraisal helped the students to acquire better thinking skills and more creative problem-solving abilities.

Case Study 2: Introduction to cascading style sheets (CSS) (Lectures 4-6)

4th week of study - Once the students had a good understanding in HTML, the lecturer introduced the CSS to add styling. This part of the course showed them how to improve the look of web pages by adding CSS to enhance them. The lab tutors helped students by introducing the practical work that matched with their current fundamental knowledge available on the website. The LBL module included the learning outline and the objectives for the case study. Then, collaborative work between students and the lab tutors was carried out to clarify the goals and learning requirements. The students followed the online lecture (containing hyperlink, picture, and videos) regarding the practical work on the HTML language during this laboratory session. Thhe subjects introduced in the website were as follows:

- What can I do with CSS?
- What is the difference between CSS and HTML?
- Which benefits will CSS give me?
- Specific CSS techniques and tricks.

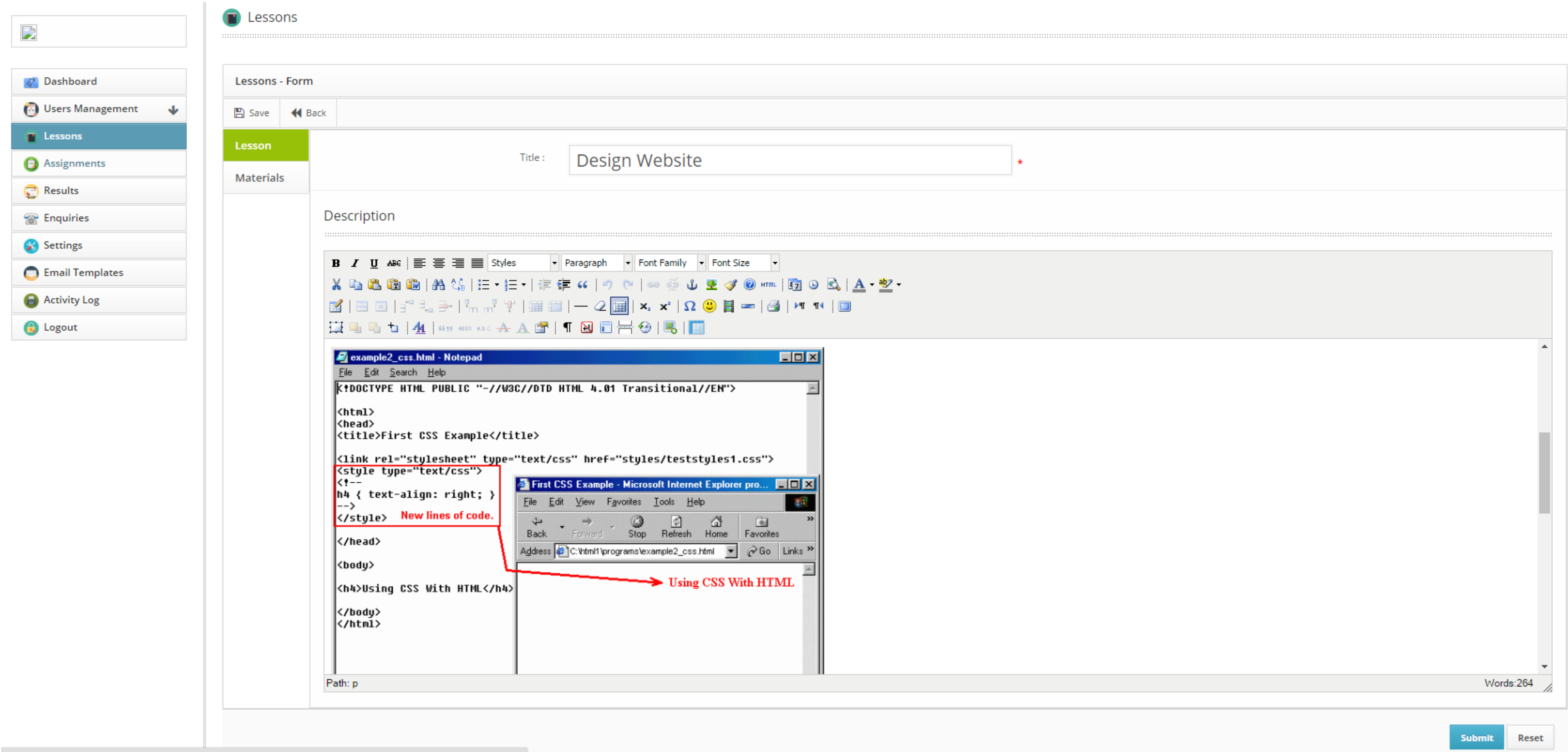
After the lab sessions, the lab tutors give the students printed papers related to the work to review the main code to write the program, and also gave students steps to help them to assimilate these materials during private time. The students were well-prepared to go to work in the lab; they were responsible and were able to work with more knowledge after the learning activities introduced in the module.

5th week of study - The lecturers delivered a lecture using a presentation to tell the students what they were expected to learn (the objectives), what knowledge they had to acquire (the contents), what teaching process would be used to developed their skills in that subject (the methodology), and how their academic performance would be measured and monitored (rating). In short, the lecture demonstrated the teaching material of the course. It also incorporated the programme of the subject as well as clear guidelines on what was asked of students in each activity and procedures to successfully comply.

In this stage a set of activities were carried out which included:

- Entering support material for students: emails, the course resources available, class notes, laboratory notes, exercise guidelines, standards of evidence and comments on the draft of the course.
- Provision of fundamental background for each lesson.
- Providing various practical applications that would help students to apply the practical work in the lab.
- A focus on student-centred learning through problem-solving activities and collaborative work.
- Using hyperlinks and video to present the practical work.
- Providing an enquiires tool for students to give them the opportunity to ask questions and clarify the set of topics introduced in the classroom.
- Delivery of virtual theoretical work plans.
- Provision of a set of styles of delivery (online material, online assessments and direct instruction by lecturer) suitable for several learning modes.

Figure 5-7: Example of virtual theoretical work plans



6th week of study - Then, in the lab-based learning at the institute, the lab tutors clarified the main software for the webpage design, which was Dreamweaver, before the hands-on application. The students received the lecturers' clarifications and watched pictorial representations as well as engaging in direct discussion with them. The lab tutors underlined to the students that the operational instructions were essential information that they must acquire. The direct guidelines from the lecturers, which depended on the use of technology, played a productive role in transferring the information to the students in a clear manner. The students' level of engagement in the discussion was restricted, with the majority of them just listening to what the lecturers said. Nonetheless, in order for their level of knowledge to be ascertained, they were asked to answer some questions on the software's working.

Under the oversight of lecturers, the students were then required to execute hands-on tasks separately. Evidently, the students were able to utilise the theory-based information and hands-on operational instructions in these tasks. They displayed self-motivation and skill to try and analytically investigate hands-on situations. Other things they did included solving of problems, listening to supervision from lecturers and generating fresh ideas, as well as engaging in the making of precise decisions.

Whilst monitoring the students, the lecturers had a hands-on operational checklist. Based on the findings, the students displayed an ability to transform the online theory-based information and operational guidelines into practice. The students were encouraged and were given an opportunity to acquire a better learning experience, as well as being groomed for the actual industrial work environment. A number of the students displayed an ability to analytically examine intricate hands-on situations and take adequate decisions.

There was a complaint from some students to the effect that they were not allowed sufficient time to finish the learning activities. It was recommended that the video of the hands-on operational instructions should be available for watching and discussion in the 6th week of study, in order for more time to be allowed for the completion of the hands-on appraisal in the 7th week.

Case Study 3: Hands-on practical work to design website

7th week of study - in this case study, each student had the opportunity to access the learning activities, including watching the tutorial video recommended by lab tutors, accessing the online materials, reading the steps, drawing the sitemap of each webpage and preparing a list of software needed to design the website, such as Dreamweaver, Visio and Photoshop. The students followed these stages to design the website on time;

the hands-on learning was implemented in the workshop at the institute. They were required to:

- Keep in flash video the phases of academic matters.
- Produce a table for comment in a database.
- Create a folder on the university's web server.
- Enter video and information links on the pages.
- Include helpful links on a number of pages.
- Assemble all pages with the home page for placement on the induction website.
- Produce documentation of the website.
- Try the website.

Learning through solving problems in the lab-based learning was discussed, and activities for learning as individuals or in groups were promoted.

A variety of assignments were involved in this stage, where the students were divided into sets by the lecturers for a collaborative learning process. The students had the opportunity to access a variety of knowledge sources and collaborate together in various practical activities. The lecturers played the role of facilitators in order to support the students whilst in the process of learning.

8th week of study - The lecturers illustrated the learning goals and outcomes in the multimedia laboratory. Additionally, through direct discussion, the students were able to interact socially with the online materials and gain the required knowledge. The students were then divided into teams; all groups were given the task of accessing a broad range of information sources from the first webpage of this week of study. There was a concern among a number of students regarding the time allocated for accomplishing this case study, particularly given the fact that a new approach to learning was involved. The lecturers assured the students that the information was arranged and constructed adequately and that they would be mentored and observed by them. Furthermore, the students were given the opportunity to accomplish a set of learning activities in their own time, in addition to assurance that direction and oversight from the lecturers were available for them whenever needed.

Below are a number of observations by researchers about the students' as well as lecturers' reactions to the use of the available information sources included in the webpage by the students:

Teamwork: As highlighted by the students, the teams contributed more effectively when they employed this facility. This is because they had the opportunity to obtain information about the problem of the project, engage dynamically in team huddles and arrange the learning activities collaboratively. Through this facility, they also had the opportunity to supply past experience examples and execute hands-on activities, as well as write insightful observations. The level of engagement by the students in this week of study was greater than their participation during the case study's 3rd week. This is due to the training and advice they were given on the employment of the discussion team, and the fact that they had become better acquainted with it. Furthermore, the students started to become more aware of the significant role played by group participation in the improvement of cognitive and soft abilities.

***Enquiries tool*:** A number of students went to the enquiries tool, concentrating on certain topics through interactive discussion. With the assistance of the exchange of ideas involved in this discussion, they could improve their thinking abilities. Whilst the students were engaged in a collaborative way of working and encouraged to access information, they participated in social communication and in the mutual sharing of information. Moreover, some questions were sent via email by a number of students during the periods of study when they were not supervised, and the lecturers replied to their emails.

Components: The Dreamweaver tool was selected by students to complete their hands-on activities under the oversight of the lecturers. They then visited the store of the institute and requested the constituent parts they needed. Therefore, their interactive skills and abilities to work as teams were enhanced.

Internet search engine: The students' problem-solving abilities were enhanced as they went online and searched through a variety of websites for highly useful information. They needed to identify the problem and seek possible solutions, as well as engage with their peers in a discussion of those solutions via the web-based forum.

Catalogues*:* The perusal of printed technical manuals helped the students enhance their technical abilities. They accessed a variety of manuals, in which well-defined and well-structured content is supplied to assist with the discovery of solutions to set assignments.

***Learning activities guidelines*:** On the pertinent webpage, a integrated copy was provided to explain the guidelines for testing and assembling the fluorescent light fittings. As indicated by the students, the instructions were conspicuous and easily comprehensible, and assisted them in the finalisation of the hands-on activities.

Video: The groups of students received pertinent information through a fluorescent light fitting example from the lab tutors. A number of students noted observations whilst watching the video, which they later utilised to assist them in identifying solutions to the hands-on activities.

HTML elements exercise: the students were given the task of identifying some tags relevant to HTML elements. As perceived by the lecturers, the students were encouraged by this exercise to collect pertinent information and work collaboratively in groups with the purpose of identifying successful solutions. They believed that this exercise assisted in the improvement of the necessary cognitive and soft skills of the students through the boosting of their personal relationships. Additionally, as observed by the lecturers, this exercise enabled the students to better analytically investigate real-life situations and suggest innovative ideas.

9th week of study – In the workshop at the institute, all groups of students showed the lecturers their hands-on activities. Enquiries were made by the lecturers, who also checked the level of understanding shown by the leaners against the learning results of the case study. As perceived by the lecturers, the students developed a greater understanding of the learning process and a greater level of familiarity with the learning possibilities available. This was observed through a number of aspects, including their interaction with the group, their preparation for an operational mechanism to assemble the fittings of fluorescent light and test it, and their efforts to solve problematic issues.

- For the majority of students, interaction with technology, such as internet browsing, was useful in seeking appropriate technical answers. This novel approach to Computer Science learning was endorsed by the lecturers, as it enabled the students to acquire new skills that a modern university needs.

10th week of study – The practice work and exercises were accessed by students in the LBL module, and there were some exercises that needed to be carried out and solved to prepare for the lab. The lecturers divided the students into groups. They used mobiles to work on the multiple-choice questions available on the website, which were determined individually. At this stage each student worked on developing a response from their own knowledge and beliefs. From the multiple-choice options, each student reasoned about the correct choice. Each individual member of the group expressed an opinion to the rest of the group in order to end up with the right option. This allowed the students to exchange their points of view and build together a suitable solution.

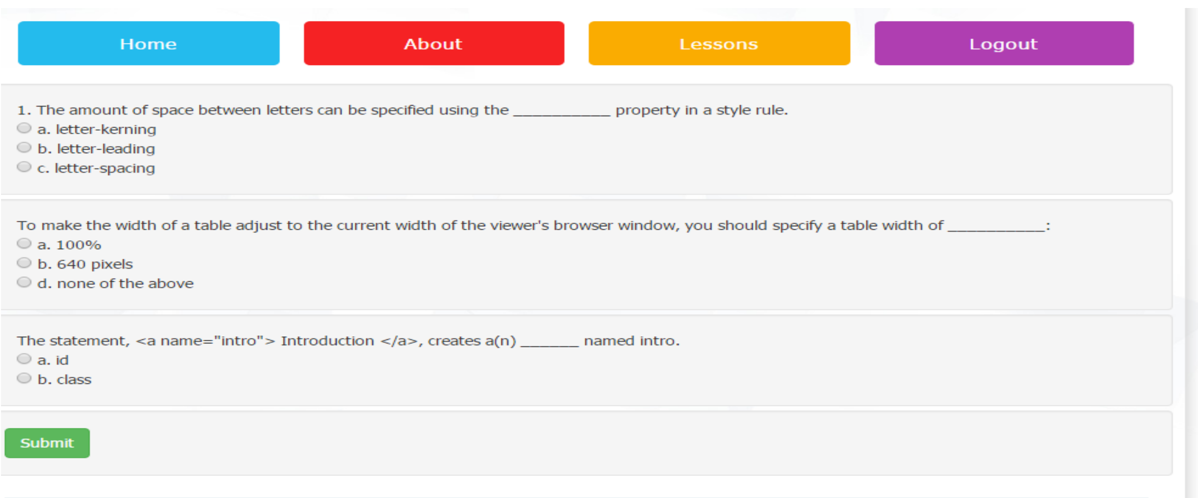


Figure 5-8: Exercises needing to be carried out and solved to prepare for the lab

The students had permission to access and answer three groups of questions on the internet in the multimedia laboratory. The case study's web-based learning materials were made accessible to the students. The answers by the students were automatically stored; the lecturers provided straightforward and clear oral feedback on the quality of their answers in this constructive appraisal. This helpfully allowed the lecturers to better understand the students' level of comprehension during the SBL programme at a time when modifications could be introduced to help the students attain the objectives of learning based on set benchmarks within a certain period of time. There was agreement among the lecturers that the students' levels of learning related to the Assure model and the lab skills model should be examined through the appraisal. A number of students found the questions difficult and were pleased to be allowed to access different information sources. Evidently, the students gained various cognitive and soft abilities. Nonetheless, the lecturers thought it was important to include these questions in the comprehensive appraisal as this could provide the students with a sense of learning progress and better encourage them when getting certain feedback related to the results of the case studies.

After the case studies, the students had to be able to:

- Apply and analyse in depth, with good understanding, the practical work needed during the lab sessions.
- Feel self-confident in their ability to implement the learning activities.
- Show various thinking abilities in team discussion to create collaborative work sessions according to the needs of the semester.
- Gather specific materials related to the design of a webpage using HTML languages from different sources.
- Understand the main steps to create a website, such as HTML links, images, header, and paragraphs.
- Understand the layout of the webpage: header, content, sidebar and footer.
- Code and design a website in easy stages.
- Create a CSS style sheet.
- Create a responsive design site.
- Use the Photoshop programme to create the background image for the website.
- Create the complete website.
- Create a web page using HTML elements.
- Apply CSS (style sheet rules) to parts of a web page, for altering display and behaviour able to program interactive JavaScript in a web page.

The design of the learning content of the LBL module was based on the Assure model and the lab skills model. In these case studies, the layout of learning content was intended to facilitate the progress of three types of skills among students, as illustrated in the lab skills model and Assure model (see section on pedagogical context in this chapter, which were fundamental knowledge, soft skills and hard skills. The learning levels of fundamental knowledge (cognitive skills) (FK), soft skills (ST) and hard skills (HS) adopted in the production of the learning material content, are demonstrated in the table in Appendix C.

The two dimensions probed by the two-dimension model, related to cognitive skills and lab skills (soft skills and hard skills). are the levels of learning and the type of knowledge. There are six levels of learning (ST-QE6) involved in the first dimension and utilised in the content produced for students based on Assure model levels (for more detail see Othman et al. (2014). Additionally, to nurture cognitive skills, knowledge was organised in such a way as to ensure students are better able to obtain information, and better able to read, remember and apply.

The type of skills learnt as part of the lab skills model, which represented the two-dimension model's soft skills and hard skills, involved six aspects, as follows:

Social networking: Social networking between programmers is very important on several fronts, because it allows students to communicate with programmers who have experience of advising students about how to use new technologies.

Teamwork and problem solving: Students must work on their software projects with other programmers, and should seek either to take the lead, in the best scenario, or at least to gain experience.

Software competitions (online quiz): Students' participation in programming competitions via the internet helps them to cope with more complicated software solutions whilst, of course, creating a competitive atmosphere between themselves and lab tutors.

Technical (core) skills: The Computer Science students transfer their knowledge into practice using mathematical and programming language skills.

Technical and academic akills: The students establish core competencies through theoretical modules, and these are converted into practical competencies through the practical modules in LBL.

