THE DEVELOPMENT AND USABILITY EVALUATION OF AN INDEPENDENT LEARNER COURSEWARE FOR WEB BASED LEARNING ENVIRONMENT (ILC-WBLE)

By

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ABSTRACT

THE DEVELOPMENT AND USABILITY EVALUATION OF AN INDEPENDENT LEARNER COURSEWARE FOR WEB BASED LEARNING ENVIRONMENT (ILC-WBLE)

Hoh Ming Chee

Today, many Malaysian higher educational institutions have progressively integrated Computer-Based Learning (CBL) courseware into the curriculums as a supplement to traditional instruction. An interactive multimedia based CBL courseware with multimedia learning objects, user control over the delivery of information, and interactivity has the capability to create independent learning environments. This research aims to develop a prototype of an interactive multimedia CBL courseware and evaluate its usability among UTAR lecturers and students. Two different sets of usability evaluation questionnaires were created to measure the perceptions of UTAR lecturers and students toward the usability of ILC-WBLE. These two sets of questionnaires were made up of five research constructs (i.e. easy to use, easy to learn, level of interactivity, user interface design, and error-free assessment). Based on Nielsen's 10 usability heuristics, five statements were built into each research construct which were measured using the 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The findings of data analysis showed a high level of agreement among respondents in which the mean values ranged between 3.7 to 4.7 for lecturers and 3.6 to 4.3 for students.

Furthermore, the research also had identified a number of strengths and weaknesses of the prototype of ILC-WBLE through users' feedback and their ratings of agreement with the five statements built into each usability measured constructs.

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FACULTY OF ENGINEERING AND SCIENCE

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Date: 19th JULY 2013

SUBMISSION OF DISSERTATION

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I understand that University will upload softcopy of my dissertation in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,

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APPROVAL SHEET

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LIST OF ABBREVIATIONS

ADDIE	Analysis Design Development Implementation Evaluation
CAL	Computer-Assisted Learning
CBL	Computer-Based Learning
CD-ROM	Compact Disk – Read Only Memory
CMS	Course Management System
DVD	Digital Versatile Disc
EFA	Error-free assessment
ETL	Easy to learn
ETU	Easy to use
F2F	Face-to-face
GNU	GNU's Not Unix
GUI	Graphical User Interface
HCI	Human-computer interaction
HEI	Higher education institution
ID Model	Instructional Design Model
ILC-WBLE	Independent Learner Courseware for Web-Based Learning Environment
ISD	Instructional System Design
LAMS	Learning Activity Management System
LMS	Learning Management System
LOI	Level of Interactivity
MMLS	Multimedia Learning System

MMU	Multimedia University
Moodle	Modular Object-Oriented Dynamic Learning Environment
OUM	Open University Malaysia
PPPJJ	Pusat Pengajian Pendidikan Jarak Jauh
SDE	School of Distance Education
SCORM	Sharable Content Object Reference Model
UID	User interface design
USM	Universiti Sains Malaysia
UTAR	Universiti Tunku Abdul Rahman
WBLE	Web-Based Learning Environment
WWW	World Wide Web

CHAPTER 1

INTRODUCTION

1.1 Introduction

Learning should not be limited to traditional face-to-face (F2F) instruction; the traditional F2F instruction mode leaves little room for personalisation, customisation, and pace adjustment. The advancement of digital technologies have revolutionised the notion of teaching and learning. Kop et al. (cited in Shafie and Mansor 2009, p. 69) asserted that teaching in the digital age is no longer telling, and learning is no longer listening. Digital learning, or online education, allows students to learn at any time, any place, and any pace, through any path. Shafie and Mansor (2009) noted that "the ideal learning environments for digital learners are rich learning environments that enable and support learners to learn independently and collaboratively" (p. 70).

Nowadays, many higher institutions are implementing blended learning. At the same time of delivering knowledge and information of a subject through traditional F2F classes such as lecture or tutorial, learning materials can be further converted into online digital learning materials which can be accessed by students at home through the Internet. Garrison and Kanuka (2004) pointed out that blended learning is an effective and low-risk

strategy that enables lecturers in universities to facilitate in teaching-learning process. In this regard, Learning Management System (LMS) is an online platform used to centralise learning materials by lecturers within an institution.

LMS is a systematic system that manages and monitors the entire learning process, including centralising learning resources and keeping track the learning progress and performance of students (Szabo and Flesher 2002; Rapuano and Zoino 2006; Watson and Watson 2007). Different tools such as discussion forums, file sharing, management of assignments, lesson plans, syllabus, chat, and so forth are integrated into a single LMS (i.e. Blackboard, WebCT, and Moodle), which is used to manage and organise all learning activities and materials in a course (Dalsgaard 2006). LMS can be employed to share the learning materials to students.

Alternatively, a Computer-Based Learning (CBL) system can be used to deliver knowledge or information of a particular subject to students. Typically, a CBL system consists of multimedia learning objects used to explain the contents of the subject within the system. CBL frees learning from time and space constraints, as students are able to learn a particular subject through accessing the system by using their own computers.

In addition, Mayer (2003) claimed that learning occurs by implementing multimedia objects such as words, narration, pictures or animation, since students could build mental representation or visualisation from the multimedia objects which are presented to them. According to Tech-

FAQ (2012), the human brain learns by using many senses such as sight and hearing, thus a teaching consisting of images and animations could help learner retain information much more effectively. Hence, it is genuinely believed that learning which constitutes of multimedia objects is able to make students learn more deeply compared to traditional modes of communication which involves only words (Mayer 2003). Therefore, the implementation of CBL in teaching and learning is definitely a sensible decision in improving the understanding of students towards a particular subject.

This research aims to develop a prototype of an interactive multimedia CBL courseware and evaluate its usability among UTAR lecturers and students. Eventually, its strengths and weaknesses are identified based on the results obtained from the usability evaluation study.

1.2 Research Background

Moodle (Modular Object-Oriented Dynamic Learning Environment) is one of the popular Web-Based Learning Environment systems widely used in education (Dougiamas and Taylor 2003; Rice IV 2007). Universiti Tunku Abdul Rahman (UTAR) is currently using a LMS known as Moodle to create a resource website called WBLE (**W**eb-**B**ased **L**earning **E**nvironment), which is available at http://wble.utar.edu.my. It serves as a platform to facilitate the teaching-learning activities at UTAR since year 2005. It also acts as the medium of communication for off-campus discussion between lecturers and

students of the university. Figure 1.1 shows the index page of WBLE.

Figure 1.1: Screenshot from the index page of WBLE

WBLE is essentially a course management system for lecturers to manage their course materials. It enables lecturers to upload instructional materials and post course-related documents/ announcements for the use of students. Currently, there are approximately 15 thousands users of WBLE in UTAR across few campuses which are located at Kampar (main campus) as well as Petaling Jaya, Setapak and Sungai Long (Klang Valley campuses).

However, through informal interviews with lecturers and students, it was revealed that not all the features available in WBLE have been explored or used to assist lecturers and students in teaching and learning. The common features of WBLE include the following:

- **Learning Materials Management:** This feature allows lecturers to upload course materials such as lecture notes,

tutorial questions, brief notes of assignments and so forth on WBLE. Students can access and download these materials anytime.

- **Announcements:** The announcement feature enables lecturers to post and manage and post-course related announcements. Students could easily obtain up-to-date course information from here anytime.
- **Grades Listing:** This feature allows students to keep track their latest coursework marks of subjects posted by lecturers especially when an online quiz has been carried out using WBLE.
- **Personal Profile and blog:** Blogging is a trend in this era; most Internet users own a personal blog. For students and lecturers who like to share their thinking, this is the good platform for them to share their personal thoughts.
- **Calendar:** This feature enables lecturers to post course-related activities and upcoming events such as submission date of assignments, presentation dates, and any other course-related notifications.

1.3 Problem Statement

As mentioned in previous section, WBLE is an existing LMS at UTAR. It was created for the management of course materials such as the sharing of

instructional materials, monitoring of the coursework marks of students and so forth. WBLE is a comprehensive system embedded with an abundance of useful features in facilitating the teaching-learning process. Nevertheless, the masses of features embedded in WBLE are always neglected by users, especially the lecturers.

Through the informal interviews with lecturers and students, most of the lecturers are merely utilising WBLE as a tool to manage instructional materials such as uploading lecture notes, assignment briefs and so forth. Meanwhile, students are found to access WBLE purely for the intention of downloading instructional materials uploaded by lecturers.

Furthermore, it is impossible for the lecturers to create their own instructional materials directly in WBLE; creation of learning materials must be done using other systems or software. In this aspect, WBLE could only allow lecturers to upload instructional materials which are created by using other software such as word processing software (e.g. Microsoft Word) or presentational graphics software (e.g. Microsoft Power Point). Direct sharing of multimedia learning objects such as images, audio, video, or animation is an impractical thing to be done in WBLE as it could mess up the overall interface of the subject in the system.

Undeniably, WBLE is a powerful system embedded with plenty of features used to facilitate teaching-learning process, including the creation of online quizzes. Most of the time, lecturers purely wish to create simple online

quizzes for the purpose of allowing students to evaluate own level of understanding towards the subject. Unfortunately, employing the online quizzes feature in WBLE is time-consuming and problematic as there are too many parameters which need to be set in order to create any online quizzes in WBLE. Lecturers are therefore mentally discouraged from creating online quizzes due to the complicated procedures.

The proposed courseware, i.e. ILC-WBLE, is embedded with online quizzes feature, in which quizzes can be created for a particular subject as interactive exercises for students. There are three types of online quizzes, namely multiple choices, fill in the blanks, and drag and drop, which can be created in ILC-WBLE. Methods used to create online quizzes in ILC-WBLE are rather simple and straight-forward compared to WBLE.

As described in the previous section, WBLE is created using Moodle. Open-source systems such as Moodle are often criticised to be useful or user-friendly only to IT experts, but are way too complicated for novice users such as teachers or educational instructors (Chavan and Pavri 2004). On the contrary, ILC-WBLE is an easy-to-use, simple and yet informative courseware. Time management is the managing of time for a person's advantage; it provides chance to spend time on the most valuable resource in the way a person chooses (University Learning Centers 2001). In order to share information of a particular subject to their students, lecturers do not need to spend too much time to adapt to ILC-WBLE, which is unlike WBLE which is deemed too complicated for novice users. Lecturers will thus have more

quality time to spend on solving students' problems and meeting students' demands.

1.4 Research Objectives

The research aims to achieve the following four objectives:

i. To design and develop an appropriate Instructional Design (ID) model which is deemed suitable for developing an interactive multimedia CBL courseware called ILC-WBLE (**I**ndependent **L**earning **C**ourseware for **W**eb-**B**ased **L**earning **E**nvironment).

ii. To develop a prototype of ILC-WBLE.

iii. To evaluate the usability of the prototype of ILC-WBLE.

iv. To identify the strengths and weaknesses of the prototype of ILC-WBLE.

1.5 Research Scope

With reference to the research objectives outlined in previous section, the research scope encompasses activities as follows:

i. The development of a prototype of ILC-WBLE. It includes the design and development of an ID model which is adapted from ADDIE model and modules design model, as well as the

development of a prototype of ILC-WBLE. The development scope of the prototype is described in detail in section 1.5.1.

ii. The usability evaluation of the prototype of ILC-WBLE.

1.5.1 The Development of a Prototype of ILC-WBLE

The development of ILC-WBLE in this research aims to produce a learning tool as a complement to WBLE. The contents of ILC-WBLE can be tailored based on the needs of users, specifically the lecturers.

The advancement of Graphical User Interfaces (GUI) and rich features of multimedia software such as Adobe Director (previously known as Macromedia Director), Adobe Flash (previously known as Macromedia Flash), and Microsoft Power Point have significantly increased the expectation of users. In general, users no longer tolerate the simple GUI and linear interaction implied in any system. Users expect to encounter multi-interaction with more attractive interfaces.

A text-intensive courseware with minimal amount of graphics or animation is lack of excitement and has caused reluctance of users in using it. Sometimes, designers do put some effort in making a courseware interesting by integrating various types of graphics into the courseware, but it is not always properly presented – graphics included without any meaning in the courseware are considered redundant. Every single graphic and illustration inserted into courseware must have its own implication, not merely for

decoration purpose. For example, illustrations included should incorporate with the design layout of the courseware and types of graphics must suit the learning contents. Moreover, if there are too many unnecessary graphics, these will disturb the view of users.

Apart from the improvement of the user interface and graphics applied in courseware, the implementation of interactivity in a specific courseware should be paid attention as well in order to create an interesting yet interactive ILC-WBLE. According to Chou (2003), implementation of interactivities in any courseware should require the understanding of the user's needs and the precise application of instructional design with an appropriate graphical user interface. Therefore, study of the methods used to create an interactive, instructional, and effective courseware is critical for the purpose of producing a valuable courseware that is recognised by professional practitioners.

Unlike WBLE, ILC-WBLE is embedded with dynamic multimedia content creation feature which allows lecturers to create interactive instructional materials for a subject in a systematical format of pages, which ingeniously avoids causing untidiness in the system. Multimedia learning objects (such as text, images, graphics audio, animation, and video) and quizzes (in the form of multiple choices, fill in the blanks, and drag and drop) are the learning objects or instructions that could be integrated into the learning materials in ILC-WBLE. Incorporating multimedia learning objects and implementing quizzes into the learning materials not only enrich the learners' learning experience, the level of understanding of learners towards

the particular subjects could also be enhanced. It should be noted that ILC-WBLE is not designed to substitute the existing LMS at UTAR (i.e. WBLE), which is normally used to monitor students' learning progress. ILC-WBLE is intended to be utilised as an interactive multimedia CBL courseware used to teach or coach the students on certain subjects or topics.

The development scope of ILC-WBLE is summarised to include the following aspects:

- **Enhanced Interface Design**: ILC-WBLE is integrated with familiar icons and buttons that can be incorporated with the contents of the system and design layout to facilitate teaching and learning process.
- **Variety of Interactivity**: Interaction more than just clickable object or linear sequencing interaction will be inserted into ILC-WBLE. These interactions are such as answering question by drag and drop the relevant word to the particular question or answering the question by filling in the answer in the blank area.
- **Dynamic content creation**: Contents in the newly-developed ILC-WBLE can be altered or inserted with new information and consequently it becomes a brand new learning module for students to learn. This can be added by lecturers/ administrators anytime and anywhere as long as there is access to Internet and ILC-WBLE.

1.5.2 The Usability Evaluation of a Prototype of ILC-WBLE

A usability evaluation study is then conducted in the research to identify whether ILC-WBLE is feasible in assisting UTAR lecturers and students in the teaching-learning process. The usability evaluation study includes five research constructs: (i) easy to use, (ii) easy to learn, (iii) level of interactivity, (iv) user interface design, and (v) error-free assessment. Two sets of usability evaluation questionnaires are used to evaluate the usability of ILC-WBLE among two different categories of participants, i.e. lecturers and students.

Due to time and budget constraints, the usability evaluation study is limited to lecturers and students at UTAR main campus which is located at Kampar, Perak. In addition, based on user feedbacks from the usability evaluation, the strengths and weaknesses of the prototype of ILC-WBLE are identified.

1.6 Research Framework

The research was conducted based on a research framework as shown in Figure 1.2 which is split into four phases.

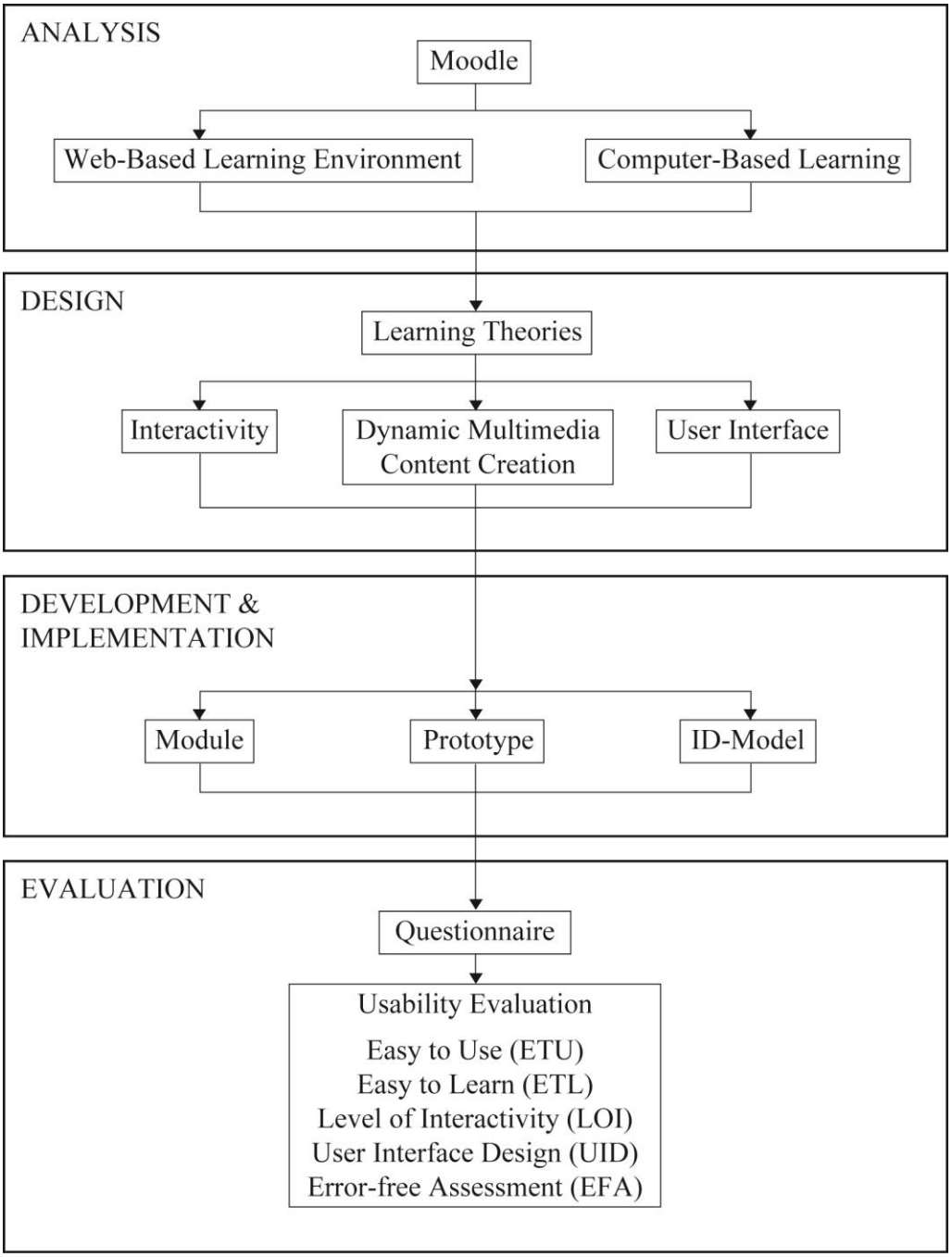

Figure 1.2: Research Framework

As can be perceived through Figure 1.2, the research was implemented in four phases as follows:

- **Analysis**: This phase comprises the studies on existing Moodle at Malaysian higher education institutions which adopted the

fundamental features of Web-Based Learning Environment and Computer-Based Learning.

- **Design**: Studies on learning theories is conducted in second level, in which scope of research is designed based on the studies carried out in this phase.
- **Development and Implementation**: The development of Instructional Design (ID) model, modules design model and storyboards are designed in this phase.
- **Evaluation**: This phase involves the usability evaluation of ILC-WBLE among lecturers and students from Centre for Foundation Studies in UTAR, Perak Campus.

1.7 Definition of Terms

Several terms used in the research are defined in this section.

1.7.1 Moodle

Moodle is provided freely as open source Course Management System (CMS). It is also known as Learning Management System (LMS) under the GNU Public License. Moodle is a tool for instructors to create online dynamic web sites and produce Internet-based courses for their students. The word "Moodle" was originally an acronym for Modular Object Oriented Dynamic Learning Environment (*Moodle* 2012).

There are a significant numbers of institutions that use Moodle as communication tool between instructors and students; higher institutions such as Universiti Teknologi Malaysia, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia and Secondary institutions such as Sekolah Menengah Kebangsaan Damansara and Sekolah Seri Puteri are using Moodle to facilitate instructors and students (*Moodle* 2012).

1.7.2 Computer-Based Learning

Computer-Based Learning (CBL), also known as Computer-Assisted Learning (CAL), is an aid or support in education or training of people. The system can test achievement at any point, provide faster or slower routes through the material for people of different aptitudes, and lastly maintain a progress record for the instructor (Daintith 2004).

The advent of CBL was in the 1980's when computers were becoming more readily used in commercial and educational institutions. CBL is increasingly used to enhance learning experience and valuable learning for students, and providing teaching resource for instructors (Overfield and Bryan-Lluka 2003). CBL has evolved into many different levels and forms and it is used in all levels of education, from elementary to higher institution.

Learning process is not limited to taking place in a classroom. In this regard, with the assistance of CBL, learning process can occur through computer as well. CBL is indeed a courseware designed for the purpose of

self-learning and at the same time enriches the learning process.

1.7.3 WBLE

The use of Web as an educational tool provided learners with wider range of new and interesting learning experiences and teaching environment that is not possible in traditional classroom education (Khan 1997). With the advancement of Web technology, many instructors are becoming interested in using Web-Based Learning Environment, where the Web enhances access to experts and real-time data while enabling multiple forms of communication among the learners (Herrington and Oliver 2000). Instructors update the teaching materials, notes or assignments and learners access to the most updated information in real-time. Without any boundaries and time constraints, Web-Based Learning Environments are accessible anytime and anywhere as long as there is connection to the Web.

WBLE is abbreviation of Web-Based Learning Environment, in which it is an online system for educational usage purpose. The word "WBLE" used in this research is representing the Web-Based Learning Environment system of UTAR in facilitating the teaching-learning process between lecturers and students. It can be accessed at http://wble.utar.edu.my but only available for internal usage. Features included in WBLE encompass learning material management, announcement, grades listing, personal profile and blog, and lastly calendar as described in section 1.2.

1.7.4 Interactive Multimedia Courseware

The American Heritage Dictionary (2011b), *Computer Desktop Encyclopedia* (2012), *Datatronics Information Systems Glossary* (2012), and Tech-FAQ (2012) define multimedia as "an integration of multiple forms of media such as text, graphics or images, audio, animation, and video". According to Vaughan (2004) and *Web Definitions and Glossary* (2012), multimedia is delivered and presented by using computer. Vaughan (2004) added that if a multimedia project is provided with user control of the content, it is an interactive multimedia. Hew (2004) noted, on the other hand, that interactive multimedia is built on the study of the interaction of people with technology (screen design, multisensory presentation, types of interactions, learner control, and the facilitation of motivation).

The word "courseware" originates from the combination of "course" and software" (*Dictionary.com* 2012). *Dictionary.com* (2012) and *The American Heritage Dictionary* (2011a) explain courseware as "educational software designed especially for classroom use". Other definitions of courseware include "…curriculum in an electronic form which includes software specifically designed to support learning" (*Open Options Glossary* 2005) and "… a Web server-based software package for education that enables teachers to post course materials, calendars, quizzes, and set up communication forums among students" (Szendeffy 2005).

With the definitions outlined above, interactive multimedia courseware refers to interactive software that include user control and it consists of text, graphics or images, audio, animation and video designed as educational material to support learning.

1.8 Summary

Over the years, numerous studies have shown that interactive multimedia learning takes less time and it is more enjoyable and enhances learning process (Hick 1997). It is believed that the development of ILC-WBLE would benefit lecturers by allowing lecturers to gain knowledge while exploiting the system, as well as improving the learning progress of students.

Based on the studies on different types of existing WBLE, the vital points of building a successful Web-Based Learning Environment will be figured out and applied in ILC-WBLE. The ultimate goal in developing ILC-WBLE is to achieve a variety of relevant interactivity which is attractive with user-friendly system interface and dynamic content creation feature. Last but not least, an evaluation which determines the efficacy of ILC-WBLE will be carried out among the lecturers and students in UTAR.

1.9 Thesis Structure

Chapter 1 introduces this research project which includes several topics such as the research background, problem statement, research objectives, research scope, research framework, and definition of terms related to this research. Chapter 2 presents a series of literature review on a number of topics. The existing Learning Management System at Malaysian higher education institutions, multimedia learning objects and instructional strategies for e-learning, interface design principles and learning theories are some of the topics covered in this chapter.

The research methodology is described in chapter 3, where an appropriate ID model that is adapted from a generic ID model called ADDIE model is introduced. In addition, the usability evaluation study which includes evaluation samples, evaluation instruments, data collection procedure and data analysis are also included in chapter 3. Chapter 4 reports the results obtained in the research. The description is divided into three sections i.e. the development of a prototype of ILC-WBLE, the usability evaluation of the prototype of ILC-WBLE, and identification of the strengths and weaknesses of the prototype of ILC-WBLE. Finally, conclusions, contributions and novelty of ILC-WBLE, as well as limitations and recommendations are discussed and summarised in chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter contains a series of literature reviews covering the following topics that related to this research: Reviews of the existing Learning Management System in Malaysian higher education institutions, teaching and learning approaches, learning theories, Instructional System Design models, instructional strategies, interface design principles, and multimedia learning objects.

2.2 Reviews of the Existing Learning Management System in Malaysian Higher Education Institutions

Computer-Based Learning (CBL) provides numerous benefits for the public. CBL allows users to learn at their own pace without any travelling to the classroom, thus, it indirectly reduces air pollution that is caused by carbon output from vehicles. Due to the fact that CBL takes place in a virtual environment, the flexibility of conveying and altering of latest information could be improved as well.

Learning Management System (LMS) is a CBL system which collaborates with online technology. The rapid and expanding use of distance education in elementary to higher education has been documented by the National Center for Education Statistics (NCES 2003). There are several LMSs that provide online education facility to institutions, with Moodle being one of the systems. Moodle is widely used in Malaysian higher education institutions (HEIs).

Moodle is an open source and freely available LMS. It supports small and large learning communities in schools and enterprises. It is also an adjustable environment for learning community and a software package designed by guided to "social constructionist pedagogy" which related to following four learning theories (*Moodle* 2012):

- **Constructivism:** Learners able to gain new knowledge through the interaction within the learning environment.
- **Constructionism:** Effective learning should include constructing learning material in various forms for learners to experience.
- **Social constructivism:** Communication and interaction within learners can improve the learning process.
- **Connected and separated:** Learners gain knowledge through defending their own ideas and finding flaws of the others and yet trying to listen and response in order to understand the other opinion.

According to Koh (2009), Moodle is beneficial for language teaching and learning. Apart from simplifying course-management, Moodle is a good mode of interaction between teachers and students. Moodle is open-source software which is easy to modify, and free to be downloaded and distributed at any time and place. Hence, there are a significant number of HEIs in Malaysia that employ Moodle as online learning environment. Taylor (2006) listed some pros and cons of Moodle as an LMS as shown in Table 2.1.

Table 2.1: Pros and Cons of Moodle

Pros	Cons
It is open-source software, free to download, modify and even distribute it.	Still in the growing period in which there have been some significant changes between releases.
Easy to learn, operate and certain features are better than other LMSs.	Difficult for novice to install, many technical glossaries in installation instructions
Source of learning materials and exercises and even a space of interaction.	Lack of illustrations and with too many technical application.

2.2.1 WBLE - Universiti Tunku Abdul Rahman

WBLE (**W**eb-**B**ased **L**earning **E**nvironment) was created as a resource website at Universiti Tunku Abdul Rahman (UTAR) in year 2005. It facilitates the teaching and learning processes among lecturers and students in UTAR as the resources from lecturers are obtainable through the system without boundaries. Besides, WBLE also improves the communication between lecturers and students. Figure 2.1 shows the features integrated in WBLE,

whereas Table 2.2 reveals the features of WBLE in relation to lecturer and student.

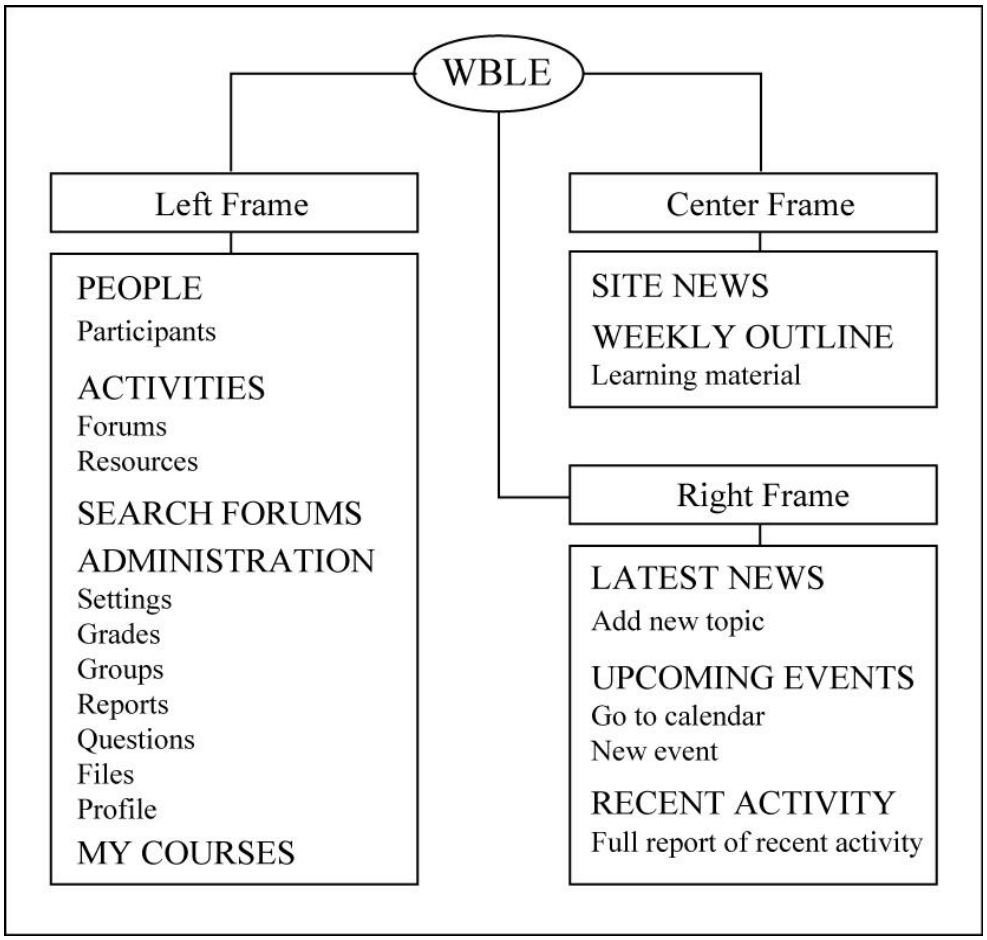

Figure 2.1: Features integrated in WBLE

Figure 2.2 shows a sample screenshot from the front page of WBLE. As can be perceived through Figure 2.2, the front page is divided into three parts as below:

i. At the **left frame** of the front page, there is a column with the subject title of "My Courses" which displays all the courses enrolled by a lecturer in a trimester.

ii. All the "Site News" retrieved from the server are posted at the **center frame** of the front page.

Table 2.2: Features of WBLE in relation to lecturer and student

Feature	Lecturer	Student
Enrolment of Courses		
Enrolment in a course	√	√
Disenrollment from a course	√	√
New Events and Announcements		
Able to view new events and announcements	√	√
Able to alter events and announcements	√	×
Learning Materials in System		
Upload lecture notes, tutorials, and other learning materials	√	×
Download lecture notes, tutorials, and other learning materials	√	√
Quizzes and Questions		
Access to quizzes and questions	√	√
Create quizzes and questions	√	×
Insert students' grades into system	√	×
Personal blog space	√	√
Administration settings	√	×
Discussion Board		
Create discussion topics	√	×
Reply discussion topics	√	√
Monitor enrolment group	√	×
User Manual		
Provide user manual	×	×

iii. All the **right frame** of the front page, there are three columns for displaying a calendar provided by the system, a list of online users who are concurrently accessing the system, and recent activity.

Figure 2.2: Sample screenshot from the front page of WBLE

Figure 2.3 depicts a sample screenshot from the main page of WBLE. The left frame in Figure 2.3 contains five columns with different subject title as follows:

i. **People:** Lecturer can view the list of students who participate in a course.

ii. **Activities:** The feature of forum is embedded in "Activities" column, in which lecturers are able to create topics for discussion and reply to the posts written by students. "Resources" is embedded in "Activities" column. This is a place in which all the files for a course are accumulated.

iii. **Search Forums:** A search engine is integrated in this column to search keywords in forum.

iv. **Administration:** This column is compacted with most of the features of the system as it permits the adjustment of most of the general settings of the system. Course format can be adjusted into a few options, which are "Learning Activity Management System" (LAMS), "Sharable Content Object Reference Model" (SCORM), "Social" (oriented around one main forum), "Topics", "Weekly", and "Weekly with no table" (organised weekly without using tables for layout) formats. In "Administration" column, courses' commencement dates, number of weeks and even the maximum upload file size can be altered too. Student enrolment parameters such as enrolment expiry date and notification for student, and language selection can be modified in the system. Furthermore, the grades scored by students can be keyed into the system for student to keep track with own latest grades. Interactive tests or quizzes prepared by lecturers for students can be imported into WBLE in the "questions" section. The "interactive" term which could be found within this section denotes the feedbacks and responses received by students based on the answers inserted. Nevertheless, monitoring of students' activities in WBLE is accessible through "Report" section, in which the accessed time and sections browsed by students are clearly stated.

v. **My Courses:** List of subjects enrolled by a lecturer in a trimester will be listed in this column.

Besides, at the right frame in Figure 2.3, it consists of three columns, which are “Latest News”, “Upcoming Events”, and “Recent Activity” which deal with all the information on latest announcements, activities, and events respectively.

Figure 2.3: Sample screenshot from the main page of WBLE

In WBLE, the feature always utilised by lecturers is the transmission of lecture notes and any other learning materials to students. Students have access to the lecture notes anytime at their own pace; assignment guidelines are available online in the system. Nowadays, there is no longer the need to photocopy lecture notes for all students.

2.2.2 MMLS - Multimedia University

MMLS stands for Multimedia Learning System. It is a virtual learning classroom at Multimedia University (MMU). Both MMLS and WBLE perform

as the communication tools among lecturers and students in respective institution. Basically, most of the features of MMLS are similar to WBLE. Figure 2.4 and Table 2.3 illustrate the features of MMLS and features of MMLS for students respectively.

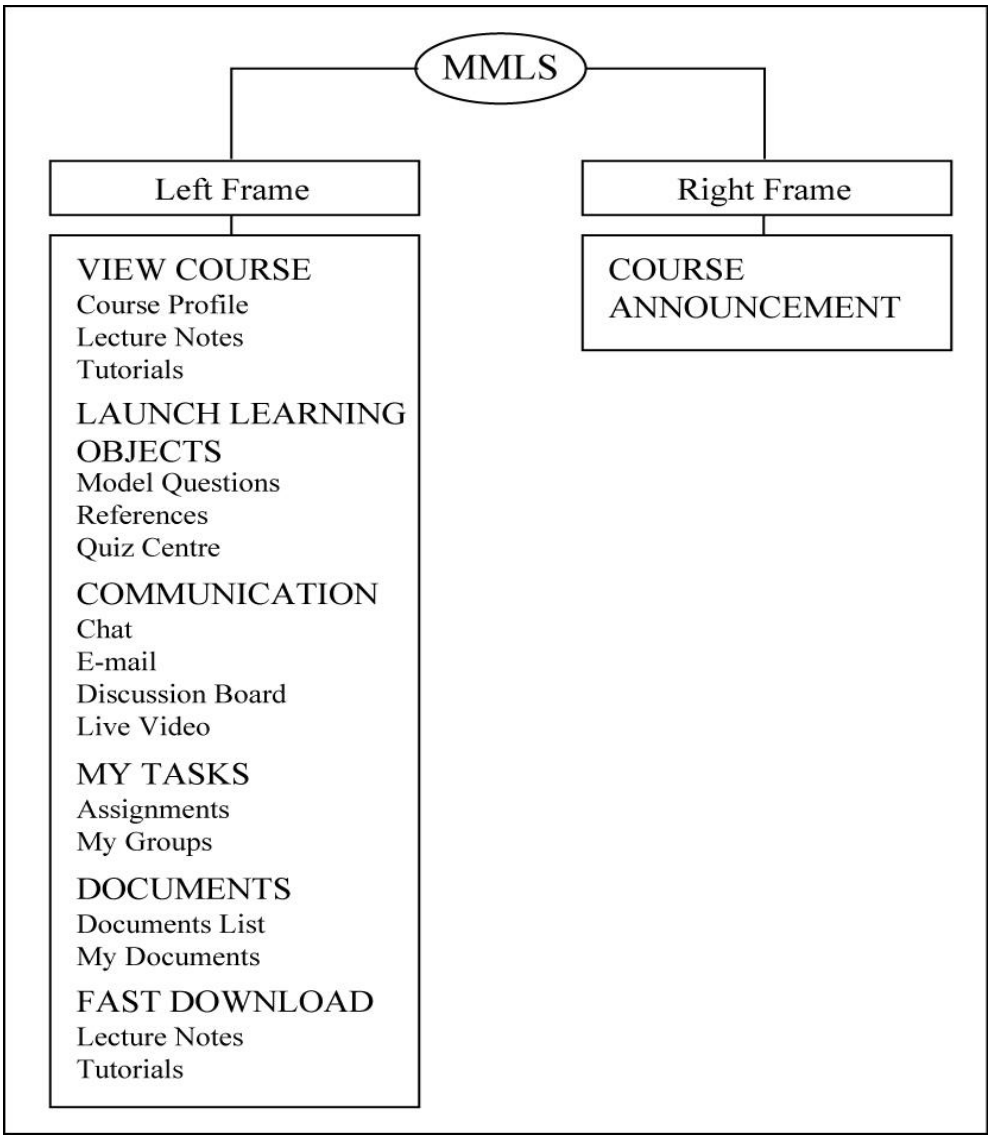

Figure 2.4: Features of MMLS

Table 2.3: Features of MMLS for students

Feature	Student
New Events and Announcements	
Able to view new events and announcements	√
Able to alter events and announcements	×
Learning Materials in System	
Upload lecture notes, tutorials, and other learning materials	×
Download lecture notes, tutorials, and other learning materials	√
Fast download lecture notes and tutorials as a zip file	√
Quizzes and Questions	
Access to quizzes and questions	√
Create quizzes and questions	×
Personal blog space	×
Administration settings	×
Discussion Board	
Create discussion topics	√
Reply discussion topics	√
Live Chat Room	
Access to live chat room	√
Email	
Email to lecturers and course mates	√
User Manual	
Provide user manual	√

Figure 2.5 shows a sample screenshot from the front page of MMLS after logged in with a student ID. A brief profile of the particular student and calendar are viewable in the front page, just like in WBLE. A list of courses registered by a student is listed out at the center of this page; further information of the courses is achievable by clicking on the respective course codes. The only difference between WBLE and MMLS is the presence of user manual. While MMLS provides a user manual to its users, WBLE excludes the facility of user manual.

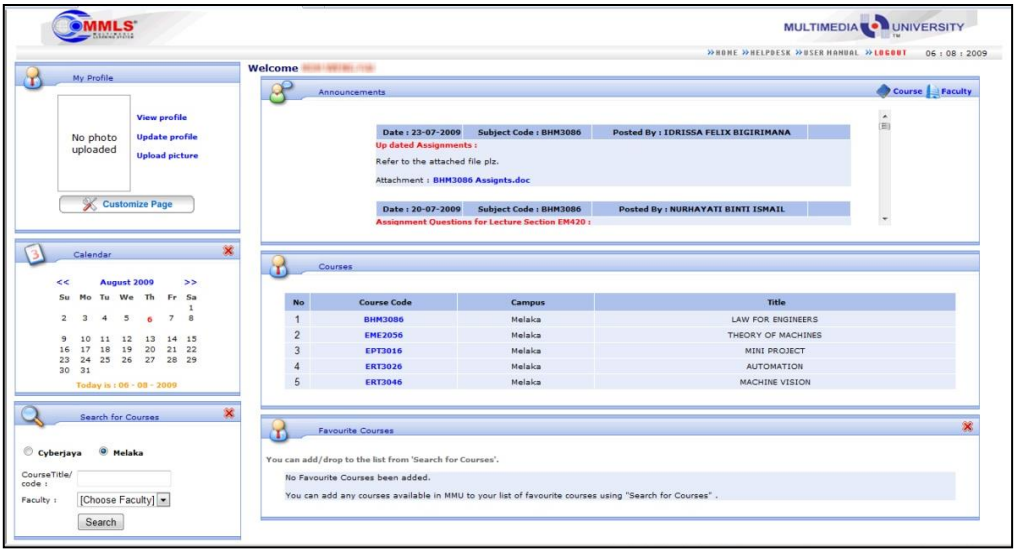

Figure 2.5: Sample screenshot from the front page of MMLS

In MMLS, not only the announcements concerning the courses taken by the student are viewable, it is also possible to view announcements made by the faculty. This feature could be functioned by switching between the buttons of “Course” and “Faculty” at the upper right corner of the front page. Figure 2.6 exemplifies a sample screenshot from the main page of MMLS displaying the course announcements for a particular student.

