

USABILITY TESTING FOR LEARNABILITY AND EFFICIENCY ON  
UUM DIGITAL LIBRARY SYSTEM

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USABILITY TESTING FOR LEARNABILITY AND EFFICIENCY ON  
UUM DIGITAL LIBRARY SYSTEM

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## **ABSTRAK**

Kepentingan penggunaan laman web sebagai proses dalam persekitaran pembelajaran di dalam bilik darjah meningkat secara mendadak. Laman web menyediakan sistem perkhidmatan dan sumber untuk mendapatkan maklumat secara pantas dan cekap kepada pengguna. Perpustakaan digital adalah laman web yang memberi perkhidmatan kepada pengguna di seluruh dunia dan diterima secara meluas. Walaupun penggunaan sistem perpustakaan digital semakin meningkat, masih terdapat sejumlah pengguna-pengguna yang membuat rungutan mengenai kebolehgunaan perpustakaan digital. Ujian kebolehgunaan bagi sistem perpustakaan digital adalah salah satu daripada ciri-ciri utama untuk mencapai kejayaan. Projek ini memberi tumpuan untuk mengkaji kebolehgunaan bagi sistem perpustakaan digital di Universiti Utara Malaysia (UUM). Keupayaan untuk belajar dan kecekapan adalah ciri-ciri kebolehgunaan yang telah dipilih bagi projek ini. Ujian kebolehgunaan bagi koleksi data kualitatif dan kuantitatif telah digunakan dalam projek ini. Tugas-tugas untuk mengukur prestasi dan borang-borang soal selidik telah diagihkan kepada responden-responden untuk mendapatkan koleksi data kuantitatif dan kualitatif. Hasil kajian daripada koleksi data kuantitatif dan kualitatif memberi rumusan bahawa sistem ini senang untuk dipelajari dan digunakan.

## **ABSTRACT**

The interest in using the Website in the classroom as part of the learning environment increase dramatically. Website provides an efficient and fast access for users to get information and service. Digital library is a website that serving worldwide users and become widely accepted. Although the digital library system increasingly used, there are a number of users complaining about usability of digital library. The usability test of digital library system is one of the key features for its success. This project focuses to look into usability of digital library system in University Utara Malaysia (UUM). Learnability and efficiency are usability attributes that has been chosen for this project. Usability testing on qualitative and quantitative data collection had been applied for this project. Tasks on performance measure and questionnaires had been distributed to respondents for quantitative and qualitative data collection. The results from quantitative and qualitative data collection showed that the system is easy to use and to learn.

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## **LIST OF ABBREVIATIONS**

CAS	College Arts and Sciences
FAQ	Frequently Asked Questions
HCI	Human Computer Interaction
HTML	Hyper Text Markup Language
ILS	Integrated Library System
ISO	International Standards Organization
LMS	Library Management System
PDF	Portable Document Format
PUEU	Questionnaire for Perceive Usefulness of Ease-of-Use
QUIS	Questionnaire for User Interaction Satisfaction
UUM	University Utara Malaysia

## **CHAPTER 1**

### **INTRODUCTION**

Chapter one provides an overview of digital library and the usability issues. It also includes brief explanation of background, problem statement, research questions, objectives, scopes and limitations, and significance of the study.

#### **1.1 Background**

The digital library systems are as common as books and serving a worldwide user. Most libraries depend on their website to give services for users when the library's doors closed as well as they are open. The digital library system not only provides hours of operation but it also allows user to search for online catalogs, online thesis, and others. It is user friendly because they can use digital library system service just in the fingertip at anytime and anywhere. It would help to increase the percentage of users.

There are many important benefits for users if they use this digital library system. It creates better and faster resources and information services, unlimited users can use the same resource, free to users, and others. The digital library system will create advantages such as faster resources and information services, unlimited users can use the same resource, free to users, and others. According to Buchanan (2009), usability and the usefulness of a digital library depends on effectiveness and efficiency of the user's experience. It is important that a user is able to accomplish their task goals when acquiring resources in relation to successful completing the task within a reasonable time (Buchanan, 2009).

Web usability testing is typically carried out with the goal of establishing where users become frustrated and where the major trouble spots lie (Gore and Hirsh, 2003). It should be remembered that usability is multi-faceted and evaluation sets out to determine users' experience of the effectiveness of many aspects of a web site including navigation, labelling, layout, look and feel, language, and accessibility (Gore and Hirsh, 2003).

The important aspect of usability for digital library system is that the user has the ability to navigate easily and learn new tool functions with efficiency. Buchanan (2009) also discusses the importance of the user's awareness of their location on the website. He states that disorientation can lead to cognitive overload. He also mentions that the learnability or instructional design of the website's functions can be considered a fundamental aspect of usability because the user's ability to learn the system is their first experience (Buchanan, 2009).