Specific task-related skills: These are, in fact, entirely linked to the skills previously used in SBL, and the students need to feel that these skills can be characterized and mastered. Proficiency in such skills can be analysed by giving the student a specific task related to a skill mastered during lab sessions.

In relation to the soft skills, the levels of learning adopted in the production of the content for students and the attitude nurtured are probed in these models. The six levels of learning (ST to QE6) regarding the prepared materials, evaluation of the content and the response to it, were included in the layout of the learning content.

The nurturing of the capabilities of obtaining and discovering information, positive engagement, listening to directions and discussion of methods of work with others should be coupled with the nurturing of social skills as well. It is intended that this case study should nurture skills of communication, given that opportunity is provided to students to acquire information and engage in communication with others. They also have the opportunity to engage in group discussion and make written submissions.

The extent to which students are able to explain HTML aspects was gauged through an appraisal conducted online. An amelioration of cognitive skills (OR1) and the abilities to listen and read can be achieved if the students memorise the data and the information they gain is related to facts.

Actual information is provided by the lecturers to the students. The ability of students to obtain and manage fresh knowledge (soft skills, SET) is the focus of the new approach that is being created. It is then the duty of the students to provide, by using outside information sources, an explanation for website design (hard skills, TS).

The students are then required to do two tasks: elucidate the key phases through which the website design is produced, and explicate the modus operandi. It is necessary for the students to grasp the operational rules and techniques within an organised framework in order to achieve better cognitive skills through the acquisition of fresh concept-based information (TA). In relation to hard skills, the students play a dynamic participatory role in the designation of operational goals (STR). In the new approach which is being produced, the focus is placed on the ability of the students to manage knowledge by playing a dynamic participatory role in setting operational guidelines. At the end, the assignments are done by the students implementing the guidelines (STR).

- The students are monitored by the lecturers who assess the extent to which they are able to implement the hands-on guidelines provided. Assessed also by the lecturers are the students' abilities to draw the needed website map (OAN4) and manage the operational processes (OS5), as well as execute the assembly work from the hands-on operational guidelines supplied (OU2).

- The students are asked to arrange for constituent parts involved in the construction of each phase of website design. The information must be prepared and analytically examined by the students (OR1). The assessable performance enables the students to acquire concept-based knowledge, given that they develop better abilities to read and think, and comprehend in which ways problematic issues can be resolved. Ways in which the pin configuration of information is solved should then be considered and expressed by the students (OAN4). In the new approach which is being created, the focus is placed on the students' ability to handle information and establish the ways in which problems can be resolved. Through the use of an outside information source, the students then get the constituent parts fully prepared (TPS).

- The fact that the students need to add the specifications of the website map and prepare the constituent parts in order for all webpages' content to be wired up, requires that they possess organised and structured information (TS). In relation to soft skills, the students should display creativity by adding to and enhancing the new knowledge produced (TA). In relation to the hard skills, the practical job is constructed by the students who also perform other actions independently without any help, relying on their previous information and experience, including the use of apparatuses and constituent parts, as well as the operation of machines (TS).

- With their pre-knowledge, the students are expected to be able to get the separate pages integrated (OR1). The students should, therefore, employ the information they possess to achieve a strategic and systematic presentation of aspects in a certain manner. It is necessary that the students, relying on their pre-experience without outside instructions (soft skills), think creatively and employ fresh ideas when operating logic gates and resolving any problematic issues (TPS) and build and amalgamate constituent parts in the assembly process.

- The results should be justified by the students who are also expected to produce a new website, based on data gathered from virtual sources and from hands-on applications (STR). Additionally, the students are expected to display an ability to use different skills in real-life applications and help achieve better hands-on operational methods (SET). Lastly, in the appraisal, the ability of the students to create new websites without guidelines is assessed (OS5).

The way the hands-on appraisal was organised was evidently aimed at nurturing the cognitive, soft and hard skills included in the lab skills model. The purpose is to transform the soft and cognitive skills from ability to learn through face-to-face and virtual methods to hard skills, which are abilities to produce actual hands-on work. The arrangement was that the students would be given an opportunity to utilise technology and communication channels for mutual interaction and then engage in various hands-on and creative learning exercises and evaluations, using cultural, social, emotional and psychological factors. Additionally, one goal of the assessment being designed in this way was to establish to what extent the students are capable of recognising and explicating web design as well as illustrating the key stages in which the development of the content is produced and its operational procedures.

This is in addition to implementing the hands-on operation guidelines provided, creating a CSS style sheet, analytically examining the website, using the Photoshop programme to create the background image for the website, creating a responsive design site and applying CSS (style sheet rules) to parts of a web page for altering display and behaviour able to program interactive JavaScript in a web page. The appraisal was thus arranged and constructed in such a way that would enable both learning levels, lower and higher, to be used in relation to the cognitive and soft as well as hard skills.

Once the hands-on appraisal had been completed, the students were given a new required task, which was to undertake an online and theoretical appraisal exercise in the 10th week of study (Figure 5.9 shows the online evaluation). The expectation was that the students would convert the knowledge acquired into long-term memory, whilst the cognitive psychology lower levels were transformed into higher levels of learning (Anderson, 2008). The figure displays the skills level in each case study. The graph indicates that the students' skills improved in the third case study (cognitive learning levels (FK), soft skills (ST) and hard skills (HS)) as defined in the lab skills model and Assure model.

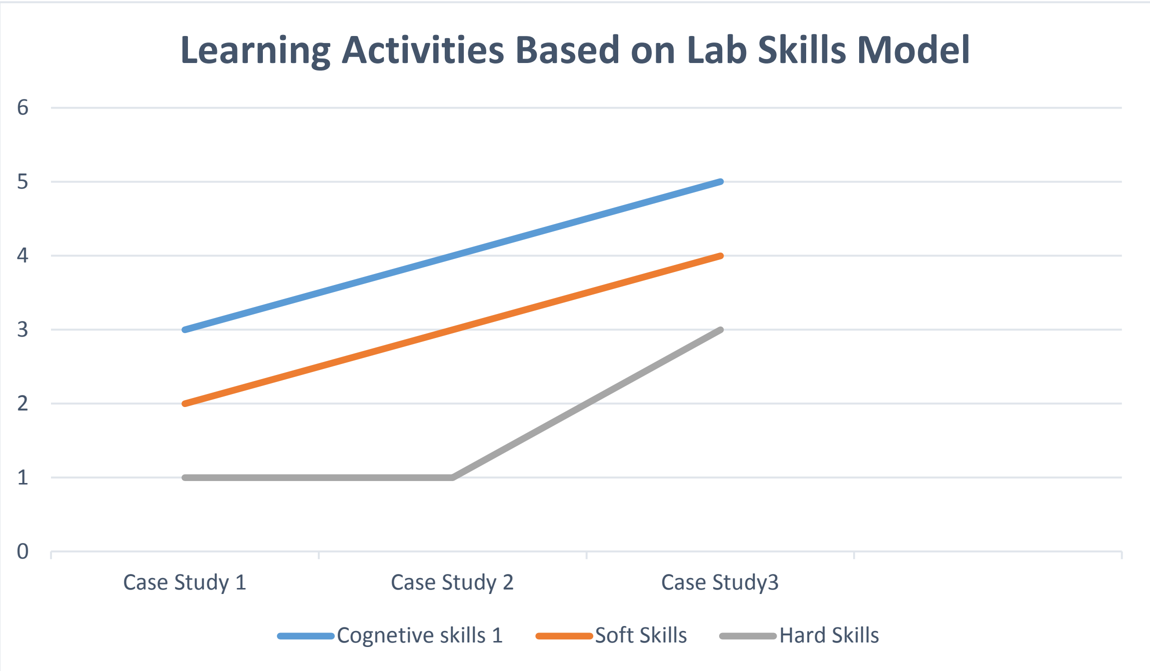


Figure 5-9: Learning activities based on lab skills model

As suggested by Knight and Yorke (2004), metacognitive skills can be employed by students in work assignments and thus they should be allowed, through the appraisal, to develop metacognitive abilities and act well when in actual situations of work. What was intended was to investigate the thinking abilities of the students, recommend improvements, and draft the learnt skills for use in real-world situations.

Summaries of the case studies introduced in the pilot study

Case study 1 presented the theoretic subjects (fundamental knowledge) for a set of lab skills. It delivered prepared materials for Computer Science students before they went to the lab and learnt basic HTML coding, and how to code it. The students logged on to their own profile to get online materials through training from the lecturer and lab tutor in the lab-based learning.

Case study 2 included soft and hard skills for studying the HTML elements and the design of a simple website by Dreamweaver software. The aim was to develop students' soft skills, including communication skills and decision making, and improve the look of the web pages by adding CSS and the development of website images by Photoshop software in a structured manner.

Case study 3 presented feasible collaborative learning in groups that aimed to develop and design a website. It contributed practical competencies on the development and design of a website in an integrated LBL module. It aimed to develop problem-solving abilities, decision making in teams and discussion in a real work environment, as well as to encourage students learning activities.

5.4 Conclusion

This chapter has presented the main phases involved in designing an integrated e-learning package that can be employed to support the learning process at Omar Al-Mukhtar University. The proposed system is named the ”LBL module system”. This study has discussed how usable and accessible web applications can be designed through the implementation of the set of techniques and procedures included under the methodological framework known as user-centred design. The purpose of the system was to prepare the students for practical lab experience by testing their fundamental knowledge of any programming language. The researcher has also presented the pilot implementation of the LBL module. It aimed to ensure that the Computer Science students were prepared for any necessary activities that could be of benefit for the practical work in the lab. Moreover, the chapter has presented an explanation of the three case studies that were introduced in the LBL module, including the different learning styles and learning activities included in the teaching plan and the improvement of students soft skills, hard skills and cognitive skills.

The presented module LBL module is expected to make an effective contribution to the enhancement of the Computer Science course because it asks the lab tutors and students to identify and create practical work in the LBL environment in a collaborative manner.

Chapter 6: A variant of TAM for Blended Learning

6.1 Introduction

This chapter will discuss how the models of accepting technology which are utilised in the forecasting and comprehension of individuals' acceptance behaviour have progressed over time. The discussion will focus on three key models, which are the Unified Theory of Acceptance and Use of Technology and the Theory of Planned Behaviour and Technology Acceptance Model, as well as the Theory of Reasoned Action. Throughout their history, these models of technology acceptance have undergone development and evolution as a result of thorough and robust authentications and contributions. Although this research chiefly focuses on the Technology Acceptance Model (TAM), the aspect of the progress of acceptance of technology has been included, given the fact that they are both interrelated, and to illustrate the TAM progression. Finally, this study has provided some of hypotheses and designed a survey for the evaluation method which is the Technology Acceptance Model (TAM) it will introduce in this chapter.

6.2 Theory of Reasoned Action (TRA)

One of the primary models created to illustrate the acceptance of technology in the area of Psychology is the Theory of Reasoned Action (Ajzen & Fishbein, 1980), which was created with the purpose of forecasting and explicating the volitional manner in which people behave and comprehending their psychological determining factors. In this theory, the presupposition is that individuals are naturally rational and behave according to available information, and that behaviour-related intentions of individuals are the key determining factor in their actions (Ajzen & Fishbein, 1980). Based on the theory, intentions play a key role in the forecasting of how an individual acts and it is through his/her intention that any external impact in relation to behaviour will be predicted (Abran, Khelifi, Suryn, & Seffah, 2003b; Al-Aulamie, 2013).

Based on TRA (Fishbein & Ajzen, 1975 cited in (Yousafzai, Pallister, & Foxall, 2003)), personal influence and social influence are two determining factors in the intentions of individuals. Individual influence involves behaviour which is related to the negative and positive assessments of an individual's behaviour (Ajzen, 1985). Social influence involves a subjective norm which can be described as the extent of an individual's perception that people essential to them believe that they should not or should achieve a certain attitude (Ajzen, 1985). The variation in the weight of these two determining factors depends on both the individual doing the behaviour and his/her examined intentions (see Figure 6.1). Based on TRA, it is through the prominent beliefs of an individual about a certain behaviour that attitude is produced. It is also through these prominent beliefs that the behaviour of a person is linked with the result of his or her doing (Abran et al., 2003b; Al-Aulamie, 2013) (as illustrated in Figure 6.1).

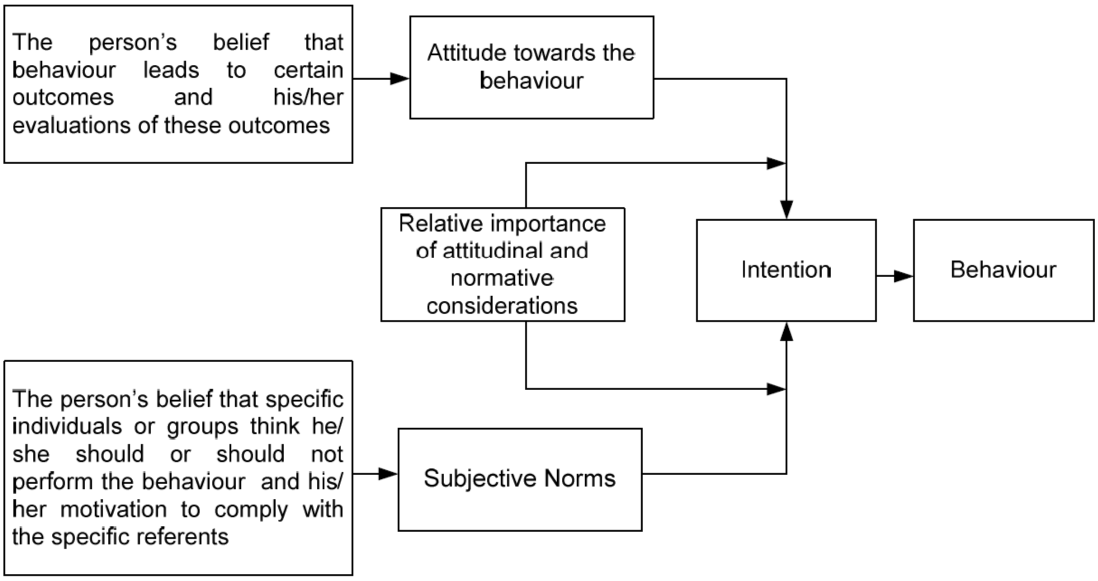


Figure 6-1: Theory of Reasoned Action (Ajzen & Fishbein, 1980)

Additionally, the impact of attitude towards behaviour is decided by the individual's assessment of the result. It is therefore possible to use the prominent beliefs and the evaluation of the situation result to assess the attitude of a person. Furthermore, in the subjective norm, which serves as a function of belief, an individual recognises the social type of pressure from their group to do the relevant behaviour (Al-Aulamie, 2013).

6.3 The Theory of Reasoned Action's limitations

TRA involves two key limitations. The first limitation is that this theory is disadvantaged by what is known as factors correspondence (Ajzen, 1985). This is understood as foreseeing that the behaviour and attitude as well as the intention of a person are necessarily connected in terms of action and context as well as time (Wright, 1998). The second limitation is that the application of this theory is exclusive to volitional behaviour that has previously been deliberated in the individual's psyche (Yousafzai, Foxall, & Pallister, 2010). TRA is consequently unable to elucidate any behaviour involving decisions that are irrational or skills that are complex, or social support (Wright, 1998).

6.4 Theory of Planned Behaviour (TPB)

In order to tackle the limitations of the TRA, Ajzen (1985) established the Theory of Planned Behaviour as a continuation of it. Perceived behavioural control, initiated by the TPB, explains people's behaviour in situations of non-volitional control. White and Hamilton (2008) define perceived behavioural control as the degree of control that a person believes he/she has in relation to doing a behaviour (Hamilton & White, 2008).

According to Ajzen (1991), perceived behavioural control has, in certain situations, a greater influence on behaviour, as illustrated by the dotted line in Figure 6.2 However, in the foreseeing of a person's behaviour, both perceived behavioural control and intention play a significant role. As stated by Gist and Mitchell (1992), TCP suggests that the extent to which an individual is prepared to devote to the degree of control, for instance, in skills and information as well as in knowledge, is a deciding factor in the success of an individual's behaviour (Al-Aulamie, 2013) (as illustrated in Figure 6.2).

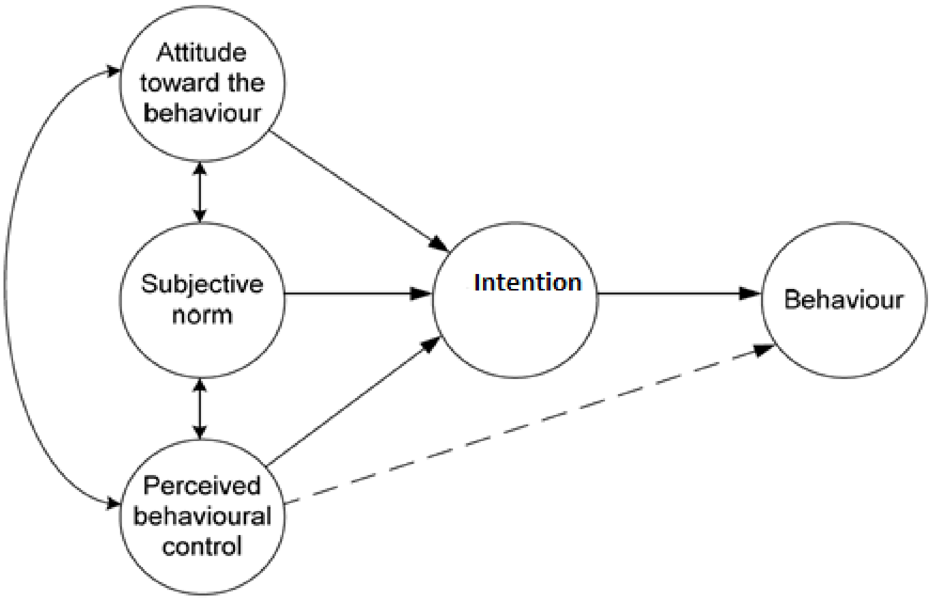


Figure 6-2: Theory of Planned Behaviour (Aizen, 1991)

6.5 The Theory of Planned Behaviour's limitations

The purpose of the development of the TPB was to tackle the limitation of volitional control in the Theory of Reasoned Action; however, the TPB itself has, with the passage of time, been the target of considerable criticism. First, it is the presupposition of the TRA theory as well as the TPB theory that an incentive is required if a person is to do a behaviour. According to Taylor and Todd (1995), doing a behaviour might be inhibited due to the existence of external hurdles, for instance price, which means that there is a possibility of this assumption being problematic for the consumer adoption behaviour (Taylor & Todd, 1995). Second, as explained by Ajzen (1991), the three variables proposed - perceived behavioural control, subjective norms and attitude - are not the only determining factors of intention. Additionally, TRA and TPB accounted for just 40% of the variation seen in people's behaviour, as demonstrated by experiment-based research studies.