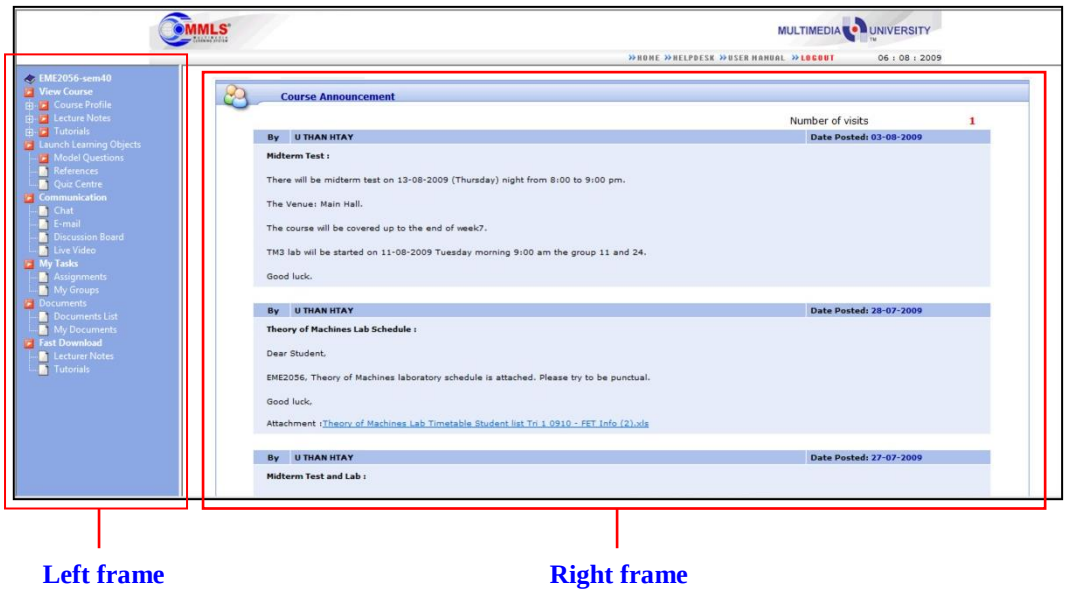

Figure 2.6: Sample screenshot from the main page of MMLS

Figure 2.7 represents a sample screenshot from MMLS main page showing the expanded navigation links. Located at the left frame of the main page, the navigation links are divided into six sections, including "View course", "Launch Learning Objects", "Communication", "My Tasks", "Documents" and "Fast Download".

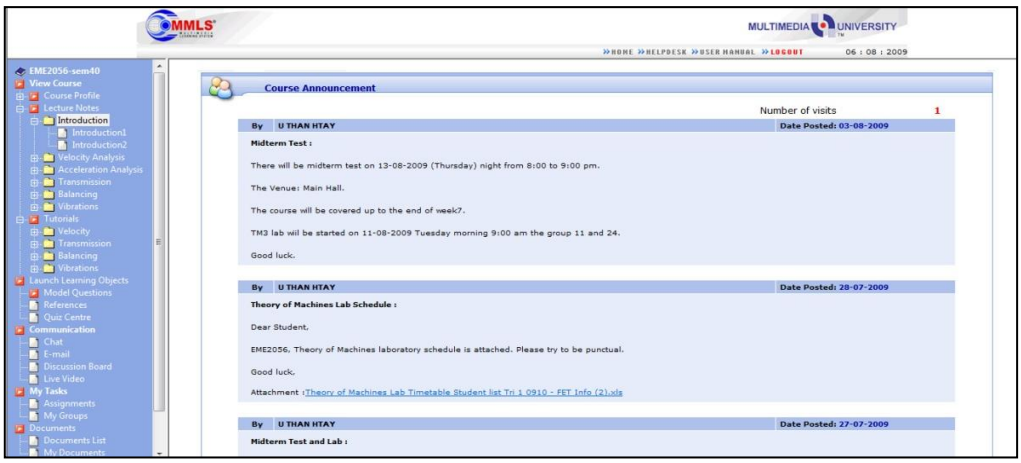

Figure 2.7: Sample screenshot from MMLS main page showing the expanded navigation links

The interface of the left frame appears similar with the interface of Windows's Operating System. Each of the navigation links is further subdivided into different topics. For instance, in "View Course", one could find the subdivisions of "Course Profile", "Lecture Notes" and "Tutorials". It is worthwhile to mention that lecture notes and tutorials are viewable in topic basis in MMLS, whereas in WBLE, weekly basis applies.

Just like WBLE, MMLS is provided with the facility of putting quizzes in the system. Meanwhile, assignment guidelines are downloadable in "My Tasks" section. The communication tools in MMLS include "Chat Room", "Discussion Board", "E-mail", and "Live Video". In this aspect, MMLS has similar features as WBLE. While facility for users to store personal documents in "Documents" is available in MMLS, WBLE has a blog space for every lecturer and student. This is one of the differences between MMLS and WBLE.

2.2.3 PPPJJ E-learning Portal - Universiti Sains Malaysia

Universiti Sains Malaysia (USM) is one of the institutions which employ Moodle system as the e-learning environment for students. "Portal e-learning PPPJJ" (Pusat Pengajian Pendidikan Jarak Jauh) is the e-learning portal of School of Distance Education (SDE) in USM. SDE USM (previously known as the Centre for Off-Campus Studies) was established in year 1971 to provide opportunities for working adults to obtain tertiary education. Figure 2.8 illustrates the features of PPPJJ e-learning portal, whereas the features for students and visitors are revealed in Table 2.4.

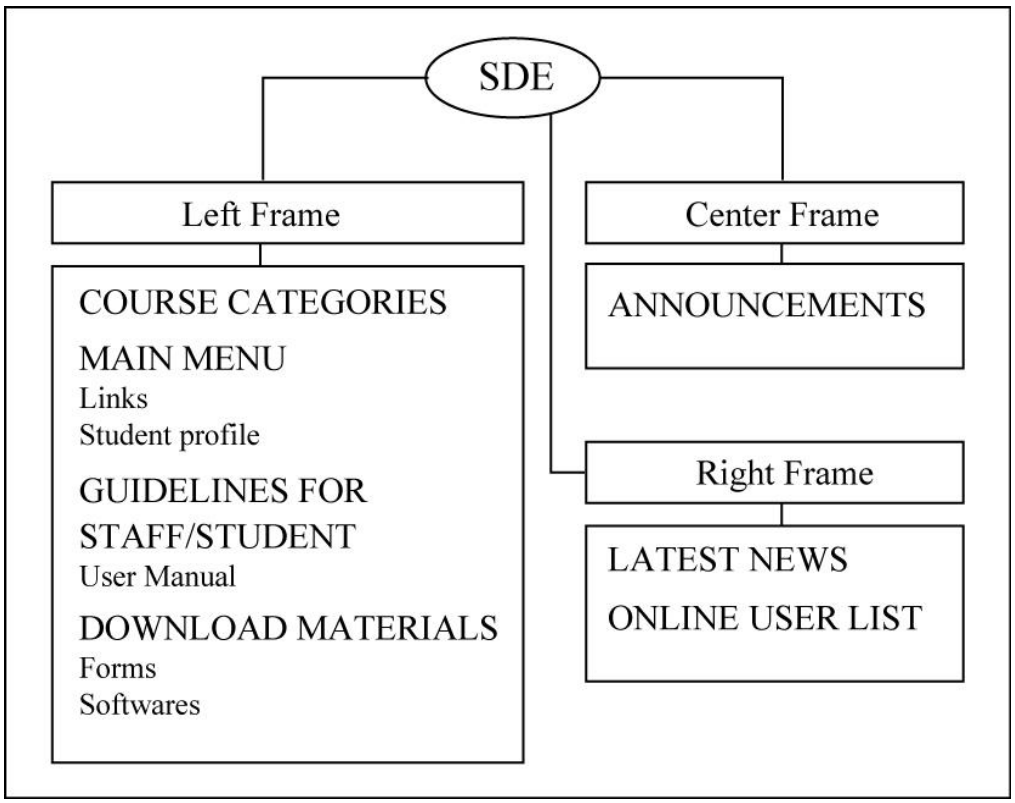

Figure 2.8: Features of PPPJJ e-learning portal

Table 2.4: Features of PPPJJ e-learning portal in relation to student and visitor

Feature	Student	Visitor
Latest news and announcements	√	√
Email service	√	
Download forms	√	√
View user Manual	√	√

Figure 2.9 shows a sample screenshot from the main page of PPPJJ e-learning portal. The categories of courses at the left frame signify that SDE offers four undergraduate and six postgraduate programmes, which are Bachelor of Sciences, Bachelor of Social Sciences, Bachelor of Arts, Bachelor of Management, Master of Arts, Master of Science, Master of Social Science,

Master of Science (Environmental Science), Master of Science (Occupational Health and Safety) and Doctor of Philosophy, respectively.

Figure 2.9: Sample screenshot from the main page of PPPJJ e-learning portal

From Figure 2.9, it is observed that the main page of PPPJJ e-learning portal is provided with links to the websites of library, email service and also "e-pos", where students could check the latest status on postage of modules from SDE. Meanwhile, announcements and latest news can be viewed without logging in to PPPJJ e-learning portal. Apart from these features, the user manuals in text and video forms are available in the portal to guide user in accomplishing various tasks, for examples the way logging in into the portal (Figure 2.10) and printing formal cover for a report (Figure 2.11).

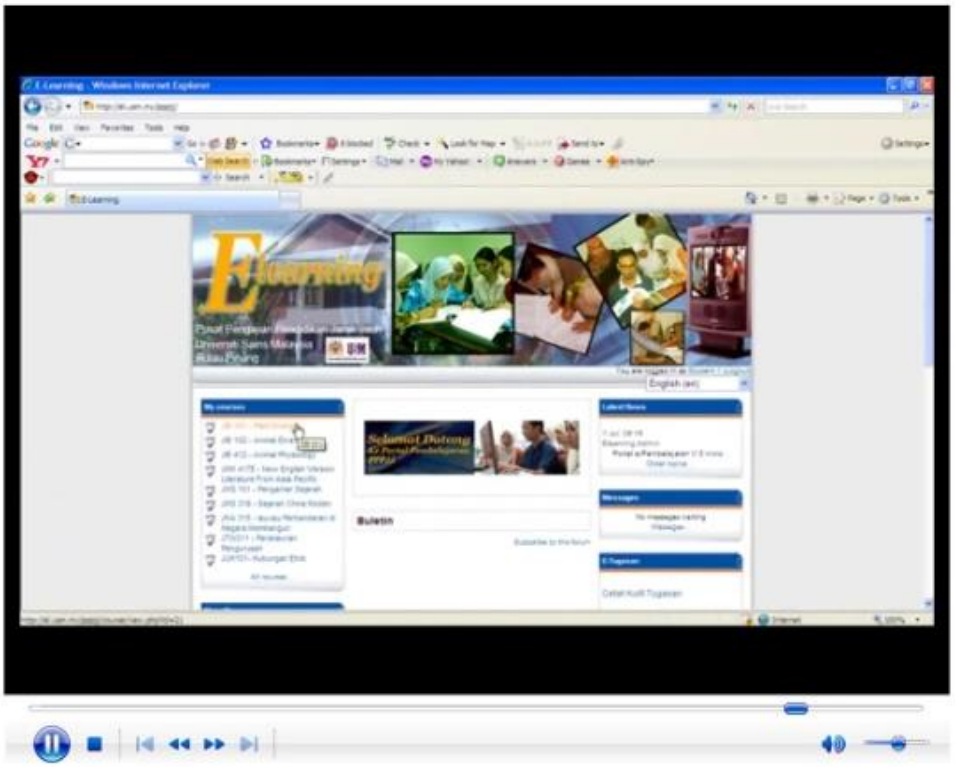

Figure 2.10: Sample screenshot from PPPJJ e-learning portal with a video that demonstrates the steps to login into the main page of the portal

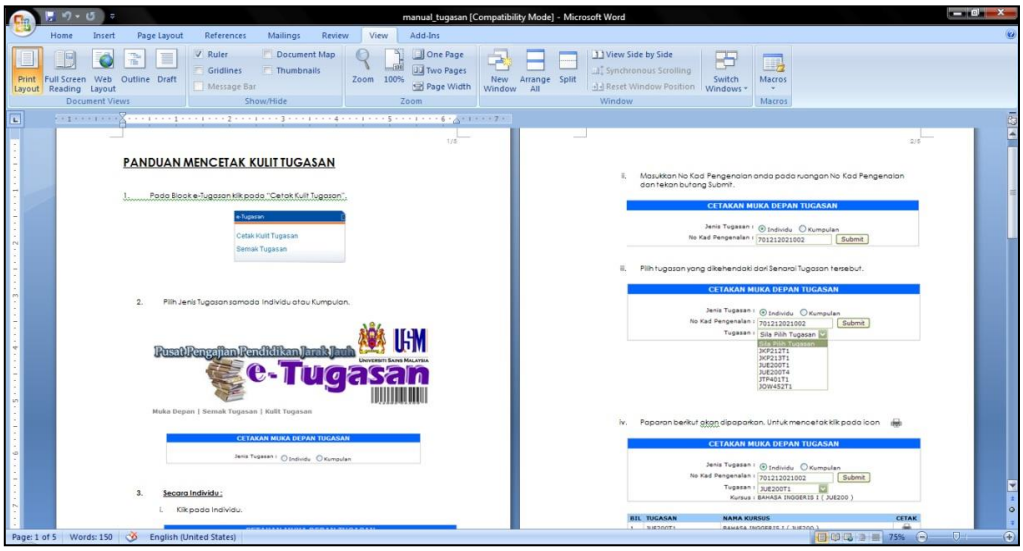

Figure 2:11: Sample screenshot from the Microsoft Word application showing a sample of user manual that downloaded from PPPJJ e-learning portal which guides user to print formal cover of a report

2.2.4 myLMS - Open University Malaysia

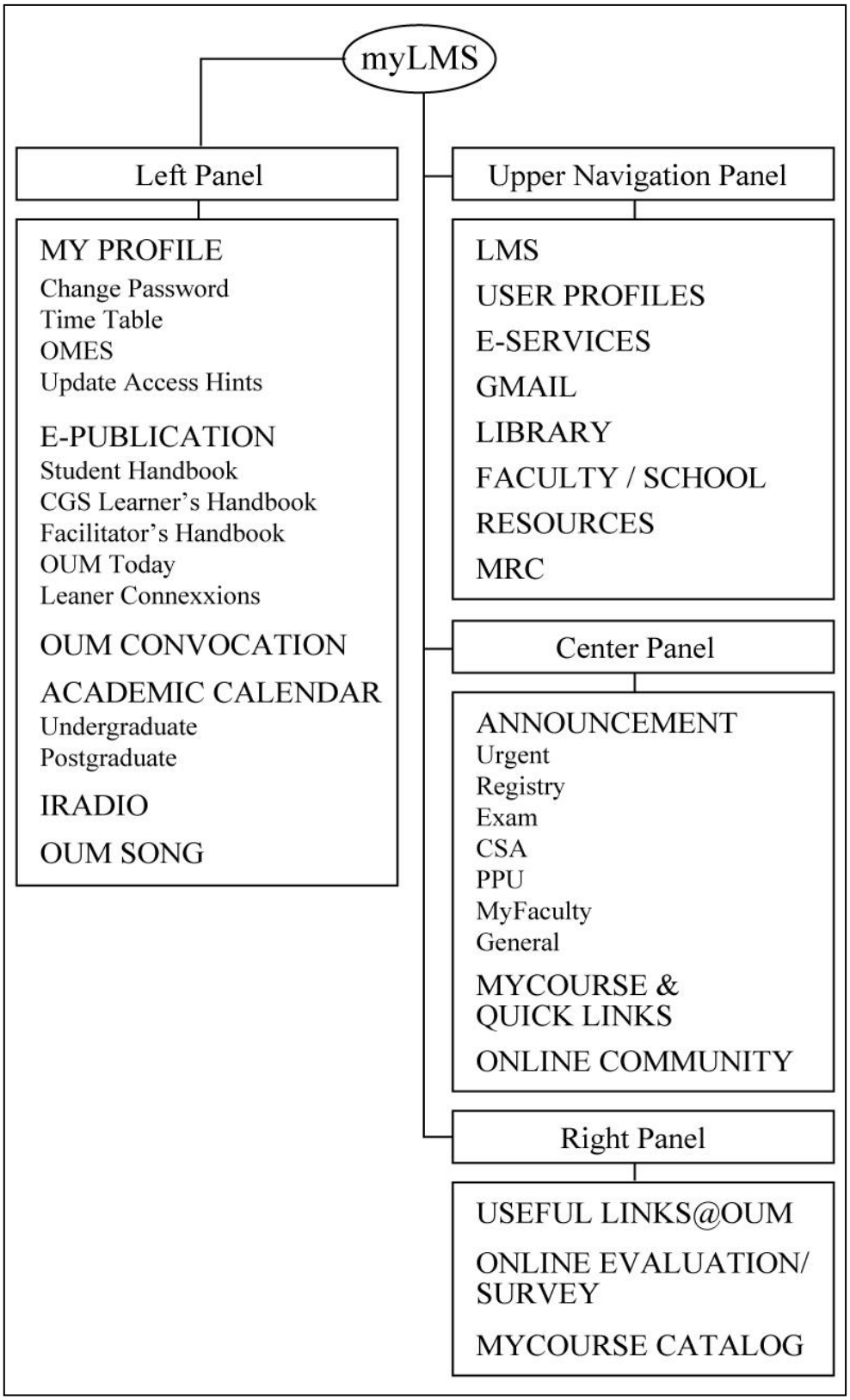

Figure 2.12: Features of myLMS

Table 2.5: Features of myLMS for tutors

Feature	Tutor
User Profile	
Update of personal details	√
View of personal finance status	√
View of personal timetable	√
New Events and Announcements	
Able to view new events and announcements	√
Able to alter events and announcements	
Learning Materials in System	
Upload lecture notes, tutorials, and other learning materials Download lecture notes, tutorials, and other learning materials	√
Email	
Email to lecturers and course mates	√
Link to personal Gmail mailbox	√
Download of resources	√
User Manual	
Provide user manual	√

myLMS is the LMS used at Open University Malaysia (OUM) which established on year 2006. myLMS consists of much information compared to WBLE and MMLS; myLMS not only contains downloadable learning material, but also include information such as radio station service, e-services, email

services, application documentation of OUM, and links to administration services of OUM. Figure 2.12 and Table 2.5 reveal the features of myLMS and features of myLMS for tutors respectively.

Figure 2.13 shows the sample screenshot from myLMS main page. At the first glance of the main page, it is full of contents, linkages and information from university's administration services to teaching and learning materials.

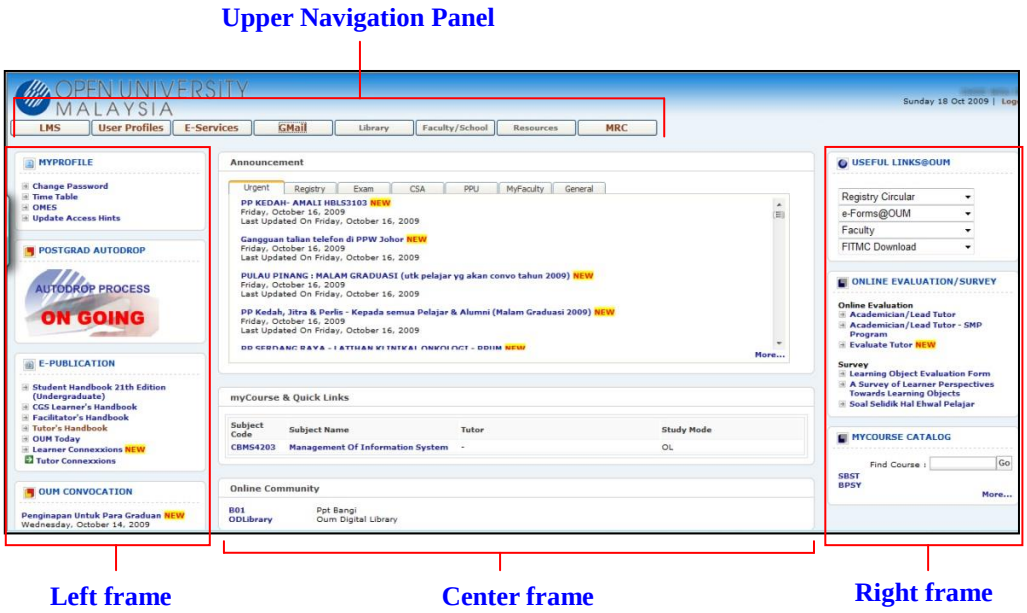

Figure 2.13: Sample screenshot from the main page of myLMS

myLMS is a one-stop web page to access most of the linkages of OUM. myLMS is divided into three frames just like any other LMS (WBLE, MMLS, and PPPJJ e-leaning portal which have been describe in previous subsections in this section). At the upper area of the main page, there are eight navigation buttons, which are "LMS", "User Profiles", "E-Services", Gmail", "Library", "Faculty/School", "Resources", and "MRC". Function of the navigation buttons are listed in Table 2.6. Sample screenshots from User Profile page, E-

Services page, and Resources page are depicted in Figures 2.14, 2.15, and 2.16 respectively.

Table 2.6: Function of navigation buttons at upper layout of myLMS's main page

Navigation button	Definition
LMS	Go to myLMS's main page
User Profiles	View of user's personal details, finance status and timetable
E-Services	Links to OUM's administration services web page
GMail	Link to user's Gmail mailbox
Library	Link to OUM's library web page
Faculty / School	Information on faculties in OUM
Resources	Resources of OUM is downloadable here (eg. Forms)
MRC	Link to "Mathematics Resources Center"

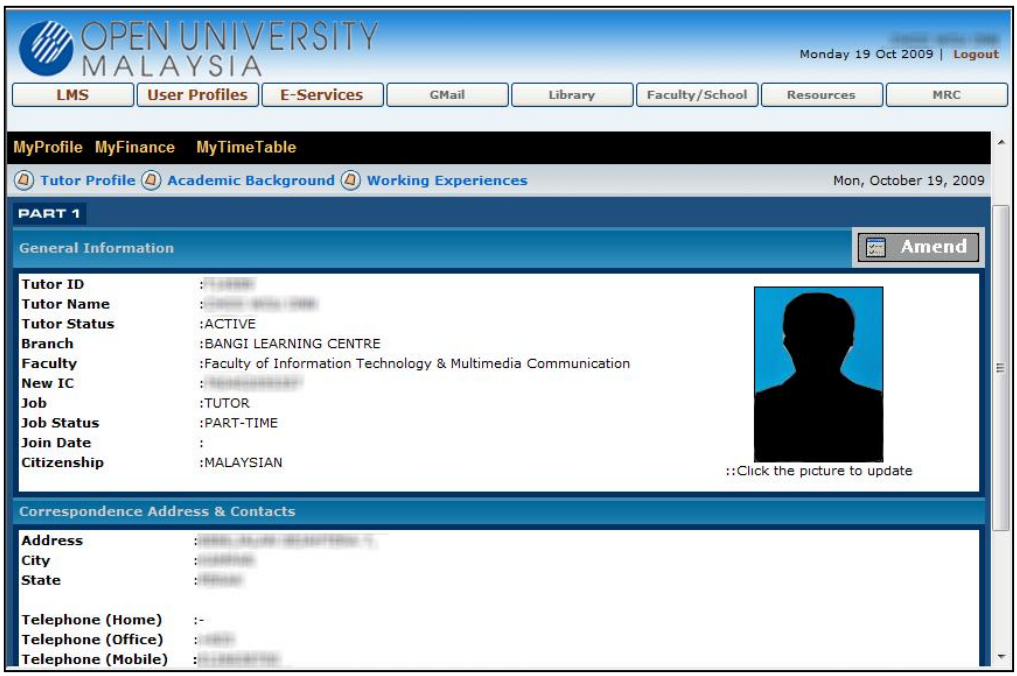

Figure 2.14: Sample screenshot from the user profile page of myLMS

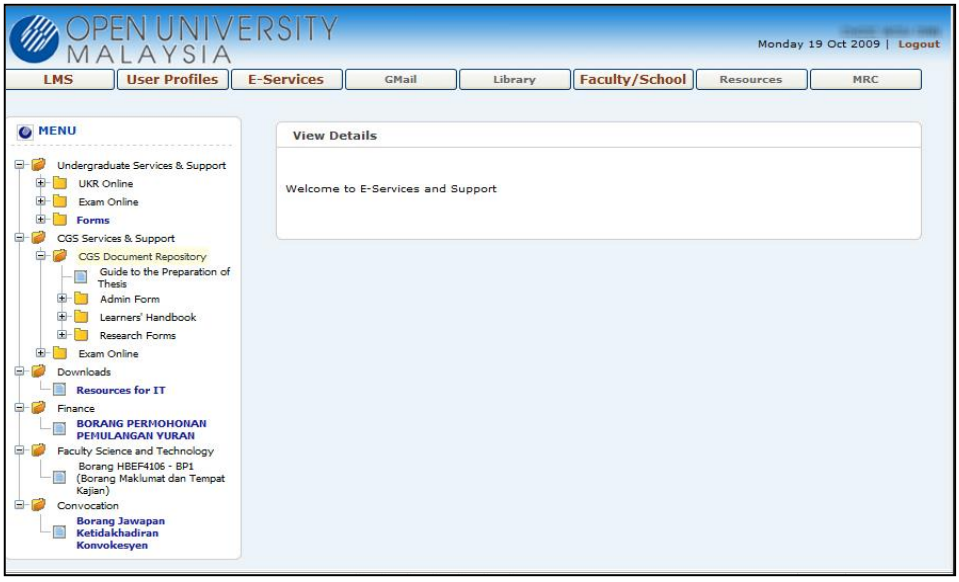

Figure 2.15: Sample screenshot from the E-Services page from myLMS

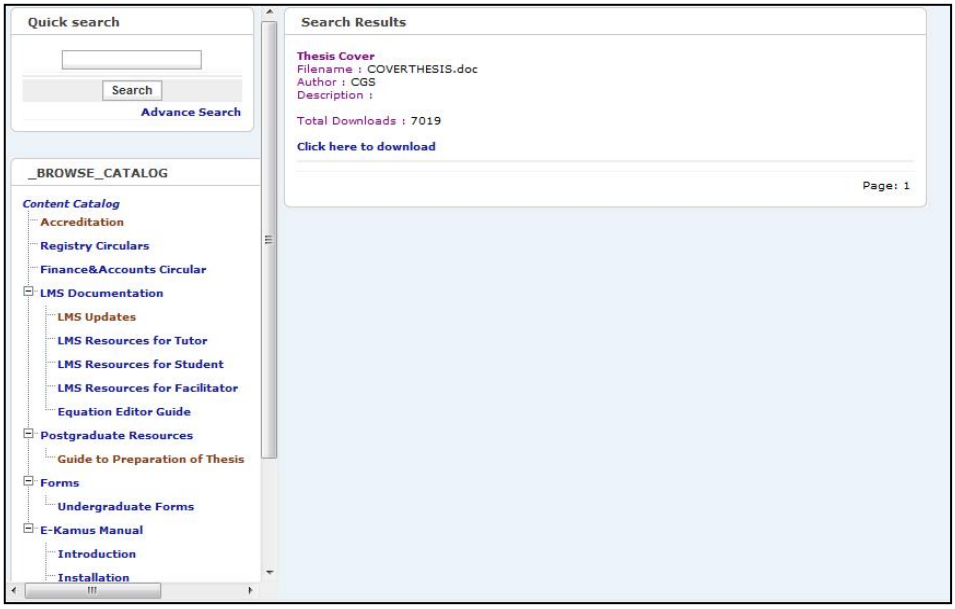

Figure 2.16: Sample screenshot from the Resources page of myLMS

As mentioned earlier, myLMS is a one-stop web page where comprised most of the links to access OUM's information. Linkages to information such as university's circulars, e-forms of OUM, faculties in OUM, online survey and evaluation, OUM's convocation particulars, academic calendar for

undergraduates and postgraduates, IRadio of OUM and even OUM theme song can be accessible through myLMS. Announcements in myLMS is properly organised into categories, which are “Urgent”, “Registry”, “Exam”, “CSA”, “PPU”, “MyFaculty”, and “General”.

2.2.5 Implication for the Research

With all the outputs from the reviews of the existing LMSs in Malaysian HEIs, three major modules are built into ILC-WBLE, which are administration management, resources management, and forum. Lecturers and students are allowed to access resources management and forum, whereas administration management is only accessible by administrator of ILC-WBLE. Features of ILC-WBLE in relation to administrator, lecturer and student are illustrated as follows:

i. **Administration Management:** This module is only accessible by the administrator of ILC-WBLE. The system administrator is responsible for the addition or deletion of new u**ser (lecturer o**nly) and modification of user (lecturer only) profiles.

ii. **Resources Management:** Two types of resources can be created in ILC-WBLE to facilitate teaching-learning process, which are content page (learning contents of the particular subject are included in content page) and quiz page (online quizzes that allow students to answer).

- **Lecturer:** Lecturers are able to create/ modify/ remove learning contents and online quizzes in ILC-WBLE.

- **Student:** Students are not given the authority to manage learning contents and online quizzes in ILC-WBLE; they can only access the learning materials and try out the online quizzes.

iii. **Forum:** It serves as a medium of communication between lecturers and students. Lecturers and students are allowed to create new discussion topics and reply to any created topics in the forum. Lecturers and students are having equal liberty in using the forum.

2.3 Teaching and Learning Approaches

Learning today takes many forms; students in tertiary institution not only learn from lecturers or designated text books, there are many sources of information and knowledge which are easy for everyone to reach. Students learn from peers, electronic media, Internet, experts from other parts of the world through World Wide Web (WWW).

All the while, the practice of the learning process is to convey the information and knowledge one had to the learners. The rapid enhancement of technology and overwhelming of information in current decade has driven to the need of lifelong learning. In today century, the notion of teaching is not defined as conveying what we know to students but it should be viewed in wider perspective of setting up different environments for effective learning to

take place. As mentioned by Reinsch (2007), lifelong learning should enable a person to be a self-directed learner. Learning is not just about remembering or applying what one has been learned, however, the learning experience should prepare oneself to be a more independent and self-directed learner, be able to utilise the skills to solve real life problems.

Therefore, a series of studies in teaching and learning approaches will be included in the following sections to identify the suitable approach to construct an efficient and effective teaching and learning process.

2.3.1 Traditional Face-to-Face Learning

Before the invention of computer and the Internet, learning was took place in a classroom. Learners have to physically attend the training in order to learn a knowledge or skill and teachers are committed in making learning occur. In most of the higher institutions are still emerging traditional face-to-face (F2F) learning as major method in delivery of knowledge to learners.

F2F learning is indeed encouraging the human interaction between instructors and learner, however this is rather time consuming and inflexible as learning is fixed at certain time and place. Based on the analysis of Borysowich (2005), there were 80% to 90% of learners in the F2F learning contexts tend to forget the information learned within two weeks. Furthermore, Learners involved in the whole learning process is relatively smaller and exchanging information merely happens among learners in the same class. Since the

lifelong learning is a continuous process without the constrain of time and place thus all individuals can fulfill their needs in learning, traditional F2F learning is insufficient to prepare oneself to be a more independent and self-directed learner and learner will not be able to utilize the skills to solve real life problems (Demirel 2009).

In order to compensate the limitation of F2F learning, electronic learning (or e-learning) has been applied to facilitate the teaching and learning processes. E-learning is further elaborated in section 2.3.2.

2.3.2 Electronic Learning

As the technologies are improving rapidly, learning can be carried out in different forms, as electronic learning is one of the learning methods widely use in HEIs. Bullen (2006) noted that teaching and learning that are occurred electronically with mediated by computer and the Internet is known as electronic learning (or e-learning).

According to Hicks et al. (2001), HEIs are demands to offer larger and variety type of technology-based learning method to facilitate lifelong learning. Hence, the transformation of learning environment is important as it is to ensure that the benefit has been fully utilised (Williams 2002).

Learning can be occurred in virtual world which is the Internet as learning materials and resources are available for learners who are connected to

the Internet as well. Since e-learning is taking place globally in the Internet, sharing of information is not limited to be occurred in the classroom, because it provides the opportunities for all kinds of learners regardless from isolated or rural places to exchange the information and expertise all over the Internet (Hill 1997; Webster and Hackley 1997). The major advantage of e-learning is definitely the flexibility of obtaining the knowledge at anytime, anywhere without the restrain of distance.

However, physical human interaction is omitted in e-learning where else, traditional F2F is encouraging the interaction between human. If learning involves both traditional F2F learning and e-learning, the learning outcome would be much better (Vaughan 2007).

2.3.3 Blended Learning

Blended learning (or hybrid learning) is the combination of traditional F2F learning and e-learning. HEIs are implementing blended learning (Bonk et al. 2005), as traditional F2F classes such as lecture or tutorial are offered to students and at the same time, learning material are uploaded into the LMS for students to download and access at home. The study of Vaughan (2007) reported that students who had the experience in blended learning indicated that blended learning model can improve learning and offers greater time flexibility. By doing this, students are being provided the opportunity to interact with the lecturers and students will be able to learn the subjects through Internet as well.

According to Ateş et al. (2008), both traditional F2F learning and e-learning are essential as F2F learning has encourage the social aspect of teaching and learning and e-Learning has given the students flexibility and independent environment in learning the knowledge. Therefore, blended learning is reliable to be executed in education as it has the potential to enhance the learning process to be more efficient and effective (Garrison and Kanuka 2004).

2.3.4 Implication for the Research

This research focuses on developing an interactive multimedia CBL system called ILC-WBLE to facilitate the teaching and learning processes electronically through Internet. ILC-WBLE allows lecturers to share the instructional materials online and quizzes or exercises can be created through the system in order to test the level of students' understanding on the subject being taught. This system is fulfilled the needs of implementing e-learning in education to supplement the traditional classroom instruction for effective learning. Therefore, learners could learn better by implementing ILC-WBLE together with traditional F2F learning.

2.4 Learning Theories

E-learning is an electronic-based learning where the use of specified delivery technologies can provide effective result to learning. Beynon (2007),

Clark (2001) and Kozma (2001) claimed that there is a constant argument about whether applying a particular technology of the learning medium improves the learning process. According to Clark (1983), technologies are just medium that used in conveying information but do not themselves influence learner accomplishment. Schramm (1977) proposed that the content and instructional strategy in the learning materials affect learning, rather than the type of technology used in delivering the instruction, Clark (1983) supported his statement by conducting meta-analysis studies on media research.

Since long time ago, theories of instruction was embedded in behavioral psychology which heavily stressed on tutorial aspect of instruction and element of analysis was fixed to the description and teaching of different categories of knowledge such as facts, concepts, and principles (Dijkstra et al., 1991). Therefore, the embedded of learning theories in e-learning system definitely enhance and influence the quality of learning.

2.4.1 Cognitive Flexibility Theory

Cognitive flexibility theory is a theoretical direction to knowledge attainment and "ill-structured domains" which is application in complexity content and irregularity application contexts (Spiro et al., 1987; 1988). According to Spiro et al. (1992), "ill-structured domain" hold two properties, which are firstly, concurrent interactive participation of multiple, wide-application conceptual structures are usually involved in each case study or example of information application and secondly, cases technically of the same

type has a significant irregularity in the pattern of conceptual incidence and interaction. Spiro and Jehng (1990) noted that “By cognitive flexibility, we mean the ability to spontaneously restructure one's knowledge, in many ways, in adaptive response to radically changing situational demands” (p. 165).

Cognitive flexibility theory declares that effective learning is context-dependent due to the theory is emphasises on the multiple ways of conveying the information and use of many case studies that present various examples, therefore, instructions require explicit notice (Kearsley 2007). Learner tends to be adaptive in learning provided with case studies which help learner gain the knowledge effectively compared to direct learning from instructor.

2.4.2 Elaboration Theory

Elaborate theory proposes instruction guidelines for numerous patterns of simple-to-complex sequencing which developed principally from cognitive theory (English and Reigeluth 1996). Modules of courseware can be organised from the most general and simple tutorial to the specific and complex tutorials such as learning starts from learning to access the main page of the system to the learning in accessing administration settings.

E-learning system such as Computer-Assisted Learning (CAL) application is best fits the elaboration theory framework particularly due to the reason it is amenable to present information in sections which can be linked to the selections that are available to learner (Tau 2000) and nevertheless, Chou

(1999) declared some of the approaches which are top-down or simple-to-complex approach of elaboration theory are most suitable for development of hypertext-based learning courseware. With the assistance of CAL, the sequence of the learning module can be decided by the learner based on learner's needs according to which the module is considers to be easier to obtain in the beginning can be opted to learn in the first place and followed by the module learner deems to be complex to learn in later.

2.4.3 Multimedia Learning Theory

Mayer and Moreno (2002) brought up the multimedia learning theory which learning occurs based on visual and verbal information are presented concurrently because learners are able to build connection between the information of visual and verbal in learning. According to Mayer (1997), there are five major principles of how to apply multimedia to assist students in understanding of knowledge as below:

i. **Multiple Representation Principle:** Explanation is always better to present in words and pictures rather than solely in words.

ii. **Contiguity Principle:** Multimedia explanation presents consequently words and pictures rather than separately.

iii. **Split Attention Principle:** Multimedia explanation presents words as voice over narration rather than as visually present text.

iv. **Individual Differences Principle:** The prior principles are more important for low-knowledge than high-knowledge

learners, and for high-spatial rather than low-spatial learners.

v. **Coherence Principle:** Multimedia explanation presents through using few rather than using many irrelevant words and pictures.

With reference to the five principles as listed above, an adequate and fascinating multimedia courseware can be developed and the courseware could enhance the learning process of a learner. Generally, a proper courseware should make use of images while explaining the content in the system other than explains through plain text. Narration is advisable to be included besides using images for explanation. Nevertheless, using lesser and more relevant multimedia element to explain the content rather than using plenty of examples that could confuse the learners.

2.4.4 Implication for the Research

Learning theories are constantly used as guideline in development of education courseware. Based on the content and context of the courseware in this research, three learning theories as described above are opted to guide the development of ILC-WBLE as follows:.

- **Cognitive flexibility theory:** ILC-WBLE is a CBL for students to learn in anytime at anywhere, hence it is a flexible and handy learning courseware. Without a real person instructs in ILC-WBLE, interaction of the system have to be precise and accurately in order to construct a successful learning for students on a particular subject, therefore, cognitive flexibility

theory is applied in developing ILC-WBLE in the resources management module. Learning is not limited in directly convey the knowledge through one method, case studies and complex context is suggested to be used in learning because learners be aware of the nature of complexity more intensely by presented with numerous presentation of same information in different contexts (Graddy 2001).

- **Elaboration theory:** The process of learning of a person starts from kindergarten to primary education and followed by elementary to higher education, which demonstrates learning is recommended to be constructed from lower stage to advanced stages. ILC-WBLE is thus guided by elaboration theory with the aim of developing a well-structured system for lecturers while creating new courseware. The sequence of the pages in the content pages created in ILC-WBLE is changeable. Three types of online quizzes (i.e. multiple choices, drag and drop, and fill in the blanks) can be created in ILC-WBLE, since Multiple choices and drag and drop are relatively easier to answer compared to fill in the blanks.
- **Multimedia learning theory:** Textbook is a primary material in learning; it contains text and images without the presence of audio, animation and video. The use of multimedia elements in learning is believed to be able to retain the concentration of learners in learning. With the implementation of multimedia learning theory in the development of ILC-WBLE, the

courseware definitely could be much more interesting and the interactivity between students and ILC-WBLE could be further enhanced.

2.5 Instructional System Design Models

Instructional System Design (ISD) is defined as a systematic process and procedure used to develop the instructional material (van Merrienboer 1997). Implementation of ISD for the development of ILC-WBLE is critical as it can ensure the proper procedure in developing the system. There are a variety of ISDs that have been developed over the years; most of them comprise the same elements of analysis, design, development, implementation, and evaluation for the system (Reiser 2001; Gustafson and Branch 2002).

In order to identify an appropriate ISD for the development of ILC-WBLE, thorough studies on ISDs had been carried out and are explained in subsequent subsections of this section. The study of ISDs focuses primarily on three ISDs, namely ADDIE model, Dick and Carey model, and Kemp's Instructional Design model.

2.5.1 ADDIE Model

ADDIE model is an initial element in the development of the system as a template, a structure, or an approach to be used (Bichelmeyer 2004). In this

model, it is not necessary to have a live instructor since ADDIE model places emphasis on the performance of students in real-world tasks (Reiser and Dempsey 2002). This sparkling attribute explains why ADDIE model is an appropriate model to be applied for the development of an online learning system (Harvey 2005).

ADDIE has been extensively used as a guideline for the whole process of multimedia application (Molenda et al., 1996; Aris 2006). It is a popular life cycle model among other ISD models for CBL application development (Parekh 2006). Researchers such as Barrese et al. (1992), Lohr (1998), Muda (2006), and Wang and Hsu (2009) were among those who had implemented ADDIE model to design, develop, and evaluate their applications respectively.

ADDIE is a generic and simple ISD model comprising of five phases, namely Analysis, Design, Development, Implementation, and Evaluation (Gustafson and Branch 2002; Molenda 2003; Tzeng et al., 2007). According to Strickland (2007), the objectives of the five phases in ADDIE model are as listed below:

i. **Analysis:** To study or identify the nature of the whole research, which includes objectives, goals, target user, and so forth.

ii. **Design:** To design and develop instructional design model and module of the system in systematic method.

iii. **Development:** To develop the system with appropriate tools and processes.

iv. **Implementation:** To implement and deliver the system to

targeted users.

v. **Evaluation:** To evaluate and determine the quality and effectiveness of the developed system.