However, digital library system also has great challenges in many different directions such as technical, organizational, legal, etc. In particular, as digital libraries become more widely available it is becoming clear that they also pose usability difficulties (Bates, Wilde, and Siegfried, 1995). The usability testing of digital library system enable librarians and developers alike to use their library's web design with satisfaction. Thus, digital library system needs evaluation by usability testing. This project will focus on the usability testing for learnability and efficiency of UUM Digital Library System (<http://cmslib.uum.edu.my/new/>). The digital library system provides a complete set of information services and tools to enhance teaching and learning process for students and lecturers.

## **1.2 Problem Statement**

The digital library system has been widely used and accepted in UUM by users. The lecturers and students use it for searching books, enhancing their teaching and learning process. The responsibility to develop digital library system that is informative and user-friendly is not an easy task. In their book, (Norlin and Winters,



2002) described about research by Roufffs (1991), Landsdale and Omerod (1994), and Galitz (1997) affirm the fact that the computer interface affects usability. It would seem likely that there is also an interrelationship between website design and usability, so that the overall success of a digital library depends on the aspect of easy to use. The digital library system has grown over the last decade, but the service is still experiencing the lack of usability and flexibility. Thus, a usability testing should carry out on the system to further clarify the usability flaws.

### **1.3 Research Questions**

The research questions are as follows:

1. Is the UUM Digital Library System easy to use and to learn?
2. Can we achieve the objective to analyze and evaluate the overall feedback from respondents for learnability and efficiency of UUM Digital Library System?
3. Can we achieve the objective to discover the usability flaws by using usability test on UUM Digital Library System?
4. Can we achieve the objective to recommend improvement for UUM Digital Library System?

### **1.4 Objectives**

In this project, the aim of this project is to test the usability of UUM Digital Library System in terms of learnability and efficiency. The specific objectives of this project are:

1. To analyze and evaluate the overall feedback from respondents for learnability and efficiency on UUM Digital Library System.
2. To discover the usability flaws on UUM Digital Library System.
3. To recommend improvement for UUM Digital Library System.

## 1.5 Scopes and Limitations

### 1.5.1 Scopes

The scopes of this study are as follows:

#### 1. Systems

This study focuses on three features in Online Resources, which are Catalogue, eResource, and UUM eThesis (see Figure 1.1). The reason for choosing these three features is because it is the most widely used by students based on the survey.



Figure 1.1: The Screen of UUM Digital Library System.

## 2. Respondents

There are twenty students for quantitative data collection and five students for qualitative data collection on this study. The respondents are postgraduate students in class population from College Arts and Sciences (CAS).

## 3. Usability Boundaries

According to Nielsen (1993), there are five usability attributes. The five usability attributes are learnability, efficiency, memorability, errors, and satisfaction. This study only focuses on two usability factors, which are learnability and efficiency for usability test on UUM Digital Library System.

### ***1.5.2 Limitations***

The limitations of this study are as follows:

1. The respondent just only focuses on postgraduate students in class population from College Arts and Sciences. It was carried out in a small range of population and not involved many users.
2. The limitation for time consuming where it is difficult to find the free time of respondents to answer all the questions.
3. Concentrated on two usability attributes only, which are learnability and efficiency. Thus, not much usability problems can be identified.

### **1.6 Significance of Study**

The significances of this study are as follows:

1. The feedback from respondents of this survey will give some insight to UUM and help them to make a proper adjustment in terms of learnability and efficiency for Digital Library System.
2. The results on this study will give recommendation for improvement and available as references for future study on UUM Digital Library System.

## **1.7 Summary**

This project report is divided and organized into five chapters. Chapter one presents the overview of the study. It consists of identifying the background of the research and problems arises which lead to defining the research objectives, research questions, scope and limitations, and also significance of the study. The next follows by chapter two whereby it focuses on the review of the relevant literature for digital library and usability. Chapter two also discusses on learnability and efficiency concepts. Chapter three that describes the phases of the research methodology used through this study and the next chapter is chapter four that explain in details about the result of finding and analysis of the data. Finally, chapter five provides a summary of the study, highlights the problems encountered during the study, and states recommendations for improvement.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

The objective of second chapter is to present the brief review of the relevant literature. Second chapter is about the concept of digital library and evaluation for digital library system.

#### **2.2 Digital Library**

There are no such terms as digital library in a few years ago. Nowadays, there are many companies involved in the digital library business and the terms of digital library become the buzzword of choice in the world. The terms of digital library has been applied to a wide variety of offerings from collections of electronics to software agents that support inquiry based education to collections of email to electronic versions of a public library, to personal information collections, and even to the entire internet. Digital libraries hold great promise as structured repositories of quality-checked information that can be manipulated and accessed in powerful ways (Bates, Wilde, and Siegfried, 2005).