Also, as stated by Taylor and Todd (1995) and Abran, Khelifi, Suryn and Seffah (2003a), the fact that TPB incorporates all non-controllable variables which influence the behaviour of a person into a single variable has triggered criticism.

6.6 The Technology Acceptance Model (TAM)

For the aim of foreseeing the acceptance and utilisation of information technology by a person, Davis (1986, 1989) suggested the TAM model as a continuation of the TRA (as illustrated in Figure 6.3).

A person's behavioural intention to utilise a technology is, based on TAM, governed by two beliefs. The first, Perceived Usefulness (PU), is described as the level of an individual's belief that his/her job performance could be improved with the employment of a certain system; and the second, Perceived Ease of Use (PEOU), is described as the level of an individual's belief that the utilisation of a certain system would involve no labour (Abran et al., 2003b; Davis et al., 1989).

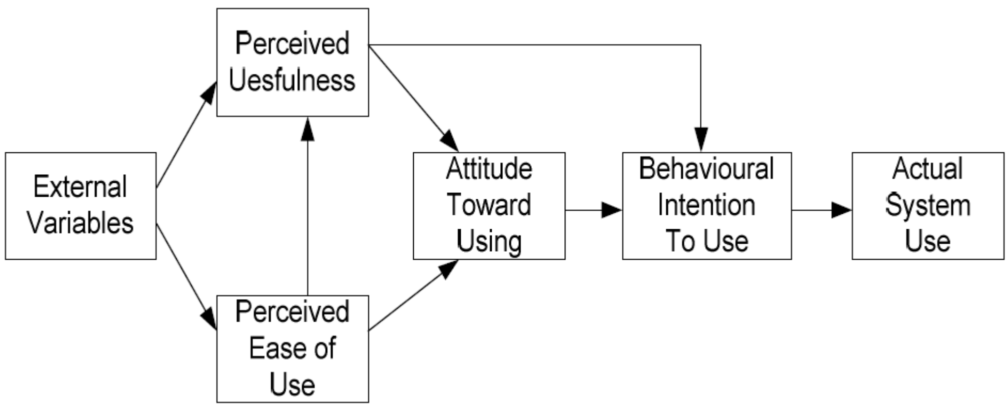


Figure 6-3: The Technology Acceptance Model (TAM)

During the past twenty years, there has been experiment-based authentication and support of the Technology Acceptance Model (for instance, Taylor & Todd, 1995; Al-Aulamie, 2013; Liu, Chen, Sun, Wible, & Kuo, 2010; Mathieson, 1991; Venkatesh, 2000). A total of 40% of the variation in the intention of a person can be explained, in a steady manner, by TAM, according to Venkatesh and Bala (2008).

The properties of the system which have an impact on a person's acceptance are also addressed by TAM (Venkatesh & Bala, 2008). The TAM original model is presented in Figure 6.3. Nevertheless, the following reasons are given by Davis et al. (1989) for the omission of attitude from the final model:

1. When considering connections involving behavioural intention, it is found that its connection with PU is of greater importance than its connection with attitude.
2. When considering the connection between PEOU and behavioural intention, it is found that attitude does not possess the ability to completely mediate this connection. External variables, for example system design attributes and computer self-efficacy, have an impact on the behavioural intention of a person, via both PU as well as PEOU, according to Davis and Venkatesh (1996).

There is a variation between different studies as to how many items are used in the measurement of PU and PEOU. In several studies, experiment-based testing and authentication have been applied to most measures of TAM's constructs. For instance, the Write One, a word processing programme, was used by Davis et al. (1989) to collect information at Michigan Business School from 107 MBA students, for the purpose of testing TAM. The results of the four measures that were employed by the study for each of the constructs (for instance, PU and PEOU), revealed a high degree of both discriminate and merging validity for each measure that was chosen.

Additionally, the psychometric characteristics of TAM's scales were concentrated upon by Adam et al. (1992). For the purpose of examining the validity of PEOU and PU in two studies regarding various technologies, Davis's work (1989) was reproduced by Adam and colleagues. Voice Mail and Electronic Mail were employed in the first of these studies, with spreadsheets and word processing as well as graphics being used in the second (Adams, Nelson, & Todd, 1992). The dependability and validity of the PEOU and PU measurements, with excellent properties that were both discriminate and merging, were verified by both of these studies. Additionally, the acceptable psychometric property of the usefulness construct of TAM was demonstrated by Chin and Todd (1995) (Chin & Todd, 1995).

The authentication of the causal connections between the constructs of TA and any external variables which have an impact on the PEOU and the PU is the subject of the second part of this phase of authentication. TAM’s constructs are causally interlinked through four factors.

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

Testing has been applied to the majority of these causal connections, and with the exception of the causal connection between PEOU and behavioural intention, the revealed results have agreed with the original model. Given the inconsistency of the connection, additional examination is needed (Venkatesh & Morris, 2000; Saade & Bahli, 2005).

6.7 Technology Acceptance Model Extension

Either integration of the model with other data system models or identification of external variables which assist the learning procedure were the means by which the second group extended TAM. A significant component in the determination of people’s behaviour is incentive, which is a necessary factor if a person is to do a specific behaviour (Tian, Liu, Lin, & Jin, 2010). It is possible to categorise incentive into two types: intrinsic and extrinsic. Henderlong and Lepper (2002) construed intrinsic motivation as engaging in action because it achieves inner enjoyment; meanwhile, Saade et al. (2009) construed extrinsic motivation as the engagement in an action because it results in being rewarded. The emphasis of TAM extensions in literature has been either on the intrinsic or extrinsic variables (Henderlong & Lepper, 2002; Saadé, Nebebe & Mak, 2009). In order to comprehend the behavioural intention of students, the first study concentrated on the extrinsic variables. An integrated theoretical structure for university students in South Korea, to foresee their behavioural intention, was suggested by Park (2009) and the three variables of computer self-efficacy, accessibility and subjective norm were established by the author. Study hypotheses determined the connections between the three variables - PU, PEOU and behavioural intention - and TAM constructs (Park, 2009). Computer self-efficacy emerged from the results as the most reliable forecaster of behavioural intention. Since PU and PEOU were insignificant regarding behavioural intention, the study yielded abnormal outcomes. The fact that attitude was mediating the connections between the three variables is a possible reason for this. The Use of Technology and Unified Theory of Acceptance (UTAUT), with some adjustments, was utilised by Jong (2009), as a means of testing the acceptance of a learning management system (LMS) by students in Taiwan (Jong, 2009). Venkatesh et al. (2003) created the UTAUT on the basis of the TAM and attitude, self-efficacy and anxiety were included in an adjustment to UTAUT by the authors. Since attitude was the most marked determining factor of behavioural intention, the results were inconsistent with TAM. Additionally, just 40% of the variation in students’ behavioural intention was accounted for by the model.

In Saudi Arabia, a study was initiated by Al-Harbi (2011) into how students in higher education accepted e-learning systems. This was done as a result of the growing focus on Information Technology in the educational establishments in that country. PEOU and PU were discovered to be consistent with the original TAM model by the results of the research. Only 43% of the variation in the behavioural intention of the Saudi students was explained by the model created. This remains low, in comparison with the current models in literature (Al-Harbi, 2011).

6.8 Unified Theory of Acceptance and Use of Technology

The development of UTAUT illustrated in the figure below followed the examination of eight rival theories and technology acceptance models (Venkatesh & Zhang, 2010). UTAUT considered the following rival theories: Technology Acceptance Model (TAM), Technology Acceptance Model 2 (TAM2), Model of PC Utilisation (MPCU), Diffusion of Innovation Theory, Theory of Planned Behaviour (TPB), Social Cognitive Theory (SCT), the Theory of Reasoned Action (TRA), and Combined Technology Acceptance Model and Theory of Planned Behaviour (Alkharang, 2014; Namuleme, 2013; Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh & Zhang, 2010).

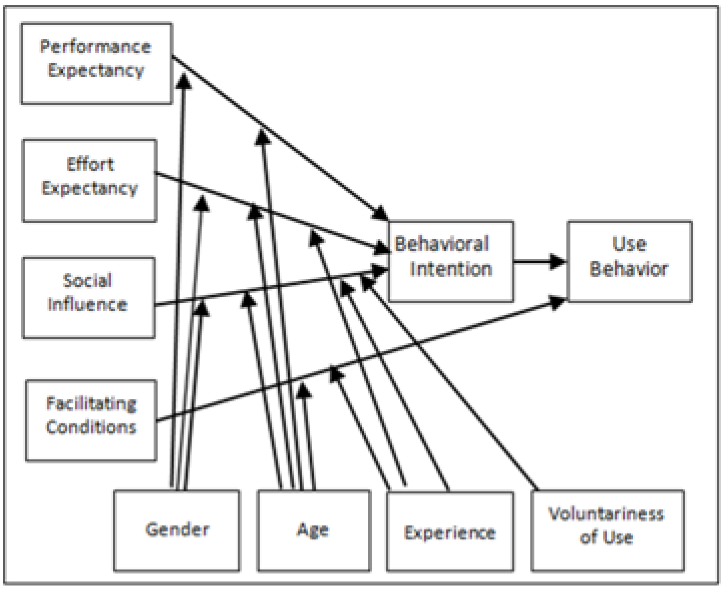


Figure 6-4: UTAUT Model (Venkatesh et al., 2003)

Acceptance of technology is impacted by the following four main components (Venkatesh et al., 2003): social influence, effort expectancy, performance expectancy and facilitating conditions. Therefore, the variables of gender, voluntariness and age of use are included in the moderating parameters that utilise behaviour or lead to intention of behaviour. Performance expectancy is described as the level of a person's belief that he/she will be able to realise gains in doing their jobs with the employment of the system. Additionally, effort expectancy was described as 'how effortless it is to employ the system', whilst social influence was described as 'the level of a person's perception of how important it is, in the eye of others, for him or her to employ the new system'. Lastly, facilitating conditions were described as 'the level of a person's belief that there is organisational as well as technical infrastructure with the purpose of assisting system employment'.

6.9 The Research Hypotheses and Developed Model

The proposition and establishment of a conceptual model for the application of e-learning is the purpose of this section. Variables from two sources are examined by the conceptual model suggested; the first source is an empirical research study conducted in Libya with the purpose of probing the significant factors that impact upon the introduction of use of technology in education establishments in the country. The second source is the TAM-LBL model. The utilisation of the conceptual model which is proposed will be as a strategy for the gathering of empirical information and for examination. Another use of the model will involve the framework of higher educational establishments in Libya to create an inclusive appraisal of the implementation of e-learning within these establishments. The key idea is to enable a consideration of the significant factors and impediments which might have an impact on the adoption of e-learning through the model. The TAM model's four links form the foundation on which the study has created its hypotheses. The ideas that enable students to participate in the e-learning system are discovered by analysing and testing the hypotheses on the basis of the UTAUT model and the TAM theory. For example, students will be more enthusiastic about using the e-learning system if they find it user-friendly, and consequently this will lead to an improved performance when they use the website. Therefore, the model is principally implemented through the variables listed below when Computer Science study uses the blended e-learning approach, thus explaining the meaning of the LBL module:

- **H1:** Satisfaction with the design of this website's interface has a direct positive impact on the system's PEOU.
- **H2:** Satisfaction with the design of this website's interface has a direct positive impact on the PU.
- **H3:** PU has a considerable impact on the stance towards using a certain system, which will assist in achieving improved performance in the Lab.
- **H4:** PEOU has a considerable impact on the stance towards using a certain system, which will assist in achieving improved performance in the Lab.

- **H5:** Attitude towards using the LBL module has a considerable impact on intention to use and re-use the system in the future.
- **H6:** Performance experience represents an external variable connected with the TAM model; it has a considerable influence on PEOU and it has a positive impact on attitude.
- **H7:** The impact of facility services on PE.

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

The two key constructs of the TAM model are PEOU and PU. There has previously been validation of the significance of these two variables (Davis, 1989; Venkatesh, 2000; Venkatesh & Bala, 2008). PU is described as the level of an individual's belief that his/her performance in their jobs would be improved with the employment of a certain system (Davis, 1989). PEOU is described as the level of an individual's belief that the utilisation of a certain system would involve no labour (Davis, 1989). The importance of the two components regarding behavioural intention in a number of varying Information Systems' domains is demonstrated by the literature that follows.

The significance of PU for the purchase intentions of customers in the e-commerce area was discovered by Liu et al. (2010). Furthermore, in the health domain, Lai and Li (2010) investigated the impact on the acceptance of systems of computer-assisted orthopaedic surgery in hospitals.

The important influence of PU and PEOU on the intentions of persons to utilise the system was one of the results of the research. Mohamed et al. (2011), in their examination of the adoption of e-health services in the United Kingdom and the United Arab Emirates, reached similar conclusions (Mohamed, Tawfik, Norton, & Al-Jumeily, 2011). Also, to evaluate the drivers of mobile office services, Tian et al. (2010) established the determining factors of PU and PEOU, in which case both components proved to be important regarding the behavioural intentions of users (Tian et al., 2010). In the area of the online environment, the determination of the behavioural intentions of students to utilise e-learning, PU has emerged as a key factor (for example, Liaw, 2002; Teo, Lee, Chai, & Wong, 2009; Van Raaij & Schepers, 2008). Also, the important links between PEOU, PU and behavioural intention have been underlined by several experiment-based studies (for example, Sánchez-Franco, Martínez-López, & Martín-Velicia, 2009; Tseng & Hsia, 2008). Nevertheless, in the e-learning analysis, a conflicting connection between PEOU and behavioural intention emerged (for example, Saadé et al., 2009; Abran et al., 2003b):

- **H4:** PEOU has a considerable impact on the stance towards using a certain system, which will assist in achieving improved performance in the Lab.

- **H5:** Attitude towards using LBL has a considerable impact on intention to use and re-use the system in the future.

6.9.2 Identifying the external variables

The principle aim of distinguishing external variables within research on acceptance of technology is to consider the distinctive setting of the research (Al-Aulamie, 2013). The potential variables that can have an impact on the acceptance of IT need to be understood. It is possible to expand the TAM model through the employment of these variables, which may also be used to focus on the research's distinctive attributes. It was within business organisations that the initial enhancements of TAM were undertaken; therefore, the external variables were chiefly concentrated on this domain. This study will examine three external variables on the basis of the TAM model, as well as the analytical aspect, as demonstrated in Chapter 7. For instance, according to Al-Ammari and Hamad (2009), a new variable that can have an impact on the utilisation of e-learning technology is the Power Distance, which is addressed to the fundamental problem of human inequality as a fixed solution. Variables like education level or system experience are included by other authors such as Burton-Jones and Hubona (2006), while Computer Self-Efficacy is included by others such as Hong, Thong and Wai-Man Wong (2002). This clear focus of this research is the assessment of the intended use of the LBL module in courses on Computer Science. These tools are used on a daily basis by a variety of students in their individual locations. According to Liu and Chen et al. (2010), it is possible for PEOU and PU to be affected by external factors. The LBL TAM model, as suggested in the following section, was used for this research, after examining each of the variants regarding the chosen model. The intended use by students in online community learning was foreseen by the TAM extension. The LBL module adjusted itself precisely in this interpretation to the e-learning community idea, since in the present-day teaching and learning method, the student himself or herself belongs to a community. Also, the understanding of community is widened by the presented implementation to a level further than the enlisted students themselves. The external variables in the research presented by Liu et al. (2010) consisted of interface design and course design, as well as past experience.

For this study, the following three variables were added by the author as an extension of TAM. They are classified as: online performance experience, facility quality, and LBL design.

Online performance experience

According to Venkatesh et al. (2003), the performance experience is identified as the level to which a person has used ICT in a previous learning experience which will assist them in achieving an improvement in task performance. This is because a more satisfying experience sometimes leads to a better learning performance in the future. This was included as an external factor because the TAM model did not take into account the user's experience, despite the fact that many studies have demonstrated the importance of this experience and its positive impact on behaviour and attitude. This is why Venkatesh et al. include this factor within their model.

In this research, the concept of employing e-learning systems is evaluated with regard to its advantages, including the saving of time, money and effort, as well as making contact with others easier, enhancing the standard of learning, and providing equal support to users to perform their duties (Al-Shafi et al., 2009; AlAwadhi & Morris, 2008). Past research studies on acceptance (Chang, Hwang, Hung, & Li, 2007; Taylor & Todd, 1995; Venkatesh & Davis, 2000; Venkatesh et al., 2003) have found that performance expectancy is a pronounced forecaster regarding the intention to utilise IT .

H6: Online performance experience represents an external variable connected with the TAM model; it has a considerable influence on PEOU and it has a positive influence on attitude.

Facility quality

Facility quality can be described as having facilitating conditions at a level to which a person holds the view that the existence of an administrative and technical framework is able to sustain the system (Venkatesh et al., 2003). In the UTAUT, the facilitating requirements consist of perceived behavioural control as well as compatibility, together with facilitating requirements from the TPB, TAM, MPCU, and IDT models (Taylor & Todd, 1995; Triandis, 1979; Venkatesh & Brown, 2001). It has been discovered by technology study researchers (for example, Moore & Benbasat, 1991; Chang et al., 2007; Taylor & Todd, 1995; Chau & Hu, 2002; Venkatesh & Speier, 1999) that there is a positive impact on the use of innovation caused by the construct of the facilitating requirements. Additionally, they discovered it to be an important forecaster of the usage of technology. On the other hand, they discovered that when the two constructs, effort expectancy and performance expectancy were utilised in the same model, then it did not foresee the intention to utilise IT (Alkharang, 2014).