Activities involved in ADDIE are not necessarily carried out in a linear mode as it is always essential to move backward and forward among activities (five phases in ADDIE) in order to fine-tune the whole research (Gustafson and Branch 2002). Gustafson and Branch claimed that the greatest strength of the ADDIE model is attributed to the self-correcting nature of the model. Figure 2.17 illustrates the model of ADDIE.

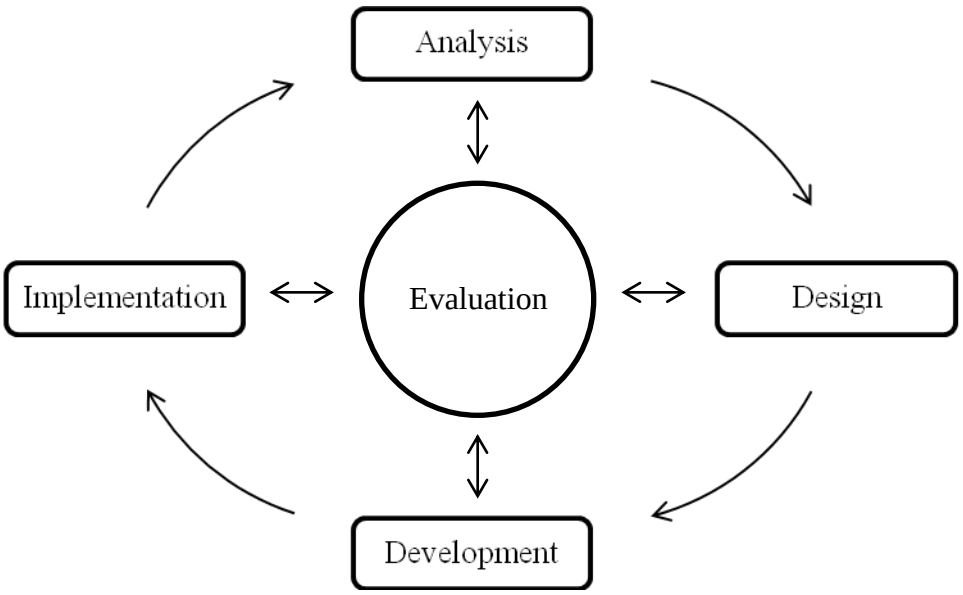

Figure 2.17: The ADDIE model

Source: Gustafson and Branch (2002, p. 18).

2.5.2 Dick and Carey Model

Dick and Carey model is widely used as an ISD model for the development of a system (Dick 1996; Surry and Farquhar 1996; Bello and Aliyu 2012). This model portrays the development process of a system, beginning from identifying the objectives of the development and proceeding through formative evaluation, revision and summative evaluation (Tessmer and Wedman 1990; Surry and Farquhar 1996; Passerini and Granger 2000). Unlike ADDIE model, Dick and Carey model comprises of ten components. All the ten components in this model are carefully connected to each other – each component bears an input from the previous component while carrying an output to the next component (Tessmer and Wedman 1990; Bello and Aliyu 2012), as depicted in Figure 2.18.

The main concern of Dick and Carey model is on the knowledge of the learners – whether or not they know what are to be done and known by the end of the course (Bello and Aliyu 2012). Consequently, each component is critical, non-ignorable and non-negligible so as to achieve the aim of an effective and efficient learning instruction (Tessmer and Wedman 1990; Akbulut 2007). As proposed by Bello and Aliyu (2012), the objectives of each component are explained as follows:

i. **Assess needs to identify goals:** To identify the learning outcomes of the instruction.

ii. **Conduct instructional analysis:** To analyse the skills to be learned and skills to be used in the instruction.

iii. **Analyse learners and contexts:** To analyse learners' characteristics and contexts in which learning and performance will take place.

iv. **Write performance objectives:** To define the conditions and criteria which the learners must perform so as to achieve successful performance.

v. **Develop assessment instruments:** To develop the necessary instruments to be used in assessing students' performance based on the defined conditions and criteria.

vi. **Develop instructional strategies:** To identify strategies that could be implemented to achieve the learning outcomes of the instruction.

vii. **Develop and select instructional materials:** To develop and decide on the instructional materials based on the identified strategies.

viii. **Design and conduct formative evaluation of instruction:** To conduct evaluation in a small group to test on the usefulness of instructional materials before the instructional materials are being delivered to students.

ix. **Revise instruction:** To summarise and interpret results from formative evaluation in an attempt to identify inadequacies or insufficiencies in the instructional materials.

x. **Design and conduct summative evaluation:** To conduct evaluation that is used to moderate the usefulness of the instruction.

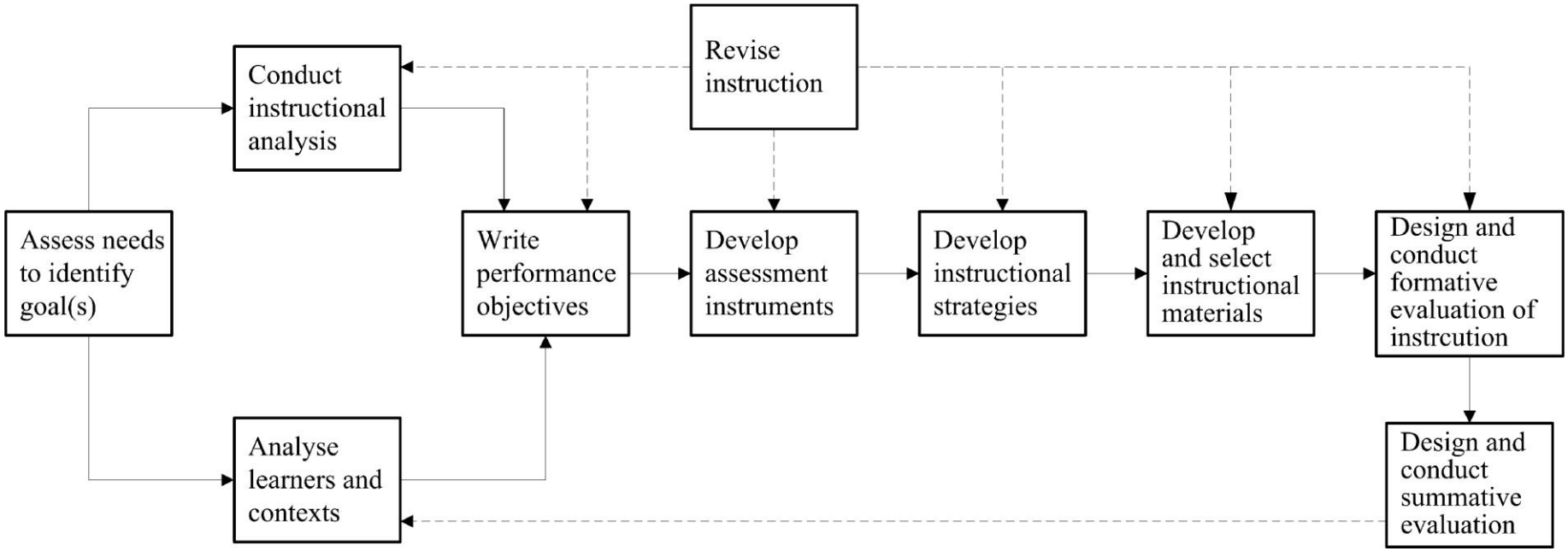

Figure 2.18: The Dick and Carey model

Source: Dick (1996, p. 58)

Given that Dick and Carey model is basically a model used to guide the development of a system, Dick (1996) insisted that all components in the model must be performed in a consistent flow, in which a failure to do so would cause disorder at the end of the development. Owing to the linear nature of the model, Akbulut (2007) commented that the process of Dick and Carey model is inflexible and impractical for the real-life instructional design situations.

2.5.3 Kemp's Instructional Design Model

According to Gustafson and Branch (2001), Kemp's Instructional Design model is a classroom-oriented instructional model. This model comprises of a series of nested ovals used to put emphasis on the independency of the elements in the model as a flexible continuous cycle that requires recurring planning, design, development, and assessment (Hanley 2009; Osman and Lee 2012), as depicted in Figure 2.19.

Surrounding the nine core elements of Kemp's Instructional Design model is the inner oval, which demonstrates that the activities of revision or formative evaluation can be carried out at each stage of the development process. The outer oval, which is required to support the actual instruction, illustrates not only the post-instruction activity (summative evaluation), but also three elements which are normally not found in other models, including project planning, project management, and support services (Hanley 2009; Yang 2012).

The objectives of the nine core elements of Kemp's Instructional Design model, as proposed by Morrison et al. (2011), are listed as follows:

i. **Instructional problems:** To identify instructional problems and define goals for the instructional programme.

ii. **Learner characteristics:** To examine learners' characteristics which deserve attention during the planning of an instructional programme.

iii. **Task analysis:** identify and analyse contents of the subject and components of the task which are related to the defined goals.

iv. **Instructional objectives:** To identify the instructional objectives for the learners.

v. **Content sequencing:** To define the sequence of the content within each component of task for logical learning.

vi. **Instructional strategies:** To design the instructional strategies in a way that enables the learners to master the stated objectives.

vii. **Designing the message:** To design the instructional message and plan the delivery method of the instructional message.

viii. **Development of instruction:** To select the resources to facilitate instruction and learning activities.

ix. **Evaluation instruments:** To develop the evaluation instruments to evaluate the stated objectives.

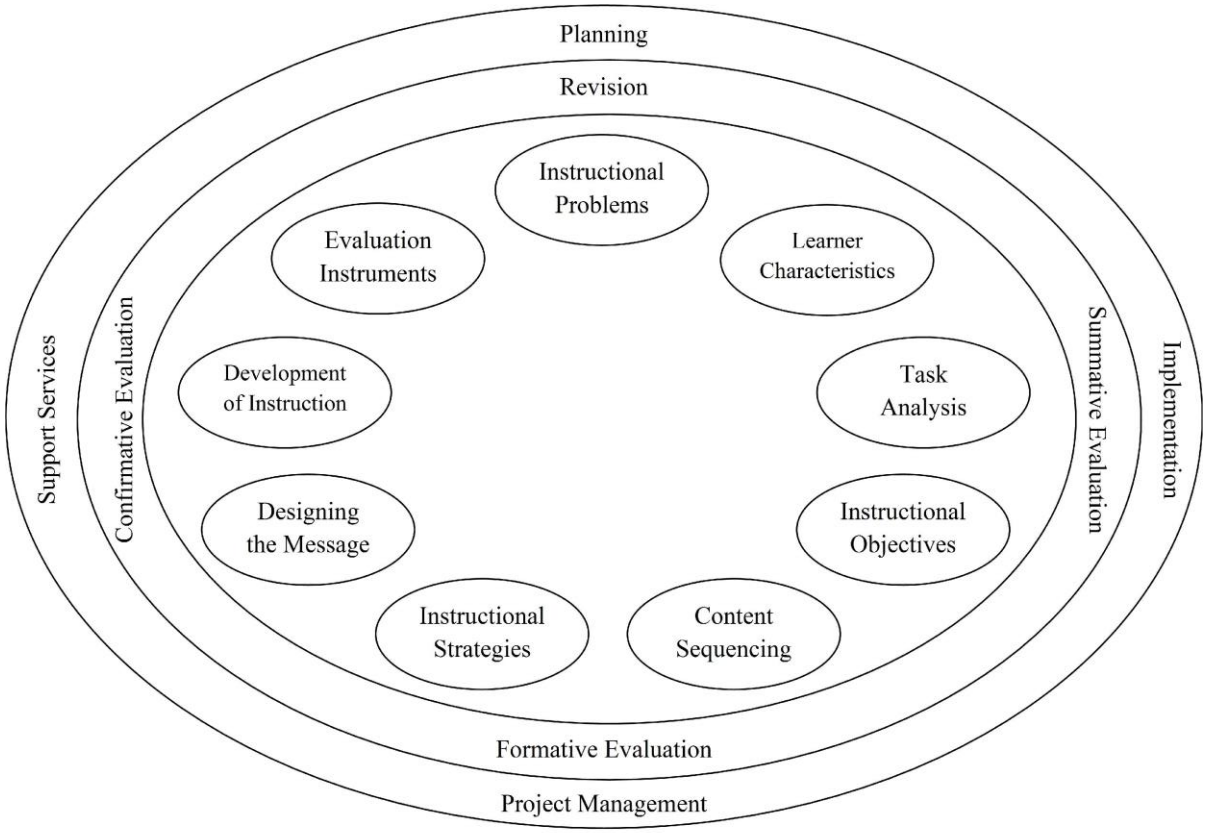

Figure 2.19: The Kemp's Instructional Design model

Source: Morrison, et al. (2011, p. 12)

Since there is no particular starting and ending points in Kemp's Instructional Design model, all the elements are independent without needing to be considered in a linear manner. All processes of designing, developing, implementing and evaluating can be done concurrently and continuously (Hanley 2009; Osman and Lee 2012).

By identifying a number of development phases without any specific order within the system, Kemp's Instructional Design model takes a more non-rigid approach in the instructional design process, which is why it is well-known as a curvilinear instructional model (Passerini and Granger 2000; Akbulut 2007). Due to the flexible connectivity among elements in this classroom-oriented model, it is generally believed that any novice instructor without much instructional design skill could effectively and effortlessly produce a piece of instruction for their learners (The Heritage Group 2004; Hanley 2009).

2.5.4 Implication for the Research

Any system that is more adapted to learner-centered approach rather than teacher-centered approach is highly encouraged to employ ADDIE model in the development of the system, since ADDIE model is more appropriate and significant for the learners (Peterson 2003). Given that the current research is to develop ILC-WBLE, a system which is learner-centered, ADDIE is preferably chosen to be used as the ISD model. The simplistic character of ADDIE (consists of five phases in which each phase is interconnected with

each other) will significantly contribute towards the integrated overview for the instructional design of the process of the application (Crawford 2004).

As discussed in section 2.5.2, all components in Dick and Carey model must be carried out in a consistent flow, as it is a linear ISD model. Dick and Carey model is rather inflexible and impractical for the real-life instructional design situations. On the other hand, due to the flexible connectivity among elements of the model without any particular starting and ending points, Kemp's Instructional Design model is more suitable to be applied as a classroom-oriented model used to develop a classroom instruction. The limitations imposed by of both these ISD models are the main reasons why they have not been selected in guiding the development process of the proposed system in this research.

2.6 Instructional Strategies

The use of computers in education began as early as in the 1960s. Mainframe computers were used to deliver tutorials and drill and-practices during lessons. With the introduction of microcomputers in the 1980s, the use of computers in schools has become widespread from primary level through the university education. In the mid-1990s, the eruption of the Internet quickly changed the nature of educational computing. Ever since, the world of e-learning is continuously growing and presenting new challenges. The extensive use of the Internet has henceforth changed the standard method of transmitting

information in education (Aggarwal and Legon 2006).

In order to meet the challenges posed by e-learning, instructional strategies for e-learning have rapidly been recognised and used by teachers across the world. These instructional strategies determine the approaches a teacher may take to facilitate learners in achieving the learning objectives.

According to Dunn and Griggs (1989), everyone has a distinctive, particular learning style, and instruction should be tailored to best accommodate different methods of learning of the learners. The teacher may choose to use different types of instructional strategies to create e-learning environments; the instructional strategies will thus determine the nature of the online activities in which the teacher and learners will be involved during the lesson.

E-learning is a learning medium which has a lot of benefits, which include self-directed learning, self-paced learning, and the exercising of various senses (Fletcher 1990). Self-directed learning is a type of learning whereby learners are given the freedom to decide topics they wish and wish not to learn, as well as having the liberty to determine the order of learning a certain topic/ subject. Ford and Chen (2001) had addressed that when users tailored their own learning styles or requirements to match their own learning preferences, learning efficiency and effectiveness will be significantly improved. Self-paced learning allows learners to go through an instructional strategy such as tutorial at a comfortable pace, either quickly or slowly. The

learning process will be highly productive and efficient, if learners are able to review the learning materials repetitively, or leave out any page that learners have already mastered. Unlike a teacher, the instructional programme will not feel exhausted having to repeat the same action for multiple times.

Research has revealed that people remember only 20% of what they hear; 40% of what they see and hear; and 75% of what they see, hear, and do (Fletcher 1990). E-learning allows learners to exercise all their senses, hence enhancing the memory and learning ability of the learners. The most commonly used instructional strategies for e-learning include tutorial, drill-and-practice and computer-mediated games. These instructional strategies are further discussed in subsequent subsections of this section.

2.6.1 Tutorial

Tutorials are sequenced, interactive, and self-paced instructional strategy in which the computer presents the subject matter to be learned (Brock 1994), guides the learner through the system, questions the learner about the subject matter, and allows the learner to practise and then assesses the learner by providing feedback on their responses (Martin and Loomis 2007).

Although certain tutorial software may include elements of drill-and-practice, tutorial is considered to be distinctive because it is designed to teach new skills using direct instruction method, thus providing new information and creating an independent teaching environment (Maddux et al., 1997).

In tutorials, the subject matter can be purely procedural or conceptual, or a combination of both, whereas feedback is often given in the form of remediation of a wrong response (Valley et al., 1996). Tutorials often offer the learners the opportunity to understand both the concept and the process (Martin and Loomis 2007).

Although tutorials are useful in distance learning or as an alternative way to learn something that teachers teach in the classroom, they discourage learners' creativity as the instructional method is often confined to be the same. Learners will also be easily demotivated with the common absence of game setting in the tutorials (Valley et al., 1996).

2.6.2 Drill-and-Practice

Drill-and-practice (also known as "Drill and Kill") is a skills-development instructional strategy which often places emphasis on response accuracy, speed, self-paced learning, and convergent question-answering abilities. Some of the first-marketed commercial drill-and-practice software contained dull and repetitive presentation, which is why this strategy is called drill and practice (Brock 1994). Unlike tutorials, drill-and-practice allows learners to practise repeatedly on previously learned subject matter until the skill or knowledge is transformed into long-term memory (Green and McNeese 2011).

Drill-and-practice, with constant practice on lower-level cognitive skills, is often matched with the behaviourist model (Maddux et al., 1997). Although

drill-and-practice is often disfavoured, it can be practical to be applied in certain contexts, like maths facts and spelling, since it needs little or no previous computer experience to use it (Brock 1994).

Computers that provide drill-and-practice are valuable learning tools, to the extent that these computers are often viewed as “non-human teacher aides” (Brock 1994). Brock added, this is because immediate yet individualised feedback could be given by separate computers to different learners at the same time during the same lesson, which is a task that teacher with a large class size can never accomplish.

In today’s classrooms, drill-and-practice software packages are either used as learning stations, “free time” choice activities, or groupware where the whole class or small team employs a software package together (Brock 1994). Drill-and-practice would sometimes take the form of a game-like environment by using animation, colours and sound to present the practice problems (Martin and Loomis 2007).

2.6.3 Computer-Mediated Game

Computer-mediated game (CMG) is a game which implies computer as the medium to create interactivity for user to play. Video games and recently-embarked online games are considered as computer-mediated games. Video game is an electronic or computerised game where user interacts with the game interface to generate relevant visual feedback on a video display. Online game

is a game based on the Internet in making the game play occurs. Computer-mediated games are believed to be able to foster the learning process in education.

Unfortunately, educators tend to ignore the usefulness of computer or video game in education and the important educational potentials of gaming but focused on the public penalty of game play (Squire 2003). There is a type of game called serious game which is used as an educational tool for learning. Further studies will be carried out in the following paragraphs.

The term “serious game” was long used before computer or electronic devices was introduced as a tool for entertainment, during which Clark brought out the term in a book named “Serious Games” back then in year 1970 published by Viking Press. Clark (1987) proposed a general definition of serious game as “We are concerned with serious games in the sense that these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement” (p. 9). Serious game (also known as edutainment game) consists of not purely enjoyment and fun, but also learning values which player learn throughout the process of playing. Learning from electronic devices and Web-based environment systems are considered less exciting than playing today’s popular games, as concluded by the majority of learners from children and teenagers (Bieliková et al., 2008).

2.6.4 Implication for the Research

Instructional strategies in e-learning determine the approaches which lecturers may take to facilitate learners in achieving the learning outcomes for a particular subject or topic. The major objective of ILC-WBLE is to allow lecturers to create courseware for a particular subject or topic through a simple and yet easy-to-use system.

Lecturers are able to create courseware for a particular subject or topic that is entirely new for students in ILC-WBLE, which serves as learning materials, or rather, tutorials, for self-paced and self-directed students. Thus, in this research, tutorial strategy is applied in ILC-WBLE when lecturers create a new topic of a subject by using content page in the system.

In order for lecturers to evaluate on the level of understanding of students towards the created courseware, it is also possible for lecturers to create interactive online quizzes for students to answer directly in the system. Thus, drill-and-practice is applied in the creation of online quizzes in ILC-WBLE to test the level of understanding of students on the instructional materials being taught in the content pages of ILC-WBLE.

By simply accessing ILC-WBLE, students will be able to learn or master a new subject or topic. Students get the opportunity to practise repeatedly on previously learned subject or topic by trying out the online quizzes in ILC-WBLE until the extent of transforming knowledge into long-term memory.

All the descriptions of the requirements of ILC-WBLE above match the characteristics featured by two of the instructional strategies – tutorial as well as drill-and-practice. As such, ILC-WBLE will implement both these instructional strategies, in an effort to achieve the learning outcomes of the subjects created in the system.

2.7 Interface Design Principles

In education applications, the user interface design and content's exploration are key issues (Metaxaki-Kossionides et al., 1999). Generally, there are two types of interface designs for an application, which are User-Centered Design and Usage-Centered Design. The differences between both these interface designs will be discussed in the following subsections.

2.7.1 User-Centered Design

An education application has one main purpose, which is for students to learn a particular skill or subject through self-learning. In order to achieve the ultimate goal which is self-learning, it is of utmost importance for the application to be user-friendly as it can directly affect the user experience in accessing the system. Designer of the application should not assume that the design of the objects in the application is always intuitive; the terrible design might sometimes cause frustration in user when they are unable to complete a simple task with ease (Abras 2004).

A designer, whom assists users in performing the desired tasks with the least possible effort in learning how to use the application, bears the responsibility as both the facilitator and mediator in developing an application (Norman 1988; Abras 2004). Given that User-Centered Design considers users as the central part of the development process, implementation of User-Centered Design in the development process of the application is essential in order for users to fulfil their needs and desires while accomplishing tasks using the application (Abras 2004).

User-Centered Design attempts to place users as the active participant in the development of the application (Johnson 1998; Kahraman 2010). Rather than forcing users to change their ways to adapt to the developed application, functions and operations of the application are defined according to the desires of the users in the development process so as to allow optimum utilisation of the application (Rubin 1994; Kahraman 2010).

Travis (2009) has pointed out three principles which support the aim of creating a successful user-centered design application, which are as follows:

i. **Early and continual focus on user and their tasks:** In order to avoid inappropriate user profile from being created, observation on how users carry out tasks is performed. The main interface will thus house the vital and essential functions whereas the less significant functions will be placed at other parts of the system to avoid the interface from being messy.

ii. **Empirical measurement of user behaviour:** The behaviours of users such **as** how effective the users are in completing the critical tasks, how effective the users are in accomplishing a specific task in terms of time consumption, and what is the level of satisfaction of users based on their experience on the design of the system are measured.

iii. **Iterative design:** In order to reduce unnecessary time spent on retesting a developed system after alteration, usability test is always conducted on paper prototypes before the system is developed. Developer obtains proper information architecture from paper prototyping while figuring out the most appropriate visual design for the system through electronic prototypes.

Since application developed by using User-Centered Design focuses mainly on the needs and interests of users, only easily understandable and usable actions are proposed in the application (Kahraman 2010). The active involvement of users in the development process has led to the effective and successful application (Preece et al., 2002), since usability of the application depends heavily on the satisfaction of the users when using the application (Kahraman 2010).

2.7.2 Usage-Centered Design

Usage-Centered Design is a systematic and model-driven approach for software and Web-based application (Constantine and Lockwood 1999; 2002a).

As easily perceived from the name of the interface design, which is "Usage-Centered Design", the main concern in the development of application is never the users, but the intended tasks by users as well as the accomplishment of tasks (Constantine et al., 2003).

2.7.3 User-Centered Design versus Usage-Centered Design

The methods of User-Centered Design are strongly grounded in the human-computer interaction world, whereas Usage-Centered Design focuses on a strong engineering direction which sets its target on producing a near-to-perfect initial design right at the beginning (Constantine et al., 2003). Constantine and Lockwood (2001) define Usage-Centered Design as the following:

> Usage-Centered Design is a flexible and scalable "industrial-strength" process that has been applied in business and industry to a wide variety of problems ranging in size from small-scale web-site design to an 18-month industrial automation project (p. 5).

The statement has clearly revealed that Usage-Centered Design, which takes on an industrial-strength approach, is a robust yet established process used to design everything from industrial automation system, consumer electronics to banking and insurance system (Constantine and Lockwood 2002a; Constantine et al., 2003). Constantine and Lockwood (2002a) and Constantine et al. (2003) summarised the differences between User-Centered Design and Usage-Centered Design as shown in Table 2.7.

Table 2.7: Differences between User-Centered Design and Usage-Centered Design

User-Centered Design	Usage-Centered Design
Focus on users' experience and satisfaction	Focus on usage which focused on task accomplishment
Driven by user input	Driven by models
Extensive user involvement in user studies, participatory design, user feedback, and user testing	Selective user involvement in explorative modelling, model validation, and usability inspections
Realistic or representational design models	Abstract design models
Varied, informal or unspecified processes	Systematic, fully specified process
Designed by trial-and-error	Designed by engineering

2.7.4 Implication for the Research

WBLE is a comprehensive LMS which is embedded with plenty of features used to monitor learners' learning progress. Different from WBLE, ILC-WBLE is an easy-to-use, simple and yet informative system which allows lecturers to create an interactive courseware for a subject.

User-friendliness of ILC-WBLE is the main characteristic of the system. As far as easiness-to-use is concerned, lecturers do not need to spend unnecessary time in learning to use ILC-WBLE before they can share information of a particular subject or topic with their students.

As discussed in sections 2.7.1 through 2.7.2, User-Centered Design places emphasis on user experience and satisfaction, whereas Usage-Centered Design is rooted on the importance of defining users' tasks while accomplishing tasks within the software. Given that Usage-Centered Design is proven to be particularly effective in developing software for usage based on robust task models such as industrial automation system (Windl and Constantine 2001; Constantine and Lockwood 2002b; Windl 2002), implementing Usage-Centered Design for the development of ILC-WBLE becomes impractical as ILC-WBLE is not a complex software.

ILC-WBLE intends to pose as a simple and straightforward platform which allows the sharing of knowledge and information through the system. User-Centered Design is therefore an adequate design which can support the development of ILC-WBLE as it gives user a greater sense of satisfaction while accessing the application (De Troyer et al., 1998).

2.8 Multimedia Learning Objects

Multimedia is an integration of text, images, sounds, video, and animation. According to Song et al. (2006), multimedia technologies applied in online learning could possible enabling interactivity and lead to active participation from learners. The implementation of multimedia in learning is essential as it could enrich the learning process. Studies on the multimedia elements will be carried out in the subsequent sections.

2.8.1 Text

Text is the most basic element uses to express a message. Explanation always occurs verbally or in verbally through the implementation of text. Usage of text in courseware must not neglect the appropriate way of collaborating text with the content of the application. For instance, words included in application must be familiar to the users, avoid using technical terms, and consistent with the words used in the application (U.S. Department of Health and Human Services 2009). Failing to do so will lead to the confusion of the understanding towards the information in the courseware.

Filling with overly fancy fonts or too many font types will overwhelm the whole documents (Capron and Johnson 2004). Distraction from the viewer of the multimedia application occurs when a proper use of text is overlooked. Therefore, proper use of font type in a system could retain the concentration of learner towards the system. According to Graham (2005), each type of font is applied in different situation. For instance, serif font as illustrated in Figure 2.20 is easier to read in long sentences than other fonts due to its thick and thin variations in letter strokes in order to make the font more distinctive. On the other hand, sans serif font as shown in Figure 2.21 works well for headlines and display types because of its simplicity and clean look. As such, sans serif font is suitable to be used to display wordings which need to be highlighted in the system, such as wordings on navigation buttons or title of the page, whereas, serif font is used to display the main text in the system.

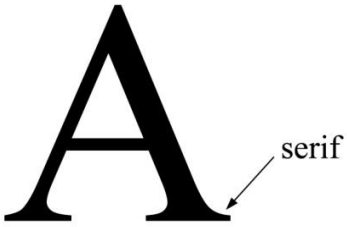

Figure 2.20: Example of Serif font

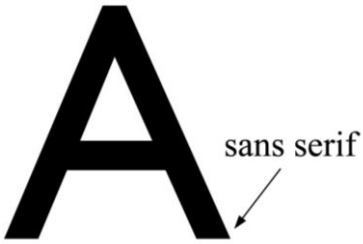

Figure 2.21: Example of Sans Serif font

2.8.2 Images and Graphics

As seen in any multimedia application, images or graphics are one of the important elements as “a picture worth a thousand words”. According to Parekh (2006), pictures can be made to impart a large amount of information in such a compact way.

In the experiment of measuring the level of understanding towards the subject by Mayer and Moreno (2002), learners are more likely to understand better by exposing words and images simultaneously to explain the subject. Learners are able to create the relationship between the corresponding words and images, consequently, it can enhance the learning experience of learners.

Graphics are able to produce and retain the interest of an audience by enriching the learning process (Capron and Johnson 2004). It is a fact that most people prefer looking at pictures rather than reading through pages of text. Based on the result of experiment from Sakar and Ercetin (2005), learners preferred visual information than textual explanation and implementing of images builds the interest of learners in learning the knowledge.

As such, courseware utilises plenty of images to explain the content in the system other than just using plain text. Figures 2.25 and 2.26 reveal sample screenshots from two different courseware using images for further elaboration of the instructional content.

Figure 2.22: Sample screenshot from a courseware entitled "Pengenalan Undang-Undang Jalan Raya" showing the use of graphics to explain traffic rules in Malaysia

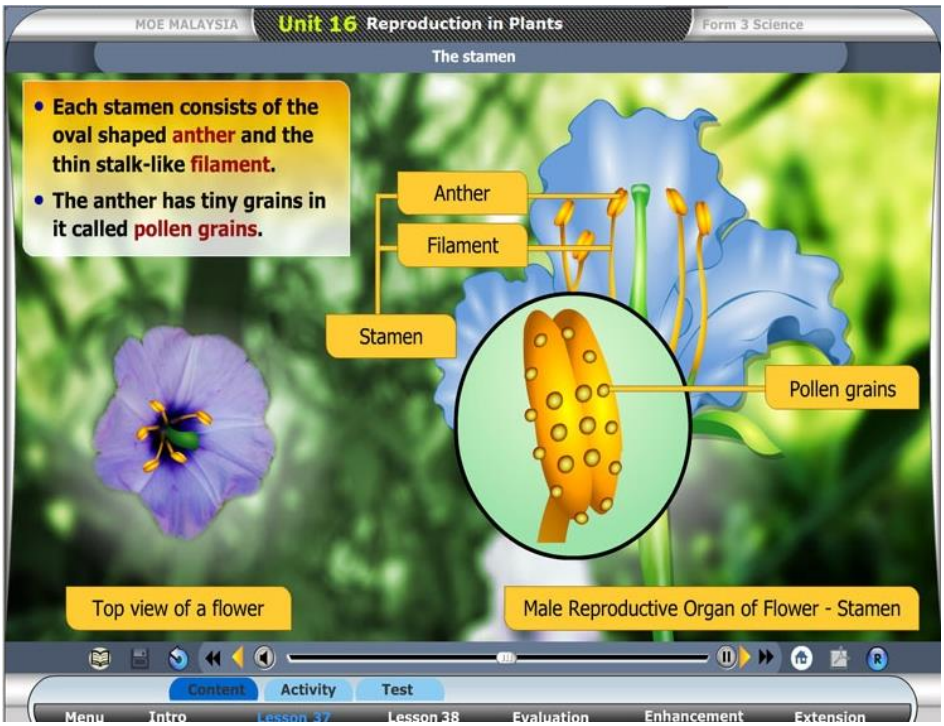

Figure 2.23: Sample screenshot from a courseware entitled "Form 3 Science", which uses images and graphics to explain the reproduction of plants

2.8.3 Audio (or Sound)

Audio is different than any of the other multimedia elements. All other multimedia elements such as images or words are primarily visually perceived through eyes while audio is perceived through the sense of hearing (Chapman and Chapman 2006).

The usage of audio as narration in learning is used to increase the understanding of the learners towards the subject. Mousavi, et al. (1995) explained the usage of narration together with visual aid can be greatly improve the learning process instead of presenting words and visual aid as narration that is involved verbal channel is freeing the capacity in visual

channel that can be allocated to process visual aid. Mayer and Moreno (2002) also concluded that present words as auditory narration is always better than visually present the words on screen. Based on the above statements, it is to believe that by employing both verbal and visual channel into the learning of learner would deeply improve the learning process.

2.8.4 Animation and Video

Throughout the twentieth century, animation was used for entertainment, advertising, instruction, art and propaganda on film and in recent times on video; it is now widely employs in World Wide Web and multimedia presentation (Chapman and Chapman 2006). In this day, video able to draw gasps from a crowd at a trade show or firmly hold a student's interest in a computer-based learning system (Vaughan 2004).

The popularity of using animations in education has greatly increased since the beginning of powerful graphics-oriented computers. Instead of using static images and texts in presenting the information to learner, using animated images such as educational animations have functioning in attracting learner attention to help them understand and remember the content. Human tend to be more fascinated into motion objects than a still images, this is the advantage in applying video and animation in education multimedia application.

Talib et al. (2006) found that students who were exposed to constructivist-animated instruction (build by using powerful object-oriented

animation features) have better understanding on the complex, abstract and dynamic science concepts compared to those taught by conventional approach. According to Kozma (2001), students might be able to relate mental imagination to the real world through video when it is hard to explain with texts. Animations and video are excellent aid to teachers when it comes to explaining difficult subjects since animation and video can present the whole teaching concept where else sometimes is hard to convey it through words. Therefore, well-designed animations and video may help students learn faster and easier.

2.8.5 Implication for the Research

By incorporating multimedia objects in learning materials, it could possibly enhance the understanding of learners towards the subjects and it retains the participation of learners as well. Hence, ILC-WBLE is embedded with dynamic multimedia content creation feature which allows lecturers to create an interactive courseware for a subject. ILC-WBLE consists of a platform allows lecturers to share information of the particular subject which embedded various types of multimedia learning objects such as text, images, graphics, audio, animation, and video.

2.9 Conclusions

Overall, the review on related literature such as the existing LMSs, learning approaches, and learning theories has plays a vital role in implementing the research. Furthermore, several ISD models such as ADDIE, Dick and Carey, and Kemp's Instructional models had been studied. Based on the comparison among these ISD models, ADDIE model is selected to guide the overall development process of ILC-WBLE.

In addition, the instructional strategies such as tutorial, drill-and-practice and computer-mediated game for CBL were elaborated in details. However, only tutorial and drill-and-practice are applied in the development of ILC-WBLE to facilitate the teaching-learning process. Meantime, based on the studies on two major types of interface design principles, namely User-Centered Design and Usage-Centered Design, User-Centered Design is deemed suitable to be applied in ILC-WBLE as it places its focus on users' experiences rather than the accomplishment of robust tasks.

Moreover, the characteristics and application of a variety of multimedia learning objects have also been studied. Multimedia objects such as text, images, graphics, audio, animation and video are crucial to be integrated in ILC-WBLE, since ILC-WBLE focuses on the creation of dynamic multimedia content. The dynamic multimedia content creation feature that allows lecturers to create interactive multimedia based instructional materials could enrich the learning process.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the phases involved in the development of a prototype of an interactive multimedia CBL (Computer-Based Learning) courseware called ILC-WBLE (**I**ndependent **L**earning **C**ourseware for **W**eb-**B**ased **L**earning **E**nvironment). Besides, it also includes several topics of discussion pertaining to the usability evaluation study such as evaluation samples, evaluation instruments, data collection procedure, and data analysis.

As has been discussed in chapter 1, there are four main research objectives set at the earlier stage of this research, which focused on the development and usability evaluation of a prototype of ILC-WBLE. So, the discussion of the research methodology is divided into two sections as below:

i. Research methodology for the development of a prototype of ILC-WBLE

ii. Research methodology for the usability evaluation of the prototype of ILC-WBLE

3.2 Research Methodology for the Development of a Prototype of ILC-WBLE

The development of a prototype of ILC-WBLE was based on a proposed Instructional Design (ID) model as shown in Figure 3.1. The proposed ID model was developed based on the generic and simple Instructional System Design (ISD) model called ADDIE model which has been discussed in section 2.5.1. It consists of five phases, which are Analysis, Design, Development, Implementation, and Evaluation.

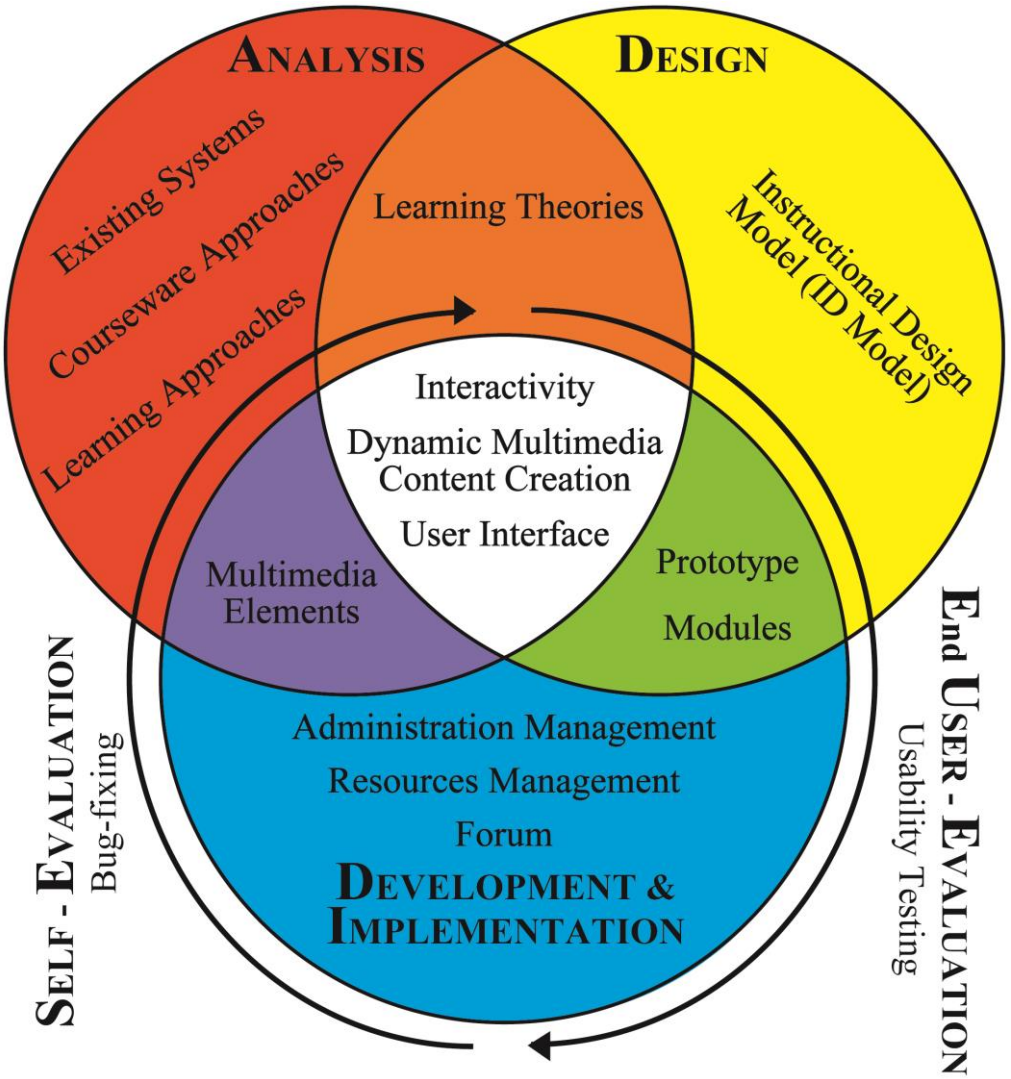

Figure 3.1: Proposed ID model for the development and usability evaluation of ILC-WBLE

3.2.1 Analysis Phase

In this phase, literature review on past studies pertaining to the development of multimedia applications for learning, which is known as Learning Management System (LMS), was carried out. It also involved the reviews of existing LMS in Malaysian higher education institutions, learning approaches, courseware approaches such as instructional strategies in e-learning, learning theories which are applicable to the development of learning systems, as well as the user interface design and multimedia learning objects which can be incorporated in the courseware.

Overall, the reviews of literature in this phase focused on identifying the strengths and limitations of existing LMS in Malaysian Higher Education Institutions (HEIs) as well as suitable methods and approaches that can be used to develop an efficient multimedia learning package. These literature reviews also assisted in the design and generation of an appropriate ID model for the development of a prototype of ILC-WBLE. The description of each component involved in the Analysis phase is presented in the following subsections.