There are many definitions for digital library. Students in a digital library course found 64 different definitions (Schwartz, 2000). In 1996, final report to the National Science Foundation, widely cited by many authors, and quoted in Borgman (2000):

“Digital libraries are a set of electronic resources and associated technical capabilities for creating, searching, and using information. In this sense they are an extension and enhancement of information storage and retrieval systems that manipulate digital data in any medium (text, images, sounds...) and exist in

distributed networks. The content of digital libraries includes data, metadata that describe various aspects of the data and metadata that consist of links or relationships to other data or metadata, whether internal or external to the digital library”. (p. 29)

“Digital library are constructed – collected and organized – by [and for] a community of users and their functional capabilities support the information needs and uses of the community. In this sense they are extension, enhancement, and integration of a variety of information institutions as physical places where resources are selected, collected, organized, preserved, and accessed in support of user community. These information institutions include, among others, libraries, museums, archives, and schools, but digital libraries also extend and serve other community settings, including classrooms, offices, laboratories, homes, and public spaces”.(p. 29)

In his book, Lesk (1997) defined digital libraries in a very comprehensive way as “Digital libraries are organized collections of digital information. They combine the structuring and gathering of information, which libraries and archives have always done, with the digital representation that computers have made possible”. Arms (2000) views digital libraries as “managed collection of information, with associated services, where the information is stored in digital formats and accessible over a network”.

The characteristics of digital library can be seen as initial innovation of the works that are stored in digital form. Later materials are always copied from the master version of the work in electronic library (Garrett and Lyons, 1993). Digital library is an information service in which all the information resources are available in computer-processable form and the functions of acquisition, storage, retrieval, access and display are carried out through the use of digital technologies (Oppenheim and Smithson, 1999). In summary, digital library is an organized and managed collection of digital information, accessible over a network, and may include service.

### 2.2.1 Advantages of Digital Library

The fundamental reason for building digital libraries is belief that it will provide better delivery of information than was not possible in the past (Arms, 2000). There are many advantages for users while using digital library. In her book, Kresh (2007) explained that there are nine advantages of digital library (see Table 2.1):

**Table 2.1: Advantages of Digital Library**

1. No physical boundary	The users of a digital library need not to go to the library physically.
2. Round-the-clock availability	People from all over the world can gain access to the information at anytime, as long as an internet connection is available. This is the major advantage of digital library.
3. Multiple accesses	The same resources can be used at the same time by a number of users.
4. Structured approach	A digital library provides access to much richer content in a more structured manner so that users can easily move from the catalog to the particular book, chapter and so on.
5. Information retrieval	There is flexibility in the use of search terms, that is, keywords. A digital library can provide very user-friendly interfaces, giving clickable access to its resources.
6. Preservation and conservation	An exact copy of the original can be made any number of times without any degradation in quality.
7. Space	Digitization is the only solution when the library has no space for extension.
8. Networking	A particular digital library can provide the link to any other resources of other digital libraries very easily; thus a seamlessly integrated resource sharing can be achieved.
9. Cost	In theory, the cost of maintaining the digital library is lower than that of a traditional library. A traditional library must spend large sums of money paying for staff, book maintenance, rent, and additional books.

### **2.2.2 Evaluation of Digital Library System**

Evaluation is a central digital library practice and it is important for managing and informing strategic decision-making. Digital library is an innovative information system and widely recognized and accepted. Nowadays, many users from different backgrounds and cultures use digital library. Digital library is also under constant development and changes. Therefore, the systems should be evaluated from time to time to ensure not only their correct evolution but also their acceptance by users.

System features and usability are new areas of evaluation in academic digital libraries. Saracevic (2004) discussed system-centered, human-centered, and usability-centered approaches. System-centered evaluation, which is the most prevalent, involves technological features such as system performance, storage capability, and user interfaces, while a user-centered approach is associated with user needs, contexts, and satisfaction (Saracevic, 2004). A usability-centered approach bridges these two approaches in that usability assessment captures users' perceptions of system features (Saracevic, 2004).

### **2.3 Integrated Library System (ILS)**

Digital library is dramatically growing. Integrated library system (ILS) as the backbone to monitor and manage the digital library. Integrated library system is also known as library management system (LMS) that design to provide the systematic system for users and librarians.

Integrated library systems have been part of college and university computing systems since the early 1980`s and would seem to be old technology and part of text-based mainframe systems (Deddens, 2002). ILS systems have also become vital in the provision of information that is licensed by libraries but does not exist in their physical collections (Deddens, 2002).