Moreover, the literature reveals that the problems of demographic variables always impede the utilisation of technology (Belanger & Carter, 2006; Loges & Jung, 2001; Selwyn, 2004). For instance, it frequently occurs that senior persons are ranked as non-users of technology, due to age classification, so it becomes necessary for any strategy of e-learning to take into account how technology makes easier the needs of older people, to avoid them from being eliminated from the advantages which e-learning provides. With regard to the use of technology, it has been noticed that older persons need considerably more help and support (Venkatesh et al., 2003; Morris & Venkatesh, 2000; Thompson et al., 1991). The computer experiences and also the standard of education of a person can also influence the person's use of technology (Selwyn, 2004). Nevertheless, the experience of using computers will be of greater worth than the standard of education of the users, within the e-learning framework.

The ability to obtain the necessary resources needed to be understood, together with the acquisition of knowledge and also the required assistance for the use of e-learning systems, were used to assess the facility quality in the course of this research. The comprehensive technical assistance that is able to supply services like the ICT department and internet availability are considered part of FQ. The internet availability as provided by the ICT technical team is also referred to as facility quality in this research. In addition, the system's ease of use has an impact on this. In order to elucidate the facility of the system usage, the analyst suggests the hypothesis below:

H7: The impact of the facility services on PEOU.

LBL design

LBL design is described as an interface's structural shape where the features and instructions for use of an information system are provided (Cho, Cheng, & Hung, 2009).The means of communication between the system and the user is the interface. An online course has been developed by LBL. The web design is responsive and the single website is able to adjust itself to a screen of any size. Because of the necessity for the features of the user interface to be considered in the system's stage of development, the design of these features is critical (Saadé & Bahli, 2005).

According to Te'eni and Sani-Kuperberg (2005), the understanding of the users regarding user interface design can be of greater significance than functionality. Liu et al. (2009) claim that students can acquire their skills efficiently if they possess an interactive interface which is designed for e-learning systems. Disorientation and users' cognitive overload can be lessened by a well-designed interface (Liu, Liao, & Pratt, 2009; Te'eni & Sani-Kuperberg, 2005).

Disorientation is described as the inclination of a user to lose the sense of location they have at the time of employing the interface of the system (Saadé & Otrakji, 2007); meanwhile, cognitive overload is described as the level of mental labour that someone needs to discharge their various duties (Rose et al., 2009; Abran et al., 2003b).

According to the assumption by Cho et al. (2009), the design of a user interface will have a positive influence on PEOU and PU for a self-paced instrument of e-learning. The connection between PU and interface design was revealed by the findings to be insignificant because of the greater effect of functionality on PU. Nevertheless, there was a significant effect on PU when functionality was withdrawn. The design of the user interface was still significant regarding PEOU in both cases.

Moreover, if high-school students are to understand how to use the system easily then it is crucial for them to have a well-designed interface for online learning communities (Liu et al., 2010). However, if the significance of the user interface design regarding PEOU and PU with LMS's usage is to be verified, then additional examination is needed. Therefore, this study will include an investigation of whether the user interface is (or is not) crucial regarding students' understanding of PEOU and PU.

- **H1:** Satisfaction with the design of this website's interface has a direct positive impact on the system's PEOU.
- **H2:** Satisfaction with the design of this website's interface has a direct positive impact on PU.

6.10 The Developed Model

The research study generated an improved acceptance of technology model on the basis of wide-ranging reviews from literature on the subject of acceptance of technology. Seven variables are included in this model; these are facility quality, LBL design, performance expectancy, perceived attitude, PU, PEOU and behavioural intention. The measured variables were adopted from previous studies using the technology acceptance model and one factor was added that has not been mentioned in previous studies which was constructed by researcher (for more detail, see Appendix E1). Also, the measurement model of the study was performed to seven latent variables that were measured by 17 indicators in the proposed model. In the literature, sample size commonly runs at 200-400 participants; in this study, there were 203 student participants.

Furthermore, the suggested hypotheses determine the connections between the model's variables. Therefore, the relationships of the produced model were constructed on the basis of the suggested hypotheses (See Figure 6.5 below).

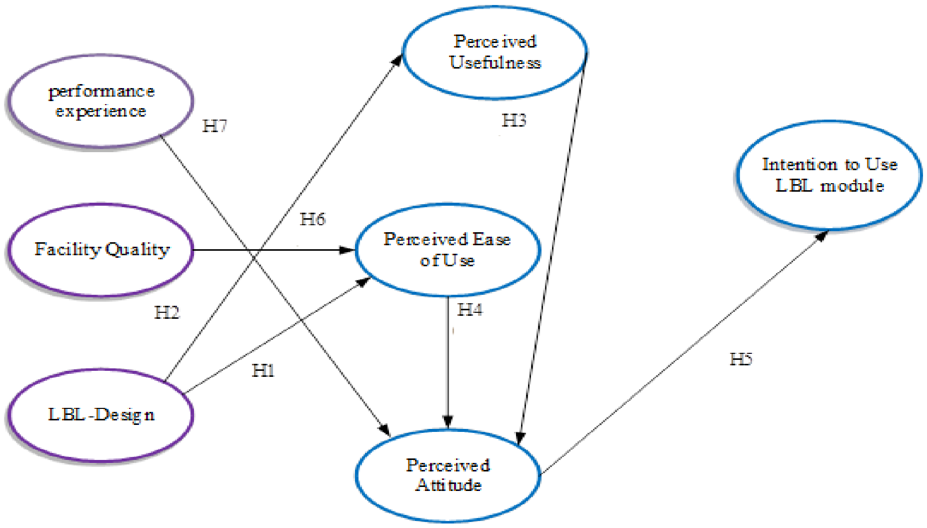


Figure 6-5: The developed LBL model based on TAM.

6.11 Conclusion

A comprehensive review of literature has been supplied in this chapter, which, in order to elucidate students' acceptance of e-learning systems, has focused on research studies that have utilised TAM. The literature review in this chapter has comprised two parts. The first part has provided a discussion of TAM work without any additional elaboration, while the second part has considered TAM work with an application of enhancement or adjustment to the model. The means of discerning the external variables and their potential significance, as presented in the sections covering the external variables and the research hypotheses, have also been expounded in this chapter. Seven variables comprised the analysis model (four TAM and three external), and together with their connections were determined and supported by the hypotheses which were proposed. A total of seven hypotheses, together with their justifications, were suggested by the research. The impediments with an impact on the success of e-learning needed to be discovered, analysed and solved in order to achieve a successful adoption of the e-learning stage. The examination and analysis of the elements affecting the implementation of e-learning in HEs in Libya is the purpose of the research study and, considering Libya as case study of a developing country, also to assist in the reduction of obstructions to online course utilisation. The next chapters of this study will therefore present and consider a number of elements that may affect the acceptance and implementation of e-learning generally, and particularly in Libya as a case study.

Chapter 7: Evaluation of Blended Learning Approach using the TAM Model

7.1 Introduction

The previous chapters have presented a full description of the research methods, discussed the methods of analysis used in this study, and explained the philosophical assumptions with regard to the data. Using the TAM model, this chapter presents discussions about the factors affecting the adoption of a quality e-learning system.

(1) Perceived usefulness and perceived ease of use are internal variables (Davis, 1989). The first factor affected the students' attitude toward the adoption of the LBL module in learning. The second factor, perceived ease of use, is also an internal variable (Davis, 1989) affecting students' attitude toward the adoption of the LBL module in learning.

(2) The LBL module design (learning process structure, flexibility, hypertext and hypermedia etc.) is an external variable linked to the TAM model.

(3) Performance experience is an external variable linked to the TAM model. It has a significant impact on perceived ease of use and a positive effect on attitude, which indicates that Computer Science students have soft skills experience, even if they are just interested in using IT-related skills (e.g., programming language, computer applications or social media), and those students will be more willing to learn in a blended learning environment.

(4) The facility quality factor has least effect on the perceived ease of use, which indicates that students may face some difficulties in using the system.

The chapter then presents the reliability of the study, followed by an explanation of the structural equation modelling and analysis of the measurement model. Finally, it discusses the main results of the study to answer the following research question:

Research question: What are the factors affecting the adoption of a quality e-learning system in the Computer Science course?

To answer this question, the researcher translated the research question into hypotheses, in order to determine the relationship between variables associated with those hypotheses.

7.2 Analysis of the Structural Model

In this study, AMOS was employed and a similar set of 'fit' indices was used to examine the structural model. To ensure that the proposed model fits the observed data, different adjustment indexes should be checked. To test the collected data for validity and reliability, and in order to test whether the experiential data conformed to the presumed model, Confirmatory Factor Analysis (CFA) was used. The CFA was undertaken using the AMOS application supported by Hu, Bentler and Hoyle (1995). In confirmatory factor analysis the researcher develop hypotheses about factors, and uses knowledge of theory, empirical research or both to test the hypotheses statistically. The aim of the measurement model is to test whether there is a good fit between the proposed measurement model and the data, in order to evaluate the overall soundness of the model. CFA relies on several statistics tests to determine the adequacy of model fit to data, (e.g., NFI, $\chi 2$ /df, CFI, RMSEA). Goodness of Fit (GoF) is used to examine how well a proposed model fits the real data.

To estimate the GoF result, a chi-square (X2) was tested, which indicated little difference between the expected and observed covariance matrices (probably >0.05). The non-normed fit index (NNFI), the incremental fit index (IFI) and RFI should be >0.9, while the root mean square error of approximation (RMSEA) should be less than 10. Based on this suggestion, the model has a good fit to the data. Consequently, the proposed model has a good fit with the statistics, based on valuation criteria such as Comparative Fit Index (CFI), which ranges from 0 to 1. An acceptable fit is indicated by a CFI value of 0.09 or greater (Suhr, 2008). Table 7.1 shows the values of the fit indices for the data used in the study. All statistical adjustment benefits are within acceptable ranges. After evaluating all measures, the proposed model was believed and accepted to be good to examine the parameter estimates. Therefore, these results cannot reject the hypotheses for the structure of the proposed model.

FIT MEASURES	VALUES	RECOMMENDED VALUE
χ^2	261.510 (p = .00)	*p* > .05
χ^2 */ DF*	2.3	< 3
RMSEA	.067	< 0.08
CFI	.93	> .90
TLI	.91	> .90
IFI	.93	> .90

Table 7.1: Goodness-of-fit measures for SEM

7.2.1 Quantitative analysis – path analysis

Analysis of the measurement model: The testing reliability was measured by reliability (suitable if Cronbach's > 0.70) and factor loadings (acceptable if FL >0.50). The testing reliability of the factors was presented to evaluate the internal reliability of the proposed model. Cronbach's alpha was selected to test the internal consistency of the provided data (Hinton et al., 2004). As illustrated in Table 7.2, the values of Cronbach's Alpha for each factor were greater than 0.70, which is recommended by Te'eni and Sani-Kuperberg (2005). This means that all data had discriminate validity, and either adequate or strong reliability. Generally, the values of the table fit the conditions in the section sufficiently for the benchmark to be consistent; consequently, the proposed model and all its factors, including the components of the technology acceptance model, had a very high reliability. As recommended by Hayton, Allen and Scarpello (2004), a factor loading value should be greater than 0.50 to be very significant. Overall, each factor loading was greater than 0.50 in CFA of the instructional equation model measurement. In this study, composite reliability (CR) was also tested to estimate internal consistency for the measurement model. The CR of the proposed model ranged from 0.52 to 0.85, as explained in the table. Bagozzi and Yi (1988) indicate that the composite reliability should be more than 0.60, and all of the data were greater than the benchmark of 0.60 (Bagozzi & Yi, 1988; Masa'deh, Shannak, & Maqableh, 2013). This indicated that all data had adequate reliability, and strong and discriminate validity, as shown in the table. The variance extracted was also above the benchmark of 0.50. The reliability for all factors, correlation between construct variables and standardized factor loadings are presented in Table 7.2 (Suhr, 2008).

Table 7.2: Convergent validity

Factors/ Constructs	*Variances extracted (VR)(>0.50)*	*Compute Composite(CR) >(0.60)*	*Indicators*	*Factor Loading>(0.50)*	*Latent variables*	*Correlation*	*Cronbach's alpha >(0.70)*
Easy	0.67	0.71	EU1	0.87	LBL <--> FQ	0.46	0.75
			EU2	0.70			
Usefulness	0.64	0.83	PU1	0.77	LBL <-->PER-	0.51	0.83
			PU2	0.87			
			PU3	0.76			
Attitude	0.56	0.79	BI1	0.78	FQ <--> PER	0.52	0.83
			BI2	0.74			
			BI3	0.74			
Intentio	0.65	0.83	ATT1	0.78			0.85

n			ATT2	0.78		
			ATT3	0.87		
Lab - skills	0.91	0.97	SO1	0.97		0.95
			SO2	0.94		
Facility Quality	0.79	0.83	NS1	0.90		0.88
			NS2	0.88		
LBL	0.61	0.73	PBC1	0.88		0.76
			PBC2	0.67		

Assessment of hypotheses: After checking the validity and reliability of the measurement model, the relationship between the constructs was tested. The hypotheses were evaluated by examining the path coefficients (ß) and levels of signification. The next step in the data analysis was to examine the significance and strength of hypothesized relationships in the research model, as well as the results of analysis of the structural model, including path coefficients, path significances and results of hypotheses for each hypothesis in Table 7.3.

Table 7.3 shows the resulting hypothesised path for the proposed research model. Overall, the seven hypotheses were supported by the data. The results showed that LBL significantly influenced 'usefulness' (β= 0.84, $P<0.001$), supporting hypothesis H2. 'Ease of use' was found to be significant in 'attitude' (β= 0.68, $P<0.001$), supporting hypothesis H4. Furthermore, 'intention' was significantly influenced by 'attitude' (β= 0.97, $P<0.001$), which supports hypothesis H 5. 'Attitude' was also significantly influenced by 'usefulness' (β=0.32, $P<0.001$). BI was found to be significantly influenced by ATT (β=0.97, $P<0.001$), which supports hypothesis H5.

As perceived by the researcher, the process of training was made more effective by the execution of the LBL module pilot, in which various styles of teaching and delivering materials were used. Both the optimistic results and limitations of the pilot were summarised by the researcher. In terms of positive outcomes, it was the understanding of the students that the delivery of the suggested module's case studies was intended to enable them to acquire better knowledge, understanding and abilities that the industry needs. The lecturers understood that all students must have previous information and experience before their participation in the learning activities associated with the case studies.

The purpose of the case studies' learning activities was to help the students gain better fundamental knowledge and improved soft and hard skills based on their levels of learning, as indicated in Chapter 4. As observed during the execution stage, the participating students were engaged in various online, direct and hands-on activities for learning. It was perceived by the researcher that the students' engagement in learning activities improved in the case study's 7th week, given their better familiarity with the web-based materials and various information sources for teamwork. The layout of learning activities allowed the lecturers to motivate the students and encourage them to engage in group work and problem-solving activities, as well as to exchange personal feelings, opinions and beliefs.

Hypothesized path	*Direct effect*	*Standardized estimate (P -value)*	*Result of hypotheses*
LBL → Easy (H1)	0.64	(***)	Supported
LBL→ Usefulness (H2)	0.84	(***)	Supported
Usefulness → Attitude (H3)	0.32	(***)	Supported
Easy → Attitude (H4)	0.68	(***)	Supported
Attitude→ Intention (H5)	0.97	(***)	Supported
Facility Quality→ Easy (H6)	0.23	(<0.05)	Supported
Performance experience→ Attitude (H7)	0.12	(<0.05)	Supported

Table 7.3: Conceptual model revision and hypotheses testing

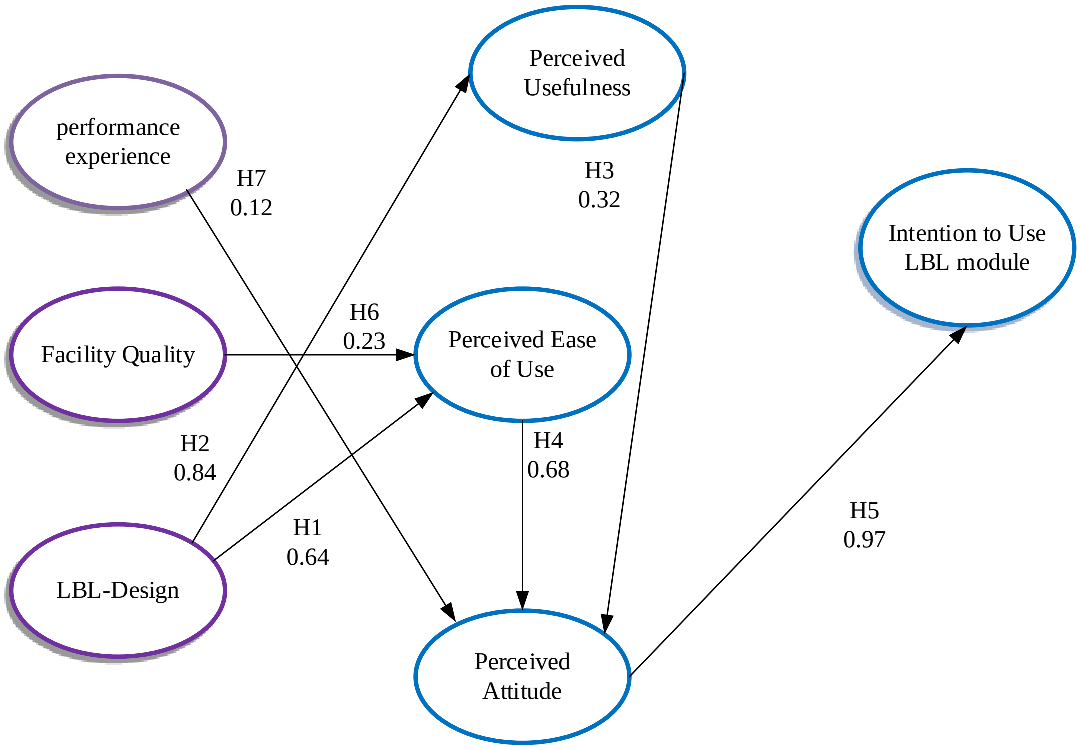


Figure 7-1: The weight of all factors in Technology Acceptance Model

7.2.3 User evaluation

This study has used the ability of TAM to present the acceptance of the LBL module and blended learning approach by focusing on data gathered from Computer Science students in Libya. Cronbach's Alpha reliability analysis presented the quality of each factor included in the questions. This was an important stage before applying confirmatory factor analysis. It proved that the questionnaire was a valid and reliable measurement.