3.2.1.1 Existing Learning Management Systems

A series of review of existing LMS in Malaysian HEIs were carried out to assist in planning the development of a prototype of ILC-WBLE. These reviews, which had been discussed in depth in section 2.2, involved LMS used in four different institutions, including WBLE at Universiti Tunku Abdul

Rahman, MMLS at Multimedia University, PPPJJ at Universiti Sains Malaysia, and myLMS at Open University Malaysia.

3.2.1.2 Learning approaches

For the past decades, the educational settings have had to frequently reinvent themselves with the constant introduction of new tools, different platforms and different approaches to learning. The study of different types of learning approaches was carried out to find out an appropriate learning approach which is deemed suitable for learning adults in higher education environments. These learning approaches include traditional face-to-face (F2F) form of learning, e-learning, and blended learning as described in section 2.3.3.

Traditional classroom learning is irreplaceable. Nonetheless, e-learning which describes the learning mode by the use of technology represents some form of an extension of the traditional classroom instruction or as an alternative to the traditional mode. Dziuban et al. (2004) claimed that e-learning has focused primarily on off-campus learning activities. With the more-recent on-campus emphasis, another type of learning mode has appeared which is called blended learning, or mixed-mode instruction. Blended learning becomes extremely fashionable nowadays, particularly in higher education settings. According to Graham (cited in McDonnell and Connolly 2008), blended learning is used to describe all manners of instructional contexts, but in general can be described as combining "face-to-face instruction with computer-mediated instruction". This research adopted blended learning approach

whereby the blend typically includes traditional F2F classroom activities, print resources, and the LMS called ILC-WBLE. ILC-WBLE was developed to complement the traditional face-to-face learning.

3.2.1.3 Courseware approaches

In the *Macmillan English Dictionary Online* (2012), courseware is defined as "computer programmes used for teaching people a subject or skill". The *BusinessDictionary.com* (2012) defines the courseware as "training material on a diskette, CD or DVD, or downloaded from the internet, for use with a self-learning or coach-assisted programme". The study of approaches applicable to the courseware development was carried out in the analysis phase. It aims to figure out suitable instructional strategies that could be included in ILC-WBLE development for effective learning. There are three typical instructional strategies incorporated in any CBL courseware, which encompass tutorial, drill-and-practice and computer-mediated instructional game, as discussed in section 2.6. In this research, two instructional strategies, namely tutorial and drill-and-practice, had been applied in the development of ILC-WBLE.

Alessi and Trollip (2001) define tutorial as "instructional programmes that are primarily intended to present information or demonstrate skills to learners and to guide the learners through their initial use of the new information or skills" (p. 89). Thus, in this research, tutorial strategy is applied in ILC-WBLE when lecturers create a new topic of a subject that is entirely

new for the students in the content page.

According to Thomas (2005), drill-and-practice is used to repeatedly exercise a simple or small area of knowledge. Clark (cited in Tan 2005) asserted that "when skills through the use of drills and practice and quizzes are repeated over a period of time, knowledge learned gets built into the long-term memory – this is how people become experts after years of practice and learning". Drill-and-practice is applied following the creation of online quizzes in ILC-WBLE to test the understanding of students on the instructional materials being taught in the content pages of ILC-WBLE.

3.2.1.4 Learning theories

There are many different theories of how people learn. One of the important tasks involves in the analysis phase is to research on a variety of learning theories such as cognitive flexibility theory, elaboration theory, and multimedia learning theory, which had been described in section 2.4. It helps to figure out the appropriate learning theories to be applied into the development of each module in ILC-WBLE for effective learning. Figure 3.2 presents the learning theories applied in each module.

3.2.1.5 User interface design

Generally, there are two types of interface designs of a system, which are User-Centered Design and Usage-Centered Design. Both interface designs

had been studied and discussed in section 2.7. With reference to the literature review, User-Centered Design had been selected in the design of user interface in ILC-WBLE. User-Centered Design is suitable for the novice users of LMS, since the main concern of this design is the experience of user in using the system instead of achievement of the usage of the system.

3.2.1.6 Multimedia elements for dynamic multimedia content creation

Although text is the main medium used to deliver information to people, other media elements such as images, graphics (static form), audio, video and animation (dynamic form) can be used to deliver instructional materials. The text-intensive materials that are delivered either verbally or in written format are rather dull and uninteresting. By incorporating multimedia elements into the instructional materials, it is strongly believed that students will find it more interesting and motivated to pick up skills and knowledge.

Therefore, ILC-WBLE should be able to support the upload of various types of multimedia elements into the system to further elaborate on the instructional contents. This is especially true when abstract concepts can be explained in the teaching-learning process via multimedia elements in the system. The implementation of multimedia objects in the courseware development had been discussed in section 2.8.6.

3.2.2 Design Phase

With all the outputs from the previous phase, an appropriate ID model (Figure 3.1) for the development of the ILC-WBLE was designed and created in this phase. ID model is defined as a guideline or strategy which leads the whole research and development of an education application (Gustafson and Branch 2002; Crawford 2004; Chiappe Laverde et al., 2007). The design of ILC-WBLE emphasises on theory-approach-based multimedia elements (e.g. cognitive flexibility theory, elaboration theory, and multimedia learning theory) and adopts a dynamic multimedia content creation feature.

Although there are plenty of features included in WBLE, however, not all the features provided in WBLE were used by lecturers. The most frequently used feature is the management of course materials; for instance, lecturers usually upload online documents such as lecture notes, assignment brief notes and so forth for students to download. In fact, the functions available in WBLE are more than uploading or downloading documents, but some functions had been neglected by users. Thus, the consideration of modules to be integrated in ILC-WBLE is crucial to ensure that this system is beneficial to all users. After studying WBLE, three major modules are built into ILC-WBLE, which are as follows:

i. **Administration Management**

- **User profiles management:** Adding a new user/ lecturer or deleting an existing user can be done in this module. The system administrator is responsible for the

addition or deletion of new user and modification of user profiles.

ii. **Resources Management:** It enables lecturers to create as well as to manage the content pages and quizzes available in the system.

- **Content:** Instructional contents are delivered through various types of multimedia elements such as text, images, graphics, audio, video, and animation can be uploaded into system. Different computer file formats (e.g. .pdf, .ppt, .zip, etc.) can be uploaded as attachments in the system as well. Lecturers are allowed to upload instructional materials into the system and manage the content pages. However, students can only access and download the instructional materials without having any authority to manage the content pages in the system.
- **Quiz:** Three types of quizzes (i.e. multiple choices, fill in the blanks, and drag and drop) can be created in the system. Only lecturer is allowed to create quizzes in the system.

iii. **Forum:** It serves as a medium of communication between lecturers and students.

- **Topics discussion:** Lecturers and students are allowed to create new discussion topics and reply to any created topics in the forum. Lecturers and students are having equal capabilities in using the forum.

Then, storyboards for developing ILC-WBLE were designed and created to visualise the content of ILC-WBLE. A storyboard contains instructions for programming, an audio script, and a detailed description of the visual elements such as text, video, graphics, and animation. Storyboard is an essential component in directing and producing a programme. The samples of storyboards are as appended in Appendix D.

3.2.3 Development and Implementation Phases

In the development phase, a prototype of ILC-WBLE is developed with all the lecturers in Universiti Tunku Abdul Rahman (UTAR) as target users. The development of ILC-WBLE is carried out according to the activities stated below:

i. The ILC-WBLE prototype is developed using *Adobe Flash* as the main authoring tool. In addition to text instructional contents, multimedia elements such as graphics, audio, animation, and video are included in the system.

ii. The integration of video and audio are edited using *Camtasia Studio*.

iii. Since ILC-WBLE is developed as an interactive multimedia CBL courseware for routine learning, the multimedia design principles as well as appropriate ID theories and pedagogical principles need to be taken into consideration in designing and developing the courseware.

Based on the proposed ID model (Figure 3.1), ILC-WBLE is integrated with dynamic multimedia content creation feature which enables lecturers to:

- create instructional materials through ILC-WBLE; and
- upload multimedia files such as background music, images, and even video clips into ILC-WBLE.

The modules design model as shown in Figure 3.2 illustrates the details of the modules integrated in ILC-WBLE. As can be perceived through Figure 3.2, there are three modules built into the system, which are Administration Management, Resources Management, and Forum.

3.2.4 Evaluation Phase

There are two types of evaluations, which are formative evaluation and summative evaluation. According to Kaynama and Keesling (2000) and Stewart et al. (2004), formative evaluation by peers gives the opportunity to the continuous improvement of the system. Hence, formative evaluation implemented in this research refers to self-test run of the system (i.e. self-evaluation as can be seen through Figure 3.1) throughout the whole development of ILC-WBLE. The scope of testing focuses mainly on bugs' detection with the purpose of refining the system. The development of ILC-WBLE involved formative evaluation to ensure smooth development and implementation processes.

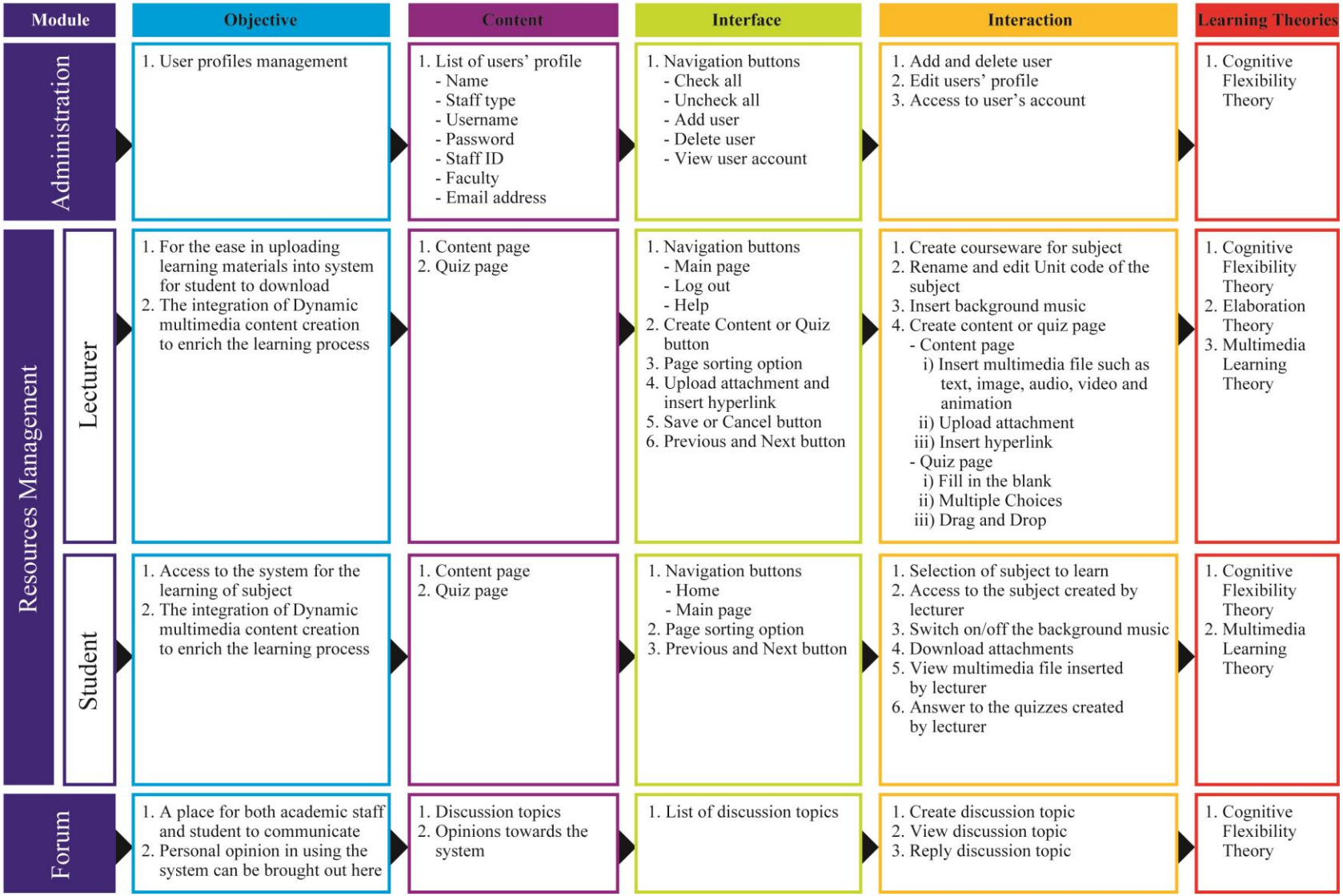

Figure 3.2: Modules design model showing the modules integrated in ILC-WBLE

The research also involved summative evaluation, namely end user-evaluation as depicted in Figure 3.1 The summative evaluation of ILC-WBLE was carried out to test its usability after the completion of ILC-WBLE development and is further discussed in section 3.3. Gustafson and Branch (1997) noted that summative evaluation is for the purpose of testing on the effectiveness of the system. Thus, summative evaluation refers to the usability test of the system. Pilot study was carried out to test the reliability of two sets of usability evaluation questionnaires before proceeding to the empirical study which was employed to test the usability of the prototype of ILC-WBLE.

3.3 Research Methodology for the Usability Evaluation of the Prototype of ILC-WBLE

This research also involves the implementation of usability evaluation among lecturers and students to evaluate the usability of developed ILC-WBLE. The usability evaluation study includes five research constructs: (i) easy to use, (ii) easy to learn, (iii) level of interactivity, (iv) user interface design, and (v) error-free assessment.

3.3.1 Evaluation Samples

One of the main research objectives is to evaluate the usability of the prototype of ILC-WBLE among lecturers and students of the university. The usability of ILC-WBLE has to be evaluated in order to identify whether or not it is feasible in assisting lecturers in creating online learning materials for

students. So, the target population for this research is UTAR lecturers and students.

Undeniably, it is ideally advisable to involve all the lecturers and students in the usability evaluation of ILC-WBLE in order to achieve results of higher accuracy. However, due to time constraint, it is impracticable to involve the entire population who are currently using WBLE in four campuses of UTAR in different locations, namely the main campus at Kampar (Perak state), and Klang Valley campuses at Petaling Jaya, Sungai Long (Selangor state) and Setapak (Kuala Lumpur). Hence, the evaluation samples for the usability evaluation study in this research were limited to convenience sample of lecturers and students from the main campus.

3.3.1.1 Lecturers

Lecturers participating in the evaluation were from any of the two categories below:

- new lecturers who are yet to be exposed to WBLE, and
- existing lecturers who have been exposed to WBLE at least more than one trimester at the time of participating in this evaluation.

Although UTAR consists of two centres (i.e. Centre for Extension Education and Centre for Foundation Studies) and nine faculties (holding programmes for bachelor, master and doctorate levels) which offer different

courses to students, but the potential participants of the evaluation study had been selected from the Centre for Foundation Studies (CFS) at main campus. All lecturers from CFS play an important role due to the fact that they are dealing with fresh undergraduates who have just entered university life.

Learning in higher education relies heavily on the use of computer as most of the learning materials are available online. In order to ensure these fresh undergraduates adapt to the new learning environment as soon as possible, methods of teaching and learning in CFS are vitally assessed and arranged to suit the students in CFS. Thus, the use of WBLE in UTAR is crucial as WBLE is the hub which centralises all the learning materials for students in entire university including students from CFS. Due to the importance of WBLE among lecturers and students in CFS, it leads to the use of ILC-WBLE because this system can be applied as a system that teaches students in using WBLE and it can facilitate lecturers to share the learning materials to students as well.

3.3.1.2 Students

Participants in the category of students were CFS students who are taking the subjects taught by the selected lecturers. Since WBLE is new to CFS students, it is thus crucial that the ILC-WBLE which is developed as a complimentary CBL courseware to WBLE has to be easy to use and easy to learn.

3.3.2 Evaluation Instruments

The main instrument in this research is the questionnaire because it is an inexpensive way to gather data from a large number of respondents. Two sets of evaluation questionnaires (see Appendices A and B) which were used to evaluate the usability of ILC-WBLE among two different categories of evaluation samples (i.e. lecturers and students) were created with reference to Nielsen's 10 usability heuristics as below:

i. **Visibility of system status:** Consistent feedback should be given in order to inform the current location/status of user in the system.

ii. **Match between system and the real world:** The system should use wordings, phases, and concepts that are familiar to user to make the content in the system naturally and logically ordered.

iii. **User control and freedom:** Features that allow user to redo an action when mistakes are committed should be available in system to avoid unnecessary actions that require user to go through from the beginning.

iv. **Consistency and standards:** Instructions in system should not confuse user that different wordings or actions of the instructions might carry out the same function.

v. **Error prevention:** Confirmation message should be displayed after user has committed in any action, in order to prevent careless mistake while using the system.

vi. **Recognition rather than recall:** Regular instructions used to perform specific task should be retrievable anytime to reduce user's memory load in memorising information that is used to perform certain task, from one part to another.

vii. **Flexibility and efficiency of use:** Experienced user should be allowed to speed up the interaction with the system by implementing accelerator type of functions in the system.

viii. **Aesthetic and minimalist design:** Irrelevant or redundant information should be eliminated from the system to prevent confusion among users.

ix. **Help users recognise, diagnose, and recover from errors:** Error message with precise explanation of the error should be displayed after any mistake is made in the system, to assist user in rectifying the error.

x. **Help and documentation:** Availability of user guideline in the system is encouraged in order to assist user when facing difficulties in using the system.

Nielsen's usability heuristics have been widely accepted in the field of human-computer interaction (HCI) and frequently cited in usability evaluation studies (Babaian et al., 2010).

The two sets of questionnaires consisted of identical measured constructs with different items. Both sets of questionnaires were split into three parts as follows:

- Part A: This part was created to collect personal details of respondents such as gender, experience in teaching (for lecturers) or current trimester of study (for students), and year of experiences in using WBLE and computers.
- Part B: It was made up of five constructs to evaluate the usability of ILC-WBLE. These constructs are (i) easy to use, (ii) easy to learn, (iii) level of interactivity, (iv) user interface design, and (v) error-free assessment. With reference to Nielsen's usability heuristics, five statements were built into each measured construct (see Tables 3.1 and 3.2). Respondents were asked to rate their level of agreement on each statement using the 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree).
- Part C: Respondents were asked to give additional comments on the developed ILC-WBLE.

Table 3.1: The application of Nielsen's usability heuristics in the ILC-WBLE evaluation questionnaires for lecturers

Usability measured constructs	Nielsen's usability heuristics
Easy to Use ETU1. Aware of the options that can be carried out in the system (such as insert a new content page, create quizzes, insert hyperlinks and upload attachments). ETU2. Aware of where to proceed to the next step that you wish (such as proceed to next page by clicking on "Next" button). ETU3. Easy to identify the creation/ modification date for the subjects in the list. ETU4. Being informed for the latest progress of your upload process. ETU5. All instructions are clearly listed in the system.	1. Visibility of system status 2. Consistency and standards

Table 3.1 (Continued)

Usability measured constructs	Nielsen's usability heuristics
Easy to Learn ETL1. Easy to understand the language (words and phrases) used in the system. ETL2. Able to create/ modify the content of the content page and quizzes. ETL3. Location of navigation buttons are placed consistently in the system. ETL4. Clear guidance is provided to guide users in the "Help" menu. ETL5. The customised "Help" icon could be found easily within any pages.	3. Match between system and the real world 4. Help and documentation
Level of Interactivity LOI1. The page type could be easily sorted by contents and quizzes. LOI2. The quizzes could be set in various methods, such as drag and drop, fill in the blank, and multiple choices. LOI3. The system supports multimedia creation in the content page (consist of text, image, sound, video, and animation). LOI4. Playing of video or audio is controllable in the system. LOI5. Supporting materials could be inserted as hyperlinks and attachments (such as .pdf, .zip, .doc/ .docx, .ppt/ .pptx, .jpg, etc.).	5. User control and freedom 6. Flexibility and efficiency of use
User Interface Design UID1. Able to display the content of each page in various layout designs. UID2. The colour scheme applied in the system is appropriate. UID3. Graphic used in each of the navigation buttons clearly indicated the function of the button. UID4. Instructions are given repeatedly in every section to reduce the use of users' memory. UID5. Each page has a clear and short title to indicate users' current location.	7. Recognition rather than recall 8. Aesthetic and minimalist design

Table 3.1 (Continued)

Usability measured constructs	Nielsen's usability heuristics
Error-Free Assessment EFA1. Users are required to confirm their actions before they delete unwanted contents. EFA2. Hyperlinks can be created without any errors. EFA3. Page type can be sorted accordingly from Content page to Quiz or back to the original sequence. EFA4. Error message pops out could precisely indicate the problem. EFA5. All error messages will be provided with the respective solutions.	9. Error prevention 10. Help users recognise, diagnose, and recover from errors

Table 3.2: The application of Nielsen's usability heuristics the ILC-WBLE evaluation questionnaires for students

Usability measured constructs	Nielsen's usability heuristics
Easy to Use ETU1. Aware of the options that can be carried out in the system (such as answer quizzes, view content, download attachments, etc.). ETU2. Aware of where to proceed to the next step that you wish (such as proceed to next page by clicking "Next" button). ETU3. The steps to view/ read/ answer contents are consistent throughout the system. ETU4. Aware of total of pages in a subject in order to estimate amount of time needed to spend in accessing the whole subject. ETU5. All instructions are clearly listed in the system.	1. Visibility of system status 2. Consistency and standards
Easy to Learn ETL1. Easy to understand the language (words and phrases) used in the system. ETL2. Aware of how to proceed to the next step that you wish (such as click on "Submit" button to review answers of the quiz). ETL3. Location of navigation buttons are placed properly in the system.	3. Match between system and the real world 4. Help and documentation

Table 3.2 (Continued)

Usability measured constructs	Nielsen's usability heuristics
ETL4. Clear guidance is provided to guide users in the "Help" menu. ETL5. The customised "Help" icon could be found easily within any page.	
Level of Interactivity LOI1. The page type could be easily sorted by contents and quizzes. LOI2. The quizzes are set in various methods (such as drag and drop, fill in the blank, and multiple choices). LOI3. The system supports multimedia contents (consist of text, images, graphics, sound, video, and animation). LOI4. Playing of video or audio is controllable in the system. LOI5. Supporting materials could be found in the forms of hyperlinks and attachments (such as .pdf, .zip, .doc/ .docx, .ppt/ .pptx, .jpg, etc.)	5. User control and freedom 6. Flexibility and efficiency of use
User Interface Design UID1. The content of each page come in various layout designs. UID2. The colour scheme applied in the system is appropriate. UID3. Graphic used in each of the navigation buttons clearly indicated the function of the button. UID4. Instructions are given repeatedly in every section to reduce the use of users' memory. UID5. Each page has a clear and short title to indicate users' current location.	7. Recognition rather than recall 8. Aesthetic and minimalist design
Error-Free Assessment EFA1. All attachments can be downloaded without any errors. EFA2. All hyperlinks can be accessed without any errors. EFA3. All page types can be sorted accordingly from Content page to Quiz or back to the original sequence. EFA4. All video and audio can be played without any errors. EFA5. All quizzes can be answered without any errors.	9. Error prevention 10. Help users recognise, diagnose, and recover from errors

3.3.2.1 Pilot study

In this research, a pilot study was conducted to test the authentication on the reliability of the usability evaluation questionnaires created. Pilot study is essential to evaluate the instrument such as questionnaire for a research (Baker 1994; van Teijlingen and Hundley 2001). There were 6 lecturers and 25 students participated in the pilot study. Participants were given a day to learn and practise the prototype of ILC-WBLE, and answer the statements that were built into five constructs (i.e. easy to use, easy to learn, level of interactivity, user interface design and error-free assessment) in the respective set of usability evaluation questionnaire. Based on the analysis of data collected from the pilot study, the reliability of both sets of the questionnaires had been calculated.

3.3.2.2 Reliability of usability evaluation questionnaires

Reliability is used to indicate the internal consistency of the instruments (Wrisley et al., 2004). Reliability testing on the questionnaire is to examine the stability and consistency of scores for all items in the questionnaire – whether scores of the items are relatively the same at different times under different conditions (Charles 1995; Ngai et al., 2007; Miller 2012). Cronbach's alpha is the most preferred value used to measure the internal consistency of the instrument (Gliem and Gliem 2003; Ferketich 2007). In order to determine the reliability of the questionnaires for the usability evaluation of ILC-WBLE, Cronbach's Alpha values were checked against the

items constructed in the questionnaire. According to Martin and Douglas (1997) and Santos (1999), Cronbach's Alpha value of more than 0.70 is considered as satisfactory and acceptable.

Based on the findings of data analysis obtained in the pilot study, the Cronbach's alpha values of the usability evaluation questionnaires for lecturers and students are 0.898 and 0.948 respectively (see Appendix C), which exceeded the minimum acceptance level of 0.70 as recommended by Martin and Douglas (1997) and Santos (1999). The results of Cronbach's alpha analysis indicated that the usability evaluation questionnaires for both lecturers and students were well constructed and reliable to be used for the usability evaluation of ILC-WBLE.

3.3.3 Data Collection Procedure

The prototype of ILC-WBLE was empirically tested with real users of WBLE at UTAR. The usability evaluation using a survey questionnaire was conducted in October 2010. The two-week time span includes the time spent on training users to use ILC-WBLE, and the time used for them to answer the usability evaluation questionnaires. Respondents were given two weeks' time to ensure that they have sufficient time to learn and practise the ILC-WBLE thoroughly, before evaluating the courseware and answering the statements constructed in the questionnaires which were measured on a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree).

Respondents were not restricted to using the prototype of ILC-WBLE within the campus, but also can access the system outside the campus. The reason for not constraining the location of the evaluation is to provide flexibility in accessing instructional materials at anytime and anywhere as long as there is Internet connection. Lecturers who participated in the evaluation had shared instructional materials using ILC-WBLE and students who participated in the evaluation had accessed those instructional materials created in the system.

At the end of the treatment, two different sets of evaluation questionnaires which include both closed and open-ended questions (see Appendices A and B) were given to respective participants (i.e. lecturers and students) to measure their perceptions toward the features provided in ILC-WBLE to find out their level of agreement with the usability of the prototype of ILC-WBLE.

3.3.4 Data Analysis

The data collected was coded into SPSS (Statistical Package for the Social Sciences) programme for data analysis. As described in section 3.2.4, the research also aims to evaluate the usability of the prototype of ILC-WBLE among the evaluation samples (i.e. lecturers and students). The descriptive statistics seemed to be the most appropriate method for analysis. Mean, standard deviation (S.D.), frequency and percentage of cases were generated to find out the number of respondents agreeing or disagreeing with each item

that measures the usability of the prototype of ILC-WBLE.

In addition, the strengths and weaknesses of the prototype of ILC-WBLE could be identified through the evaluation on samples' feedback and their ratings of agreement with the five statements included in each of the research constructs (i.e. easy to use, easy to learn, level of interactivity, user interface design and error-free assessment) that measures the usability of the prototype of ILC-WBLE.

3.4 Conclusions

In conclusion, this chapter has discussed the activities and processes involved in achieving all the research objectives. It covers two sections: The first section (i.e. research methodology for the development of a prototype of ILC-WBLE) involved the five-phase development process as shown in the proposed ID model which was developed based on ADDIE model. The second section (i.e. research methodology for the usability evaluation of the prototype of ILC-WBLE) described the usability evaluation study that was carried out to test the usability of the prototype of ILC-WBLE among UTAR lecturers and students. Five research constructs (i.e. easy to use, easy to learn, level of interactivity, user interface design and error-free assessment) that based on Nielsen's usability heuristics were built into the usability evaluation questionnaires to measure the perceptions of lecturers and students toward the usability of the prototype of ILC-WBLE.

Having discussed the research methodology in detail, the following chapter presents and discusses the results of data analysis using tables and charts. The discussion in chapter 4 also includes the strengths and weaknesses of the prototype of ILC-WBLE which were summarised from the data collected through questionnaire.

CHAPTER 4

RESULTS AND DISCUSSION

5.1 Introduction

This chapter focuses on the discussion of the results obtained in the research. It is divided into three sections, which are:

i. The development of a prototype of ILC-WBLE,

ii. The usability evaluation of the prototype of ILC-WBLE, and

iii. The identification of the strengths and weaknesses of the prototype of ILC-WBLE.

5.2 The Development of a Prototype of ILC-WBLE

This section presents the results of the research and is divided into the following topics:

i. The design and development of an Instructional Design (ID) model for the development of ILC-WBLE, and

ii. The prototype of ILC-WBLE development.

4.2.1 The Design and Development of an Instructional Design Model for the Development of ILC-WBLE

As has been discussed in chapter 3, an ID model for the development of ILC-WBLE had been designed and developed. The proposed ID model as shown in Figure 3.1 was developed based on a generic ID model called ADDIE model.

4.2.2 The Prototype of ILC-WBLE Development

The main output of the development in the research is a prototype of ILC-WBLE. It is an interactive multimedia CBL courseware created using Adobe Flash which can be accessed at http://www.hohmingchee.com. Figure 4.1 depicts the screenshot from the first page of ILC-WBLE. The end users of ILC-WBLE are categorised into two types, which are as follow:

i. **Administrator and Lecturer:** The lecturers are granted with the authority to create all the subjects assigned to them in the current trimester of study. To create a new subject, a lecturer have to login into the system using username and password provided by the system administrator.

ii. **Student:** Students do not have the authority to create a new subject in the system. They are allowed to view all the subjects registered in the current trimester of study.

Figure 4.1: Screenshot from the first page of ILC-WBLE

In addition to Administrator/ Lecturer and Student sections, ILC-WBLE also includes a Forum for the communication among all the users, which can be accessed by clicking the hypertext “here” in Figure 4.1.

4.2.2.3 Administrator/ Lecturer section

The system administrators are responsible for creating new user accounts, deleting existing user accounts and managing user profiles. While creating accounts for lecturers, each lecturer will be given a username and password for accessing his/ her account.

I. Administrator section

After the system administrators login into the system, the main page for managing user profiles as shown in Figure 4.2 is displayed.

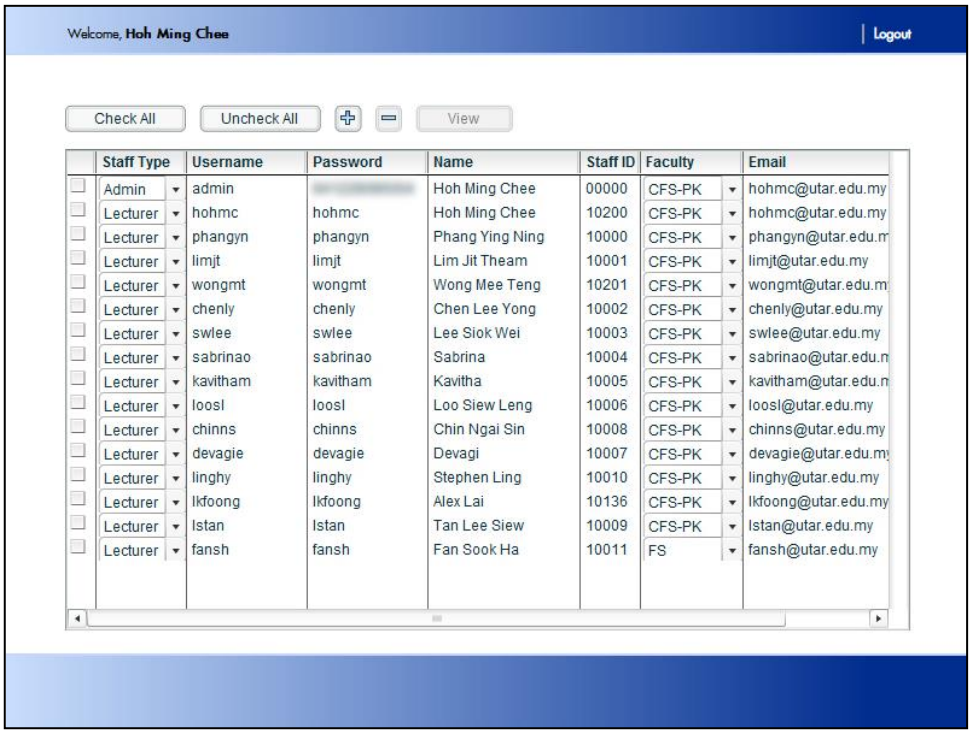

Figure 4.2: Screenshot from the main page of the Administrator section for managing user profiles

As can be perceived through Figure 4.2, the user profiles of lecturers include the following information:

- **Staff Type:** There are two types of staff namely "Admin" (i.e. system administrators) and "Lecturer".
- **Username:** The login ID provided to user is displayed in the Username column. The login ID is preset and can only be changed by system administrators.

- **Password:** The password given to each user is shown in the Password column. Similar to the username, the password is preset and can only be changed by system administrators.
- **Name:** This column displays the names of lecturers.
- **Staff ID:** This column shows the IDs of lecturers.
- **Faculty:** The details of users are presented according to the faculty, centre or department in UTAR which the lecturers are attached to.
- **Email:** This column shows the email addresses of users.

As mentioned earlier in this section, only the system administrators are able to create new user accounts in the page as shown in Figure 4.3.

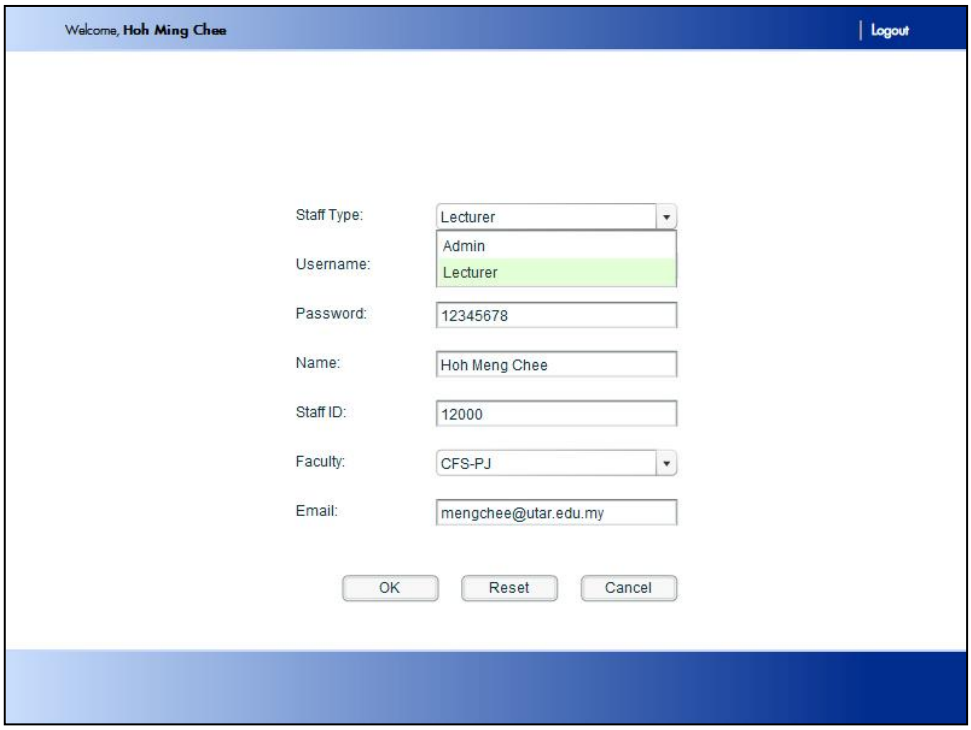

Figure 4.3: Screenshot from the page for creating new user accounts in the Administrator section

II. Lecturer section

A lecturer can login into his/ her account by keying in the username and password provided by administrators in the page as shown in Figure 4.4. Then, users will be directed to the main page in the Lecturer section as depicted in Figure 4.5, where lecturers are allowed to create all the subjects assigned to them. The details of each subject created such as “Subject Code”, “Subject name”, “Date Created” and “Date Modified” are displayed in Figure 4.5.

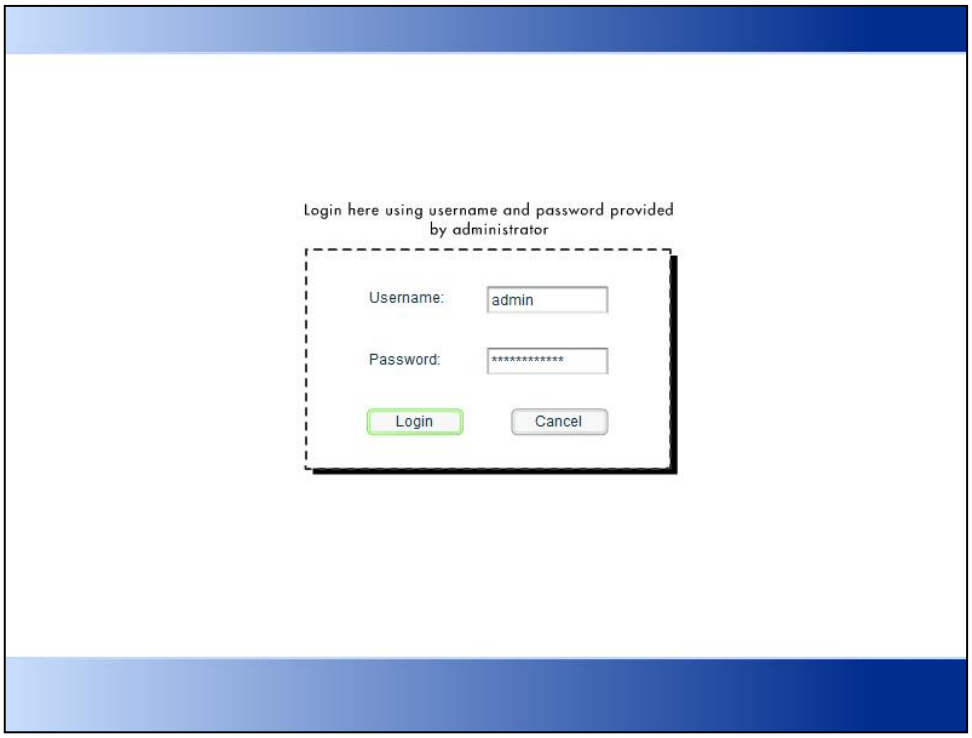

Figure 4.4: Screenshot from the login page of ILC-WBLE

Even though the main medium of instruction in UTAR is English, however, UTAR also offers programmes that utilise Chinese language in instruction such as Chinese studies, Journalism in Chinese Media and Chinese Medicine. ILC-WBLE enables lecturers and students involved in those programmes to create any subjects offered in Chinese as an example shown in

Figure 4.5, since it supports Chinese language. Lecturers can add a new subject in the page as shown in Figure 4.6.

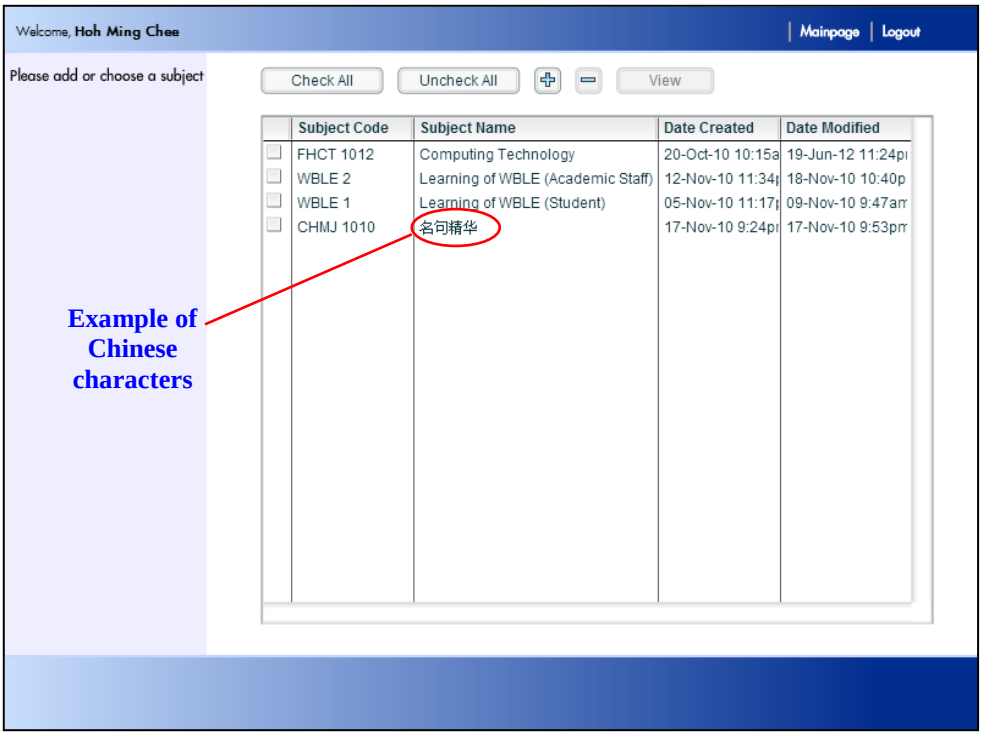

Figure 4.5: Sample screenshot from the main page of Lecturer section showing a subject created in Chinese

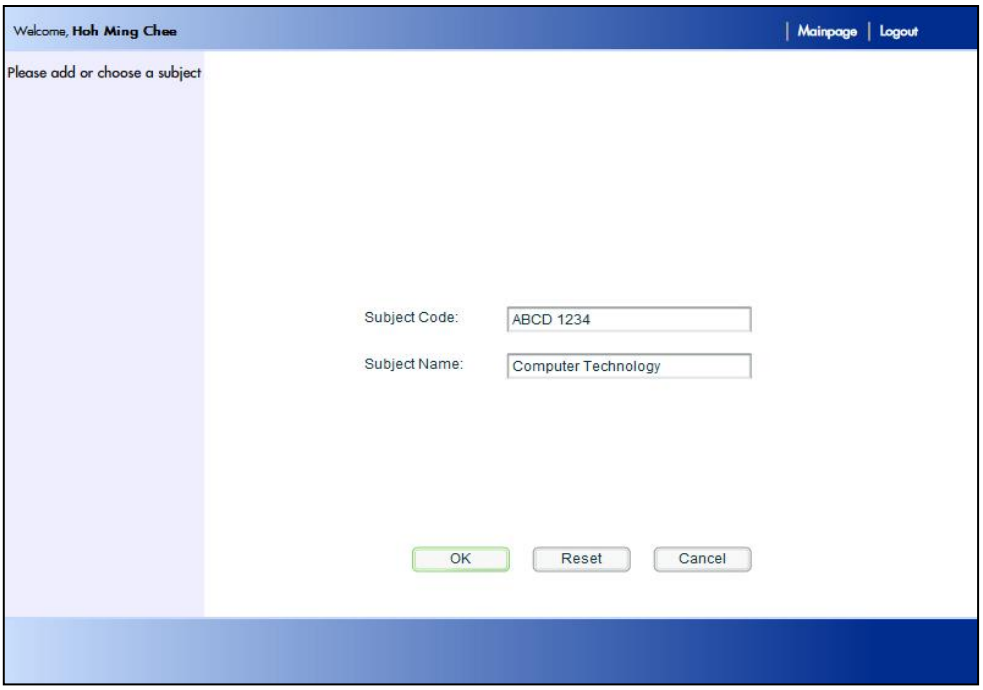

Figure 4.6: Sample screenshot from the "Creating subject" page in the Lecturer section

Figure 4.7 shows a sample screenshot from the page in the Lecturer section displaying the content of a subject. As can be perceived through Figure 4.7, the layout of the "Content" page adopts split-screen method. To add a new content page, user can click on the "Content" button as shown in Figure 4.8. There are eight choices of layout available to create the content (see Figure 4.8). Based on the layout selected, in addition to text, a lecturer is able to insert other multimedia elements (i.e. images, graphics, audio, and video) into the multimedia field in the "Content" page as revealed in Figure 4.9. Besides, each selected layout consists of a title field for inserting the title of a new page.

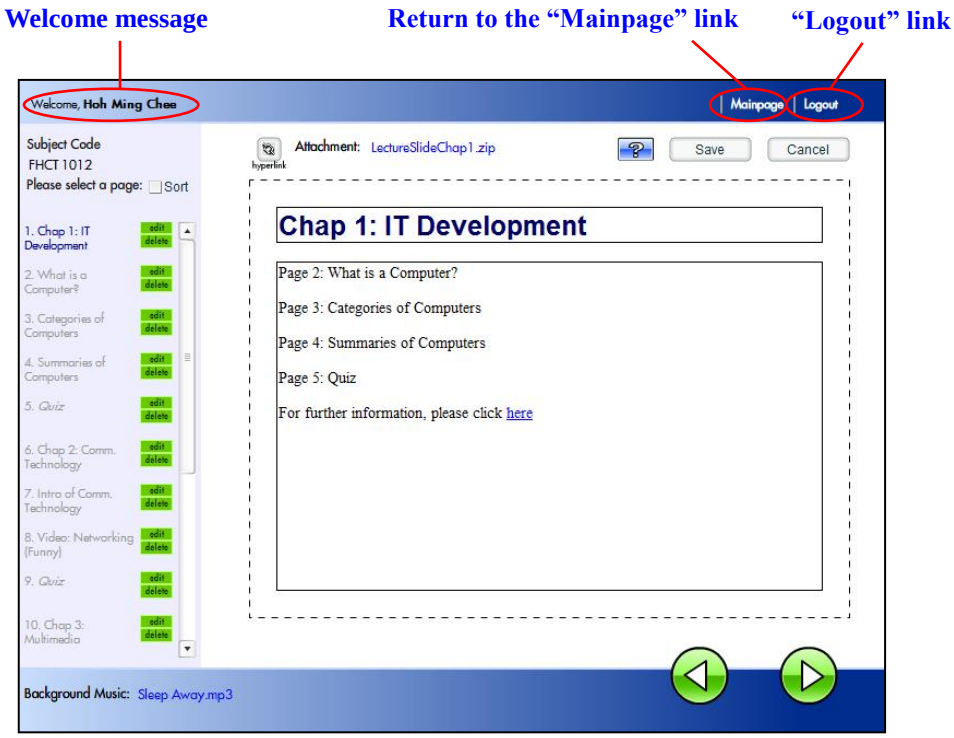

Figure 4.7: Sample screenshot from one of the "Content" pages in the Lecturer section showing the content of a subject

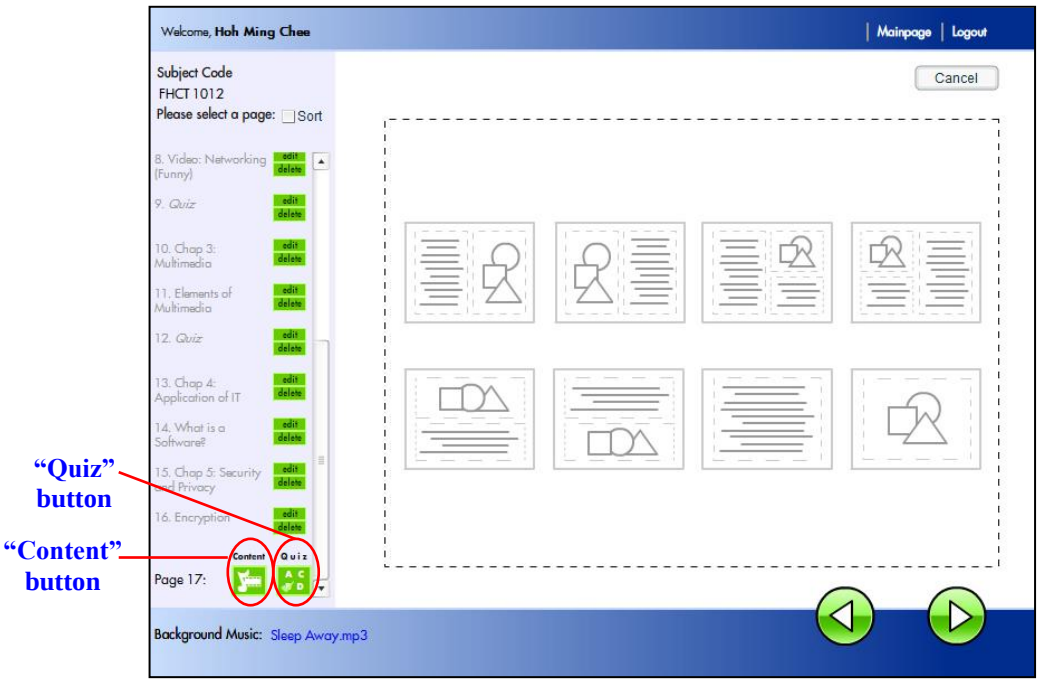

Figure 4.8: Sample screenshot from the "Content" page in the Lecturer section showing the eight choices of layout for adding a new content page

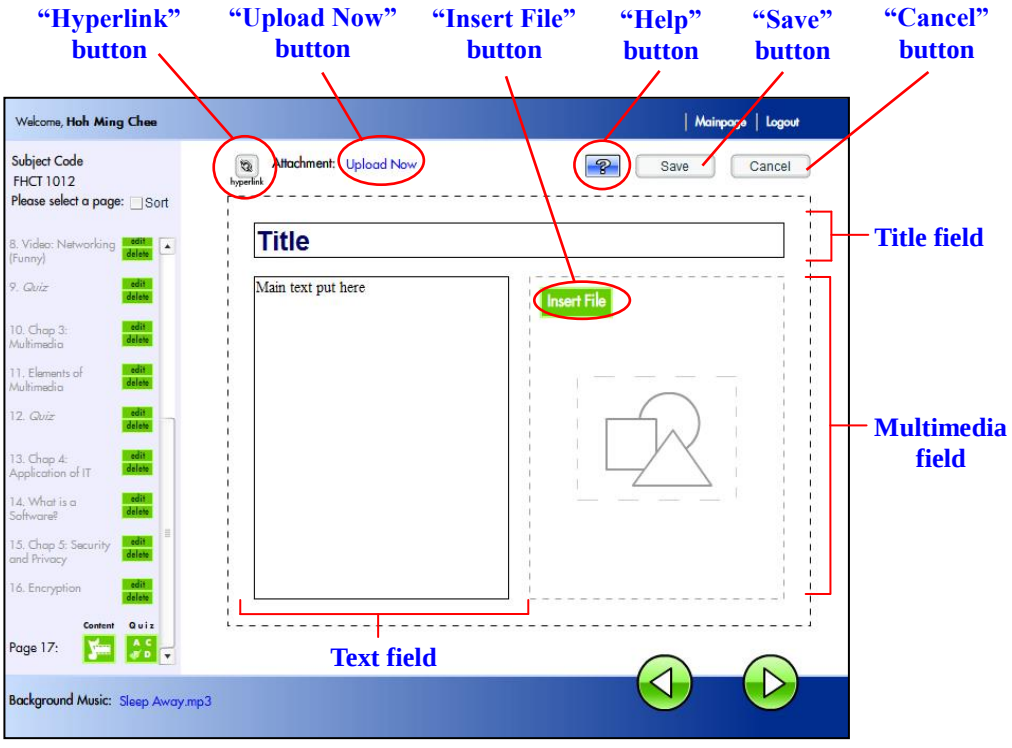

Figure 4.9: Sample screenshot from the "Content" page in the Lecturer section

As can be perceived through Figure 4.9, there are six main buttons included in the "Content" page. Each of their functions is listed as below:

- **"Insert File" button:** A popup dialogue box as shown in Figure 4.10 appears after user clicks on the "Insert File" button. It allows users to upload all types of multimedia files into the "Content" page.
- **"Hyperlink" button:** Hyperlink which links students to another source for further information of the particular page can be added into the "Content" page by clicking the "Hyperlink" button. To insert a hyperlink in "Content" page, first, highlight the word that a lecturer desires to make it into hyperlink and then, click on the "Hyperlink" button. After clicking the button, a hyperlink field for entering the targeted link (e.g. http://www.utar.edu.my) is displayed as revealed in Figure 4.11.
- **"Upload Now" button:** Users are also allowed to upload an attachment in any file type. Figure 4.12 shows a pop-up dialogue box appears after clicking on the "Upload Now" button to select a file and upload it as an attachment.
- **"Help" button:** User can click on this button to access the guidelines on how to create a content page, in a popup dialogue box as shown in Figure 4.13.
- **"Save" button:** User needs to click on the "Save" button to save the created content.
- **"Cancel" button:** "Cancel" button is used to cancel the editing process in the "Content" page.

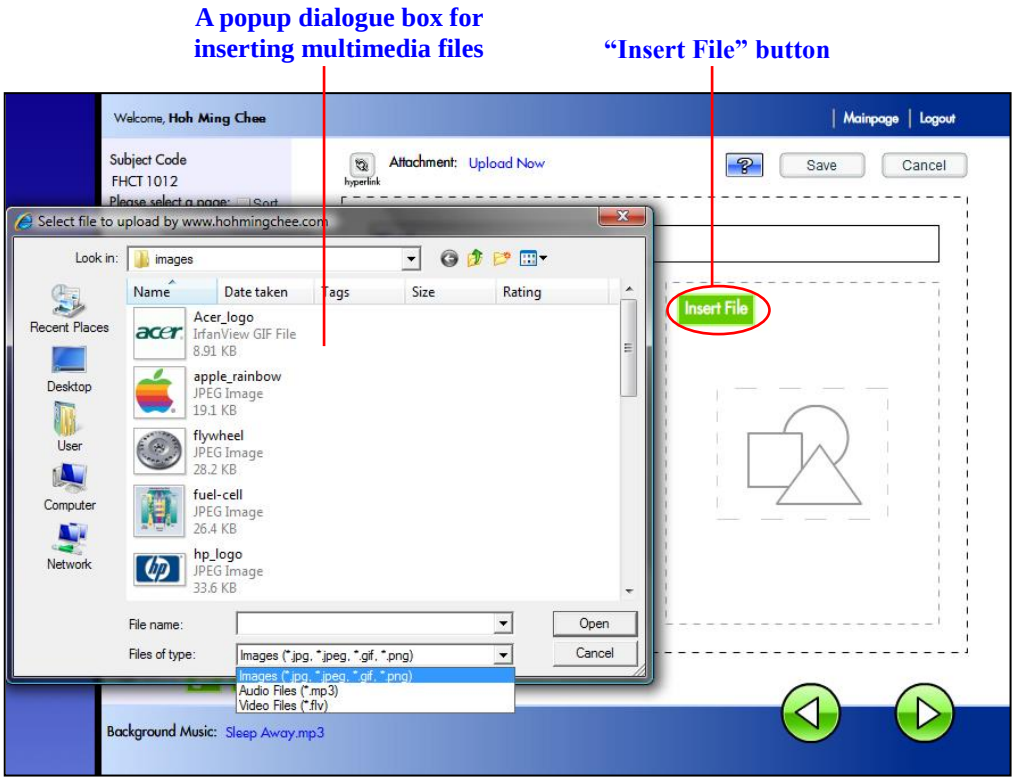

Figure 4.10: Sample screenshot from the "Content" page in the Lecturer section showing a popup dialogue box for inserting multimedia files

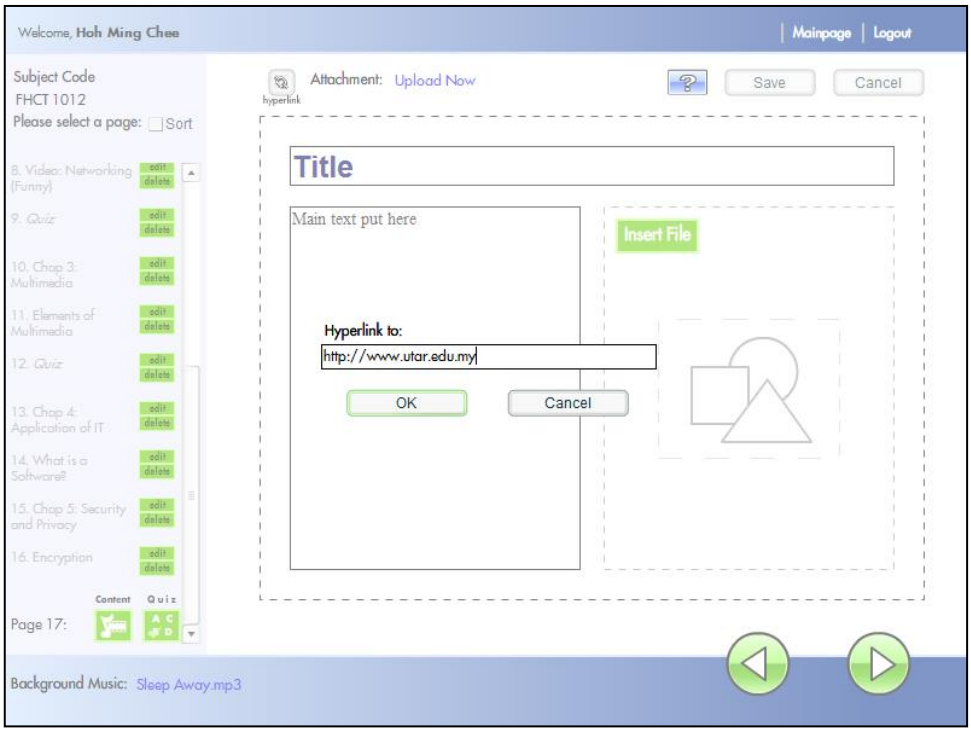

Figure 4.11: Sample screenshot from the "Content" page in the Lecturer section showing the hyperlink field for entering a targeted link

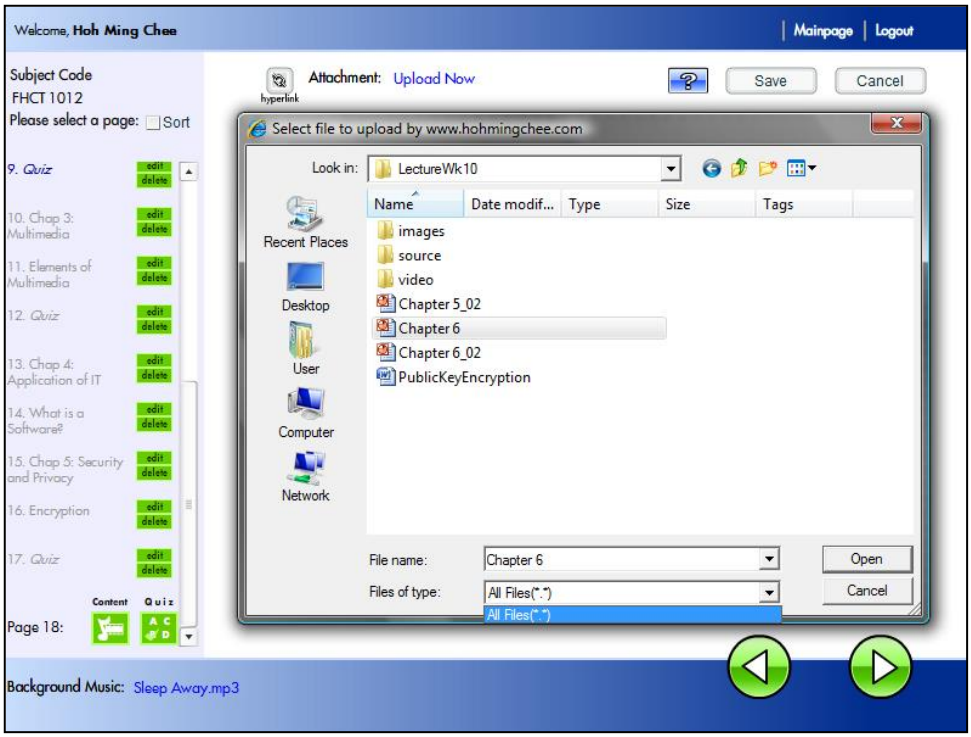

Figure 4.12: Sample screenshot from the "Content" page in the Lecturer section showing the popup dialogue box to select a file and upload it as attachment

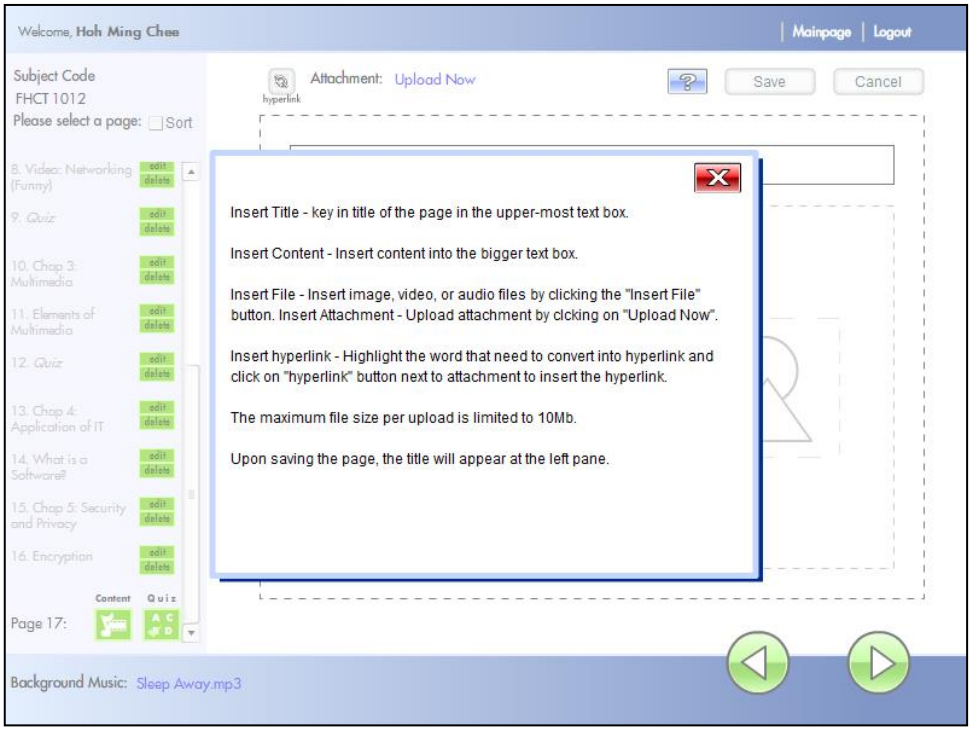

Figure 4.13: Sample screenshot from the "Content" page showing the guidelines in creating a content page

In addition to the “Content” page, ILC-WBLE also enables lecturers to create online quizzes by clicking the “Quiz” button in Figure 4.9. Quizzes are created for a particular subject as interactive exercises for students to test their understanding on the topics being taught in the “Content” pages. There are three types of quizzes for selection in Figure 4.14: “Fill in the Blank”, “Multiple Choices”, and “Drag and Drop”. Each type of quiz in the “Quiz” page consists of the following three main buttons as shown in Figure 4.15:

- the “+” icon for adding a new question,
- the “–” icon for deleting a selected question, and
- the “magnifying glass” icon for previewing the quiz page.

Besides, guidelines on how to create each type of quizzes are provided by clicking on the “Help” button embedded in each type of “Quiz” page, as shown in Figures 4.15 to 4.17.

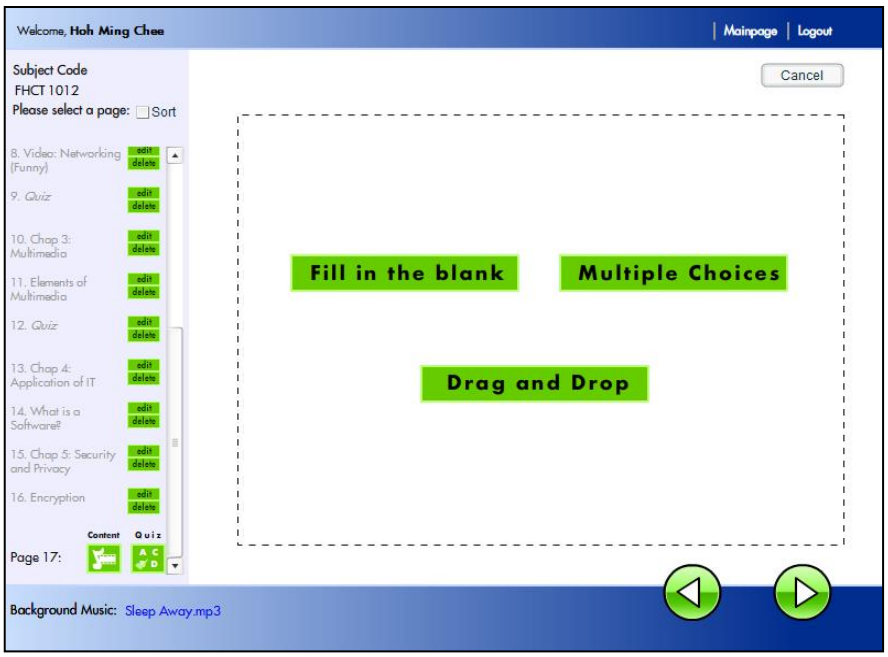

Figure 4.14: Sample screenshot from the “Quiz” page in the Lecturer section showing the three selections of quizzes to create a new quiz page

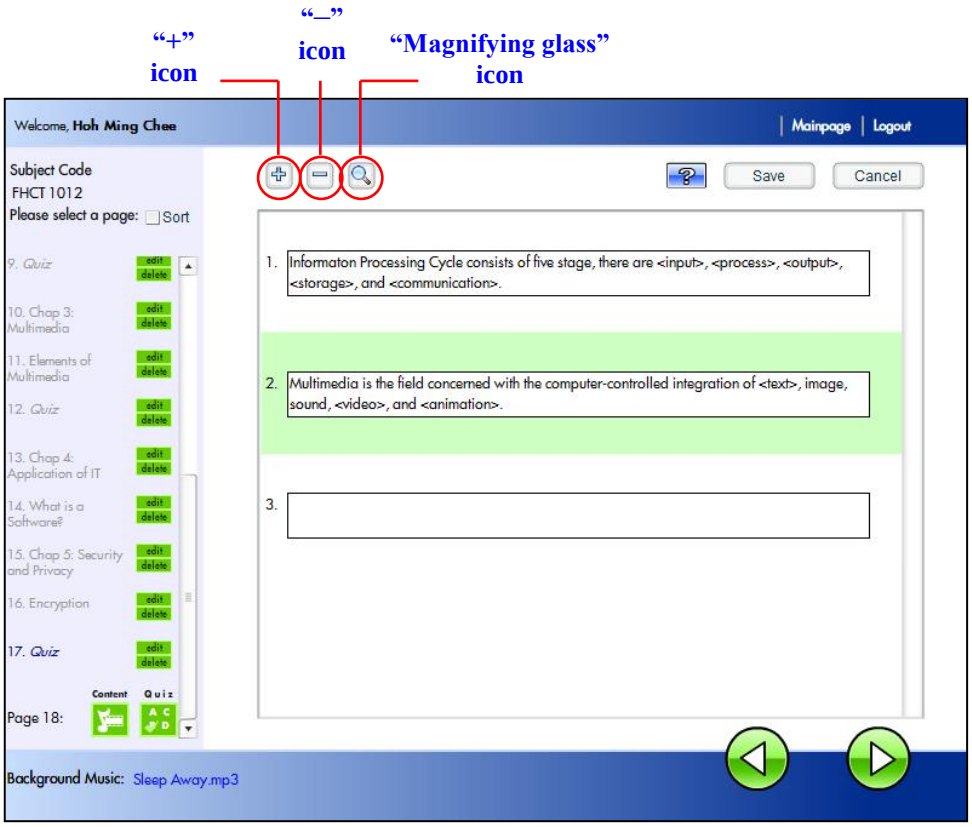

Figure 4.15: Sample screenshot from the "Quiz" page with the "Fill in the Blank" quiz type selected

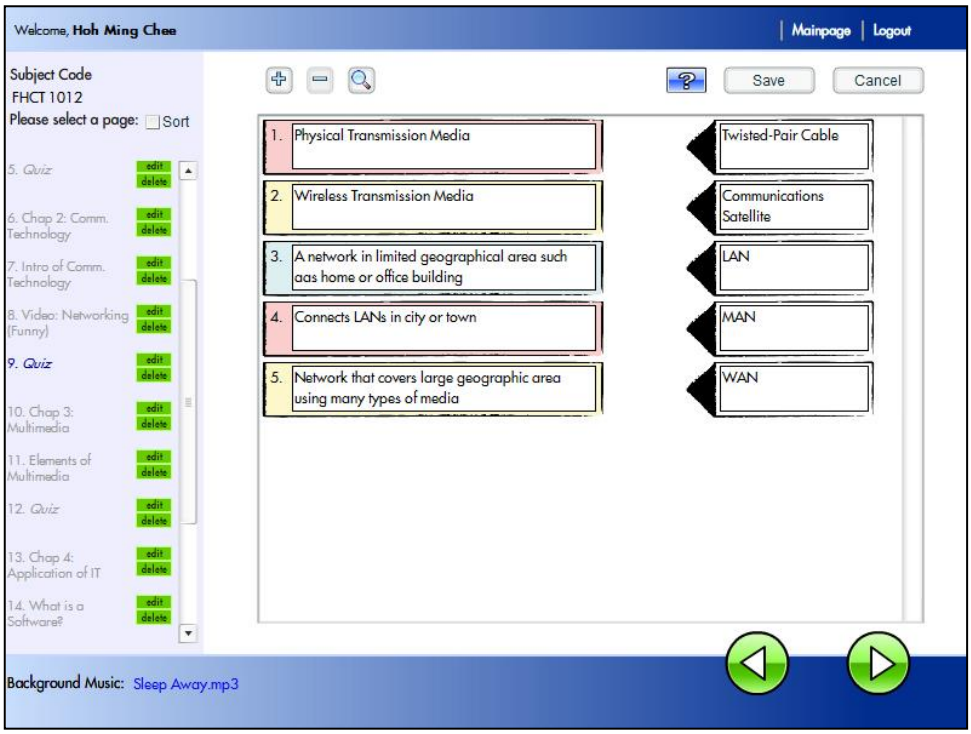

Figure 4.16: Sample screenshot from the "Quiz" page with the "Drag and Drop" quiz type

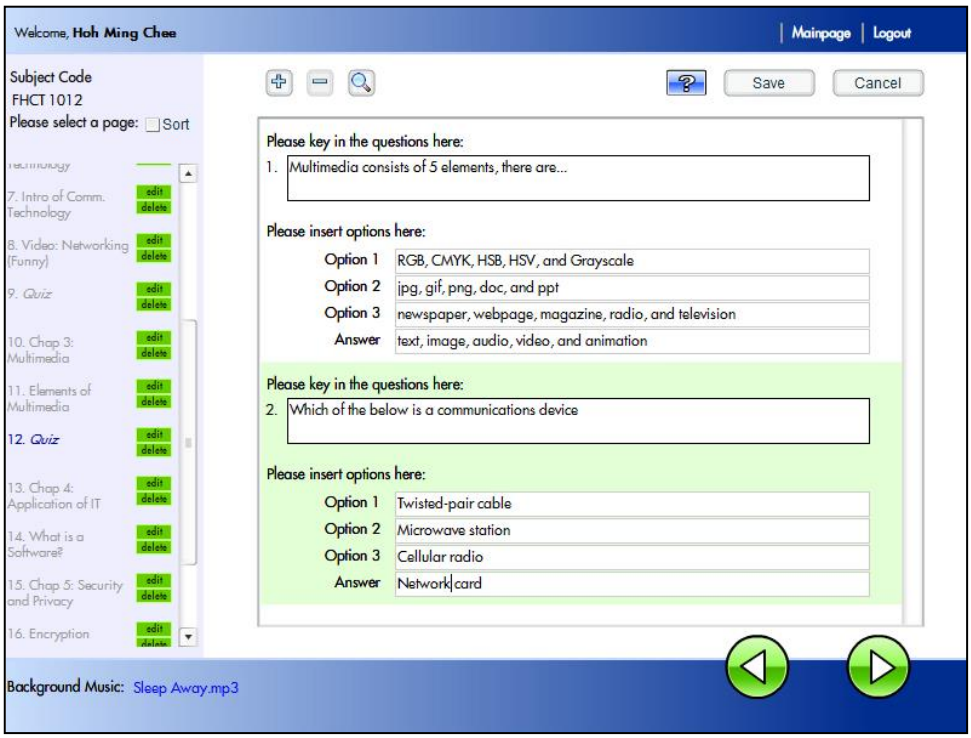

Figure 4.17: Sample screenshot from the "Quiz" page with the "Multiple Choices" quiz type selected

4.2.2.3 Student section

Subjects created by lecturers can be viewed in the main page of Student section as shown in Figure 4.18. This section is accessible by clicking on the "Student" button at the first page of the ILC-WBLE as shown in Figure 4.1 without any login process.

There are two fields in the main page as revealed in Figure 4.18:

i. The first field (i.e. **Lecturer:**) reveals a list of lecturers who created the subjects (in the format of "Faculty/ Centre/ Department-Campus they are attached to – Name of lecturer". For example, CFS-PK – Hoh Ming Chee).

ii. The second field (i.e. **Subject:**) indicates the subjects created (in the format of "Subject name – Subject code such as FHCT 1012 – Computing Technology). Student can click on the "View" button in Figure 4.18 to access the selected subject.

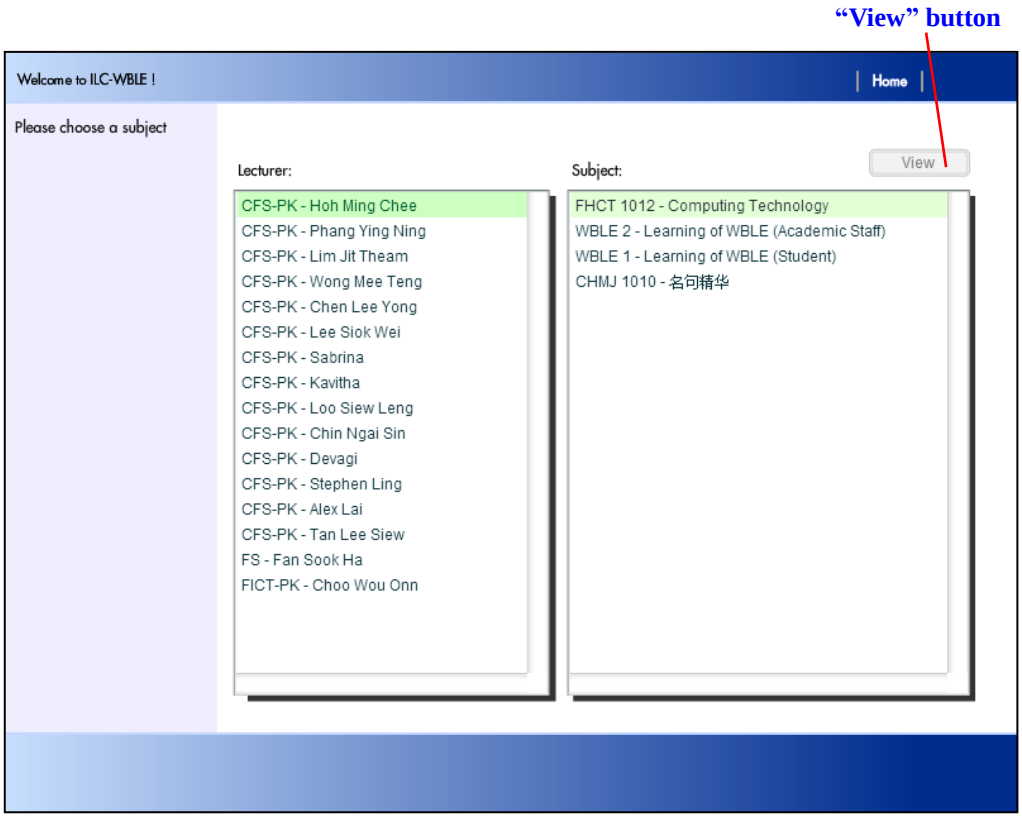

Figure 4.18: Screenshot from the main page of Student section

Figure 4.19 depicts a sample screenshot from the "Content" page in the Student section. The layout of the subject page adopts a split-screen method. As can be perceived through Figure 4.19, the frame at the left-side of the screen is devoted to a list of topic options for the selected subject. The list of topic options is displayed all the time on the screen.

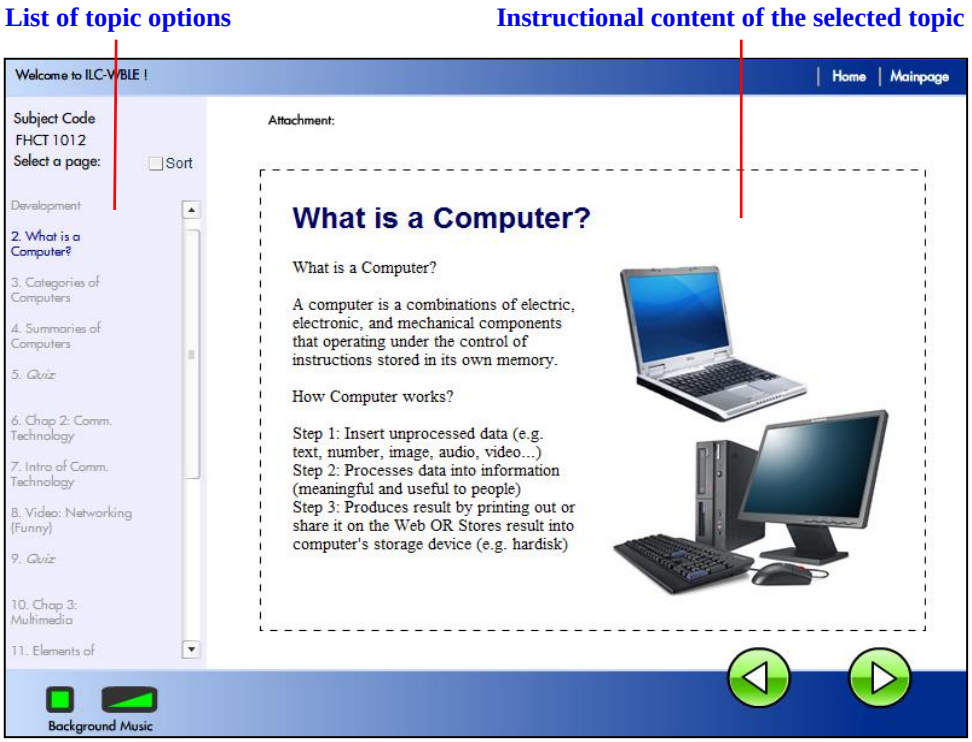

Figure 4.19: Sample screenshot from the "Content" page in the Student section

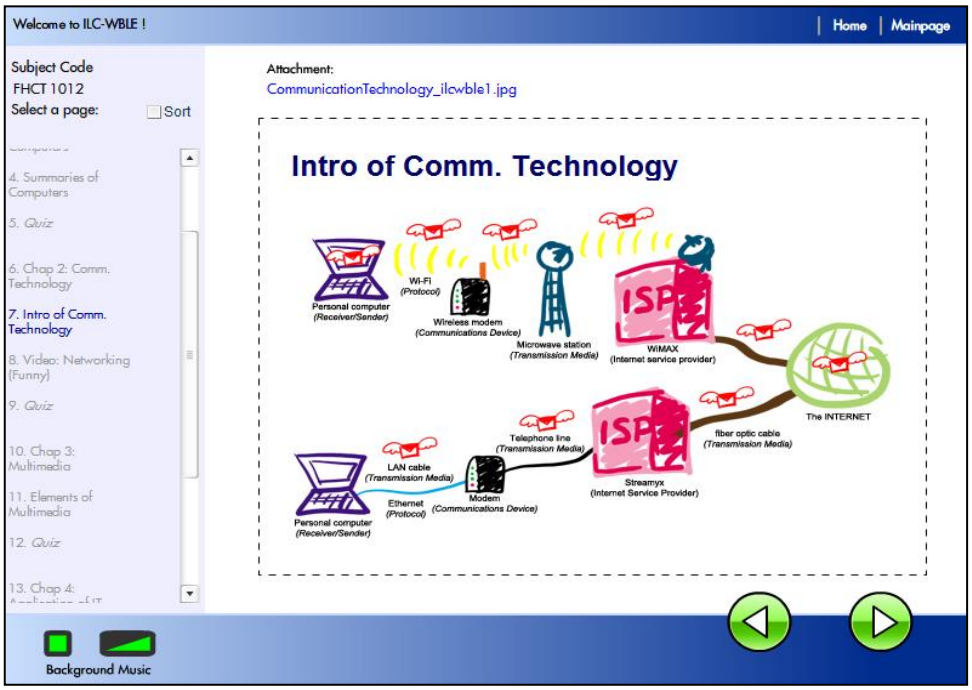

Figure 4.20: Sample screenshot from the "Content" page in Student section showing the explanation of an object using graphic elements

The instructional content of the selected topic (e.g. What is a Computer?) is presented in the remainder of the screen at the right in Figure 4.19. The instructional content refers to the description of a selected topic of the subject. Multimedia elements such as graphics, images, video, and audio are used in the delivery of instructional content as the examples shown in Figures 4.20 (using graphic elements) and 4.21 (using video element).

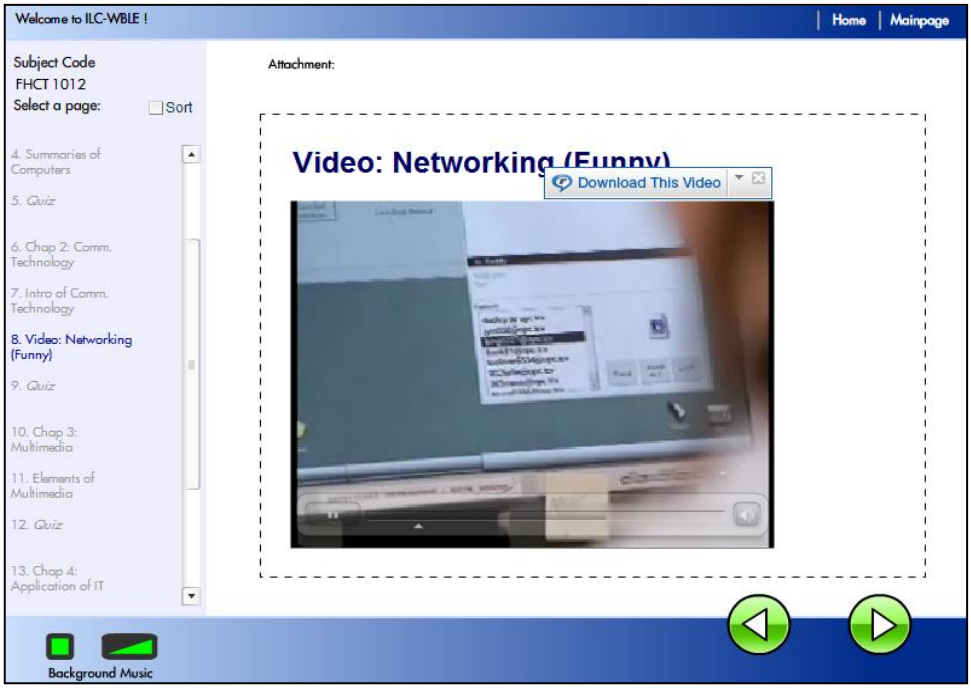

Figure 4.21: Sample screenshot from the "Content" page in Student section showing an embedded video clip in teaching a topic

Furthermore, as has been described in section 4.2.2.1, quizzes are created to test the understanding of students on topics learnt. There are three types of quizzes as follows:

i. **Fill in the Blank:** This type of quiz requires students to fill in the blanks with appropriate answers in the answer fields provided (Figure 4.22).