The structured equation model was used to examine all the hypotheses, which were confirmed as being true for Computer Science students using the LBL blended learning approach module. The results support the definitions of Davis (1986), who originally established the TAM, by proving that perceived usefulness and ease of use have an influence on the determining factors of behavioural intention, which in turn have a direct effect on the behavioural intention to use. The outcomes of the hypotheses displayed a significant link between students' attitudes and their behavioural intention towards the LBL module, and their trust of its advantages for their study is likely to be a mediator of their attitudes in the future. Moreover, the influence of the design of the user interface is closely related to flexibility, which is part of perceived ease of use, and because there is clearly a strong relationship between these factors, it is evident that flexibility determines final intention to use. This shows that a system design which focuses on flexibility in tools and functions, as well as in the interface tools which define the interaction benefit from the services offered as part of these new environments, significantly affects the perceived benefit. The result that can be obtained is that the students want services that are directly useful to them and which provide them with access to the information contained in the electronic sites. Another important point is responsiveness, which is related to perceived ease of use. Thus, responsive features play a key role in designing courses as the implementation of access needs to be easy and straightforward. The implication here is that if users perceive a tool to be useful, easy to handle, and provided with a great capacity for interaction, this will positively influence the decision to use. The hypothesis states that the design of the LBL will have a positive impact on the perceived ease of use of a component, and the results are shown in Figure 7.1. This shows that the more flexible and accessible the system, the more the students feel they can deal with it easily.

It is clear this system has several advantages that the old system did not possess, the most important of these being easy and quick access at any time and in any place; the possibility of choosing components of courses online and constantly increasing quantities; ease and speed of review, update and edit; and distribution of educational components which allow the student to study according to his ability (quickly or slowly). It also offers a variety of facilities and educational methods to prevent boredom and facilitates follow-up to the students if required. A further advantage is that it allows tens of students easy access to the same source at the same time without having to use paper sources. This seems an appropriate benefit for the area of computing, and will also enable more students to undertake distance learning. Moreover, the proliferation of new technologies suggests that students generally have high IT skills and are therefore highly experienced in the use of technology systems, including learning platforms. It appears, therefore, reasonable to extend this study to other areas of knowledge and students of other courses to determine whether or not this hypothesis is sustained.

Overall, the results indicate that the acceptance of technology in this study focused on the design of each individual instrument as a whole tool, and that this was the major factor influencing the intention to use it. Moreover, it was important that the design included responsive features that could be opened in other devices without taking unnecessary time for the page to load. The students’ attitude and the ease of use of the system were the most important factors that had a positive impact on students’ adoption and use of e-learning techniques. This confirms the theory that greater technical adaptation of the system, and techniques to make it easy to use whenever and wherever the students wish, increase the degree of adoption and deployment. The usefulness which students perceived from the use of e-learning techniques also affected the level of acceptance of the use of e-learning techniques through the internet.

None of the hypotheses can be rejected on the grounds of lack of statistical significance. The path coefficient refers to the importance of each variable and its impact on acceptance of the use of e-learning techniques by students. Thus, the study showed that each of the hypotheses was proved significantly. Overall, the results in relation to the hypotheses show why the Computer Science students used the LBL module. The study has displayed the capability of the TAM model to prove the students' acceptance of the module, and has found the attitude of the user to using the LBL module to be the most influential factor in determining their behavioural intention to use it. Furthermore, their perceived ease of use of the system had a great influence on their behavioural attitude. The ease of use of the website had a significant influence on their attitude to study using the electronic module. However, the students' attitude to the LBL module had a greater influence compared to the ease of use of the system.

The study aimed to add new variables to the TAM model, namely, lab-based learning module design, the facility quality, and online experience, and it investigated whether the students were prepared to adopt the blended learning method. The empirical research confirms that the proposed research model and hypotheses can be supported. In conclusion, if the website is useful, then their perception of the usefulness of the system and the lab-based learning module will be strengthened, and this is the most significant factor that affects perceived usefulness. This means that the students gained great satisfaction from the lab-based learning module (e.g., it met the students' needs in terms of different learning styles and user-friendly websites, and was designed with responsive features which could run smoothly with tablets and smart phones). The results for the lab-based learning module in this study support the findings of other studies (e.g., Lord & Lomicka, 2008) that having a user-friendly website (for an LBL module) is the most significant factor that impacts perceived ease of use. When the website is designed in a flexible and user-friendly form, students find it easier and more comfortable to use. Other studies which match these findings include Martin-Michiellot and Mendelsohn (2000) and Jones et al. (1995), cited in Liu et al. (2010). Moreover, the perceived ease of use has a great effect on attitude to use, particularly when the website has some interactive tools, such as an enquiries tool to enable them to ask the lecturer questions at any time, the facility to exchange emails, and interactive lessons. Such tools allow the students to feel motivated to engage in a cooperative environment. The impact that perceived usefulness has on attitude to use of the LBL module is not as strong as that of perceived ease of use; moreover, the study discovered that when the system makes the lab-based learning easy to use, students will have a stronger attitude to using the online module, and it was found that attitude to use has a great effect on intention to use the system.

In lab-based learning, it is difficult for the lecturer to guide every student and give them instructions on how to operate or run a program. The use of digital tools in the learning environment can provide structure and thus overcome the limitations of traditional lab learning. The study aimed to present guidelines for a strategy to implement the blended learning approach. It also aimed to define further improvements to the Computer Science course by exploring external variables. In terms of the LBL module, students were provided with easy and comfortable access to personalised and user-centred interfaces. They were also given the opportunity to use different types of devices, for example smart phones, tablets, PCs or PDAs, so they could have different experiences in learning. At the same time, the researcher tried to ensure that students felt the module was both useful and easy to use and, consequently, the students' intention to use the lab-based learning module could be stronger.

7.3 Summary

The definition of external variables made an important contribution to the exploration of the online module. As this was based on a Computer Science course, the implications of the study's findings will provide some strategies for the design of future virtual lab-based learning. With regard to the main factors influencing Computer Science students to adopt the online LBL module, the data analysis has validated all the hypotheses in this study as follows:

(1) Perceived usefulness ***and perceived ease of use*** are internal variables (Davis, 1989). The first factor affected the students' attitude toward the adoption of the LBL module in learning. Perceived ease of use is also an internal variable (Davis, 1989) affecting students' attitude toward the adoption of the LBL module in learning.

(2) The LBL module design (learning process structure, flexibility, hypertext and hypermedia etc.) is an external variable linked to the TAM model. The findings indicate that the LBL design was the most significant variable affecting the attitude towards e-learning. The intention to use the lab-based learning was directly and strongly affected by attitude to use, and the attitude to use was directly affected by ease of use and usefulness. Therefore, when designing a comprehensive virtual module for Computer Science students, the first element which should be considered is that it is capable of satisfying the students' requirements. For example, it must ensure that the students feel the lessons (online lectures, tutorials), enquiry facilities and email elements of the module are helpful.

(3) Performance experience is an external variable linked to the TAM model. It has significant impact on perceived attitude and a positive effect on intention, which indicates that Computer Science students have soft skills experience, even if they are just interested in using IT-related skills (e.g., programming language, computer applications or social media), and those students will be more willing to learn in a blended learning environment. In other words, if the students have enough experience in soft skills, their intention to use the module will be stronger. These results support the findings of other researchers Arbaugh and Duray (2002, cited in Liu et al., 2010). The students found it easy to run the website using any device, and they had a good ability to solve problems if they encountered any difficulties with operating the website. The students should be motivated to get more soft skills experience and to use these skills to learn programming languages. For instance, students could access other Computer Science websites or online tutorials in order to become more familiar with new virtual websites in the future.

(4) The facility quality factor has least effect on the perceived ease of use. This indicated that students may have faced some difficulties in using the system due to weak internet signal. According to the Akamai report, the internet speed in Libya is very slow. Cheng (2012) states that facility quality is a significant element of perceived usefulness in online environment usage (Cheng, 2012). However, the facility quality was not an important influence in predicting their perceived ease of use and satisfaction. On the other hand, other studies have shown that technical support and availability of the internet have played an important role in improving students' acceptance of the online environment (Cheng, 2012; Ramayah & Lee, 2012; Roca, Chiu, & Martínez, 2006). Therefore, the Libyan government should develop the ICT support in relation to the availability of the internet, and expand technical support to allow students to continue to use the system and thereby improve their intentions to do so. The quality of services such as technical support and availability of the internet for information communication is important for improving facility quality, and that can assist students to use the LBL module. In particular, it will lead to improved user gratification with the e-learning application. The researcher will consider this issue when designing the strategy plan for implementing the blended learning approach.

(5) **All the factors** in the technology acceptance model have been explored to clarify the acceptance of the LBL module as a blended learning approach for use in the Computer Science course. The project undertaken in this study has presented a set of factors affecting the adoption of a blended learning approach in a specific case in Libya, within an important example of a Libyan university, with regard to the acceptance of new technology in their course. The outcomes have revealed that ease of use, flexibility, usefulness and attitude were significant in the adoption of a blended learning approach within the university. In conclusion, three contributions of this confirmatory study can be highlighted. First, the extended TAM model has been successfully used to explain the process of adoption of e-

learning in higher education in Libya. Second, an important finding is the evidence of a strong and significant relationship between flexibility of the system and perceived ease of use of the e-learning platform, which has implications for the design of such platforms in relation to the control and resources given to users. Third and finally, the study indicates that the results with regard to all hypotheses were statistically significant for the student sample adopting the e-learning platform. This part of the research has presented an in-depth discussion of the results of the structured equation model. The next section of this thesis will focus on the barriers that could have a direct influence on the LBL module in the Computer Science course.

7.4 Qualitative Analysis

The study has its own set of restrictions that must be recognized. Firstly, it is frequently the case that lecturers are deployed to e-learning environments whilst having little or no technical and professional support to help them with adaptation to the new educational setting. A key hurdle to the success of an e-learning course or programme is the absence or shortage of technical support for lecturers. Secondly, some consideration should be given to poor internet connections and the high rate for this service, which costs a high price every month. Finally, it is important to identify a strategy plan which considers these factors when designing an online website; this can be one element for future study. The participating students and lecturers were asked to provide a list of three difficulties they encountered during their use of LBL module. The gathered qualitative data were elicited from the answers provided by the students and lecturers to the questionnaires' open-ended questions, as well as from brief conversations conducted with lecturers. Analysis of responses provided by the students showed four key kinds of difficulty which they encountered; these were related to the individual, context, technology and teaching.

7.4.1 Difficulties encountered by students

In the view of most students in all groups, technological difficulties constituted the predominant hurdle; as perceived by the Computer Science students, insufficient infrastructure and inadequate access to the internet represented the key difficulties. This view might be understood in the light of the fact that much educational infrastructure, especially in Baida City, had been destroyed in the armed conflict that erupted in Libya in 2011. As was the case with the students, most lecturers in all groups also perceived difficulties related to technology as the predominant hurdle.

"There should be better network systems. There must be a fast Internet speed during the day; this is to serve a greater number of students whose use the Internet during the day. This is apparently a difficulty that is encountered by the majority of lecturers and students alike.”

“Computers and networks either malfunction or suffer low bandwidth connections and recurrent failures.”

“Lecturers and students have inadequate access to the Internet, and are not provided with enough computers to use or have access to only computers with poor capacity and speed.”

“With the insufficient number of computers, lecturers are sometimes forced to share a single computer in an office with several other colleagues; when it comes to students, things are even worse.”

Cited as possible hurdles to engagement in the LBL module were insufficient experience, poor computer skills and lack of technical assistance and training, insufficient incentive among students, and shortage of specialists and university support:

“When I face technical issues, I feel frustrated. Whenever I need some technical help and go to the help desk, I find no one. This makes the use of e-learning difficult”.

“I am not confident about the availability of technical assistance people and their ability to fix the technical problem when needed. For me, this is a big obstacle. Also, there is no training available whatsoever. I am still depending on training courses like those related to modern pedagogical techniques”

“A number of students are not well knowledgeable about technical matters and do not have the abilities and skills to access materials and tests available on the Internet. That is why they do not engage in learning activities. This hurdle prevents students from involvement in e-learning.”

Technical aspects constitute a vital part of the process of applying and incorporating e-learning technological means into the system of education. These technical aspects involve installation, a steady power supply and obtainability of the latest technology, as well as a fast connection to the internet, security, support, maintenance and administration. As suggested by Bakari, Tarimo, Yngström and Magnusson (2005), it is the case in the majority of countries in the developing world that they do not have quality specialists to apply and maintain ICT.

Nonetheless, the second principle hurdle, as indicated by the lecturers, related to the challenges of teaching, including the need for a new design of curriculum and new methods of pedagogy. From the students’ standpoint, the sole significant teaching-related barrier was the dominance of traditional pedagogical methods. The participating students highlighted restricted awareness of learning based on technology and restricted grasp of

English among the challenges related to context.

The key hurdle related to context, as indicated by the lecturers, was the absence of motivation among the students. All participants – students and lecturers – expressed extremely little satisfaction with the infrastructure of technology available at the higher education institutes, with the quality of internet access attracting a markedly low level of satisfaction. A previous research study by Abran et al. (2003b) at Al-Fateh University in Libya produced similar conclusions. Overall, based on the researcher's conclusions, the e-learning courses were not positively viewed by the students, who regarded direct, rather than online, learning as less intricate and challenging. In the researcher's view, the low level of students' satisfaction and enthusiasm about the use of technology could have been caused by insufficient access to computer and internet facilities.

7.5 Conclusion

The key findings of the study have been detailed in this chapter. The presentation of the questionnaire data analysis started with analysis of the structural equation model to test the collected data for validity and reliability. In order to test whether the experiential data conformed to the presumed model, confirmatory factor analysis (CFA) was used and the user evaluation have been presented. The outcomes of the hypotheses have shown there is a significant link between the student's attitude and their behavioural intention to use the LBL module and their trust of its advantages for their study is a mediator of their attitude to using it in the future. Moreover, the influence of the design of the user interface is closely related to the flexibility factor in terms of effect on the perceived ease of use. There is clearly a strong relationship between these factors and in this work it is evident that flexibility also determines final intention to use. This shows that a system design focused on flexibility in the tools and functions, as well as in the interface tools which define the user's sense of benefit from interaction with the services of these new environments, significantly affects the perceived benefit. The conclusion that can be drawn is that the students want services that are useful to them directly and which provide them with access to the information contained in the electronic sites. Responsive features were also an important point in terms of perceived ease of use. A qualitative data analysis has also been presented in this chapter. The outcomes and limitations of this study are provided in the next chapters, which also include the contributions of the current research, as well as future research recommendations aimed at comprehending issues linked to the application and embracing of blended learning in the system of higher education in Libya.

Chapter 8: Recommendation for the Blended Learning Strategy for Computer Science courses

This research study showed that the majority of participants – students, lecturers, and lab assistants –were skilled and able to use ICT to a good level, are positive about the LBL website, and were eager to join the virtual course. This involves the prospect of more incorporation of blended learning in of Libyan university system, given the discernment by both students and lecturers of the e-learning benefits.

A set of recommendation for the blended learning strategy for Computer Science course has been formulated on basis of the following aspects:

- Researcher works as lecturer at Omer AL-mukhtar University teaching computer science course, so she is aware from her personal experience as educational practitioner about disadvantages of traditional teaching method and advantages of using technology in higher education.
- Quantitative and qualitative analysis for questionnaires results, where the requirements from students, lecturers, and lab assistants have been formulated
- Study of another examples of blended learning strategy from universities all over the world, which can be used as examples for best practise.
- Analysis of feedback from students and lecturers about using the developed e-learning package in real environment showing the usefulness of using technology in higher education for teaching learning and assessment purposes.

In this research study, valuable evidence-based information is provided which can assist decision-makers, managers and lecturers in the incorporation of e-learning in Libya's higher education system, as planned by the government.

This chapter offers recommendations based on the outcomes of this study which have been derived from the analysis of student's skills and TAM model related to the successful implementation of blended Computer Science course in a real environment.

1. An ICT infrastructure that is fixed and connected to the internet should be made more accessible, and attention should be paid to reducing inequalities on grounds of gender and regions. ICT and the internet being made more accessible would help students and lecturers enhance their skills and abilities of using technology; this would also lead to a positive change in their perceptions of technology and e-learning.

2. Particularly in the event of the internet infrastructure available being inadequate and unreliable, the mobile phone, which is a technological means, should be promoted as a practical e-platform of learning. By doing so, there could be new conduits of communication and new opportunities for education as well as better access to materials intended for education.

3. There should be constant development and enhancement of online technologies and applications through which information and services related to university are made accessible. E-learning could be more attractive and accepted through additional development of these technologies, which students and lecturers alike found extremely

helpful.

4. The English language skills of both students and lecturers should be enhanced through the launch of initiatives for this purpose, so that resources available at a global scale, such as freeware which is extremely vital, can be more accessible. The existing deficit in such resources in Arabic can be resolved through the ability to use available English-language resources.

5. Local e-learning content should be enhanced in order for culturally appropriate and materials that every Libyan user can access (for example, availability in the Arabic language) to be produced. Greater numbers of students and lecturers would be interested in e-learning, should appropriate Arabic resources be made more available. The status of Libya, as an e-learning provider, would improve as a result of the ability to produce such content.

6. Lecturers should be trained to acquire skills needed in ICT and e-learning. The e-learning process could be supported through proficient ICT lecturers who could also inspire their students. Furthermore, the building of ICT capacity in lectures can play an assistive role in the transformation from teaching centring around the lecturer to a more effective type of teaching centring around the student.

7. The users of e-learning at higher education institutes should be supplied with adequate technical support. Given that the success of e-learning initiatives vitally depends on adequate technical support being supplied, the concern about such support not being available greatly worries both students and lecturers now.

8. Cooperation should be established with neighbouring Arab countries as well as other world countries in order to utilise their experience and expertise in the area of e-learning, with the purpose of facilitating and speeding the incorporation of e-learning in Libya.