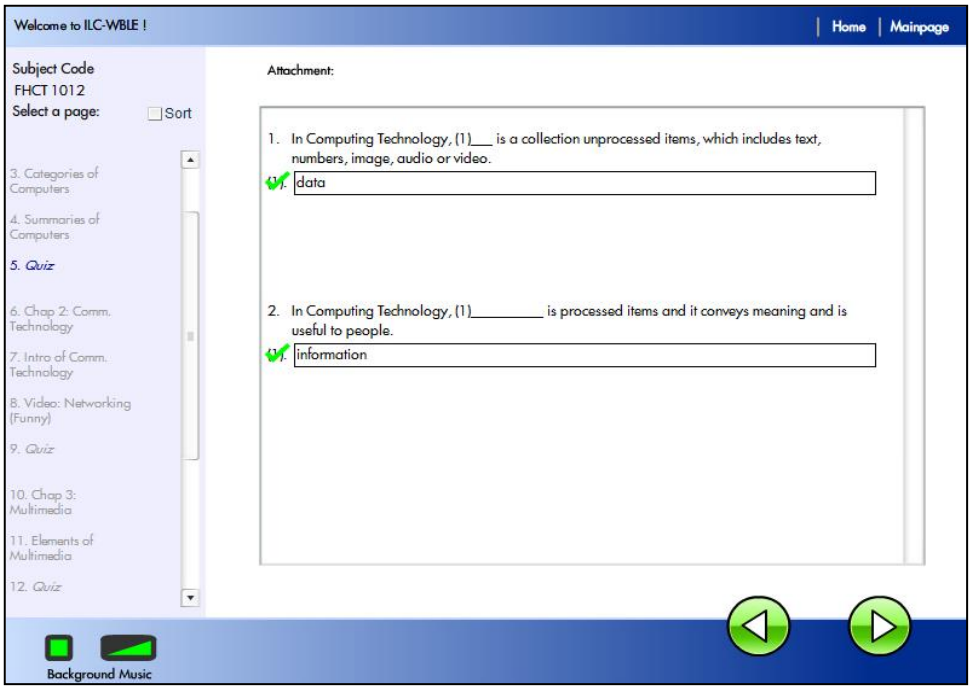

Figure 4.22: Sample screenshot from the "Content" page in the Student section showing the "Fill in the Blank" type of quiz

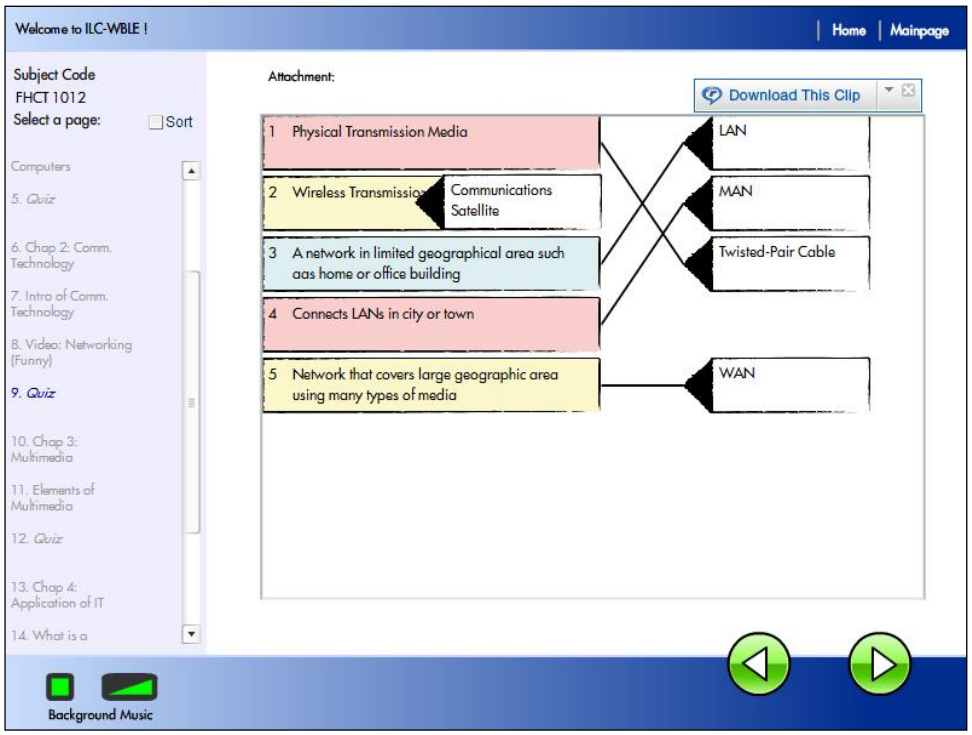

Figure 4.23: Sample screenshot from the "Content" page in the Student section showing the "Drag and Drop" type of quiz

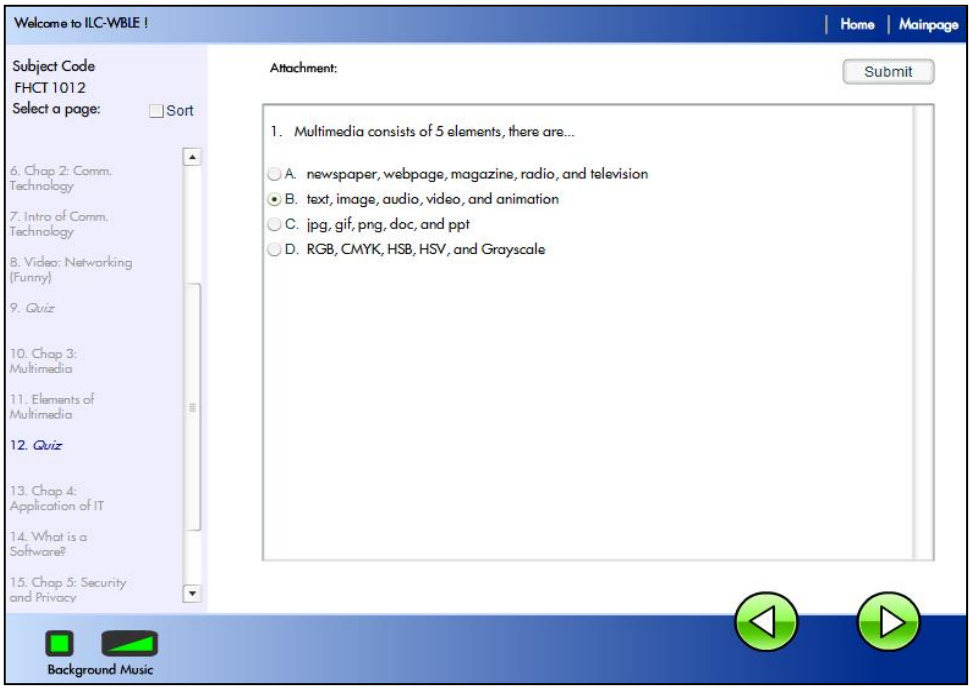

Figure 4.24: Sample screenshot from the "Content" page in the Student section showing the "Multiple Choices" type of quiz

ii. **Drag and Drop:** For this type of quiz, answer options are provided on top of the questions given. Students are required to drag an answer to match and drop at the relevant question (Figure 4.23).

iii. **Multiple Choices:** For this type of quiz, students must choose a correct answer from the four answer options provided for each question (Figure 4.24).

As shown in Figures 4.19 to 4.24, there are two hyperlinks located at the top right hand corner of the "Content" page in the Student section namely "Home" and "Mainpage" hyperlinks. The "Home" hyperlink links users back to the first page of ILC-WBLE, whereas the "Mainpage" hyperlink directs users to the main page of Student section. Besides, users can adjust the volume

of the background music using the “Background Music” controller located at the bottom left hand corner of the “Content” page. Then, the “Previous” and “Next” icons located at the bottom right hand corner of the “Content” page allow users to navigate to the previous and next pages of the topic selected.

The sequence of the pages integrated in the subject page can be rearranged according to the page type by selecting the “Sort” option as indicated in Figure 4.25. By selecting the “Sort” option, pages will be rearranged according to instructional content followed by quizzes. Users are allowed to uncheck the “Sort” option to go back to the initial page sequences of the subject.

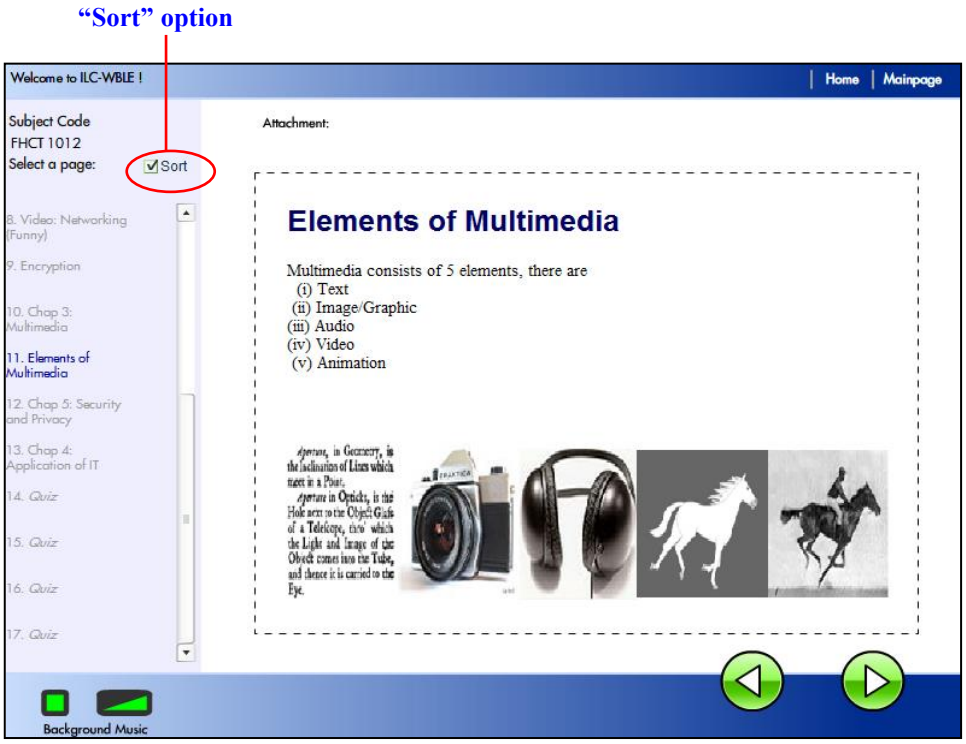

Figure 4.25: Sample screenshot from the “Content” page in the Student section showing the “Sort” option is checked

4.2.2.3 Forum

The third section in the ILC-WBLE is a Forum which serves as the medium of communication between lecturers and students. The main page of the Forum as shown in Figure 4.26 can be accessed by clicking the hypertext "here" in Figure 4.1. Besides, all the necessary supporting software for converting multimedia files into ILC-WBLE supported file formats are available on the Forum.

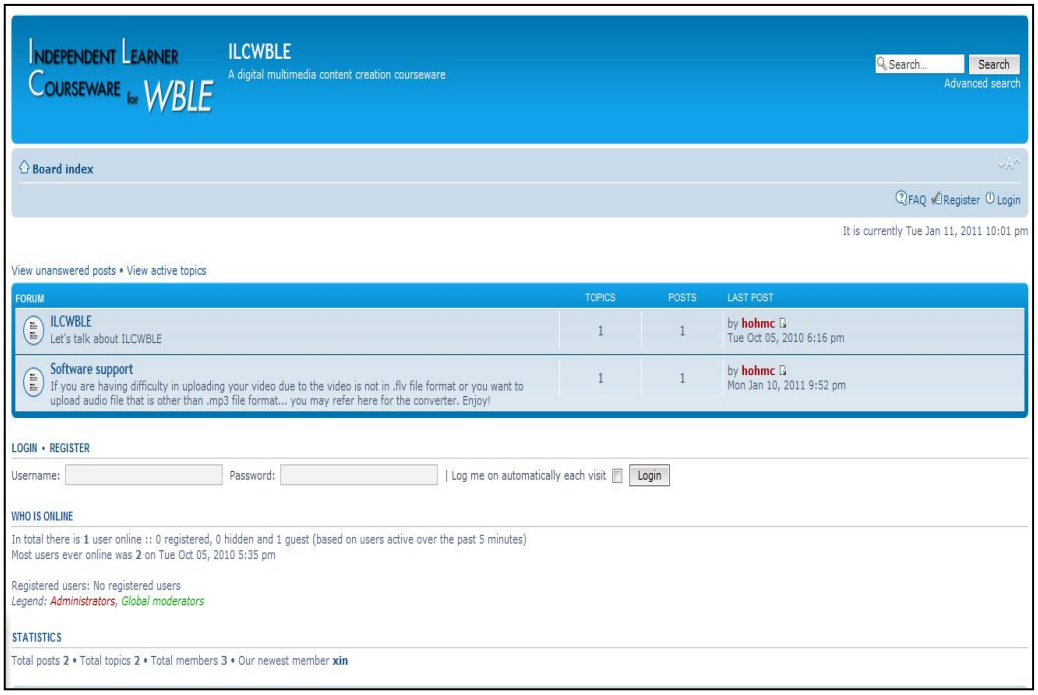

Figure 4.26: Sample screenshot from the main page of the Forum

4.3 The Usability Evaluation of the Prototype of ILC-WBLE

As has been described in chapter 3, survey questionnaire technique had been used to collect the data for measuring the perceptions of two groups of

evaluation samples (i.e. lecturers and students) toward the usability of ILC-WBLE. The five constructs built into the two sets of usability evaluation questionnaires are as follows:

i. **Easy to Use (ETU):** It evaluates the ease of access to the system as well as the ease of use of the features provided in ILC-WBLE.

ii. **Easy to Learn (ETL):** It is used to evaluate the ease of learning of ILC-WBLE.

iii. **Level of Interactivity (LOI):** It measures the ease-of-use of interaction features provided in ILC-WBLE. The examples of these features include the "Sort" option that enables the sorting of page sequences in the "Content" page of "Student" section, the instructional content and quizzes creations by clicking "Content" and Quiz" buttons, inserting multimedia files, attachments and hyperlinks into the system, controlling the background music and so forth.

iv. **User Interface Design (UID)**: This construct evaluates the overall user interface design of ILC-WBLE.

v. **Error-free Assessment (EFA):** This construct evaluates whether or not ILC-WBLE is free from errors and provides suggested solutions for error prevention.

The research constructs were developed based on Nielsen's usability heuristics, and each construct consisted of five statements (see Tables 3.1 and 3.2). The 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly

agree) were used to measure these statements built into each of the constructs. The respondents were asked to rate their level of agreement with the statements that measure those five research constructs as described above.

Two sets of questionnaires (see Appendices A and B) were used to evaluate the usability of ILC-WBLE among two categories of evaluation samples, namely lecturers and students. All the evaluation samples were selected from the Centre for Foundation Studies at the main campus located at Kampar, Perak.

For the category of lecturers, 12 evaluation questionnaires were distributed, but only 10 lecturers returned their questionnaires at the end of evaluation. The response rate was 83.33%. The failure in obtaining 100 percent response rate may due to the heavy teaching load among Foundation lecturers compared to other faculties in UTAR. Bouma and Atkinson's 1995 study (cited in Shiratuddin 2002) noted that if the population that is to be sampled is fairly homogeneous (i.e. the relevant characteristics are fairly evenly distributed), a smaller sample can be relied on than if the population is highly variable. In this research, the basic requirement of the samples is, they must have some experiences in using WBLE. Since this requirement is easily met, hence, a small number of participants are assumed to be adequate.

Besides, for the category of students, students who participated in the evaluation study were Foundation students who are taking "Computing Technology" subject in year 2010, 2nd trimester. There were 120 evaluation

questionnaires distributed to students, however only 101 (84.17% response rate) questionnaires were collected. Based on the feedback from the students, it can be concluded that the low response rate was due to two reasons. Most of the students had either forgotten about the evaluation or lost the questionnaires. Students did not show their enthusiasm to participate in the evaluation study since almost all of them (i.e. 19 students) felt that the failure in returning the questionnaire would not affect their academic performance.

All the evaluation samples were given two weeks' time to learn and practise the prototype of ILC-WBLE. Each respondent was then required to fill out the relevant usability evaluation questionnaire which composed of five research constructs with respective five statements as follows:

- Easy to use
- Easy to learn
- Level of interactivity
- User interface design
- Error-free assessment

The following subsection presents the findings of data analysis. Analysis started with the coding of data and was completed by interpreting the results obtained by using SPSS (Statistical Package for Social Science) statistical package.

4.3.1 Findings of Data Analysis of Participants' Background

Before presenting the results which measure the lecturers' and students' usability of ILC-WBLE, summaries of the participants' background data are presented in Figures 4.27 and 4.28.

There were 2 male (20%) and 8 female (80%) lecturers from CFS in UTAR main campus who had participated in the usability evaluation of ILC-WBLE. Five (50%) of them have experience of less than 1 year in teaching. Three (30%) of these lecturers have been teaching for 3 years, while 1 (10%) of these lecturers has 4 years experience in teaching. Meanwhile, 1 (10%) of them has been teaching for more than 5 years. On the other hand, 3 (30%) of these lecturers have an experience in using WBLE for less than 1 year, while 5 (50%) of them have been using WBLE for 3 years. There were respectively 1 (10%) lecturer each who has an experience of 2 years and 4 years in using WBLE (see Figure 4.27).

As can be perceived through Figure 4.28, there were 41 (40.6%) male and 60 (59.4%) female students from CFS in UTAR main campus who had participated in the usability evaluation of ILC-WBLE. Among the respondents, 90.1% of them were pursuing their studies in 2nd trimester. 6.9% of these students were studying in 3rd trimester and only 3% of them were in 1st trimester.

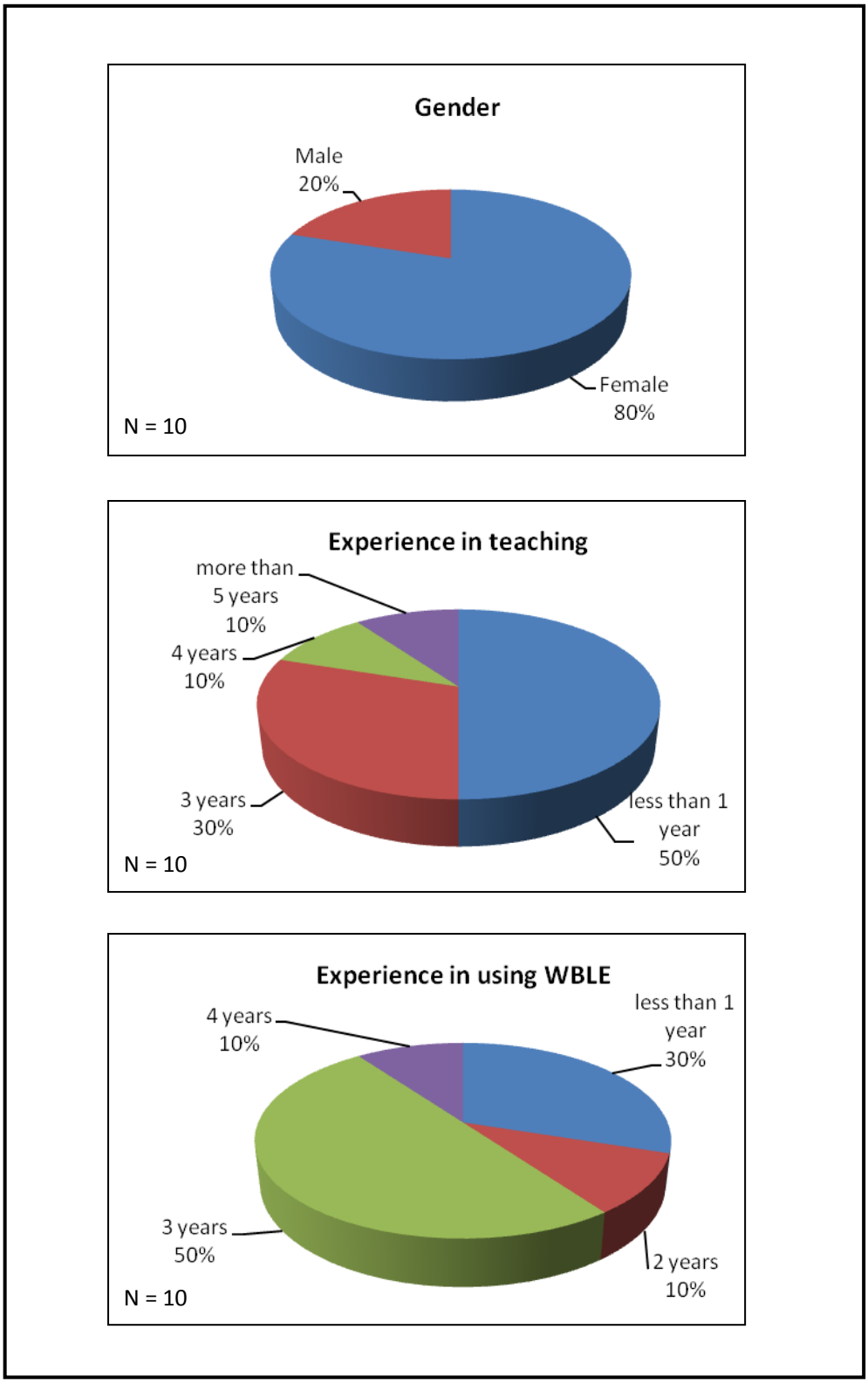

Figure 4.27: Lecturers' background data

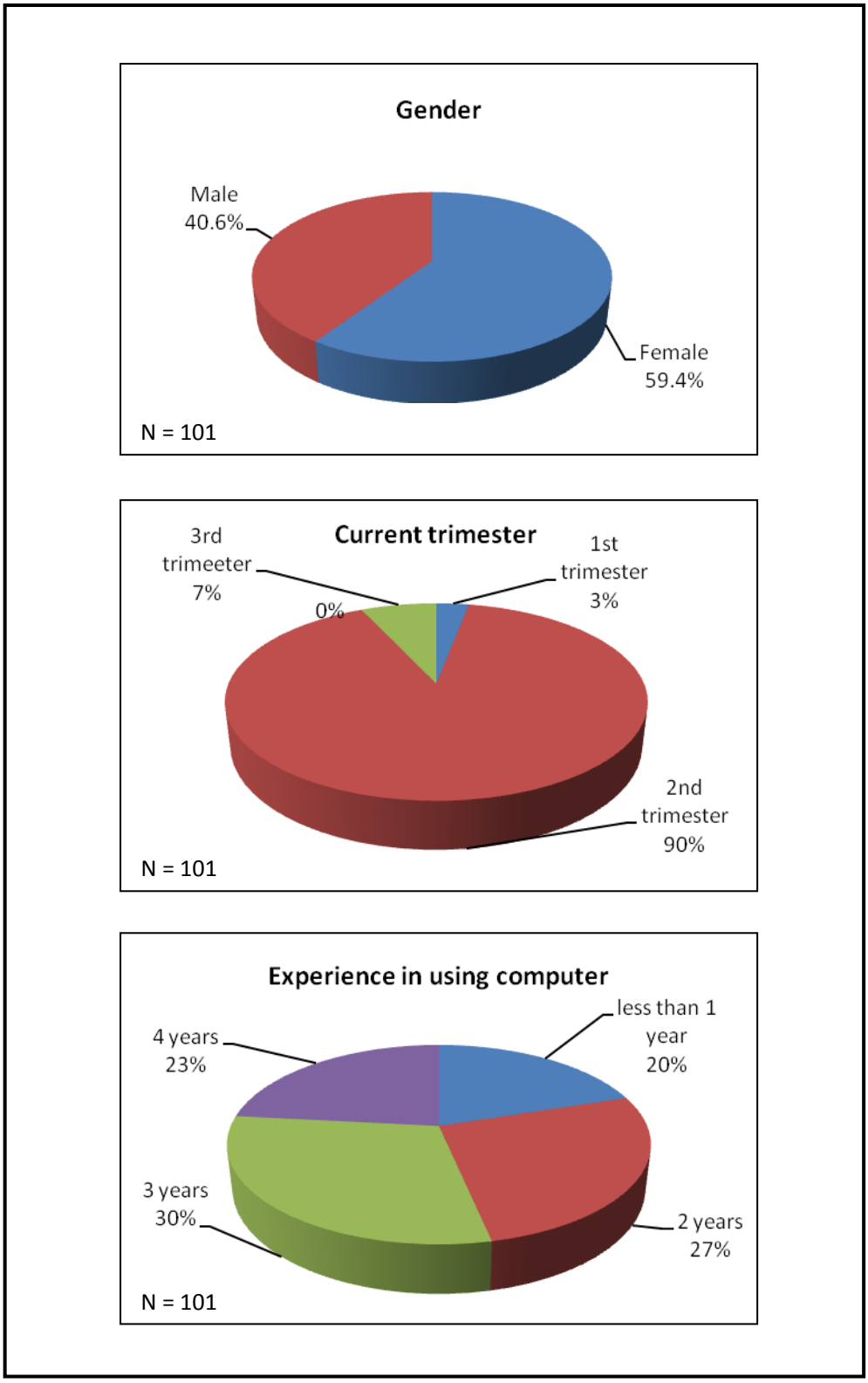

Figure 4.28: Students' background data

Meanwhile, Figure 4.28 reveals that most of the students (63.4%) have been using computer for more than 5 years. There were respectively 6.9% each of these students who have an experience of using computer for 4 years and 5 years. Meanwhile, 8.9% of students have been using computer for 3 years and 7.9% of students have been using computer for 2 years. The remaining students (5.9%) have an experience in using computer for only less than 1 year. In short, the samples did represent different genders, trimesters of study and computer experience.

4.3.2 Findings of Data Analysis of Usability Evaluation

The results of the usability evaluation which embrace five research constructs as listed above are further discussed in this section. The discussion is divided into two different categories of evaluation samples, namely lecturers and students. The descriptive statistics seem to be the most appropriate method for analysis. Mean, standard deviation (S.D.), frequency and percentage of cases were generated to find out the number of respondents agreeing or disagreeing with each statement.

4.3.2.1 Ease to Use

All respondents were asked about their opinions on five statements pertaining to the ease of use of ILC-WBLE.

I. Lecturers

The results of "Ease to Use" evaluation among lecturers are shown in Tables 4.1 and 4.2. The frequency and percentage of responses for "Ease to Use" evaluation among lecturers are clearly shown in Figure 4.29.

The average response for each of the statement on navigation and interactivity evaluation is above 4 of Likert scale (see Table 4.1). This means that the respondents show a high level of agreement and their answers ranged between strongly agree and agree (see Table 4.2 and Figure 4.29). As all the statements that measure the "Ease to Use" construct possess mean above 4.0 (see Table 4.1), therefore, the general perception of Foundation lecturers towards the "Ease to use" of ILC-WBLE is positive.

Table 4.1: Descriptive statistics of "Easy to Use" evaluation for the category of lecturers (N=10)

Statement	Mean	S.D.
ETU1. Aware of the options that can be carried out in the system (such as insert a new content page, create quizzes, insert hyperlinks and upload attachments).	4.4	0.516
ETU2. Aware of where to proceed to the next step that you wish (such as proceed to next page by clicking on "Next" button).	4.3	0.675
ETU3. Easy to identify the creation/ modification date for the subjects in the list.	4.2	0.789
ETU4. Being informed for the latest progress of your upload process.	4.4	0.516
ETU5. All instructions are clearly listed in the system.	4.3	0.823

Table 4.2: Frequency and percentage of responses for "Easy to Use" evaluation among lecturers (N=10)

Statement	Response	Frequency	Percentage
ETU1. Aware of the options that can be carried out in the system (such as insert a new content page, create quizzes, insert hyperlinks and upload attachments).	Strongly Agree	4	40
	Agree	6	60
	Neutral	0	0
	Disagree	0	0
	Strongly Disagree	0	0
ETU2. Aware of where to proceed to the next step that you wish (such as proceed to next page by clicking on "Next" button).	Strongly Agree	4	40
	Agree	5	50
	Neutral	1	10
	Disagree	0	0
	Strongly Disagree	0	0
ETU3. Easy to identify the creation/ modification date for the subjects in the list.	Strongly Agree	4	40
	Agree	4	40
	Neutral	2	20
	Disagree	0	0
	Strongly Disagree	0	0
ETU4. Being informed for the latest progress of your upload process.	Strongly Agree	4	40
	Agree	6	60
	Neutral	0	0
	Disagree	0	0
	Strongly Disagree	0	0
ETU5. All instructions are clearly listed in the system.	Strongly Agree	5	50
	Agree	3	30
	Neutral	2	20
	Disagree	0	0
	Strongly Disagree	0	0

The findings in Table 4.2 and Figure 4.29 show that all the respondents gave positive responses to statements ETU4 (40% strongly agreed and 60% agreed) and ETU1 (40% strongly agreed and 60% strongly agreed). No "Neutral", "Disagree", and "Strongly Disagree" responses were recorded.

When respondents were asked to rate their level of agreement with statement ETU2, 90% respondents had a favourable opinion (40% strongly agreed and 50% agreed). Only 10% of respondents gave neutral responses. None of the respondents showed either disagree or strongly disagree behaviour (see Table 4.2 and Figure 4.29).

Meanwhile, the findings in Table 4.2 and Figure 4.29 also indicate that the respondents had shown a high response rate (i.e. 80%) on statements ETU5 (50% strongly agreed and 30% agreed) and ETU3 (40% strongly agreed and agreed respectively). The rest of the respondents (20%) remained neutral. None of the respondents showed either disagree or strongly disagree behaviour.

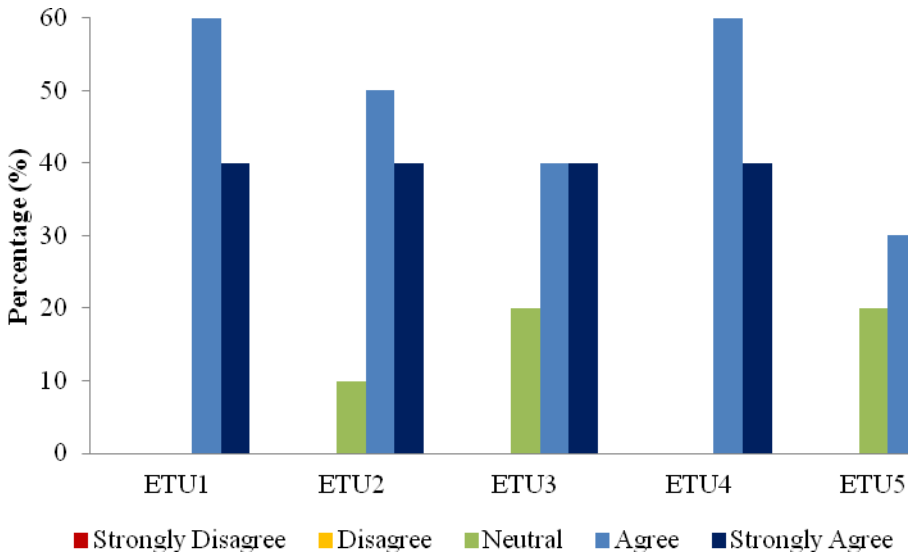

Figure 4.29: Frequency and percentage of responses for "Easy to Use" evaluation among lecturers

II. Students

The results of "Ease to Use" evaluation among students are shown in Tables 4.3 and 4.4. The frequency and percentage of responses for "Ease to Use" evaluation among students are clearly shown in Figure 4.30.

The average response for each of the statement on "Easy to Use" evaluation among students is above the midpoint (3) of Likert scale (see Table 4.3). This means that the respondents show a high level of agreement and their answers ranged between strongly agree and agree (see Table 4.4 and Figure 4.30). Since all the statements that measure the "Ease to Use" construct possess mean above 3.5 (see Table 4.3), therefore, the general perception of Foundation students towards the "Ease to Use" of ILC-WBLE is positive.

Table 4.3: Descriptive statistics of "Easy to Use" evaluation for the category of students (N=101)

Statement	Mean	S.D.
ETU1. Aware of the options that can be carried out in the system (such as answer quizzes, view content, download attachments and etc.).	4.1	0.791
ETU2. Aware of where to proceed to the next step that you wish (such as proceed to next page by clicking "Next" button).	4.1	0.773
ETU3. The steps to view/ read/ answer contents are consistent throughout the system.	3.9	0.891
ETU4. Aware of total of pages in a subject in order to estimate amount of time needed to spend in accessing the whole subject.	3.9	0.884
ETU5. All instructions are clearly listed in the system.	4.0	0.889

Table 4.4: Frequency and percentage of responses for "Easy to Use" evaluation among students (N=101)

Statement	Response	Frequency	Percentage
ETU1. Aware of the options that can be carried out in the system (such as answer quizzes, view content, download attachments and etc.).	Strongly Agree	31	30.7
	Agree	49	48.5
	Neutral	19	18.8
	Disagree	1	1.0
	Strongly Disagree	1	1.0
ETU2. Aware of where to proceed to the next step that you wish (such as proceed to next page by clicking "Next" button).	Strongly Agree	31	30.7
	Agree	54	53.5
	Neutral	13	12.9
	Disagree	2	2.0
	Strongly Disagree	1	1.0
ETU3. The steps to view/ read/ answer contents are consistent throughout the system.	Strongly Agree	28	27.7
	Agree	37	36.6
	Neutral	32	31.7
	Disagree	3	3.0
	Strongly Disagree	1	1.0
ETU4. Aware of total of pages in a subject in order to estimate amount of time needed to spend in accessing the whole subject.	Strongly Agree	23	22.8
	Agree	49	48.5
	Neutral	23	22.8
	Disagree	4	4.0
	Strongly Disagree	2	2.0
ETU5. All instructions are clearly listed in the system.	Strongly Agree	34	33.7
	Agree	36	35.6
	Neutral	28	27.7
	Disagree	2	2.0
	Strongly Disagree	1	1.0

The findings in Table 4.4 and Figure 4.30 show that 84.2% of the respondents gave positive responses to statement ETU2 (30.7% strongly agreed and 53.5% agreed), while 3.0% had contrary opinion (2.0% disagreed and 1.0% strongly disagreed. There were 12.9% respondents remained neutral.

Meanwhile, when respondents were asked about their perceptions toward statement ETU1 (i.e. the awareness of options that can be carried out in the system), findings in Table 4.4 and Figure 4.30 depict that 79.2% of the respondents provided positive responses (30.7% strongly agreed and 48.5% agreed). However, they were 2.0% gave negative responses to statement ETU1 (1.0% disagreed and 1.0% strongly disagreed). 18.8% remained neutral,

Furthermore, as can be seen in Table 4.4 and Figure 4.30, 64.3% of the respondents expressing an opinion either strongly agreed (27.7%) or agreed (36.6%) with ETU3. However, 4.0% of the respondents had contrary opinion on statement ETU3 (3.0% disagreed and 1.0% strongly disagreed). The rest of the respondents (31.7%) provided neutral responses to this statement.

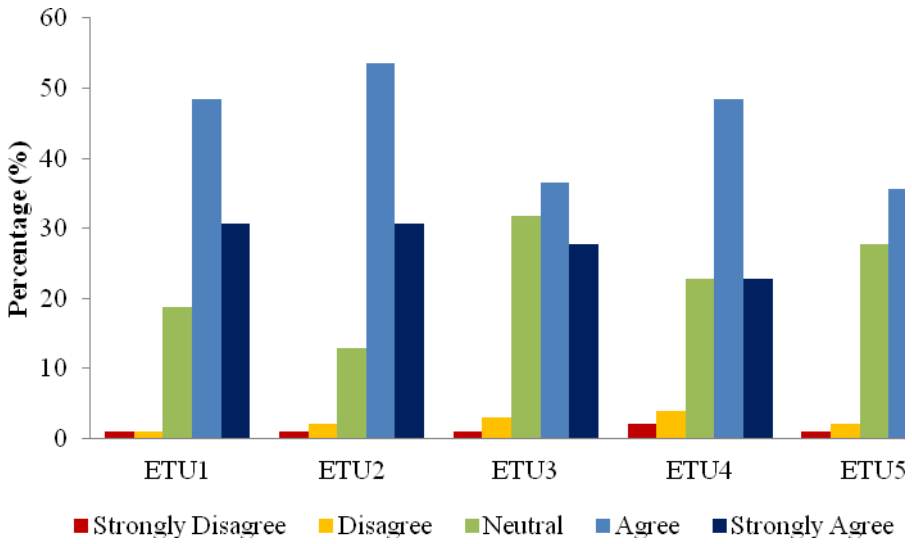

Figure 4.30: Frequency and percentage of responses for "Easy to Use" evaluation among students

For statement ETU4, 71.3% of the respondents gave positive opinions (22.8% strongly agreed and 48.5% agreed), whereas 6.0% of them disagreed

with this statement. The rest of the respondents (22.8%) remained neutral (see Table 4.4 and Figure 4.30).

Besides, Table 4.4 and Figure 4.30 also show that 69.3% of the respondents either strongly agreed (33.7%) or agreed (35.6%) that all instructions are clearly listed in ILC-WBLE (statement ETU5). 27.7% of the respondents provided neutral responses. Only a small amount of respondents had contrary opinion (2.0% disagreed and 1.0% strongly disagreed) on statement ETU5.

4.3.2.2 Easy to Learn

Respondents were asked to indicate their level of agreement with five statements regarding the ease of learning of ILC-WBLE.

I. Lecturers

Tables 4.5 and 4.6 show the results of the evaluation on the system's ease of learning among lecturers. The frequency and percentage of responses for "Ease to Learn" evaluation among lecturers are clearly shown in Figure 4.31.

Table 4.5: Descriptive statistics of "Easy to Learn" evaluation for the category of lecturers (N=10)

Statement	Mean	S.D.
ETL1. Easy to understand the language (words and phrases) used in the system.	4.6	0.516
ETL2. Able to create/ modify the content of the content page and quizzes.	4.7	0.483
ETL3. Location of navigation buttons are placed consistently in the system.	4.4	0.516
ETL4. Clear guidance is provided to guide users in the "Help" menu.	4.4	0.699
ETL5. The customised "Help" icon could be found easily within any pages.	4.4	0.699

Table 4.6: Frequency and percentage of responses for "Easy to Learn" evaluation among lecturers (N=10)

Statement	Response	Frequency	Percentage
ETL1. Easy to understand the language (words and phrases) used in the system.	Strongly Agree	6	60
	Agree	4	40
	Neutral	0	0
	Disagree	0	0
	Strongly Disagree	0	0
ETL2. Able to create/ modify the content of the content page and quizzes.	Strongly Agree	7	70
	Agree	3	30
	Neutral	0	0
	Disagree	0	0
	Strongly Disagree	0	0
ETL3. Location of navigation buttons are placed consistently in the system.	Strongly Agree	4	40
	Agree	6	60
	Neutral	0	0
	Disagree	0	0
	Strongly Disagree	0	0
ETL4. Clear guidance is provided to guide users in the "Help" menu.	Strongly Agree	5	50
	Agree	4	40
	Neutral	1	10
	Disagree	0	0
	Strongly Disagree	0	0
ETL5. The customised "Help" icon could be found easily within any pages.	Strongly Agree	5	50
	Agree	4	40
	Neutral	1	10
	Disagree	0	0
	Strongly Disagree	0	0

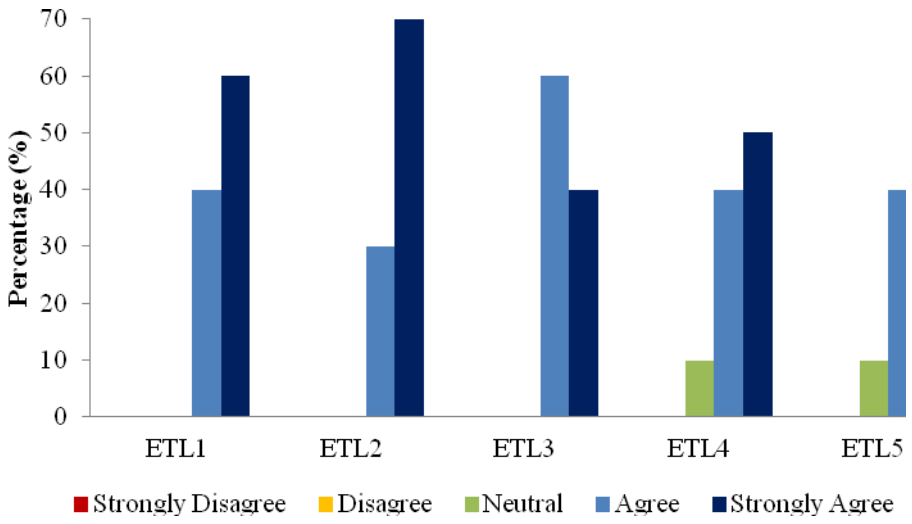

Figure 4.31: Frequency and percentage of responses for "Easy to Learn" evaluation among lecturers

The average response for each of the statement on "Ease to Learn" evaluation is above 4 of Likert scale (see Table 4.5). This means that the respondents show a high level of agreement and their answers ranged between strongly agree and agree (see Table 4.6 and Figure 4.31). Since all the statements that measure the "Ease to Learn" construct possess mean ranged between 4.4 and 4.7 (see Table 4.5), hence, the general perception of Foundation lecturers towards the "Ease to Learn" of ILC-WBLE is positive.