9. **Pedagogical Support:** Lecturers should be given dynamic training in order to be able to master and use the platform of e-learning. Additionally, new technological means can play a significant role in the field of teaching, but they could be a mere waste of money if no support and constant training are provided for lecturers and students. Lecturers should regularly be offered suitable opportunities for career development. Additionally, there should be plans for staff development through keeping the technical abilities and knowledge of lecturers up-to-date for proficient use of technological tools. Similarly, the educational abilities and knowledge of lecturers should be enhanced in order for them to be able to perform their roles in teaching in a proper manner.

The educational factor is considered to be the most vital aspect in the creation of a quality e-learning process. This pedagogical factor has gauges and standards that can be different from the delivery setting and mode. Learning settings centring around the student encourage involvement in learning methodologies that are more critical and self-directed, through the provision of levels of freedom, contemplation, self-regulation and decision-making (Hasan Khan, Atiqur Rahman, & Ahmed, 2011; Fresen, 2005; Holsapple & Lee-Post, 2006; Hosie, et al., 2005; Marshall, 2006; Oliver, 2006, cited in Hasan Khan et al., 2011).

Therefore, students' success can be influenced, to a considerable degree, by their dynamic involvement in voicing their views, and writing, about their process of learning as well as incorporating and implementing previous experiences in their everyday lives (Chickering & Ehrmann, 1996). Thus, the sub-factors mainly include the following:

- The way in which the setting of e-learning is created should facilitate and inspire students to engage dynamically in acquiring new abilities and building knowledge.
- The design of evaluation assignments and learning activities should be done in a way that will help build and improve participation by students.
- The students should be brought to participate in genuine learning activities and assignments (for example, discussions and tasks connected with experiences in the real world).

10. **Technical Support:** This is the second aspect of the framework suggested by Khan. Technical support is related to technology infrastructure issues in the setting of e-learning, such as the infrastructure plan as well as hardware and software (Hasan Khan et al., 2011)

a) *Infrastructure Plan:* This involves the process of planning for IT requirements as well as the procedures of maintaining, appraising and providing human resources for ICT upkeep and support.

b) *Hardware:* This is related to access to hardware needed to conduct the course and to assist with development purposes in relation to the institute and students. It is recommended that students are given a clear idea about the ICT facilities that they need to finish the course.

c) *Software:* This is related to access to software that is needed to conduct the course and to assist with development purposes in relation to the institute. It is recommended that the students are given an idea about the software that they need to finish the course.

For an e-learning programme to produce positive results, the students must be provided with technical support. It is advisable that suitable technical support or certain training courses are made available, when needed, in order to help students to fully grasp the relevant settings of e-learning (Fresen, 2005; Marshall, 2006; Zhao, 2003). Numerous different ideas have been suggested for a more successful e-learning process in the countries of respondents. The most commonly cited of these include:

- Access to hardware (especially computers)
- Faster internet connection/better bandwidth
- Better software
- Adequate strategies supportive of e-learning
- Supplying e-learning technical support at various levels
- More affordable rates for internet connection
- Access to reliable power supply
- Suitable content in suitable languages
- Provision of better training to e-learning instructors at all levels
- Access to technical help and other forms of support during the entire the course or programme.

As explained in Chapter 7, it is frequently the case that lecturers are deployed to e-learning environments whilst having little or no technical or professional support to help them with adaptation to the new educational setting. A key hurdle to the success of an e-learning course or programme is the absence or shortage of technical support for lecturers. It is recommended that the design, development and delivery of the course are guided and informed through formal development of methods and criteria for e-learning. Lecturers should play an assistive role in conducting courses for e-learning.

To increase the effectiveness of IT in Libya, universities should take the following issues into account (Othman, Pislaru, Kenan, & Impes, 2013):

• The need for Libyan companies to translate programs that are used in the design of e-courses into Arabic language; also, the need for the development of Arabic sites on the internet, so that lecturers can design modules in the Arabic language for students at different stages.

• The need to train pre-service education students in the use of online modules and methods, in order to prepare them to make use of ICT skills in general and develop their ability to use and design courses; this should be an integral part of their training and should form one of the requirements for graduation.

• Training courses should be established for lecturers at all levels and all disciplines on the use of module-mail and design methods.

• It is important to interest universities in teaching online courses, and to encourage them to create sites for electronic modules rather than using traditional teaching methods. This would contribute to solving the problem of shortage of faculty members, lack of classrooms and overcrowding of classrooms, and would address the steady increase in the number of students applying who are interested in education.

• When designing online courses there are a number of things that should be taken into account, which are: the importance of setting goals, tasks and electronic discussions clearly; the use of public and private messages to give feedback on all targets and tasks; meeting with students on face-to-face visits before the start of study; the integration of chat rooms and discussion threads within modules; emphasis on the need for time commitment and encouragement of students to commit to this; the need to train students to connect to the internet and gain access to sites several weeks before the start of their course of study; and training in additional techniques used for remote connection such as by audio, image and phone when necessary.

• Before placing any module on the internet, the following should be considered: the justification for the use of online or e-learning should be determined, the needs of students and lecturers should be identified, and the teaching strategies should be reconciled with the environment of distance education.

• When using e-courses for the first time, the following should be considered. The skill level of students in the use of the computer should be determined before starting registration for study on the online module. The requirements of the existing computer use policy should be identified and strengthened. Students' skills and attitudes should be continuously evaluated, and diversification of the educational components should be ensured. Students should be provided with the necessary technical support by the school or the department, particularly in relation to web design. The first lectures for university students should be convened in the traditional manner to enable students to meet face-to-face with their colleagues at least once. Graduate students should be used to help guide Bachelor's degree students. Course content should be provided in several ways, making use of a number of channels of communication to ensure flexibility. Contact should be made with students by telephone and initial notes distributed to them. To improve the teaching and learning process through the internet, goals should be set to determine participation in the programme and roles should be identified to enrich the dialogue. Struggling students should be provided with support and follow-up. Lecturers should keep abreast of developments and urge the students to participate in debate by making them aware of the importance of interaction in achieving learning objectives.

Chapter 9: Conclusion

9.1 Introduction

This research study was wholly aimed at developing a greater understanding of how blended learning is experienced and viewed by students and lecturers in the area of Computer Science programmes in higher education in Libya. The process of gathering and analytically examining data was steered by the research questions below:

- What are the students' skills and learning styles, and what is the skills gap between LBL and SBL?
- Which technologies and pedagogical strategies have been used with the blended learning approach in the Computer Science course?
- How can an e-learning package be implemented in a traditional classroom?
- Does the Technology Acceptance Model help evaluate the blended learning approach in Omar Al-Mukhtar University?
- What are the factors affecting the adoption of a quality e-learning system in the Computer Science course?

Involved in this research study were higher education students, lab instructors and teaching staff from Libya's Omar Al-Mukhtar University. The sections below detail the study's key findings from the research questions by which the investigation was guided. The recommendations illustrated below are based on these findings and indicate that e-learning should be incorporated in the higher education system in Libya in the future.

Chapter 1 presented the structure and characteristics of the Computer Science course at Omar Al-Mukhtar University and described the aims, objectives and research questions for this thesis.

Chapter 2 introduced existing publications related to lab-based learning and research materials with a relative emphasis on models and theories regarding the practice of e-learning. The assessment of this literature brought to light the powerful connections between lab-based learning, technology for procedures of teaching and learning, theories and paradigms of learning and structures of information quality. In this study the design of the questionnaires used Bloom's taxonomy, which integrated three domains (cognitive, affective and psychomotor). The formulation of the activities from the case studies included in the proposed e-learning package considered experiential learning theory on the basis of Dewey's philosophical expediency and Piaget's cognitive paradigm.

-The questionnaire regarding the students learning styles was designed based on four learning styles defined by Kolb. Considerable research has been concentrated on deciding the problems (technological and contextual) of adjusting both the individual and the course to online learning and ICT within developing nations. Literature sources concerning the e-learning experiences of lecturers and students has shown that an acceptable standard of teaching and learning has been achieved for both. Studies regarding the conceptions of lecturers and students have concentrated on the establishment of their degree of satisfaction and their disposition. It has been advocated that the principle features which promote the productiveness of web-based learning are highly regarded among all parties involved in online learning and ICT.

Chapter 3 described the research methodology adopted for this project. The researcher designed three questionnaires by considering aspects of reliability, validity, bias and triangulation. The results of quantitative and qualitative analysis of the answers have been used to formulate the blended learning approach and to design and evaluate the e-learning package. The quantitative analysis used a statistical technique and qualitative analysis was undertaken by looking at the answers to the open-ended questions.

Chapter 4 presented the original contribution of the study regarding the identification of a skills gap between SBL and LBL, and described the proposed LBL skills model. Lecturers and lab instructors completed Questionnaire 1 in order to determine what skills are required from students when they go into the lab sessions. Then, the proposed LBL skills model was designed based on the analysis of answers to Questionnaire 1. Also, the students completed Questionnaire 2 to enable the researcher to determine their preferred learning styles for lab classes. Quantitative and qualitative analysis of the responses was described in this chapter.

Chapter 5 described the original contribution of the study to the design, development and implementation of the e-learning package in the proposed blended learning approach. The user-centred design comprised the following phases: user analysis, structure and representation, knowledge and communication analysis, and interface and navigation design.

Case study 1 contained theoretical concepts and exercises related to the design of a website using attributes and main elements related to HTML coding. Case study 2 included exercises leading to the design of a simple website using Dreamweaver software, and enabling the development of students' soft skills, including communication skills and decision-making.

Other exercises referred to were used to improve the look of web pages with a one or two column layout. Case study 3 aimed to enable feasible collaborative learning in groups whereby students developed and designed websites by following a series of main steps, such as HTML links, images, headers and paragraphs. The students were divided into two teams: team one collected the content for the website and drew up the site map, while team two designed the website and selected the appropriate elements required for the website design. The presented LBL module aimed to provide an effective contribution to the enhancement of the Computer Science course by asking lab tutors and students to identify and create practical work in the LBL environment in a collaborative manner.

Chapter 6 contained a comprehensive review of present theories related to technology acceptance models (TAM), with focus on the evaluation of students' acceptance of e-learning systems. In order to elucidate the students' acceptance, the review of literature focused on research studies that have utilised TAM. There was a discussion of TAM work without any additional elaboration, followed by a consideration of TAM work with the application of enhancement or adjustment to the model. The means of discerning the external variables and their potential significance, as presented in the sections covering external variables and the research hypotheses, were also expounded in this chapter. The analysis model comprised seven variables (four TAM and three external) which, together with their connections, were determined and supported by the hypotheses which were proposed. A total of seven hypotheses, together with their justifications, were suggested by the research. Any impediments with an impact on the success of e-learning needed to be discovered, analysed and solved if a successful adoption of the e-learning stage were to be achieved. The examination and analysis of elements affecting the implementation of e-learning in HEs in Libya is the purpose of the research study and, by considering Libya as a case study of a developing country, also to assist in more general reduction in obstruction to online courses utilisation. This study contained analysis of a number of elements that may affect the acceptance and implementation of e-learning, and particularly in Libya as a case study.

Chapter 7 was the final chapter that presented an original contribution, which was the evaluation of the blended learning course using a TAM model. The structural equation model was used to test the collected data for validity and reliability, and a presumed model was used to test the experiential data through confirmatory factor analysis (CFA) before presenting the user evaluation. The outcomes of the hypotheses showed a significant link between the students' attitude and their behavioural intention toward the LBL module, and their trust in its advantages for their study would be a mediator of their attitude in the future. Moreover, the influence of the design of the user interface is closely related to flexibility in terms of its effect on perceived ease of use. There was clearly a strong relationship between factors in this work and it was evident that flexibility also determined final intention to use. This shows that a system design focused on flexibility in the tools and functions, as well as in the interface tools which define the user's concept of benefit from the services of these new environments, significantly affects the perceived benefit. It was therefore obvious that the students want services that are useful to them directly and which provide them with access to the information contained in the electronic sites. Another important point was the effect of responsive features on perceived ease of use. Finally, a qualitative data analysis was presented in this chapter.

Chapter 8 presented recommendations and a strategy for further work on the blended learning approach. This chapter also presented a set of recommendations related to the design of a blended learning strategy in the School of Computing at Omar Al-Mukhtar University. These were derived from the analysis of students' skills and use of the TAM model to evaluate the successful implementation of blended learning in the Computer Science course.

Chapter 9 summarises the salient points and draws conclusions. In addition, recommendations for further work are proposed.

9.2 The Importance Of E-learning for Libyan Universities

The findings indicate that the e-learning system has several advantages. It allows the student to study according to his ability (quickly or slowly); it offers a variety of facilities and educational methods to prevent boredom; it facilitates follow-up for the students; and it enables tens of students to easily access the same source at the same time without having to rely on paper sources. This seems a considerable advantage, since it would allow all students to undertake distance learning, and it is also an appropriate way to study in the field of computing. Moreover, the proliferation of new technologies suggests that, indeed, most students have high IT skills and are highly experienced in the use of technology systems, including learning platforms. It appears, therefore, reasonable to extend this study to other areas of knowledge and students of other courses to determine whether or not the hypotheses proven here are sustained. The results indicate that the acceptance of technology in this study focused on the design of each individual instrument as a whole tool, and that this was the major factor influencing the intention to use it. Moreover, the acceptance was affected by the design of responsive features that could be opened in other devices.

The students' attitude and the ease of use of the system were the most important factors that had a positive impact on the students' adoption and use of e-learning techniques. This confirms the theory regarding the link between technical adaptation of systems which make them easy to use at any time, and an increased degree of adoption and deployment. The degree of usefulness which students perceived from the use of e-learning techniques also affected their level of acceptance of the use of e-learning techniques through the internet.

Overall, the results of the study, which were considered in relation to the hypotheses, show why the Computer Science students used the LBL module. They also demonstrated the capability of TAM theory to prove the students' acceptance of the module, and found that the attitude of the user to using the LBL module was the greatest influential factor in defining their behavioural intention to use it. Furthermore, the students' perception of the ease of use of the system had a great influence on their behavioural attitude. The ease of use of the website had significant influence on their perceived attitude to study using the electronic module. However, the students' attitudes to the LBL module had a greater influence compared to the ease of use of the system.

Furthermore, the study showed that each of the hypotheses was proved significantly. These findings match with those of other studies (e.g. Martin-Michiellot & Mendelsohn, 2000; Jones et al., 1995, in Liu et al., 2010).

Moreover, the findings suggest that perceived ease of use has a great effect on perceived attitude, particularly when the website has some interactive tools, such as an enquiries tool to enable them to ask the lecturer questions at any time, facility to exchange emails, and interactive lessons. Such tools allow students to feel motivated to engage in a cooperative environment. The impact that perceived usefulness had on attitude to use of the LBL module was not as strong as that of perceived ease of use; moreover, the study discovered that when the system made the lab-based learning easy to use, students had a stronger attitude to using the online module, and it was found that perceived attitude had a great effect on intention to use the system.

The study provides managerial insights to university management and e-learning managers on how to motivate students to continue using e-learning systems in higher learning institutions.

Generally, essential means of technology, such as desktop computers, laptops and mobile phones, were highly accessible to the students regardless of the different cities they came from. The high mobile phone penetration rates recorded are consistent with results cited in previous studies related to mobile phone obtainability in countries in the developing world (UNESCO, 2012; Gallup, 2011; Andrews et al., 2011;Cherrayil, 2010; Muttoo, 2011;

Rhema, 2013). High access to mobile phones is likely to help ensure the process of teaching and learning in higher education institutes in Libya is more productive. Moreover, the students involved in the study viewed the LBL as beneficial and found it helpful to use different means of technology such as the internet and mobile phones. The majority of the participating students expressed interest in utilising these technological means in the learning and teaching process. There is consistency between these views and the outcomes of similar research studies, such as those conducted by Nihuka (2011), Tagoe (2012) and Buabeng-Andoh (2012). These optimistic views were commonly expressed via the participating students, regardless of where they come from – on the Computer Science course. Additionally, the design and creation of web pages for learning purposes was viewed as beneficial by a significant percentage of all participants. In the view of the majority of the students, mobile phones, as a means of technology, are extremely instrumental, especially given that they facilitate the receipt of information about grades and courses through the LBL website.

Satisfaction with technology: All of the factors in the technology acceptance model clarified the acceptance of the LBL module as blended learning approach for use in the Computer Science course. The project undertaken in this study has presented a set of factors affecting the adoption of a blended learning approach in the specific case an important example of a Libyan university, and the acceptance of new technology in their course. The outcomes have shown that ease of use, flexibility, usefulness and attitude were significant in the adoption of the blended learning approach within the university. In conclusion, three contributions of this confirmatory study can be highlighted. First, using the extended TAM model to evaluate the process of adoption of e-learning in higher education in Libya has been successful. Second, an important finding is the evidence of a strong and significant relationship between flexibility of the system and the perceived ease of use of an e-learning platform, which has implications for the design of these platforms in relation to the control and resources given to the users.

“I am very interested to apply new method in my teaching as e-learning package because many of the computer science issues is extremely difficult to be taught entirely theoretically, and, in particular, such as highly skilled, and use the e-learning represents one proposed to solve such problems solutions.”

“Yes, I am interesting use e-learning package because it can find solutions to the problem of large numbers of students solutions.”

“Yes, because it can help for the multiplicity of sources of knowledge as a result of contact of different sites on the Internet”

“Yes, I have found it more efficiency to get materials by easy and simple manner especially, in saving time and money but it cannot be a substitute method for traditional education.”

“In general, I think this Web-based learning environment provides good opportunities for learning more skills as communication with lecturer.”

“In general, I am satisfied with the internet availability to display the LBL module.”

“The web site allows me to display content in the right way in all types of devices”

Attitudes towards ICT and e-learning: E-learning was favoured by most participants of the Computer Science course, who expressed a belief that it was useful. The potential of e-learning in the facilitation of greater acquisition of fresh knowledge and better experience of learning attracted markedly positive strong views from participants. These conclusions are consistent with the findings of other research studies, such as those conducted in Saudi Arabia by Hussain (2007) and in India by Suri and Sharma (2013, cited in Rhema, 2013).

“Of course it is. The introduction of eLearning in university and library has saved a great deal of time and efforts and made the updating of database more easily performed IT IS A GREAT IDEA.”

“It quite good however some method of e-learning need more ability to understand how it is work.”