As can be perceived through Table 4.6 and Figure 4.31, when the respondents were asked to rate their level of agreement with statements ETL1, ETL2 and ETL3, all the respondents gave positive responses to these three statements respectively (i.e. 60% strongly agreed and 40% agreed with statements ETL1; 70% strongly agreed, and 30% agreed with statement ETL2; 40% strongly agreed and 60% agreed with statements ETL3). The findings indicated that all the respondents agreed that they are able to create or modify

the content in the content page and quizzes, the language used in ILC-WBLE is easy to understand, and the navigation buttons are consistently placed in ILC-WBLE. No responses of “Neutral”, “Disagree” or “Strongly Disagree” were recorded on these three statements.

Then, regarding statements ETL4 and ETL5, the survey revealed that 50% repondents strongly agreed and 40% agreed with these two statements respectively. Only 10% respondents gave neutral responses to ETL4 and ETL5. None of the respondents either strongly diagreed or disagreed with these two statements (see Table 4.6 and Figure 4.31). This means that almost all the respondents (i.e. 90%) agreed that clear guidance to guide users is provided in the ‘Help’ menu and could be easily found in all pages.

II. Students

Tables 4.7 and 4.8 reveal the results of “Ease to Learn” evaluation among students. The frequency and percentage of responses for “Ease to Learn” evaluation among students are clearly shown in Figure 4.32.

The average response for each of the statement on “Ease of Learn” evaluation is above the midpoint (3) of Likert scale (see Table 4.7). This means that the respondents show a high level of agreement and their answers ranged between strongly agree and agree (see Table 4.8 and Figure 4.32). As all the statements that measure the “Ease of Learn” construct possess mean above 3.5 (see Table 4.7), therefore, the general perception of Foundation students

towards the “Ease of Learn” of ILC-WBLE is positive.

Table 4.7: Descriptive statistics of “Easy to Learn” evaluation for the category of students (N=101)

Statement	Mean	S.D.
ETL1. Easy to understand the language (words and phrases) used in the system.	4.3	0.767
ETL2. Aware of how to proceed to the next step that you wish (such as click on “submit” button to review answers of the quiz).	4.0	0.786
ETL3. Location of navigation buttons are placed properly in the system.	3.9	0.828
ETL4. Clear guidance is provided to guide users in the “Help” menu.	3.7	0.965
ETL5. The customised “Help” icon could be found easily within any pages.	3.7	0.920

Based on the findings in Table 4.8 and Figure 4.32, 84.2% of the respondents had favourable opinion on statement ETL1 (42.6% strongly agreed and 41.6% agreed). 13.9% of the respondents remained neutral while only 2.0% of the respondents disagreed with statement ETL1. None of the respondents gave “Strongly Disagree” responses to this statement.

The survey also indicated that 79.2% of the respondents provided positive responses to statement ETL2 (28.7% strongly agreed and 50.5% agreed). 16.8% of the respondents gave “Neutral” responses and 4.0% of the respondents disagreed with statement ETL2. No responses of “Strongly Disagree” were recorded (see Table 4.8 and Figure 4.32).

Table 4.8: Frequency and percentage of responses for "Easy to Learn" evaluation among students (N=101)

Statement	Response	Frequency	Percentage
ETL1. Easy to understand the language (words and phrases) used in the system.	Strongly Agree	43	42.6
	Agree	42	41.6
	Neutral	14	13.9
	Disagree	2	2.0
	Strongly Disagree	0	0
ETL2. Aware of how to proceed to the next step that you wish (such as click on "submit" button to review answers of the quiz).	Strongly Agree	29	28.7
	Agree	51	50.5
	Neutral	17	16.8
	Disagree	4	4.0
	Strongly Disagree	0	0
ETL3. Location of navigation buttons are placed properly in the system.	Strongly Agree	27	26.7
	Agree	44	43.6
	Neutral	26	25.7
	Disagree	4	4.0
	Strongly Disagree	0	0
ETL4. Clear guidance is provided to guide users in the "Help" menu.	Strongly Agree	25	24.8
	Agree	32	31.7
	Neutral	33	32.7
	Disagree	11	10.9
	Strongly Disagree	0	0
ETL5. The customised "Help" icon could be found easily within any pages.	Strongly Agree	20	19.8
	Agree	38	37.6
	Neutral	32	31.7
	Disagree	11	10.9
	Strongly Disagree	0	0

Meanwhile, as can be perceived through Table 4.8 and Figure 4.32, the results show that 70.3% of the respondents gave positive opinion on ETL3 i.e. the locations of the navigation buttons are placed properly in the system (26.7% strongly agreed and 43.6% agreed). However, 25.7% of the respondents remained neutral while 4.0% of the respondents disagreed with statement ETL3. No responses of "Strongly Disagree" were recorded.

As for the statement ETL4, the findings in Table 4.8 and Figure 4.32 reveal that majority of the respondents either strongly agreed (24.8%) or agreed (31.7%) that clear guidance is provided to guide users in the "Help" menu. However, there were 10.9% of the respondents disagreed with statement ETL4. None of the respondents gave "Strongly Disagree" responses to this statement. 32.7% of the respondents showed neutral behaviour.

There were 57.4% of the respondents had favourable responses to statement ETL5 (19.8% strongly agreed and 37.6% agreed). 31.7% of the respondents remained neutral and 10.9% of the respondents disagreed with this statement. No responses of "Strongly Disagree" were recorded on statement ETL5 (see Table 4.8 and Figure 4.32).

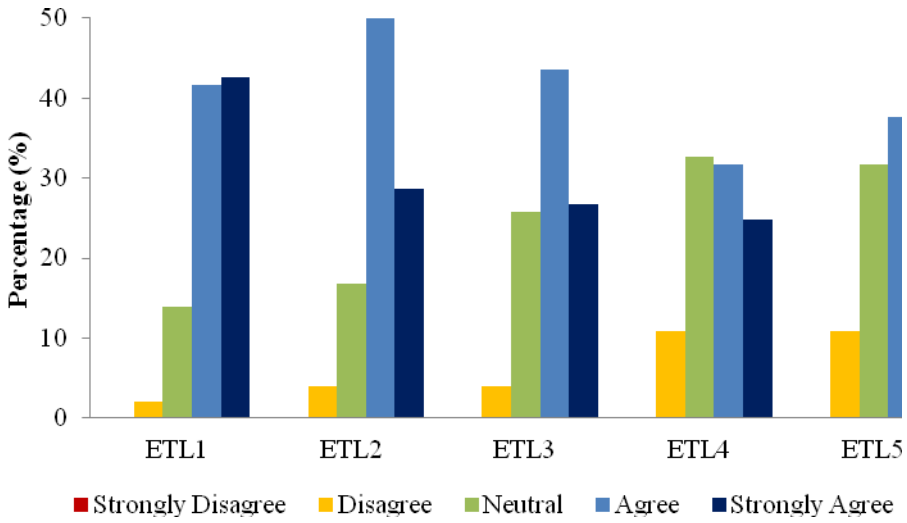

Figure 4.32: Frequency and percentage of responses for "Easy to Learn" evaluation among students

4.3.2.3 Level of Interactivity

Respondents were asked to give their degree of agreement on five statements pertaining to interactivity design.

I. Lecturers

Tables 4.9 and 4.10 reveal the findings of "Level of Interactivity" evaluation among lecturers. The frequency and percentage of responses for "Level of Interactivity" evaluation among lecturers are clearly shown in Figure 4.33.

Table 4.9: Descriptive statistics of "Level of Interactivity" evaluation for the category of lecturers (N=10)

Statement	Mean	S.D.
LOI1. The page type could be easily sorted by contents and quizzes.	4.0	0.816
LOI2. The quizzes could be set in various methods, such as drag and drop, fill in the blank, and multiple choices.	4.2	0.422
LOI3. The system supports multimedia creation in the content page (consist of text, image, sound, video, and animation).	4.2	0.632
LOI4. Playing of video or audio is controllable in the system.	3.8	0.632
LOI5. Supporting materials could be inserted as hyperlinks and attachments (such as .pdf, .zip, .doc/ .docx, .ppt/ .pptx, .jpg, etc.).	4.4	0.516

The findings in Table 4.10 and Figure 4.33 show that all the respondents agreed that the quizzes could be set in various methods, such as drag and drop, fill in the blank, and multiple choices (statement LOI2 with

20% strongly agreed and 80% agreed) and they were able to insert supporting materials as hyperlinks and attachments (statement LOI5 with 40% strongly agreed and 60% agreed). No respondents reported either strongly disagreed or disagreed with these two statements. No "Neutral" responses were recorded.

Table 4.10: Frequency and percentage of responses for "Level of Interactivity" evaluation among lecturers (N=10)

Statement	Response	Frequency	Percentage
LOI1. The page type could be easily sorted by contents and quizzes.	Strongly Agree	2	20
	Agree	7	70
	Neutral	1	10
	Disagree	0	0
	Strongly Disagree	0	0
LOI2. The quizzes could be set in various methods, such as drag and drop, fill in the blank, and multiple choices.	Strongly Agree	2	20
	Agree	8	80
	Neutral	0	0
	Disagree	0	0
	Strongly Disagree	0	0
LOI3. The system supports multimedia creation in the content page (consist of text, image, sound, video, and animation).	Strongly Agree	3	30
	Agree	6	60
	Neutral	1	10
	Disagree	0	0
	Strongly Disagree	0	0
LOI4. Playing of video or audio is controllable in the system.	Strongly Agree	1	10
	Agree	6	60
	Neutral	3	30
	Disagree	0	0
	Strongly Disagree	0	0
LOI5. Supporting materials could be inserted as hyperlinks and attachments (such as .pdf, .zip, .doc/ .docx, .ppt/ .pptx, .jpg, etc.).	Strongly Agree	4	40
	Agree	6	60
	Neutral	0	0
	Disagree	0	0
	Strongly Disagree	0	0

The findings in Table 4.10 and Figure 4.33 also reveal that majority of the respondents (i.e. 90%) agreed with statements LOI1 (20% strongly agreed, and 70% agreed) and LOI3 (30% strongly agreed, and 60% agreed). Only 10%

of the respondents gave neutral responses to both statements LOI1 and LOI3. None of the respondents either strongly disagreed or disagreed with these two statements.

Regarding the statement of "Playing of video or audio is controllable in the system" (statement LOI4), the findings showed that only 70% of the respondents had a favourable opinion (10% strongly agreed and 60% agreed). No respondents gave "Disagree" or "Strongly Disagree" responses, while 30% respondents showed neutral behaviour (see Table 4.10 and Figure 4.33).

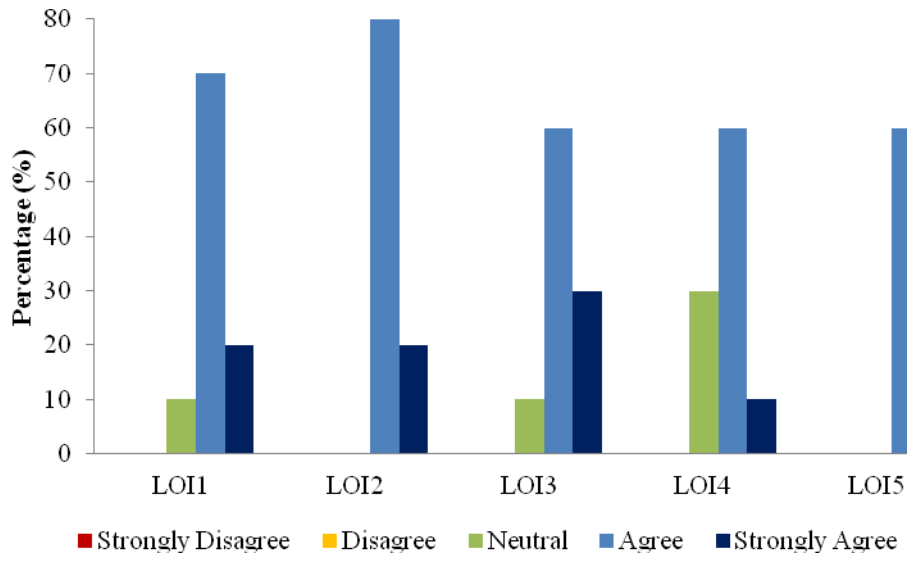

Figure 4.33: Frequency and percentage of responses for "Level of Interactivity" evaluation among lecturers

II. Students

The results of the "Level of Interactivity" evaluation among students are shown in Tables 4.11 and 4.12. The frequency and percentage of responses for "Level of Interactivity" evaluation among students are clearly shown in

Figure 4.34.

The average response for each of the statement on "Level of Interactivity" evaluation is above the midpoint (3) of Likert scale (see Table 4.11). This means that the respondents show a high level of agreement and their answers ranged between strongly agree and agree (see Table 4.12 and Figure 4.34). Since all the statements that measure the "level of Interactivity" construct possess mean above 3.5 (see Table 4.11), therefore, the general perception of Foundation students towards the "Level of Interactivity" of ILC-WBLE is positive.

Table 4.11: Descriptive statistics of "Level of Interactivity" evaluation for the category of students (N=101)

Statement	Mean	S.D.
LOI1. The page type could be easily sorted by contents and quizzes.	3.8	0.809
LOI2. The quizzes are set in various methods (such as drag and drop, fill in the blank, and multiple choices).	3.9	0.770
LOI3. The system supports multimedia contents (consist of text, images, graphics, sound, video, and animation).	4.0	0.889
LOI4. Playing of video or audio is controllable in the system.	4.0	0.906
LOI5. Supporting materials could be found in the forms of hyperlinks and attachments (such as .pdf, .zip, .doc/ .docx, .ppt/ .pptx, .jpg, etc.).	4.0	0.872

Based on the findings in Table 4.12 and Figure 4.34, 76.3% of the respondents gave positive opinion on statement LOI4 (31.7% strongly agreed and 44.6% agreed). 16.8% of the respondents gave "Neutral" responses while 5.9% of the respondents disagreed with statement LOI4. Only 1.0% of the

respondents strongly disagreed with this statement.

Table 4.12: Frequency and percentage of responses for "Level of Interactivity" evaluation among students (N=101)

Statement	Response	Frequency	Percentage
LOI1. The page type could be easily sorted by contents and quizzes.	Strongly Agree	20	19.8
	Agree	47	46.5
	Neutral	29	28.7
	Disagree	5	5.0
	Strongly Disagree	0	0
LOI2. The quizzes are set in various methods (such as drag and drop, fill in the blank, and multiple choices).	Strongly Agree	22	21.8
	Agree	53	52.5
	Neutral	22	21.8
	Disagree	4	4.0
	Strongly Disagree	0	0
LOI3. The system supports multimedia contents (consist of text, images, graphics, sound, video, and animation).	Strongly Agree	33	32.7
	Agree	43	42.6
	Neutral	18	17.8
	Disagree	7	6.9
	Strongly Disagree	0	0
LOI4. Playing of video or audio is controllable in the system.	Strongly Agree	32	31.7
	Agree	45	44.6
	Neutral	17	16.8
	Disagree	6	5.9
	Strongly Disagree	1	1.0
LOI5. Supporting materials could be found in the forms of hyperlinks and attachments (such as .pdf, .zip, .doc/ .docx, .ppt/ .pptx, .jpg, etc.).	Strongly Agree	32	31.7
	Agree	40	39.6
	Neutral	24	23.8
	Disagree	5	5.0
	Strongly Disagree	0	0

Regarding the statement LOI3, 75.3% of the respondents agreed that ILC-WBLE supports multimedia contents (32.7% strongly agreed and 42.6% agreed). However, 17.8% of the respondents remained neutral and 6.9% of the respondents disagreed with this statement. No responses of "Strongly disagree" were recorded (see Table 4.12 and Figure 4.34).

Table 4.12 and Figure 4.34 also indicate that there were 74.3% of the respondents either strongly agreed (21.8%) or agreed (52.5%) with statement LOI2. 21.8% of the respondents gave "Neutral" responses while 4.0% of the respondents disagreed with statement LOI2. None of the respondents provided "Strongly disagree" responses to statement LOI2.

When respondents were asked whether or not to find the supporting materials in the system (LOI5), 71.3% of the respondents provided positive opinion (31.7% strongly agreed and 39.6% agreed), but 5.0% of them disagreed with this statement. Meanwhile, no respondents strongly disagreed with this statement. The rest (23.8%) remained neutral (see Table 4.12 and Figure 4.34).

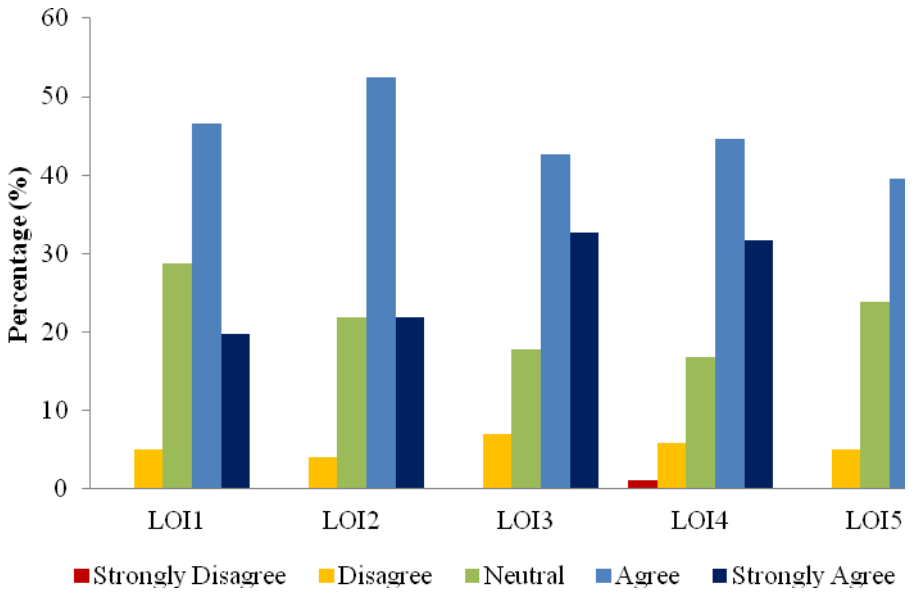

Figure 4.34: Frequency and percentage of responses for "Level of Interactivity" evaluation among students

As for the statement LOI1, the results in Table 4.12 and Figure 4.34 reveal that 66.3% of the respondents gave favourable opinion (19.8% strongly agreed and 46.5% agreed). However, the survey also indicated that there were 5.0% of the respondents disagreed with statement LOI1, while 28.7% of them showed neutral behaviour. No responses of "Strongly disagree" were recorded.

4.3.2.4 User Interface Design

All respondents were asked their perception on five statements pertaining to the user interface design.

I. Lecturers

The findings of the evaluation on "User Interface Design" of ILC-WBLE among lecturers are shown in Tables 4.13 and 4.14. The frequency and percentage of responses for the evaluation are clearly shown in Figure 4.35.

The average response for each of the statement on user interface design evaluation is above 4 of Likert scale (see Table 4.13). This means that the respondents show a high level of agreement and their answers ranged between strongly agree and agree (see Table 4.14 and Figure 4.35). Almost all the statements that measure the "User Interface Design" construct possess mean equal or above 4.0, except UID4 (mean = 3.9) (see Table 4.13), Therefore, the general perception of Foundation lecturers towards the user interface design of ILC-WBLE is positive.

Table 4.13: Descriptive statistics of "User Interface Design" evaluation for the category of lecturers (N=10)

Statement	Mean	S.D.
UID1. Able to display the content of each page in various layout designs.	4.0	0.816
UID2. The colour scheme applied in the system is appropriate.	4.1	0.568
UID3. Graphic used in each of the navigation buttons clearly indicated the function of the button.	4.2	0.422
UID4. Instructions are given repeatedly in every section to reduce the use of users' memory.	3.9	0.316
UID5. Each page has a clear and short title to indicate users' current location.	4.1	0.738

Table 4.14: Frequency and percentage of responses for "User Interface Design" evaluation among lecturers (N=10)

Statement	Response	Frequency	Percentage
UID1. Able to display the content of each page in various layout designs.	Strongly Agree	3	30
	Agree	4	40
	Neutral	3	30
	Disagree	0	0
	Strongly Disagree	0	0
UID2. The colour scheme applied in the system is appropriate.	Strongly Agree	2	20
	Agree	7	70
	Neutral	1	10
	Disagree	0	0
	Strongly Disagree	0	0
UID3. Graphic used in each of the navigation buttons clearly indicated the function of the button.	Strongly Agree	2	20
	Agree	8	80
	Neutral	0	0
	Disagree	0	0
	Strongly Disagree	0	0
UID4. Instructions are given repeatedly in every section to reduce the use of users' memory.	Strongly Agree	0	0
	Agree	9	90
	Neutral	1	10
	Disagree	0	0
	Strongly Disagree	0	0
UID5. Each page has a clear and short title to indicate users' current location.	Strongly Agree	3	30
	Agree	5	50
	Neutral	2	20
	Disagree	0	0
	Strongly Disagree	0	0

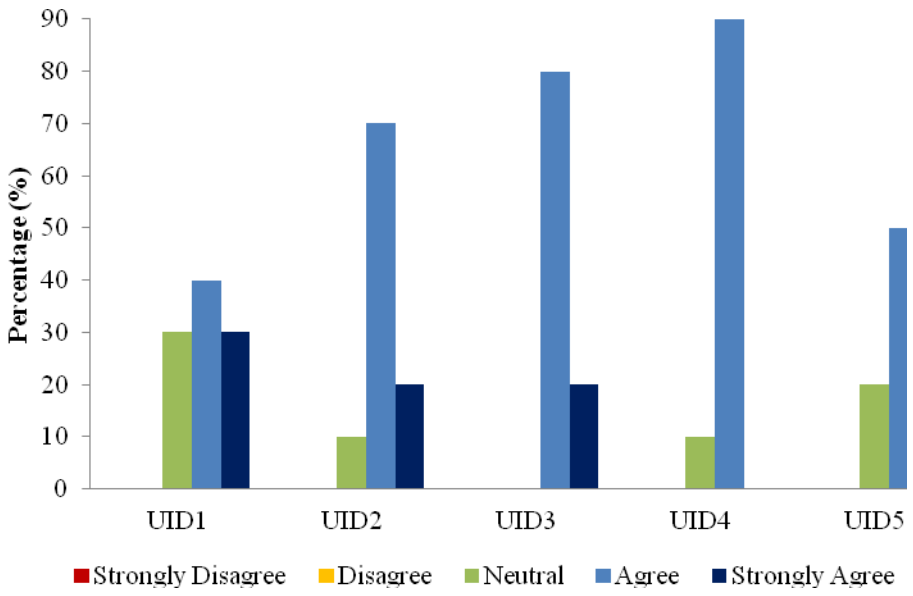

Figure 4.35: Frequency and percentage of responses for "User Interface Design" evaluation among lecturers

As can be perceived through Table 4.14 and Figure 4.35, when respondents were asked about the statements UID3 (i.e. Graphics used in navigation buttons are clearly explained the function of the button), all the respondents had favourable responses to agreed with statements (20% strongly agreed and 80% agreed). No "Neutral", "Strongly Disagree" and "Disagree" responses were recorded. As for statement UID4 (i.e. Colour usage is suitable in the contents), 90% of the respondents strongly agreed and 10% of the respondents remained neutral.

The findings in Table 4.14 and Figure 4.35 also show that majority of the respondents thought that the colour scheme applied in the system is appropriate (statement UID2), i.e. 20% strongly agreed and 70% agreed. 10% gave neutral responses to this statement. None of the respondents showed either disagree or strongly disagree behaviour.

Besides, the findings also indicated that the respondents had shown a high response rate (30% strongly agreed and 50% agreed) on statement UID5 (i.e. Each page has a clear and short title to indicate the current location). 20% respondents showed neutral responses. None of the respondents showed either strongly disagree or disagree behaviour (see Table 4.14 and Figure 4.35).

Furthermore, when respondents were asked to rate their level of agreement with statement UID1 namely "Able to display the content of each page in various layout designs", 70% respondents had a favourable opinion (30% strongly agreed and 40% agreed). Meanwhile, the rest (30%) remained neutral. No responses of "Strongly Disagree" and "Disagree" were recorded (see Table 4.14 and Figure 4.35).

II. Students

The results of the evaluation on "User Interface Design" of ILC-WBLE among students are shown in Tables 4.15 and 4.16. The frequency and percentage of responses for the evaluation are clearly shown in Figure 4.36.

The average response for each of the statement on "User Interface Design" evaluation is above the midpoint (3) of Likert scale (see Table 4.15). This means that the respondents show a moderate level of agreement and their answers ranged between strongly agree and agree (see Table 4.16 and Figure 4.36). Almost all the statements that measure the "User Interface Design" construct possess mean above 3.5 (see Table 4.15). Hence, the general

perception of Foundation students towards the "User Interface Design" of ILC-WBLE is positive.

Table 4.15: Descriptive statistics of "User Interface Design" evaluation for the category of students (N=101)

Statement	Mean	S.D.
UID1. The content of each page come in various layout designs.	3.8	0.784
UID2. The colour scheme applied in the system is appropriate.	3.8	0.828
UID3. Graphic used in each of the navigation buttons clearly indicated the function of the button.	3.7	0.859
UID4. Instructions are given repeatedly in every section to reduce the use of users' memory.	3.6	0.760
UID5. Each page has a clear and short title to indicate users' current location.	4.0	0.706

As can be seen in Table 4.16 and Figure 4.36, when respondents were asked to rate their level of agreement with the statement that measure whether or not each page has a clear and short title to indicate users' location (statement UID5), 79.2% of the respondents provided positive responses to this statement (25.7% strongly agreed and 53.5% agreed). 19.8% of the respondents remained neutral. Only a small number of the respondents (1.0%) disagreed with this statement.

There were 66.3% of the respondents gave favourable opinion on statement UID1 (18.8% strongly agreed and 47.5% agreed). However, 29.7% of the respondents provided neutral responses and 4.0% of the respondents disagreed with statement UID1. No "Strongly Disagree" responses were recorded (see Table 4.16 and Figure 4.36).

Table 4.16: Frequency and percentage of responses for "User Interface Design" evaluation among students (N=101)

Statement	Response	Frequency	Percentage
UID1. The content of each page come in various layout designs.	Strongly Agree	19	18.8
	Agree	48	47.5
	Neutral	30	29.7
	Disagree	4	4.0
	Strongly Disagree	0	0.0
UID2. The colour scheme applied in the system is appropriate.	Strongly Agree	20	19.8
	Agree	46	45.5
	Neutral	29	28.7
	Disagree	6	5.9
	Strongly Disagree	0	0.0
UID3. Graphics used in each of the navigation buttons clearly indicated the function of the button.	Strongly Agree	21	20.8
	Agree	38	37.6
	Neutral	36	35.6
	Disagree	6	5.9
	Strongly Disagree	0	0.0
UID4. Instructions are given repeatedly in every section to reduce the use of users' memory.	Strongly Agree	12	11.9
	Agree	44	43.6
	Neutral	40	39.6
	Disagree	5	5.0
	Strongly Disagree	0	0.0
UID5. Each page has a clear and short title to indicate users' current location.	Strongly Agree	26	25.7
	Agree	54	53.5
	Neutral	20	19.8
	Disagree	1	1.0
	Strongly Disagree	0	0.0

Based on the responses to statement UID2 as shown in Table 4.16 and Figure 4.36, 65.3% of the respondents either strongly agreed (19.8%) or agreed (45.5%) that the colour scheme applied in ILC-WBLE is appropriate. 28.7% of the respondents gave neutral responses while 5.9% of the respondents disagreed with this statement. None of the respondents showed "Strongly Disagree" behaviour.

Furthermore, the survey also showed that there were 20.8% of the respondents strongly agreed and 37.6% agreed with statement UID3. However, 5.9% of them had contrary opinion. 35.6% remained neutral (see Table 4.16 and Figure 4.36).

For the statement of "Instructions are given repeatedly in every section to reduce the use of users' memory" (statement UID4), the findings in Table 4.16 and Figure 4.36 reveal that 55.5% of the respondents provided positive responses (11.9% strongly agreed and 43.6% agreed), whereas 5.0% of them disagreed with this statement. There were 39.6% respondents remained neutral.

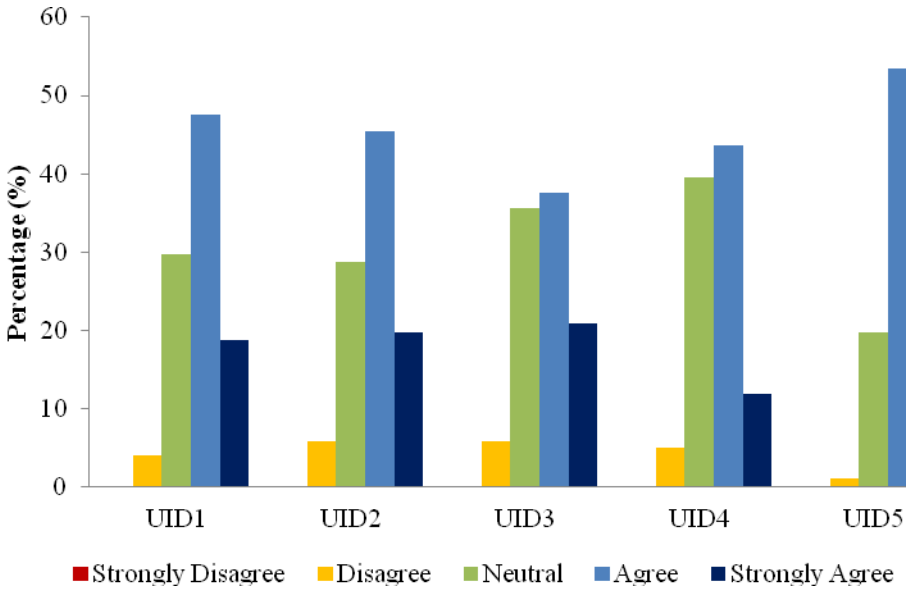

Figure 4.36: Frequency and percentage of responses for "User Interface Design" evaluation among students

4.3.2.5 Error-free Assessment

All respondents were asked their opinions on five statements pertaining to "Error-free Assessment" evaluation.

I. Lecturers

The results of "Error-free Assessment" evaluation among lecturers are shown in Tables 4.17 and 4.18. The frequency and percentage of responses for the evaluation among lecturers are clearly shown in Figure 4.37.

Table 4.17: Descriptive statistics of "Error-free Assessment" evaluation for the category of lecturers (N=10)

Statement	Mean	S.D.
EFA1. Users are required to confirm their actions before they delete unwanted contents.	4.5	0.527
EFA2. Hyperlinks can be created without any error.	3.7	0.823
EFA3. Page type can be sorted accordingly from Content page to Quiz or back to the original sequence.	3.9	0.876
EFA4. Error message pops out could precisely indicate the problem.	4.0	0.816
EFA5. All error messages will be provided with the respective solutions.	3.9	0.738

The average response for each of the statement on "Error-free Assessment" evaluation is above the midpoint (3) of Likert scale (see Table 4.17). This means that the respondents show a high level of agreement and their answers ranged between strongly agree and agree (see Table 4.18 and Figure 4.37). Almost all the statements that measure the "Error-free

Assessment" construct possess mean above 3.5 (see Table 4.17). Hence, the general perception of Foundation lecturers towards the "Error-free Assessment" of ILC-WBLE is positive.

Table 4.18: Frequency and percentage of responses for "Error-free Assessment" evaluation among lecturers (N=10)

Statement	Response	Frequency	Percentage
EFA1. Users are required to confirm their actions before they delete unwanted contents.	Strongly Agree	5	50
	Agree	5	50
	Neutral	0	0
	Disagree	0	0
	Strongly Disagree	0	0
EFA2. Hyperlinks can be created without any error.	Strongly Agree	1	10
	Agree	6	60
	Neutral	2	20
	Disagree	1	10
	Strongly Disagree	0	0
EFA3. Page type can be sorted accordingly from Content page to Quiz or back to the original sequence.	Strongly Agree	2	20
	Agree	6	60
	Neutral	1	10
	Disagree	1	10
	Strongly Disagree	0	0
EFA4. Error message pops out could precisely indicate the problem.	Strongly Agree	3	30
	Agree	4	40
	Neutral	3	30
	Disagree	0	0
	Strongly Disagree	0	0
EFA5. All error messages will be provided with the respective solutions.	Strongly Agree	2	20
	Agree	5	50
	Neutral	3	30
	Disagree	0	0
	Strongly Disagree	0	0

The findings in Table 4.18 and Figure 4.37 show that all the respondents expressing an opinion either strongly agreed (50%) or agreed (50%) with statement EFA1 namely "Users are required to confirm their actions before they delete unwanted contents". No respondents reported either strongly disagreed or disagreed with this statement. No responses of "Neutral"

were recorded too.

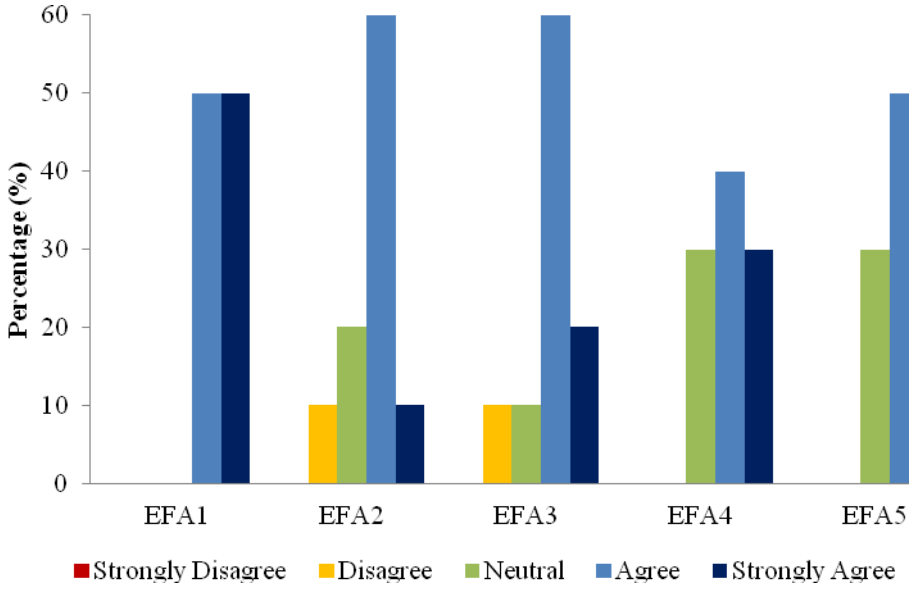

Figure 4.37: Frequency and percentage of responses for "Error-free Assessment" evaluation among lecturers

The findings in also revealed that 80% respondents agreed with statement EFA3 (i.e. 20% strongly agreed and 60% agreed), while 10% respondents had contrary opinion. The rest of the respondents (10%) remained neutral. None of the respondents either disagreed or strongly disagreed with this statement (see Table 4.18 and Figure 4.37).

The findings in Table 4.18 and Figure 4.37 also reveal that 70% of the respondents agreed with statements EFA4 (30% strongly agreed and 40% agreed) and EFA5 (20% strongly agreed and 50% agreed). The rest (30%) of the respondents gave neutral responses to statements EFA4 and EFA5 respectively. None of the respondents either strongly disagreed or disagreed with statements these two statements.

Regarding the statement EFA2, i.e. “Hyperlinks can be created without any errors”, the findings in Table 4.18 and Figure 4.37 show that majority of the respondents, (i.e. 70%) had a favourable opinion (10% strongly agreed and 60% agreed). However, 10% respondents had contrary opinion, while 20% respondents showed neutral behaviour. No respondents gave “Strongly Disagree” responses,

II. Students

The results of the evaluation on “Error-free Assessment” of ILC-WBLE among students are shown in Tables 4.19 and 4.20. The frequency and percentage of responses for the evaluation are clearly shown in Figure 4.38.

The average response for each of the statement on “Error-free Assessment” evaluation is above the midpoint (3) of Likert scale (see Table 4.19). This means that the respondents show a moderate level of agreement and their answers ranged between strongly agree and agree (see Table 4.20 and Figure 4.38). Almost all the statements that measure the “Error-free Assessment” construct possess mean above 3.5 (see Table 4.19). Hence, the general perception of Foundation students towards the “Error-free Assessment” of ILC-WBLE is positive.

Table 4.19: Descriptive statistics of "Error-free Assessment" evaluation for the category of students (N=101)

Statement	Mean	S.D.
EFA1. All attachments can be downloaded without any errors.	3.7	0.954
EFA2. All hyperlinks can be accessed without any errors.	3.7	0.981
EFA3. All page types can be sorted accordingly from Content page to Quiz or back to the original sequence.	3.9	0.899
EFA4. All video and audio can be played without any errors.	3.7	0.926
EFA5. All quizzes can be answered without any errors.	3.7	0.966

Table 4.20: Frequency and percentage of responses for "Error-free Assessment" evaluation among students (N=101)

Statement	Response	Frequency	Percentage
EFA1. All attachments can be downloaded without any errors.	Strongly Agree	23	22.8
	Agree	36	35.6
	Neutral	32	31.7
	Disagree	9	8.9
	Strongly Disagree	1	1.0
EFA2. All hyperlinks can be accessed without any errors.	Strongly Agree	25	24.8
	Agree	35	34.7
	Neutral	30	29.7
	Disagree	10	9.9
	Strongly Disagree	1	1.0
EFA3. All page types can be sorted accordingly from Content page to Quiz or back to the original sequence.	Strongly Agree	25	24.8
	Agree	44	43.6
	Neutral	25	24.8
	Disagree	6	5.9
	Strongly Disagree	1	1.0
EFA4. All video and audio can be played without any errors.	Strongly Agree	23	22.8
	Agree	37	36.6
	Neutral	33	32.7
	Disagree	7	6.9
	Strongly Disagree	1	1.0
EFA5. All quizzes can be answered without any errors.	Strongly Agree	23	22.8
	Agree	42	41.6
	Neutral	24	23.8
	Disagree	11	10.9
	Strongly Disagree	1	1.0

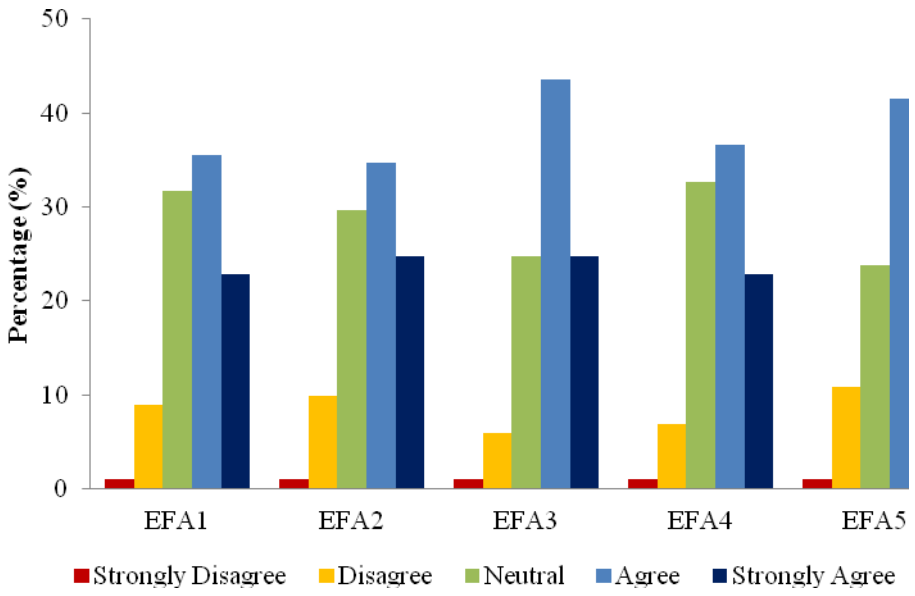

Figure 4.38: Frequency and percentage of responses for "Error-free Assessment" evaluation among students

Based on the findings in Table 4.20 and Figure 4.38, 68.4% of the respondents provided favourable opinion on statement EFA3 (24.8% strongly agreed and 43.6% agreed). Among the rest of the respondents, 24.8% remained neutral, 5.9% disagreed, and only 1.0% strongly disagreed on statement EFA3.

As can be seen in Table 4.20 and Figure 4.38, while respondents were asked to rate on their level of agreement with statement "All quizzes can be answered without any error" (EFA5), 64.4% gave positive responses (22.8% strongly agreed and 41.6% agreed). 23.8% of the respondents gave "Neutral" responses while 11.9% of the respondents had contrary opinion (10.9% disagreed and 1.0% strongly disagreed).

Findings in Table 4.20 and Figure 4.38 also reveal that there were 58.4% of the respondents agreed on statement EFA1 (22.8% strongly agreed

and 35.6% agreed). 31.7% of the respondents remained neutral, while 8.9% of the respondents disagreed on this statement. Only 1.0% of the respondents strongly disagreed on statement EFA1.

When respondents were asked whether or not to access all hyperlinks without any errors (statement EFA2), the findings in Table 4.20 and Figure 4.38 indicate that there were 24.8% of the respondents strongly agreed and 34.7% of them agreed with this statement. The survey also showed that 10.9% of the respondents had contrary opinion (9.9% disagreed and 1.0% strongly disagreed) whereas the rest (29.7%) showed neutral behaviour.

Meanwhile, the findings in Table 4.20 and Figure 4.38 also reveal that there were 59.4% of the respondents provided positive opinion on statement EFA4 (22.8% strongly agreed and 36.6% agreed). However, some of the respondents either disagreed (6.9%) or strongly disagreed (1.0%) with statement EFA4. 32.7% of the respondents remained neutral.

4.4 The Identification of Strengths and Weaknesses of the Prototype of ILC-WBLE

The research also aims to identify the strengths and weaknesses of the prototype of ILC-WBLE. Its strengths and weaknesses could be identified through users' feedback and their ratings of agreement with the five statements built into each construct (i.e. easy to use, easy to learn, level of interactivity, user interface design and error-free assessment) that measure the usability of

ILC-WBLE.

Table 4.21: Descriptive statistics of five constructs for usability evaluation

Easy to Use	Lecturers		Students	
	Mean	**S.D.**	**Mean**	**S.D.**
ETU1	4.4	0.516	4.1	0.791
ETU2	4.3	0.675	4.1	0.773
ETU3	4.2	0.789	3.9	0.891
ETU4	4.4	0.516	3.9	0.884
ETU5	4.3	0.823	4.0	0.889
Easy to Learn	**Lecturers**		**Students**	
	Mean	**S.D.**	**Mean**	**S.D.**
ETL1	4.6	0.516	4.3	0.767
ETL2	4.7	0.483	4.0	0.786
ETL3	4.4	0.516	3.9	0.828
ETL4	4.4	0.699	3.7	0.965
ETU5	4.4	0.699	3.7	0.920
Level of Interactivity	**Lecturers**		**Students**	
	Mean	**S.D.**	**Mean**	**S.D.**
LOI1	4.0	0.816	3.8	0.809
LOI2	4.2	0.422	3.9	0.770
LOI3	4.2	0.632	4.0	0.889
LOI4	3.8	0.632	4.0	0.906
LOI5	4.4	0.516	4.0	0.872
User Interface Design	**Lecturers**		**Students**	
	Mean	**S.D.**	**Mean**	**S.D.**
UID1	4.0	0.816	3.8	0.784
UID2	4.1	0.568	3.8	0.828
UID3	4.2	0.422	3.7	0.859
UID4	3.9	0.316	3.6	0.760
UID5	4.1	0.738	4.0	0.706
Error-free Assessment	**Lecturers**		**Students**	
	Mean	**S.D.**	**Mean**	**S.D.**
EFA1	4.5	0.527	3.7	0.954
EFA2	3.7	0.823	3.7	0.981
EFA3	3.9	0.876	3.9	0.899
EFA4	4.0	0.816	3.7	0.926
EFA5	3.9	0.738	3.7	0.966

Based on the results of data analysis which had been discussed in more detail in section 4.3, it can be concluded that all the respondents were satisfied

with the key design aspects in ILC-WBLE. The results of the respondents' ratings for each statement of those five research constructs are depicted in Tables 4.2, 4.4, 4.6, 4.8, 4.10, 4.12, 4.14, 4.16, 4.18 and 4.20 (see also Figures 4.29 to 4.38). Meanwhile, the average mean score of all the statements were greater than the neutral point (3) as summarised in Table 4.21 reflected that the respondents' level of agreement was high and they were agreeable to all the five measured constructs (i.e. easy to use, easy to learn, level of interactivity, user interface design and error-free assessment).

Furthermore, as described in chapter 3, Part C of the usability evaluation questionnaire is an open-ended question which required the users to give additional comments on the system. All the positive and negative comments given by lecturers and students are summarised in Tables 4.22 and 4.23 respectively.

Table 4.22: Summary of comments from lecturers

Primary Positive Aspects	Primary Negative Aspects
Easy to access compared to UTAR's WBLE.	Loading of the contents in student section is slow.
Able to create quizzes in the system is useful for lecturers to set up test for students easily.	Font size, font colour, type of bullet and numbering function are not available in the system.
User-friendly interactions in the system.	Unable to create courseware with same subject name that is created earlier in the system.

Table 4.23: Summary of comments from students

Primary Positive Aspects	Primary Negative Aspects
ILC-WBLE is an easy to use and easy to learn system.	Colour scheme applied in the system is unattractive.
ILC-WBLE is an informative system.	Loading speed of the content and downloading speed of the attachments are slow.
Contents included in the system could improve the academic performance of students.	Wordings used in the system are not interesting.

According to the responses from lecturers and students participating in the usability evaluation study, the strengths of ILC-WBLE could be categorised into three aspects, which are:

- **Easiness in accessing and using the ILC-WBLE compared to existing LMS (i.e. WBLE) in UTAR:** ILC-WBLE is an interactive multimedia CBL courseware in which the instructional materials are incorporated with multimedia learning objects (i.e. text, images, graphics, animation, audio and video) that could be directly created in the system.
- **ILC-WBLE is a simple yet informative system:** Even though functions of ILC-WBLE are not as many as WBLE, however, all the functions provided in ILC-WBLE are perceived useful and user-friendly to lecturers especially the function which creates instructional materials directly in the system.
- **High level of interaction in creating quizzes:** The feature of creating quizzes online is available in ILC-WBLE. Its capability

to create quizzes online facilitates the lecturers in providing interactive exercises to students.

On the other hand, based on the outcomes obtained from the usability evaluation study, the weaknesses of ILC-WBLE could be categorised into the following three aspects:

- **Colour schemes and wordings applied in the ILC-WBLE are unattractive:** Respondents of the usability evaluation of ILC-WBLE prefer to have more control in modifying the appearance of the learning materials in the system such as changing the background colour or the style of the text in the system.
- **Absence of text editor in the system:** It is to be noted that one of the objectives of the development of ILC-WBLE is to use it as an alternative LMS to WBLE which enables lecturers to share the instructional materials online, thus the system does not emphasise on varying the colour of the background or the font style.
- **Slow loading and downloading speeds of the system:** Slow accessing speeds that occur in the system are due to the web hosting package that is used to host the system. Currently, ILC-WBLE is hosted in a shared web server, which means bandwidth assigned to the web site (ILC-WBLE) is shared among many other web sites that are hosted in the same web server. If the system is hosted in a dedicated web server such as

UTAR's server, loading and downloading speeds of the system are deemed to be faster.

4.5 Conclusions

In conclusion, the existence of ILC-WBLE may bring a new experience of teaching and learning to lecturers and students of UTAR. Based on the results obtained and presented using appropriate tables and figures, it is clearly shown that the main research objectives formed in chapter 1 had been successfully achieved. The outcomes explained in this chapter provided inputs to the next chapter, which is the final chapter in this thesis.

CHAPTER 5

CONCLUSIONS

5.1 Introduction

The research objectives (chapter 1) and literature review (chapter 2) led to a structured research methodology (chapter 3) which involved the design and development of an appropriate ID model for ILC-WBLE development, as well as the development and usability evaluation of ILC-WBLE. The findings (chapter 4) of data analysis obtained in the research have contributed to the conclusions and recommendations for future studies outlined in this final chapter. This chapter wraps up the discussion of this research, which encompasses the following topics:

- overall conclusions from the outcomes of the research,
- research contributions, and
- limitations and future recommendations.

5.2 Overall Conclusions from the Outcomes of the Research

As described in chapter 1, this research arose due to the problems identified in the existing Learning Management System (LMS) at UTAR i.e. a resource website called WBLE. In particular, this research focused on the

development of a prototype of ILC-WBLE, which would be utilised as an alternative LMS to WBLE, to facilitate lecturers and students of the university in the teaching and learning processes. Moreover, this research also evaluated the usability of the prototype of ILC-WBLE and identified the strengths and weaknesses of ILC-WBLE using a survey questionnaire approach. To achieve the expectations of this research, four main objectives were formed:

i. To design and develop an appropriate Instructional Design (ID) model which is deemed suitable for developing an interactive multimedia CBL courseware called ILC-WBLE (**I**ndependent **L**earning **C**ourseware for **W**eb-**B**ased **L**earning **E**nvironment).

ii. To develop a prototype of ILC-WBLE.

iii. To evaluate the usability of the prototype of ILC-WBLE.

iv. To identify the strengths and weaknesses of the prototype of ILC-WBLE.

Overall, all the objectives of this research had been achieved. The following subsections discuss the outcomes of this research.

5.2.1 The Design and Development of an ID Model for ILC-WBLE Development

After reviewing several Instructional System Design (ISD) models in section 2.5, an appropriate instructional design (ID) model as shown in Figure 3.1 for developing ILC-WBLE had been designed and created based on a generic five-phase ID model called ADDIE model. The proposed ID model (Figure 3.1) was used as a guideline to ensure the smooth development of ILC-

WBLE and the usability evaluation. The proposed ID model composed of five phases namely Analysis, Design, Development, Implementation, and Evaluation phases, which has been discussed in section 3.2.1.

5.2.2 The Prototype of ILC-WBLE Development

Furthermore, before the commencement of ILC-WBLE, modules design model (Figure 3.2) and storyboards had also been designed and created. Through the formation of modules design model and storyboards, a prototype of ILC-WBLE has been developed. ILC-WBLE is a dynamic multimedia content creation system, which enables lecturers to incorporate multimedia elements such as text, graphics, images, audio and video in the delivery of instructional contents. In addition, lecturers are able to create quizzes using the quiz creation feature provided in the system. Three types of quizzes namely fill in the blanks, drag and drop and multiple choices questions can be created as interactive exercises to test the understanding of students on a learned topic.

5.2.3 The Usability Evaluation of the Prototype of ILC-WBLE

Questionnaire is the main instrument used to evaluate the usability of ILC-WBLE. The evaluation involved two categories of evaluation samples, i.e. lecturers and students using two different sets of usability evaluation questionnaires. Both sets of questionnaire for the usability evaluation were made up of five research constructs, which are easy to use, easy to learn, level of interactivity, user interface design, and error-free assessment. Each construct

consisted of five statements which were created based on Nielsen's 10 usability heuristics using 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Respondents were asked to rate their level of agreement with each statement.

A reliability test was carried out using Cronbach's alpha, which measures the internal consistency of the survey questionnaire that consisted of 25 statements measuring the usability constructs. Cronbach's alpha values for both sets of questionnaires were 0.898 and 0.948 respectively, which exceeded the minimum acceptance level of 0.70 as recommended by Martin and Douglas (1997) and Santos (1999) (see section 3.3.2.2). Thus, it can be concluded that these two sets of questionnaires used in the usability evaluation of ILC-WBLE possess internal consistency and reliability.

Then, the usability evaluation study was carried out among CFS lecturers and students from the main campus at Kampar. The findings of data analysis showed a high level of agreement in which the mean values ranged between 3.7 to 4.7 for lecturers and 3.6 to 4.3 for students. The results obtained from the usability evaluation study had been discussed in more detail in section 4.3.

5.2.4 The Identification of the Strengths and Weaknesses of the Prototype of ILC-WBLE

In addition to measuring the perception of lecturers and students toward the usability of ILC-WBLE, the strengths and weaknesses of the prototype of ILC-WBLE could also be identified via the usability evaluation study. The evaluation samples' feedback and their ratings of agreement with the five statements included in each usability construct (i.e. easy to use, easy to learn, level of interactivity, user interface design and error-free assessment) reflected their level of satisfaction with the design aspects and features provided in ILC-WBLE (which had been discussed in section 4.4). Further discussion on the limitations and recommendations of the research are presented in section 5.4.

5.3 Research Contributions

This section presents several research contributions pertaining to ILC-WBLE development and overall research work.

5.3.1 The Contributions to the Instructional Multimedia Development

The ILC-WBLE system developed in this research is unique compared to other systems currently used in universities (such as WBLE). To sum it up, the differences between WBLE and ILC-WBLE are tabulated in Table 5.1.

Table 5.1: Differences between WBLE and ILC-WBLE

WBLE	ILC-WBLE
WBLE is a course management system for lecturers to manage their course materials.	ILC-WBLE is a CBL which is embedded with dynamic multimedia content creation feature which allows lecturers to create interactive instructional materials (courseware) online for a subject in a systematical format of pages.
WBLE is created by Moodle.	ILC-WBLE is created by Flash platform.
Moodle (which also refers to WBLE) are often criticised to be useful or user-friendly only to IT experts, but are way too complicated for novice users such as teachers or educational instructors.	Based on the result of the usability evaluation (Chapter 4), ILC-WBLE is an easy-to-use, simple and yet informative courseware.
Many types of online quizzes can be created in WBLE, however, it is time-consuming and problematic as there are too many parameters which need to be set in order to create any online quizzes in the system.	There are three types of online quizzes, namely multiple choices, fill in the blanks, and drag and drop, which can be created in ILC-WBLE. Methods used to create online quizzes in ILC-WBLE are rather simple and straight-forward compared to WBLE.

Other than the differences above, several other significant contributions of ILC-WBLE which include usefulness of ILC-WBLE in education, lecturer adoption of ILC-WBLE, and real-time viewing of multimedia learning contents in ILC-WBLE are discussed in the following subsections.

5.3.1.1 Usefulness of ILC-WBLE in teaching and learning processes

As mentioned in chapter 1, Learning Management System (LMS) has been a systematic system that manages and monitors the entire teaching-learning process, including centralising learning resources and keeping track the learning progress and performance of students in education (Szabo and Flesher 2002; Rapuano and Zoino 2006; Watson and Watson 2007). As discussed in section 1.3, most of the lecturers in UTAR are merely using WBLE to manage the instructional materials (e.g. upload lecture notes, assignment briefs and so forth) rather than fully utilise the features embedded in WBLE (which has been described in section 1.2) due to the fact that the WBLE is rather challenging to be learnt and use.

WBLE, MMLS, and myLMS (which have been described in detail in section 2.2) are comprehensive LMSs which embedded with numerous features that were used to monitor students' learning progress in respective institution. However, it is impossible to use those LMSs to directly create instructional materials for a course. For instance, prior to uploading the instructional materials onto WBLE, lecturers have to create instructional materials using external software such as Microsoft PowerPoint, Adobe Flash, Adobe Director and so forth. Nonetheless, the functions built into the ILC-WBLE are different from those LMSs.

Contrarily, ILC-WBLE is an easy-to-use, simple, and yet informative system which allows lecturers to create their personalised online courseware

using the features built into the ILC-WBLE that have been further described in section 4.2.2, especially features presented in Figures 4.6, 4.8, and 4.9. No external software is needed as required in the existing LMSs as described in section 2.2. Therefore, ILC-WBLE that enables lecturers to create interactive multimedia based-instructional contents directly in the system is a significant contribution of the research. ILC-WBLE could be used as an alternative tool to directly create online interactive multimedia courseware in addition to the formal LMS used in UTAR namely WBLE.

5.3.1.2 Lecturer Adoption of ILC-WBLE

As the trend nowadays implements the use of computer in facilitating teaching and learning, lecturers have to use computer to foster teaching and learning process. However, there are plenty of lecturers who are not skilful in using computer, hence finding it tough in learning to use computer to share online learning material to students. Several studies have revealed that the lack of knowledge in using information technology is the main hurdle to lecturers in integrating CBL system into teaching and learning (Cuban 2003; Thomas and Stratton 2006). Consequently, lecturers may hesitate to use information technology and refuse to employ CBL system in facilitating teaching and learning process (Andersson 2006; Zhao 2007).

Different from the complex design of WBLE (UniversitiTunku Abdul Rahman), MMLS (Multimedia University), and myLMS (Open University Malaysia), ILC-WBLE is a simple and yet easy-to-use online system that

requires minimal background knowledge on computer or internet. The user interface design of ILC-WBLE is rather intuitive and easier to use because the system is developed based on User-Centered Design. As discussed in section 2.7.1, User-Centered Design considers users as the central point of the development, By implementing User-Centered Design in the development of ILC-WBLE, lecturers' needs and desires are being greatly taken care of while they create courseware using the system.

As far as easiness-to-use is concerned, lecturers do not need to spend unnecessary time in learning to use ILC-WBLE before they are able to create courseware for a particular subject or topic. According to Table 4.21 which shows the evaluation result under the constructs of "Easy to Use" and "Easy to Learn", the mean scores of both constructs from lecturers are within the range of 4.2 to 4.4 and 4.4 to 4.7 respectively. The outcome has reflected that the respondents' level of agreement was high and they agree that ILC-WBLE is deemed a simple and easy-to-use system which facilitates lecturers in the creation of online interactive courseware.

5.3.1.3 Real-time Viewing of Multimedia Learning Contents in ILC-WBLE

Apart from that, real-time viewing of multimedia files is a noteworthy contribution of ILC-WBLE in view of the fact that LMS requires students to download all the online learning materials into their computers before being accessed using other afore-mentioned external software. ILC-WBLE is thus undeniably a straightforward and useful system that facilitates and enhances

the teaching-learning process in any range of education.

ILC-WBLE is an online system which permits lecturers to create interactive courseware by inserting multimedia objects into the system. As discussed in section 2.8, multimedia objects could possibly enhance the understanding of learners towards the subjects and it retains the participation of learners.

Lecturers are able to create interactive online quizzes to evaluate the level of understanding of students towards the created courseware as well. As discussed in section 2.6.2, drill-and-practice enables students to practise repeatedly on what they have learnt until the knowledge is transformed into long-term memory.

By drawing conclusions from the above discussions, ILC-WBLE is a well-tailored system which is embedded with dynamic multimedia content and quizzes creation features to improve the overall level of understanding of students, while enriching the learning experience of students on the created courseware in ILC-WBLE.

5.3.2 The Contributions to the Multimedia Research

This section discusses the contribution of the research outcomes to future research work. It includes the development of ID model and the usability evaluation questionnaires employed in this research.

5.3.2.1 ID Model

The proposed ID model (see Figure 3.1) for the development of ILC-WBLE was developed using the core-ideas of the five-phase Instructional System Design (ISD) model called ADDIE model (which has been discussed in section 2.5.1). Each component involved in the five phases of the proposed ID model has been created based on the literature reviews in chapter 2.

ID model is defined as a guideline or strategy which leads the whole research and development of an education application (Gustafson and Branch 2002; Crawford 2004; Chiappe Laverde et al., 2007). Hence, each phase in the proposed ID model has contributed to the smooth and systematic development and evaluation of ILC-WBLE. Each phase in the proposed ID model listed below is followed by a description:

i. **Analysis:** The strengths and limitations of existing LMS in Malaysian HEIs as well as suitable methods and approaches that can be used to develop an efficient multimedia learning package were identified.

ii. **Design:** An appropriate ID model was designed and created based on all the outputs from the previous phase. The design of ILC-WBLE emphasised on theory-approach-based multimedia elements (e.g. cognitive flexibility theory, elaboration theory, and multimedia learning theory) and adopted a dynamic multimedia content creation feature.

iii. **Development and Implementation:** A prototype of ILC-WBLE was developed in this phase with the implementation of three major modules in ILC-WBLE. The three major modules are administration management (allows the management of users' profile in the system), resources management (enables lecturers to create as well as to manage the courseware in the system), and forum (serves as a medium of communication between lecturers and students).

iv. **Evaluation:** The usability evaluation among lecturers and students to evaluate the usability of developed ILC-WBLE was carried out in this phase.

ILC-WBLE was developed based on the proposed ID model and subsequently, the usability evaluation of ILC-WBLE was carried out. The fact that the mean score of all the statements in the evaluation was greater than the neutral point (3) (summarised in Table 4.21) reflected that the respondents' level of agreement to all the statements in the evaluation was high. As a result, the proposed ID model is proven to be reliable for the development of any online CBL courseware/ system.

5.3.2.2 Evaluation Questionnaire

The usability evaluation of ILC-WBLE had involved two categories of evaluation samples (i.e. lecturers and students). Two different sets of questionnaires (see Appendices A and B) consisting of identical measured

constructs with different items were used for lecturers and students. Both sets of questionnaires were divided into three parts. Part A was created to collect personal details of respondents whereas Part B was composed with five constructs to evaluate the usability of ILC-WBLE. These constructs are(i) easy to use, (ii) easy to learn, (iii) level of interactivity, (iv) user interface design, and (v) error-free assessment. Respondents were asked to rate their level of agreement on each statement using the 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Part C allowed respondents to provide additional comments on the developed ILC-WBLE.

Five statements were built into each measured construct in Part B (see Tables 3.1 and 3.2) by referring to Nielsen's 10 usability heuristics. Nielsen's usability heuristics was chosen to be implemented in creating evaluation questionnaires because it has been widely accepted in the field of human-computer interaction (HCI) and frequently quoted in usability evaluation studies (Babaian et al., 2010). Descriptions of each usability heuristic by Nielsen had been discussed in section 3.3.2.

In order to test the authentication of the reliability of the created usability evaluation questionnaires, a pilot study had been carried out. Cronbach's alpha values were used in pilot study to check against the items constructed in both questionnaires to determine the reliability of the questionnaires for the usability evaluation of ILC-WBLE. As discussed in section 3.3.2.2, as long as Cronbach's alpha value is more than 0.70, items asked in evaluation questionnaires are considered satisfactory and acceptable.

Based on the findings of data analysis obtained in the pilot study, the Cronbach's alpha values of the usability evaluation questionnaires for lecturers and students are 0.898 and 0.948 respectively (see Appendix C). Hence, the usability evaluation questionnaires for both lecturers and students are considered reliable and suitable to be used for the usability evaluation of ILC-WBLE.

As a result, the created usability evaluation questionnaires in this research can be used as reference in creating usability evaluation questionnaires for any related development of CBL system. These created questionnaires could be further modified for the usability evaluation of an online CBL courseware/ system in any future work as well.

5.3.2.3 The Research Publications

This research had published a variety of publications which include national and international conference proceedings as well as lecture note (LNCS Book Chapter) (see Appendix E). The publications were derived from respective key stage of this research which is deemed useful as the sources of reference to the multimedia research in future.

5.4 Limitations and Recommendations

The limitations of this research are mostly due to the weaknesses found in ILC-WBLE. Taking into account these limitations, the discussion in this section will also suggest future research topics which could be considered by new researchers. The limitations and recommendations of this research are discussed in subsequent subsections of this section which can be divided into two categories:

i. The development scope of ILC-WBLE

ii. The usability evaluation

5.4.1 The Development Scope of ILC-WBLE

The development scope of ILC-WBLE was mainly created as a dynamic multimedia content creation system. It did not include the profiling system and registration of users. The profiling system is used to keep track of user profiles. Currently, lecturers can only create, edit, and delete subjects created in the system but are not able to create/ modify their own personal details. Besides, lecturers are not allowed to self-register as users. Only the system administrators can create or delete user accounts. Lecturers can login into the system using the username and password provided by the system administrators. Meanwhile, any updating of the passwords can only be done by system administrators as well. In short, it is the administrators of ILC-WBLE who are responsible for creating new user accounts, deleting existing user accounts and managing user profiles. For higher task efficiency, it is suggested

that features such as profiling system and registration of users should be included in the system to enhance user's flexibility in carrying out essential functions by themselves, and to reduce the dependency of the users upon the administrators.

ILC-WBLE is embedded with a feature whereby quizzes can be created for a particular subject as interactive exercises for students to test their understanding on the learning materials uploaded in the system. Immediate feedback which indicates the correct answer for each question will be displayed after every attempt of the quizzes. However, scores of the quizzes have not been programmed to be generated in the system. Generation of scores for quizzes is useful to evaluate and monitor the performance of a student. Implementation of the feature in the future research would assist lecturers in observing students' performance and level of understanding towards a particular topic or subject.

Even though it is possible for lecturers to insert multimedia files into the system, however, ILC-WBLE only supports video files in .flv file format (flash video). It is therefore recommended that ILC-WBLE could be enhanced in the future to support any other common video file formats such as .mp4, .wmv, and .mov. This future implementation could be useful because many educational video or animation come in a variety of file formats, and not just limited to flash video.

Currently, text used in the content creation is limited to single font i.e. Times New Roman, 12pt, black colour. This means that the typeface, size, style, and colour of text cannot be altered in ILC-WBLE. Text editor is suggested to be added as one of the future enhancements of the system because it provides the pathway to change the appearance of the wordings in the system in order to place emphasis on the key words or main points of the learning information.

Based on the results of the usability evaluation as discussed in chapter 4, respondents commented on their experiences on the low accessing speed to the system. ILC-WBLE is a system dealing with multimedia learning materials, thus the system has to be hosted in a fast and more reliable web server in order to perform in a satisfactory state. Due to the limitation of budget, ILC-WBLE is currently hosted in one of the shared web servers and this leads to the slow accessing speed. The loading and downloading speeds of the system are deemed to be faster if the system is hosted in a dedicated Web server such as UTAR's server.

5.4.2 The Usability Evaluation

The usability evaluation of ILC-WBLE had been conducted to identify whether or not ILC-WBLE is feasible in assisting lecturers and students from UTAR in the teaching-learning process. As discussed in section 3.3.1, the evaluation samples of the usability evaluation of ILC-WBLE were limited to one environment that is the lecturers and students from the main campus at Kampar. Thus, in the future research, it is preferable to involve larger sample

sizes from all campuses of the university to be participants in the usability evaluation of the system in order to achieve a higher accuracy for the findings.

Furthermore, the usability evaluation study in this research only attempted to determine users' perceptions toward the usability of ILC-WBLE without measuring the true usefulness effects. With regard to this, investigations into how to actually measure activity usefulness and what attributes should be measured ought to be conducted. This would probably require a long-term evaluation and comparative studies to be carried out by educationists and psychologists.

5.5 Conclusions

Today, Malaysian HEIs have progressively integrated CBL courseware into the curriculums as a supplement to traditional instruction. With the advancement of ICT (information and communication technology), learning and teaching are no longer limited to the traditional F2F classroom instruction mode. Many studies had shown that normal instruction supplemented by CBL could be more effective than normal instruction alone.

Globally, e-learning which describes the learning mode by the use of technology represents some form of an extension of the traditional classroom instruction or as an alternative to the traditional mode. E-learning covers all learning that takes place using electronic means such as the computer and

World Wide Web (Internet), or storage devices such as CD-ROMs or DVDs. E-learning gradually takes place in educational settings. The novelty of e-learning facilitates and enhances both formal and informal learning and knowledge-sharing at any time, at any place, and at any pace.

As a matter of fact, in UTAR, not all users (both lecturers and students) have fully utilised or explored all the features embedded in the existing e-learning system, i.e. WBLE. With the emergence of ILC-WBLE, it is anticipated that lecturers will gain benefit utilising the system for course management while students may improve their learning experiences exploring the system.

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Appendix A

ILC-WBLE Usability Evaluation Questionnaire (Lecturer)

PART A: PERSONAL DETAILS

Instruction: Please tick [✓] the relevant field for each of the following question.

1. Gender:

   □ Male
   □ Female

2. Experience in teaching:
   □Less than 1 year
   □2 years
   □3 years
   □4 years
   □5 years
   □More than 5 years

3. Experience inusing WBLE:
   □Less than 1 year
   □2 years
   □3 years
   □4 years
   □5 years
   □More than 5 years

PART B: USABILITY EVALUATION

Instruction: Please tick [✓] the relevant column whether you Strongly Disagree, Disagree, Neither Agree nor Disagree (Neutral), Agree or Strongly Agree with each of the following statements.

Note:

Score Value	1	2	3	4	5
Indicator	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Section 1: Easy to Use					
Item Questions	**1**	**2**	**3**	**4**	**5**
1. Aware of the options that can be carried out in the system (such as insert a new content page, create quizzes, insert hyperlinks and upload attachments).					
2. Aware of where to proceed to the next step that you wish (such as proceed to next page by clicking on "Next" button).					
3. Easy to identify the creation/modification date for the subjects in the list.					
4. Being informed for the latest progress of your upload process.					
5. All instructions are clearly listed in the system.					

Section 2: Easy to Learn					
Item Questions	**1**	**2**	**3**	**4**	**5**
1. Easy to understand the language (words and phrases) used in the system.					
2. Able to create/ modify the content of the content page and quizzes.					
3. Location of navigation buttons are placed consistently in the system.					
4. Clear guidance is provided to guide users in the 'Help' menu.					
5. The customised 'Help' icon could be found easily within any pages.					

Section 3: Level of Interactivity					
Item Questions	**1**	**2**	**3**	**4**	**5**
1. The page type could be easily sorted by contents and quizzes.					
2. The quizzes could be set in various methods, such as drag and drop, fill in the blank, and multiple choices.					
3. The system supports multimedia creation in the content page (consist of text, image, sound, video, and animation).					
4. Playing of video or audio is controllable in the system.					
5. Supporting materials could be inserted as hyperlinks and attachments (such as .pdf, .zip, .doc/ .docx, .ppt/ .pptx, .jpg, etc.).					

Section 4: User Interface Design					
Item Questions	**1**	**2**	**3**	**4**	**5**
1. Able to display the content of each page in various layout designs.					
2. The colour scheme applied in the system is appropriate.					
3. Graphic used in each of the navigation buttons clearly indicated the function of the button.					
4. Instructions are given repeatedly in every section to reduce the use of users' memory.					
5. Each page has a clear and short title to indicate users' current location.					

Section 5: Error-free Assessment					
Item Questions	**1**	**2**	**3**	**4**	**5**
1. Users are required to confirm their actions before they delete unwanted contents.					
2. Hyperlinks can be created without any errors.					
3. Page type can be sorted accordingly from Content page to Quiz or back to the original sequence.					
4. Error message pops out could precisely indicate the problem.					
5. All error messages will be provided with the respective solutions.					

PART C: COMMENTS/ SUGGESTIONS

Please give your feedback, comments and/or suggestions on any other aspects of the system that you feel are matters of concern.

Thank you for completing this questionnaire

Appendix B

ILC-WBLE usability evaluation questionnaire (Student)

PART A: PERSONAL DETAILS

Instruction: Please tick [✓] the relevant field for each of the following question.

1. Gender:

   □ Male
   □ Female

2. Current Trimester:

   □1st
   □2nd
   □3rd
   □4th
   □Others, please specify: _____

3. Experience in using computer:
   □Less than 1 year
   □2 years
   □3 years
   □4 years
   □5 years
   □More than 5 years

PART B: USABILITY EVALUATION

Instruction: Please tick [✓] the relevant column whether you Strongly Disagree, Disagree, Neither Agree nor Disagree (Neutral), Agree or Strongly Agree with each of the following statements.

Note:

Score Value	1	2	3	4	5
Indicator	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Section 1: Easy to Use					
Item Questions	**1**	**2**	**3**	**4**	**5**
1. Aware of the options that can be carried out in the system (such as insert a new content page, create quizzes, insert hyperlinks and upload attachments).					
2. Aware of where to proceed to the next step that you wish (such as proceed to next page by clicking on "Next" button).					
3. Easy to identify the creation/modification date for the subjects in the list.					
4. Being informed for the latest progress of your upload process.					
5. All instructions are clearly listed in the system.					

Section 2: Easy to Learn					
Item Questions	**1**	**2**	**3**	**4**	**5**
1. Easy to understand the language (words and phrases) used in the system.					
2. Aware of how to proceed to the next step that you wish (such as click on "Submit" button to review answers of the quiz).					
3. Location of navigation buttons are placed properly in the system.					
4. Clear guidance is provided to guide users in the 'Help' menu.					
5. The customised 'Help' icon could be found easily within any pages.					

Section 3: Level of Interactivity					
Item Questions	**1**	**2**	**3**	**4**	**5**
1. The page type could be easily sorted by contents and quizzes.					
2. The quizzes are set in various methods (such as drag and drop, fill in the blank, and multiple choices).					
3. The system supports multimedia contents (consist of text, images, graphics, sound, video, and animation).					
4. Playing of video or audio is controllable in the system.					
5. Supporting materials could be found in the forms of hyperlinks and attachments (such as .pdf, .zip, 6. .doc/ .docx, .ppt/ .pptx, .jpg, etc.).					

Section 4: User Interface Design					
Item Questions	**1**	**2**	**3**	**4**	**5**
1. The contents of each page come in various layout design.					
2. The colour scheme applied in the system is appropriate.					
3. Graphic used in each of the navigation buttons clearly indicated the function of the button.					
4. Instructions are given repeatedly in every section to reduce the use of users' memory.					
5. Each page has a clear and short title to indicate users' current location.					

Section 5: Error-free Assessment					
Item Questions	**1**	**2**	**3**	**4**	**5**
1. All attachments can be downloaded without any errors.					
2. All hyperlinks can be accessed without any errors.					
3. All page types can be sorted accordingly from Content page to Quiz or back to the original sequence.					
4. All video and audio can be played without any errors.					
5. All quizzes can be answered without any errors.					

PART C: COMMENTS/ SUGGESTIONS

Please give your feedback, comments and/or suggestions on any other aspects of the system that you feel are matters of concern.

Thank you for completing this questionnaire

Appendix C

Results of Cronbach's Analysis

Reliability of the Usability Evaluation Questionnaire(Lecturers)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.898	0.904	25

Item Statistics

	Mean	Std. Deviation	N
Section 1.1	3.83	0.408	6
Section 1.2	4.50	0.837	6
Section 1.3	4.50	0.548	6
Section 1.4	4.33	0.516	6
Section 1.5	3.50	1.049	6
Section 2.1	4.67	0.516	6
Section 2.2	4.50	0.548	6
Section 2.3	4.50	0.548	6
Section 2.4	4.17	0.983	6
Section 2.5	4.00	0.894	6
Section 3.1	4.33	0.516	6
Section 3.2	4.33	0.816	6
Section 3.3	3.83	0.753	6
Section 3.4	3.83	0.753	6
Section 3.5	4.17	0.753	6
Section 4.1	4.17	0.753	6
Section 4.2	4.00	0.632	6
Section 4.3	4.00	0.632	6
Section 4.4	3.67	0.516	6
Section 4.5	4.00	0.632	6
Section 5.1	4.83	0.408	6
Section 5.2	4.17	0.753	6
Section 5.3	4.50	0.548	6
Section 5.4	3.83	0.753	6
Section 5.5	3.67	0.816	6

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	4.153	3.500	4.833	1.333	1.381	0.118	25

Reliability of the Usability Evaluation Questionnaire(Students)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.948	0.951	25

Item Statistics

	Mean	Std. Deviation	N
Section 1.1	3.64	0.700	25
Section 1.2	4.20	0.707	25
Section 1.3	3.92	0.759	25
Section 1.4	3.72	0.843	25
Section 1.5	4.04	0.611	25
Section 2.1	4.08	0.572	25
Section 2.2	3.76	0.926	25
Section 2.3	3.76	0.779	25
Section 2.4	3.48	0.770	25
Section 2.5	3.40	1.000	25
Section 3.1	3.68	0.748	25
Section 3.2	3.72	0.891	25
Section 3.3	3.96	1.020	25
Section 3.4	3.80	1.041	25
Section 3.5	3.56	0.961	25
Section 4.1	3.72	0.936	25
Section 4.2	4.08	0.954	25
Section 4.3	3.92	0.759	25
Section 4.4	3.60	0.957	25
Section 4.5	4.08	0.862	25
Section 5.1	3.36	0.757	25
Section 5.2	3.60	0.707	25
Section 5.3	4.00	0.707	25
Section 5.4	3.40	1.000	25
Section 5.5	3.92	0.862	25

Summary Item Statistics

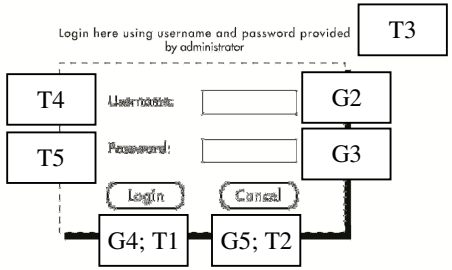
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.776	3.360	4.200	0.840	1.250	0.057	25

Appendix D

Samples of Storyboards

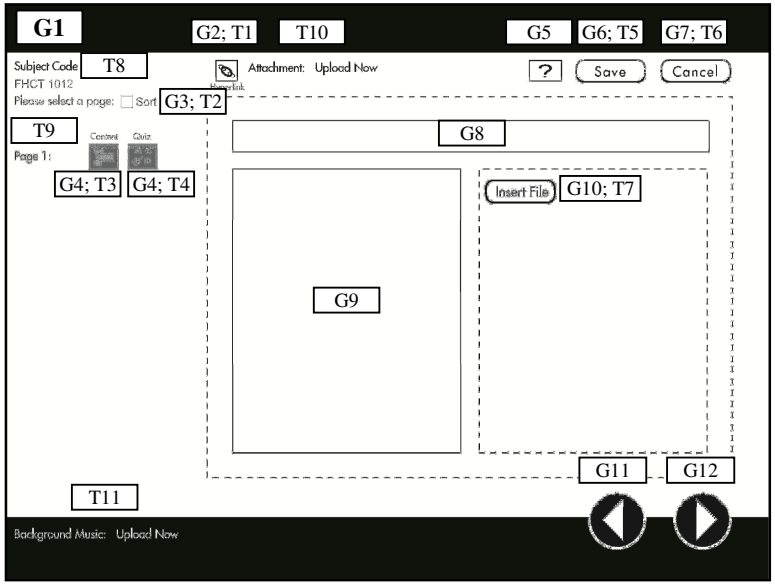
No. of Storyboard : SB(1) F (1) I(1)
Title of Project : The Development and Usability Evaluationof an Independent Learner Courseware for Web-Based Learning Environment (ILC-WBLE)
Topic : Login Page

G1



Graphical Instruction: Text (T)/Graphic (G)/ Animation (A)/Audio (S)/Video (V)	**Authoring Instruction:** Text (T)/Graphic (G)/ Animation (A)/Audio (S)/ Video (V)
G1 –A white coloured background with two blue colour bars at the top and bottom of the page. **G2** – A square shape used to insert username. **G3 –** A square shape used to insert password. **G4; T1 –** A caption button with the text "Login". **G5; T2 –** A caption button with the text "Cancel". **T3 – T**ext "Login here using username and password provided by administrator". **T4 –** Text "Username:". **T5 –** Text "Password:". **T1- T5** – Font type: Arial, size: 12, colour: Black **T3** – Font type: Future-Normal, size: 12, colour: Black	1. Key in username in G2. 2. Key in password in G3. 3. Click G4; T1 to go to the main page. 4. Click G5; T2 to reset username and password in G2 and G3 respectively.

No. of Storyboard : SB(1) F (1) I (1)
Title of Project : The Development and Usability Evaluationof an Independent Learner Courseware for Web-Based Learning Environment (ILC-WBLE)
Topic : Content Page



Graphical Instruction: Text (T)/Graphic (G)/ Animation (A)/Audio (S)/Video (V)	**Authoring Instruction:** Text (T)/ Graphic (G)/ Animation (A)/ Audio (S)/ Video (V)
G1 –A white colouredbackgroundwith two blue colourbars at the top and bottom of the page. **G2; T1** – A caption button with the text "Hyperlink". **G3; T2 –** A square check box with the text "Sort". **G4; T3–**A caption button with the text "Content". **G4; T4 –** A caption button with the text "Quiz". **G5 –** An icon with a "question mark" symbol. **G6; T5 –** A caption button with the text "Save". **G7; T6 –** A caption button with the text "Cancel". **G8** – A square shape used to insert title. **G9** – A square shape used to insert text. **G10; T7** – A green coloured caption button with the text "Insert File". **G11** – A button with a backward arrow sign. **G12** – A button with a forward arrow sign. **T8** – A place to show subject code of the subject. **T9** – Text to show the current page, e.g. Page 1:. **T10** – Text "Attachement: Upload Now". **T11**– Text "Background Music: Upload Now". **T1, T3-4** – Font type: Future-Normal, size: 8, colour: Black **T2, T5-6** – Font type: Arial, size: 12, colour: Black **T7** – Font type: Futura-Normal, size: 14, colour: White **T8-11** – Font type: Futural-Normal, size: 12, colour: Black **S1** – Background music: .mp3 audio format	1. Click G2; T1 to create hyperlink. 2. Check on G3; T2 to sort pages. 3. Click G4; T3 to create a content page. 4. Click G4; T4 to create a quiz page. 5. Click G5 to view help instructions. 6. Click G6; T5 to save the current page. 7. Click G7; T6 to delete current page. 8. Insert title of the page in G8. 9. Insert text content in G9. 10. Click G10; T7 to insert image/ audio/ video/ animation. 11. Click G11 to go back to the previous page. 12. Click G12 to go to the next page. 13. T8 shows the subject code of the courseware. 14. T9 shows the current page number. 15. Click T10 to insert attachment. 16. Click T11 to insert S1

Appendix E

List of Publications

1. Hoh Ming Chee, Choo Wou Onn, Siew Pei Hwa, Research Finding For Usability Testing On ILC-WBLE, The 2nd International Visual Informatics Conference 2011 (IVIC'11), 2011. (LNCS Book Chapter)

2. Hoh Ming Chee, Choo Wou Onn, Siew Pei Hwa, Dynamic Multimedia Content Creation For Independent Learner: A Web Based Learning Environment, Knowledge Management International Conference 2010 (KMICE'10), 2010. (ISI Thomson Indexed)

3. Hoh Ming Chee, Choo Wou Onn, Siew Pei Hwa, Implementation Of LMS Among Private Higher Learning Institutions In Malaysia, Knowledge Management International Conference 2010 (KMICE'10), 2010. (ISI Thomson Indexed)

4. Hoh Ming Chee, Choo Wou Onn, Yeoh Ging Sun, Preliminary Study For The Usage Of Multimedia In Education, Symposium For Progress In Information & Communication Technology 2009 (SPICT'09), 2009.