“I think that the e-learning is a good idea to be at university, where it has a number of advantages, such as more flexible, it can be done in any time, and it can fit around your timetable. It can be used wherever and by whatever, laptop, phone, tablet.“

It was more likely for the students who demonstrated advanced technology skills to view e-leaning positively; the attitudes of the students were found to be forecast most vitally by the level of skill. These findings corroborate other conclusions produced by authors of previous studies conducted on the links between abilities and behaviours (Liaw & Huang, 2003). Another finding was that the access of the students to technological means had a positive impact on their positions on e-learning, to a reasonable degree. This conclusion is consistent with the findings produced by other research studies conducted by Geer and

Sweeney (2010, cited in Rhema, 2013).

Cultural awareness is about the fulfilment of necessary modern skills and abilities at the place of work. The cultural awareness concept was introduced into the place of work by Tomalin and Stempleski (2013). The utilisation of knowledge and the display of positive behaviour in hands-on situations form the focal point on which this concept was built and industrial companies highly recommended it. It was suggested that this element was considered in the module and incorporated into a variety of learning activities. As observed by the researcher, the collaborative activities of learning incorporated into the module played an assistive role in the development of the students' cultural awareness. The lecturers, nonetheless, felt that the learning material, especially in the case of real work situations, should include more examples. In their view, it is advisable to implement understanding about cultural awareness in learning based on theory and critical ways of thinking as well as in learning based on practical situations.

9.3 Challenges Faced by E-learning Users

Analysis of answers by the participating students and lecturers highlighted four kinds of challenges, related to individual, context, technology and teaching. The key hurdle to e-learning utilisation was the challenge related to technology, especially restricted access to the internet and absence of information and communication technologies (ICT) infrastructure. This finding concurs with the conclusions about the level of satisfaction with the virtual course voiced by those involved in the study (see Chapter 7), and may also be a reflection of the fallout of the armed war that erupted in 2011 in Libya (Rhema, 2013).

Technical aspects constitute a vital part of the process of applying and incorporating e-learning into the system of education. These technical aspects involve installation, a steady power supply and obtainability of the latest technology, as well as fast connection to the internet, security, support, maintenance and administration. As suggested by Bakari et al. (2005), it is the case in the majority of countries in the developing world that they do not have quality specialists to apply and maintain ICT.

"Although e-learning has advantages, for example every person is able to learn at their own pace, and it is more flexible because there is no certain time for learning, and the lower cost, on the other hand there is lack of control because there are no set times to be doing it so students with low motivation might fall behind, and another drawback is technical issues as you have to ensure that all students have a device that supports the learning modules, and ensure there is good internet connection."

The second principal hurdle, as indicated by the lecturers, related to the challenges of teaching, including the need for a new design of curriculum and new methods of pedagogy. From the students' viewpoint, the sole significant teaching-related barrier was the dominance of traditional pedagogical approaches. The participating students highlighted restricted awareness of learning based on technology and restricted grasp of English as the challenges related to context.

The key hurdle related to context, as indicated by the lecturers, was the absence of motivation among the students. All participants – students and lecturers – expressed extremely little satisfaction with the infrastructure of technology available at higher education institutes, with the quality of internet access attracting a markedly low level of satisfaction. The internet connections are poor despite the fact that this service costs a high price every month. Finally, a strategy plan will be required to consider these factors when designing online websites; this can be one element for future study. A previous research study by Asunka (2008) at Ghana University produced similar conclusions. Based on the researcher's conclusions, the e-learning courses were not positively viewed by the students, who regarded direct, rather than online, learning as less intricate and challenging. In the researcher's view, the low level of students' satisfaction and enthusiasm about the use of technology could have been caused by insufficient access to computer and internet facilities.

Similarly, the low satisfaction expressed by the participants could be due to the fact that the educational infrastructure in Libya was significantly damaged as a result of the infighting that the country seen since February 2011.

9.4 Contributions of this Study

The results of this study have covered the knowledge gap in the literature on e-learning in Libya and provided a clear picture of the Computer Science course at Omar Al-Mukhtar University. E-learning has been adopted for the first time at Omar Al-Muktar University by this study, so the findings will aid the university in defining the main factors that can help to implement the e-learning approach in the future. The study has implemented a blended learning approach by using web-based learning and examined technology acceptance in a Libyan university. In particularly, the study aimed to:

- Analyse the skills gap between school-based learning and the lab requirements for the Computer Science course. The aim behind this was to understand the role of the lab in defining and strengthening the link between cognitive content and cognitive processes, and for the university to consider these strengths to achieve many of the goals of science teaching (building skills, developing deeper understanding, representation of fact, teaching the perceived) in the future.

- Develop a lab skills model and apply it to the Computer Science course. This model can be used to prepare any necessary activities that can be of benefit to the practical work in the lab. This lab skills model can be used for other computer science courses or other courses from faculty of science when designing and implementing SBL and LBL activities with easy application of theoretical knowledge into practical lab applications.
- Implement a new blended learning approach (including the design, development and implementation of new e-learning package). The main phases of the e-learning package are designed to be integrated so that they can be employed to support the learning process at Omar Al-Mukhtar University. This model can be used to design usable and accessible web applications through the implementation of the set of techniques and procedures included under the methodological framework.
  - A variant of TAM was used for evaluation of proposed blended learning approach based on the SEM model. Three new Factors-Module design, performance experience, and facility quality – have been added to this variant of TAM in order to reflect more accurately the elements affecting the implementation of e-learning in HEs in Libya, also to assist in the reduction of obstructions to the utilisation of online courses and e-learning generally, and particularly in Libya as a case study.

- Formulate recommendations for the blended learning strategy for the Computer Science course by identifying specific factors of successful web-based learning experiences. This provides a source of information that can facilitate the design of such a strategy and demonstrate how it can be applied in practice, how it may work and its possible limitations.

9.5 Future Work

The proposed lab skills model should be extended in order to become applicable to a range of different Computer Science courses in various universities in Libya.

The proposed LBL module should be implemented with other labs in different courses, lectures and modules. It could also be implemented with a larger number of students from the Computer Science course or applied to other courses at Omar Al-Mukhtar University.

A questionnaire could be designed to provide suggestions for further strategies of blended learning implementation.

The LBL module should be improved and all lecturers given the opportunity to submit their own materials.

If the module is allocated an appropriate time within the study plan for the academic semester, more evidence on measuring the effectiveness of the proposed module can be provided.

A further evaluation questionnaire should be designed after three years to determine the difference between the courses provided without the LBL module and those provided with the module.

The research results introduced in this thesis can be used to formulate an advanced strategy for identifying the requirements of modern computer skills, and for planning and developing the content of up-to-date learning resources employing innovative technology. The implementation of new learning content can be assessed using the TAM model, and new academic approaches can be developed to improve performance in Computer Science courses in Libya.

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Appendices

Appendix A

The two questionnaire sent by email to Omer AL-muktar University to the stakeholders (Lecturers, Lab tutors and students).

To Sara Albarasi CC/BCC

questionnaire is to find out your opinions about the e-learning implementation in Libyan Higher Education Institutions (LHEIs).

Dear Colleagues,

My name is Aisha Othman and I am a research student at the University of Huddersfield, UK doing a PhD project on using a blended learning approach to improve the teaching and learning methods in Higher Education to create a supportive, efficient learning atmosphere.

.This questionnaire is not subject to a time limit. You will probably take 10 to 15 minutes. The accuracy of the results depends on the extent to which you can be honest. . Take time in answering the questions, preferably with work situations in mind. . Indicate how you actually act and think, and how you would behave. There are no right or wrong answers.

The questionnaire is based on a 4-scale:

For the most important statement put number 4, and for the least important put number 1. . Make sure you do not miss any statement.

Your answers will be treated as confidential, will only be included in the analysis of this study and will not be published anywhere without your personal consent

With all my thanks for your cooperation,

Aisha Othman,

PhD Researcher,

School of Computing and Engineering,

University of Huddersfield, UK

Appendix A1: The Lecturers and Lab Tours' Questionnaire (Q1)

QUESTIONAIRE

My name is Aisha Othman and I am a research student at the University of Huddersfield, UK doing a PhD project on using blended learning approach to improve the teaching and learning methods from Higher Education and create supportive, efficient learning atmosphere.Thank you for accepting to complete this questionnaire aiming to determine the skills gap between LBL (Lab Based Learning) and SBL (School Based Learning) for the Computer Science Department at the University of Omar Al-Mukhtar. You have been selected to participate at this survey because you are working or studying within Computer Science Department at the University of Omar Al-Mukhtar. Your answers will be treated as confidential, will be included only in this analysis of this study and will not be published anywhere without your personal consent**. Section A: PERSONAL DETAILS**

Gender: Male Female ☐

Age: 30-39 ☐ 40-49 ☐ More than 50 years ☐

Please tick to indicate your employment title:

Laboratory demonstrator ☐

Lecturer ☐

How many years have you been working/ studying at University of Omar Al-Mukhtar?

1-4 5-10 11-20 20+

☐ ☐ ☐

Section B: QUESTIONS: This section contains statements and you are asked to express your opinion against the statements on a scale of 1 – 5.

1- Strongly agree
2- Agree
3- Neutral
4- Disagree
5- Strongly disagree

No	Statement	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Dimension 1 – Cognitive Skills						
1	Students have ability to solve problem by using example					
2	Student is able to know the hardware concepts					
3	Student is able to understands perceptions and has knowledge of the Operating systems					
4	Student is able to understand Web development languages					
5	Student has enough knowledge about computing, science, and mathematic					
6	Student has enough knowledge in the cloud computing					
7	Student is able to understand the fundamentals of project management					
8	Student is able to ask questions and to develop their potential.					
9	Student is able to evaluate, interpret and gather a variety of complex information					
Dimension 2 –Soft Skills						
11	Student is able to understand the ethical responsibility					
12	Student is able to understand the importance of the time management					
13	Student is able to communicate with other effectively					

14	Student is able to understand the responsibility of the leadership principles, leader and attitudes					
15	Student is able to understand the business and university policy					
16	Student is able to work confidently and without hesitation using innovative methods of generating ideas, planning to reach the optimal solution optimization					
17	Student is able to start work individually and be motivated to achieve aims					
18	Student is able to participant activity in co-operation, team working and group discussion.					
19	Student is able to achieve hardworking with a good effort ethic.					
20	Student is able to communicate their ideas to other people					
21	Student is able to understand the security and safety rules and know more issues related antivirus, spam.					
22	Student is able to understand rules and copyright laws					
Dimension 3 –Hard Skills						
23	The ability to write programme in different languages					
24	The ability to solve problems by mathematical models					
25	Student is able to formulate, identify, and solve computer problems					
26	Student has internet access					
27	Student is able to understand the skills, modern					

	technology tools necessary for programming practice					
28	Student has enough knowledge about a specialized area linked to computer science					
29	Student has ability to apply practical work individually					
30	Student is able to use a variety of mathematical skills to solve problem.					
31	Student is able to apply a range of relevant social media as Skype, Facebook and have email to communication					

Section C – COMMENTS

This survey includes the opportunity for general comments because it is difficult to anticipate all the needs and concerns of lecturers, lab demonstrators and students.

Your suggestions are extremely valuable because it will help us to focus on the areas that need improvement.

1. Is there anything else you would like to tell us about your personal experience of attending lab classes related to computer programming?

....

2. If you could make one change to lab classes, what would it be?

....

3. What do you most like about the lab classes related to computer programming?

....

4. What do you least like (dislike) about the lab classes related to computer programming?

....

Any other comments about the areas that need improvement

………
……..

Appendix A2: The Students' Questionnaire (Q2)

My name is Aisha Othman and I am a research student at the University of Huddersfield, UK doing a PhD project on using a blended learning approach to Improve the teaching and learning methods in Higher Education to create a supportive, efficient learning atmosphere.

This questionnaire is not tied to a questionnaire. This not subject to a time limit. You will probably need 10 to 15 minutes. You will probably take 10 to 15 minutes. The accuracy of the outcome depends on the extent to which you can be honest. The accuracy of the results depends on the extent to all which you can be honest. If in answering the questions, preferably work situations in mind. Take time in answering the questions, preferably with work situations in mind. Indicate how you act in reality and think, and how you would like to behave. Indicate how you actually act and think, and how you would behave. You are no right or wrong answers. There are no right or wrong answers. If you agree with a statement, put a plus sign (+) to the question.

The questionnaire is based on a 4-scale:

For the most important statement whole number 4, and for the least Important pit number 1. Make sure you do not miss any statement.

Your answers will be treated as confidential, will only be included in the analysis of this study and will not be published anywhere without your personal consent

Section A: PERSONAL DETAILS

Gender: Male Female

Age: 20 -25 26-30 over 30

Section B: QUESTIONS

A (Accommodating)		B (Diverging)	C (Assimilating)	D (Converging)
1.In the delivery of a new programme	I am a practitioner.	I prefer to be doing things.	I find it difficult to find new ideas.	I am someone who likes to think a lot, before going to a lab.
2. When I am working on new digital tools and software,	I trust my feelings and hunches.	I work hard to get things completed.	I am dependent on logical thinking.	I like to be active.
3. My learning improves	If I'm in a new situation, where I am challenged, I am feeling rather than thinking Involved	If I'm in a new situation, where I am challenged, I am doing rather than working or looking on	If I am in a new situation, where I am challenged, I am thinking rather than feeling busy	Reflection speaks to me more than trying out new ideas.
4. I like the learning materials to include	Feeling.	Doing.	Thinking.	Watching
5.During the learning process,	I get involved.	Trying out new ideas speaks to me more than reflection.	I evaluate things.	I observe more than I talk.
6.During the learning process	Concrete experiences attract me more than abstract thinking.	The important thing is that something works in practice.	I like to break things into parts and analyse them.	I love work where I have time to revisit everything.
7. During the lab session	I search for new experiences.	I like to be active.	I prefer to go through a systematic approach.	I prefer to look at all aspects of the situation.
8.During the classroom sessions	I study with my friends.	I write my own notes.	I use my examples and imagination.	I do simulation work.
9. I like	Group discussion learning style.	Questions and answers.	Self-study/	On-line learning style.

10.When I am explaining something to someone, I prefer to use	Videos.	Pictures.	Animations.	Experiments
11.I am usually in discussion	In discussions, I am often a source of new ideas.	I reflect on my observations.	In conversations with others, I am usually the one that is most neutral and objective.	When I hear about a new idea or a new approach, I immediately start to work out, in practice, the application.
12. I like this style for learning	Group discussion style.	Guest speakers.	Example.	Questions and answers style.
13 I like this activity when the lecturer is introducing new ideas	Problem solving activities.	Group activities.	Pictures and videos.	Practical sessions.
14.During a practical session in the workshop	I talk more than I listen.	Upon hearing a new idea, I start thinking immediately how it would work in practice.	Giving examples and ideas.	I like to try things out to see if they work in practice.
15.During a class discussion, I tend to	Active in group work.	Observe and watch situation.	Reading theories and producing ideas.	Able to realise and touch objects.
16. I tend to say that	Explain the practical instructions.	I am often able to see a better practical way to see how something needs to be done.	Let me think about how to do it.	Let me try it out.

17. In group discussion, I like to be	Participate and explain things out.	I like watching things.	Be active and excited.	In discussions or meetings, I think it's nice to see how the other participants are doing.
18. When I am a member of group work	I like using my experience.	In conversations or meetings I wear practical achievable ideas.	I prefer to think to get new ideas.	I judge ideas on their practical value.
19. When I am learning a new skill, I prefer to	I like to work with my colleague.	With large groups.	Individual learning style.	In small groups.
20.Learning environment	I like to work in a large classroom.	I like to work with groups.	Small classroom.	Workshops.

Appendix A3: The Lecturers and Lab tutors' Questionnaire1 Results.

No	Evaluate the Cognitive Skills of the student and effectiveness in the lab and classroom by lecturers	Frequencies				T-Test		
1	Students have ability to solve problem by using example	2.03	Strongly agree	43.3	13	0.000	1.299	.237
2	Student is able to know the hardware concepts	1.86	Strongly agree	46.7%	14	0.000	1.666	.212

3	Student is able to understands perceptions and has knowledge of the Operating systems	1.86	Strongly agree	46.7%	14	0.000	1.166	.212
4	Student is able to understand Web development languages	2.00	Strongly agree	43.3%	13	0.000	1.286	.234
5	Student is able to apply knowledge computing, science, and mathematic	1.96	Strongly agree	43.3	13	0.000	1.217	.222
6	Student is able to apply knowledge in the cloud computing	1.93	Strongly agree	43.3%	13	0.000	1.172	.214
7	Student is able to understand the fundamentals of project management	1.93	Agree	46.7%	14	0.000	1.142	.208
8	Student is able to ask questions and to develop their potential.	1.90	Strongly agree	46.7%	14	0.000	1.241	.226
9	Student is able to evaluate, interpret and gather a variety of complex information	1.86	Strongly agree	46.7%	14	0.000	1.166	.212
	Total first axis	1.9256	Agree			0.000		

	Evaluate the soft Skills of the student and effectiveness in the lab and classroom by lecturers	Frequencies				T-Test		
		Mean	General trend	percentage	Frequency	Sig	St. Deviation	Std. Error
10	Student is able to understand the ethical responsibility	4.26	Disagree	53%	16	0.000	.784	.1433
11	Student is able to understand the importance of the time management	4.16	Disagree	46%	14	0.000	.912	.1666
12	Student is able to communicate with other effectively	4.33	Strongly disagree	46%	14	0.000	.785	.1384
13	Student is able to understand the responsibility of the leadership principles, leader and attitudes.	4.23	Strongly disagree	46%	14	0.000	.971	.1773
14	Student is able to understand the business and university policy	4.03	Strongly disagree	40%	12	0.000	1.098	.2004
15	Student is able to work confidently and without hesitation using innovative methods of generating ideas, planning to reach the optimal solution optimization	4.23	Strongly disagree	46%	14	0.000	.971	.1773
16	Student is able to start work individually and be motivated to achieve aims	4.16	Strongly disagree	50%	15	0.000	1.116	.2038

17	Student is able to participant activity in co-operation, team working and group discussion.	4.20	Disagree	46%	14	0.000	.996	.1819
18	Student is able to achieve hardworking with a good effort ethic.	4.26	Strongly disagree	46%	14	0.000	.944	.1724
19	Student is able to communicate their ideas to other people	4.23	Strongly disagree	46%	14	0.000	.935	.1707
20	Student is able to understand the security and safety rules and know more issues related antivirus, spam.	4.10	Strongly disagree	43%	13	0.000	1.093	.1997
21	Student is able to understand rules and copyright laws	3.70	Disagree	36%	11	0.007	1.317	.2404
22	Student is able to understand rules and copyright laws	3.96	Strongly disagree	43%	13	0.000	1.272	.2323
	Total first axis	4.16	Strongly disagree			0.007		

No	Evaluate the soft Skills of the student and effectiveness in the lab and classroom by Laboratories demonstrator	Frequencies				T-Test		
		Mean	General trend	percentage	Frequency	Sig	St. Deviation	Std. Error Mean
10	Student is able to understand the ethical responsibility	2.45	Agree	30 %	10	.108	1.50	.33619
11	Student is able to understand the importance of the time management	1.70	Agree	50 %	8	.000	.923	.20647
12	Student is able to communicate with other effectively	2.05	Agree	40 %	8	.003	1.23	.27601
13	Student is able to understand the responsibility of the leadership principles, leader and attitudes	2.15	Agree	45 %	9	.009	1.30	.29267
14	Student is able to understand the business and university policy	2.05	Agree	45 %	9	.005	1.35	.30327
15	Student is able to work confidently and without hesitation using innovative methods of generating ideas, planning to reach the optimal solution optimization	2.05	Agree	45 %	9	.005	1.35	.30327
16	Student is able to start work individually and be motivated to achieve aims	1.50	Strongly agree	50 %	10	.000	.512	.11471
17	Student is able to participant activity in co-operation, team working and group discussion.	2.35	Strongly agree	40 %	8	.091	1.63	.36473

18	Student is able to achieve hardworking with a good effort ethic.	2.00	Agree	45%	9	.002	1.25	.28098
19	Student is able to communicate their ideas to other people	2.05	Agree	50%	10	.003	1.23	.27601
20	Student is able to understand the security and safety rules and know more issues related antivirus, spam.	2.20	Strongly agree	35%	7	.009	1.23	.27720
21	Student is able to understand rules and copyright laws	1.50	Agree	50%	10	.000	.512	.11471
22	Student is able to understand rules and copyright laws	1.65	Agree	55%	11	.000	.587	.13129

No	Evaluate the Hard Skills of the student and effectiveness in the lab and classroom by Laboratories	Frequencies				T-Test		
		Mean	General trend	percentage	Frequency	Sig	St.Deviation	Std.Error Mean
23	Student have ability to use best practice in information technology	4.300	Disagree	50%	10	0.000	.656	.14690
24	Student is able to conduct project and design system as well as interpret and analysis data	4.400	Disagree	60%	12	0.000	.502	.11239
25	Student is able to formulate, identify, and solve computer problems	1.500	Disagree	50%	10	0.000	.512	.11471
26	Student is able to understand data base and computer network	4.350	Disagree	55%	11	0.000	.587	.13129
27	Student is able to understand the skills, modern technology tools necessary for programming practice	1.500	Disagree	50%	10	0.000	.512	.11471
28	Student is able to apply knowledge in a specialized area linked to computer science	4.300	Disagree	50%	10	0.000	.656	.14690
29	Student has ability to apply practical work individually	4.350	Disagree	55%	11	0.000	.587	.13129
30	Student is able to use a variety of mathematical skills to solve problem.	4.350	Disagree	55%	11	0.000	.587	.13129
31	Student is able to apply a range of relevant software applications to interpret and store information	4.350	Disagree	65%	13	0.000	.489	.10942
	Total first axis	3.71	Disagree			0.000	.656	.14690

No	Evaluate the Cognitive Skills of the student and effectiveness in the lab and classroom by Laboratory Demonstrators	Frequencies				T-Test		
		Mean	General trend	percentage	Frequency	Sig	St.Deviation	Std.Error Mean
1	Students have ability to solve problem by using example	4.20	Strongly disagree	55%	11	0.000	1.19	.267
2	Student is able to know the hardware concepts	4.45	Strongly disagree	60%	12	0.000	.944	.211
3	Student is able to understands perceptions and has knowledge of the Operating systems	4.40	Strongly disagree	60%	12	0.000	.940	.210
4	Student is able to understand Web development languages	4.20	Strongly disagree	55%	11	0.000	1.19	.267
5	Student is able to apply knowledge computing, science, and mathematic	3.50	disagree	35%	7	0.135	1.43	.320
6	Student is able to apply knowledge in the cloud computing	3.95		55%	11	0.009	1.46	.328
7	Student is able to understand the fundamentals of project management	4.05	disagree	45%	9	0.001	1.19	.266
8	Student is able to ask questions and to develop their potential.	3.80	disagree	50%	10	0.004	1.10	.247
9	Student is able to evaluate, interpret and gather a variety of complex information	4.10	Strongly disagree	60%	12	0.000	.640	.143

Appendix B: The Students' Questionnaire 2 Results.

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Accommodating	5.659	19	.000	5.50000	3.4656	7.5344
Diverging	10.825	19	.000	22.55000	18.1900	26.9100
Assimilating	16.711	19	.000	26.15000	22.8747	29.4253
Converging	3.651	19	.002	5.80000	2.4747	9.1253

Table: Compare means

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Accommodating	20	5.5000	4.34681	.97198
Diverging	20	22.5500	9.31595	2.08311
Assimilating	20	26.1500	6.99831	1.56487
Converging	20	5.8000	7.10522	1.58878

Table : All activities percentage

Group Statistics					
	Gender	N	Mean	Std. Deviation	Std. Error Mean
Learning activity 1	Male	19	3.21	.713	.164
	Female	41	3.27	.549	.086
Learning activity 2	Male	19	2.37	.761	.175
	Female	41	2.41	.836	.131
Learning activity 4	Male	19	2.95	.705	.162
	Female	41	3.00	.837	.131
Learning activity 3	Male	19	3.11	.809	.186
	Female	41	2.46	.809	.126
Learning activity 5	Male	19	2.42	.692	.159
	Female	41	2.39	.666	.104
Learning activity 6	Male	19	2.32	.671	.154
	Female	41	2.32	.756	.118
Learning activity 7	Male	19	3.37	.597	.137
	Female	41	3.29	.512	.080
Learning activity 8	Male	19	2.26	.806	.185
	Female	41	2.39	.771	.120
Learning activity 9	Male	19	1.89	.737	.169
	Female	41	2.07	.755	.118
Learning activity 10	Male	19	3.21	.713	.164
	Female	41	3.10	.664	.104

Learning activity 11	Male	19	2.1053	.87526	.20080
	Female	41	2.1463	.69141	.10798
Learning activity 12	Male	19	2.4211	.69248	.15887
	Female	41	2.6341	.48765	.07616
Learning activity 13	Male	19	2.3684	.83070	.19058
	Female	41	2.3171	.75627	.11811
Learning activity 14	Male	19	2.6316	.68399	.15692
	Female	41	2.4390	.97593	.15241
Learning activity 15	Male	19	2.6842	.58239	.13361
	Female	41	2.4634	.55216	.08623
Learning activity 16	Male	19	2.5789	.69248	.15887
	Female	41	2.5122	.50606	.07903
Learning activity 17	Male	19	2.3158	.67104	.15395
	Female	41	2.4634	.55216	.08623
Learning activity 18	Male	19	2.1579	.83421	.19138
	Female	41	2.3415	.76190	.11899
Learning activity 19	Male	19	2.5789	.60698	.13925
	Female	41	2.5854	.54661	.08537
Learning activity 20	Male	19	2.1053	.73747	.16919
	Female	41	2.2927	.60183	.09399

Table 6:Independent Samples Test

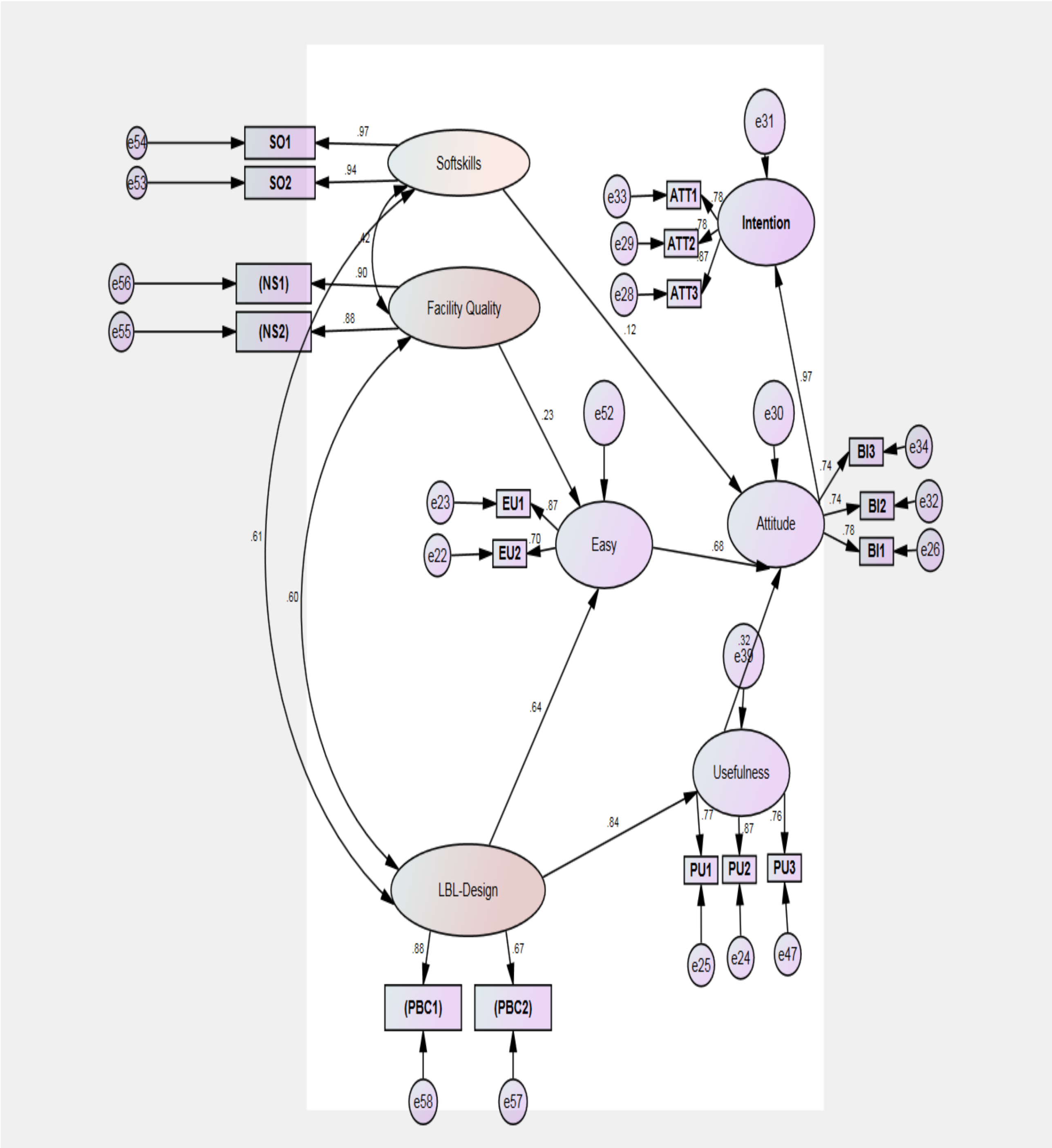
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of	
									Lower	Upper
	Equal variances assumed	1.754	.191	-.344	58	.732	-.058	.168	-.394	.278
	Equal variances not assumed			-.313	28.274	.757	-.058	.185	-.436	.320
Learning activity 2	Equal variances assumed	.334	.566	-.205	58	.839	-.046	.226	-.498	.406
	Equal variances not assumed			-.212	38.366	.833	-.046	.218	-.487	.395
Learning activity 4	Equal variances assumed	.879	.352	-.238	58	.813	-.053	.222	-.496	.391
	Equal variances not assumed			-.253	41.253	.801	-.053	.208	-.472	.367
Learning activity 3	Equal variances assumed	.082	.775	2.858	58	.006	.642	.225	.192	1.091
	Equal variances not assumed			2.858	35.149	.007	.642	.225	.186	1.098
Learning activity 5	Equal variances assumed	.090	.765	.165	58	.870	.031	.187	-.344	.406
	Equal variances not assumed			.162	33.945	.872	.031	.190	-.355	.417
Learning activity 6	Equal variances assumed	.266	.608	-.006	58	.995	-.001	.203	-.407	.405
	Equal variances not assumed			-.007	39.299	.995	-.001	.194	-.394	.391
Learning activity 7	Equal variances assumed	1.591	.212	.505	58	.615	.076	.150	-.224	.376
	Equal variances not assumed			.477	30.745	.636	.076	.159	-.248	.399
Learning activity 8	Equal variances assumed	.183	.671	-.586	58	.560	-.127	.217	-.561	.307
	Equal variances not assumed			-.576	33.768	.568	-.127	.221	-.575	.321
Learning activity 9	Equal variances assumed	.031	.860	-.858	58	.394	-.178	.208	-.595	.238
	Equal variances not assumed			-.865	35.904	.393	-.178	.206	-.597	.240
Learning activity 10	Equal variances assumed	1.217	.275	.599	58	.551	.113	.189	-.264	.490
	Equal variances not assumed			.583	32.946	.564	.113	.194	-.281	.507
Learning activity 11	Equal variances assumed	.308	.581	-.196	58	.845	-.04108	.20906	-.45955	.37740
	Equal variances not assumed			-.180	28.831	.858	-.04108	.22799	-.50749	.42533
Learning activity 12	Equal variances assumed	7.046	.010	-1.373	58	.175	-.21309	.15522	-.52381	.09762
	Equal variances not assumed			-1.210	26.592	.237	-.21309	.17618	-.57484	.14865
Learning activity 13	Equal variances assumed	.265	.609	.237	58	.813	.05135	.21651	-.38204	.48474
	Equal variances not assumed			.229	32.336	.820	.05135	.22421	-.40516	.50786
Learning activity 14	Equal variances assumed	5.191	.026	.775	58	.442	.19255	.24855	-.30496	.69007
	Equal variances not assumed			.880	48.542	.383	.19255	.21875	-.24715	.63226
Leraning activity 15	Equal variances assumed	.078	.780	1.416	58	.162	.22080	.15589	-.09126	.53285
	Equal variances not assumed			1.388	33.503	.174	.22080	.15902	-.10255	.54414
Learning activity 16	Equal variances assumed	5.733	.020	.422	58	.675	.06675	.15832	-.25016	.38367
	Equal variances not assumed			.376	27.261	.710	.06675	.17744	-.29716	.43067
Learning activity 17	Equal variances assumed	.819	.369	-.899	58	.372	-.14763	.16419	-.47629	.18104
	Equal variances not assumed			-.837	29.750	.409	-.14763	.17645	-.50812	.21287
Learning activity 18	Equal variances assumed	.036	.851	-.843	58	.403	-.18357	.21787	-.61969	.25255
	Equal variances not assumed			-.815	32.425	.421	-.18357	.22536	-.64237	.27523
Learning activity 19	Equal variances assumed	.190	.665	-.041	58	.968	-.00642	.15709	-.32087	.30803

Appendix C: Table - Learning Activities Based on Lab Skills Model

	Indicator Students must demonstrate that they can		Fundamental Knowledge (Assure Model)						Soft skills			Hard Skills		
			ST	OR1	OU2	OA3	OAN 4	OS5 & OE6	Social Networking SET	Teamwork and Problem Solving TPS	Software Competitions SCO	Technical (Core) Skills TS	Technical and Academic Skills TA	Specific Task-Related Skills STR
Case Study 1	Week 1	Cover the effective knowledge and information about the LBL module	×	×	×				×	×		×		×
Introduction to HTML Language	Week 2	Design Website using attributes ,and main elements that introduced in HTML	×			×	×		×	×	×		×	×
	Week 3	Learn basic HTML coding, will learn what this is, and how to code it			×		×		×	×		×	×	×
Case Study 2	Week4	Design simple Website by Dreamweaver software. Develop students" soft skills, including communication skills, and decision making.	×					×		×				
	Week5	Introduction to Cascading Style Sheets. To improve the look of your web pages by adding CSS to enhance them.				×		×			×	×	×	×
	Week6	Define and use variables, perform looping and branching, develop user interfaces, capture and validate user input, store data, and create well-structured applications.		×				×		×	×	×	×	×
Case Study 3	Week7	Design the website in interactive and make pretty things for interface design. Improve students" hard skills.						×						
	Week8	Contribute in decision making and solving problems during the lab work.			×			×	×	×	×	×	×	×
	Week9 -10	Online quiz at the end of the module write a report evaluation their experience	×	×		×		×	×	×	×	×	×	×

-

Appendix E 1: The conceptual model in AMOS (Structural Equation Modelling)



Appendix E2: the questionnaire 3 (TAM)

Construct	Item	Question
Perceived Ease of Use	**EU1**	My interaction with LBL module is understandable and clear.
	EU2	I found the LBL module easy to use and easy to get materials.
Perceived Usefulness (PU)	**PU1**	Using the LBL module will ...make it easier to learn practical work in the lab.
	PU2	..Increase my learning performance and improve my effectiveness in programming language.
	PU3	.....could improve my learning productivity by using this system
Usage Behaviour(UB)	**BI1**	The LBL module for learning practical work is a good idea to learn the fundamental knowledge before go to lab.
	BI2	I believe, it's a wise idea of using LBL module to get theoretical materials.
	BI3	LBL module is pleasant idea to understand practical work.
Behavioural intention (BI)	**ATT1**	I intend to use the LBL module and downloading lecture notes to learn theoretical materials.
	ATT2	I intend to use the LBL module in the next semester.
	ATT3	overall, my plan to use LBL module frequently for learn other activities and learn practical work in the next semester

performance experience	**SO1** **SO2**	In general, I am satisfied with my online experience which I had it before. My Previous Online Learning Experience was good.
Facility Quality	**NS1** **NS2**	In general, I am satisfied with the internet availability to display the LBL module. General, facility services for operating the system are acceptable
LBL-Design	**PBC 1** **PBC 2**	In general, I am satisfied with the design of the interface of this website The web site allows me to display content in the right way in all types of devices