According to Muller (2011), integrated library systems are multifunction, adaptable software applications that allow libraries to manage, catalog and circulate their materials to patrons. In choosing ILS software, libraries must base their decision not only on the performance and efficiency of the system, but also on its



fundamental flexibility to readily adapt to the future demands and needs of their patrons (Muller, 2011).

## **2.4 Usability**

Usability is a user-centered evaluation and has a theoretical base in Human Computer Interaction (HCI). According to Dumas and Redish (1993), usability is defined as the people who use the product can do so quickly and easily to accomplish their own tasks. Nielsen (1993) defines usability as learnability, efficiency, memorability, low error rate, and satisfaction. He treats learnability as the most fundamental criteria. The system should be easy to learn so that the user can rapidly start getting some work done with it. Usability has several aspects, including interface design, functional design, data and metadata, and computer systems and networks (Arms 2000).

Usability principles would have us organize the user interface in a way that is natural to the user, makes simple tasks easy to do, makes important tools visible, reduces the cost of making mistakes by implementing the undo command, and maintains “consistency with purpose” to reduce user memory load (Constantine and Lookwood, 1999).

Usability is a quality that many products possess, but many, many more lack (Rubin and Chisnell, 2008). The most widely cited definitions are the ones of the International Standards Organization (ISO) and Nielsen. The ISO (1994) defines usability as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use” p. 10.

Usability originates from the word usable which mean capable of being used or convenient and particular for use (Webster dictionary, 1999). Shackel (1991) reports that the definition of usability was probably first attempted by Muller (1971) in terms of measures for “ease of use”. The first fully discussed with an attempt at a detailed formal definition by Shackel (1981, 1984) are “the capability in human functional terms to be used easily and effectively by the specified range of users, given specified training and user support, to fulfill the specified range of tasks, within the specified range of environmental scenarios” (p. 53-54)

According to Nielson (1993), usability frequently allied with these five attributes:

1. **Learnability:** the system should be easy to learn so that the user can rapidly start getting some work done with the system.
2. **Efficiency:** the system should be efficient, so that once the user has learned the system; a high level of productivity is possible.
3. **Memorability:** the system should be easy to remember, so that the casual user is able to return to the system after some period of not having used it, without having to learn everything all over again.
4. **Errors:** the system should have a low error rate, so that the users make few errors during the use of the system, and so that if they do make errors they can easily recover from them. Further, catastrophic error must not occur.
5. **Satisfaction:** the system should be pleasant to use, so that the users are subjectively satisfied when using it and they will like it. (p. 26)

Battleson et al. (2001) suggested that to improve usability an interface must be easy to learn, remember, and use, with few errors for its target users and the specific tasks it is designed to support. The study only focuses on two usability attributes which are learnability and efficiency. The study only focuses on learnability and efficiency because of the time limitation and this two attributes are important to improve usability for an interface as suggested by Battleson et al. (2001). In this second chapter, only learnability and efficiency attributes are discussed in details.

### **2.4.1 Learnability**

Learnability is a part of effectiveness and has to do with the user's ability to operate the system to some defined level of competence after some predetermined amount and period of training (Rubin and Chisnell, 2008). It can also refer to the ability of infrequent users to relearn the system after periods of inactivity (Rubin and Chisnell, 2008). Learnability relates to how easy it is to learn an application and to move from being a novice to being a skilled user (Norlin and Winters, 2002).

Learnability is one of the important usability attribute since most system needs to be easy to learn, and since the first experience most people have with a new system is that of learning to use it (Nielsen, 1993). According to Senapathi (2005), learnability consists of four specific measurable attributes which were ease of learning (familiarity, consistency, and predictability), information feedback, error handling and online help. All these attributes can help to evaluate digital library system effectively.

### **2.4.2 Efficiency**

Efficiency can be defined as the ease-of-use to some researcher and can be described as the speed with accuracy in which users can complete the tasks for which they use the product. It is metrics that include the number of clicks or keystrokes required or the total 'time on task'. Efficiency is the quickness with which the user's goal can be accomplished accurately and completely and is usually a measure of time (Rubin and Chisnell, 2008). Efficiency refers to the expert user's steady-state level of performance at the time using the system (Nielsen, 1993).

Users may not reach the level of efficiency for the first time using the system and it may take several times to users for expert level of performance. ISO 9241 defines efficiency as the total resources expended in a task. The navigation design elements would give impact to efficiency. The navigation design elements are keyboard shortcuts, menus, links, and other buttons. According to Nielsen (1993), efficiency of a system means when there is no increased in the users' level of performance when using the system, it shows that the users has achieve the

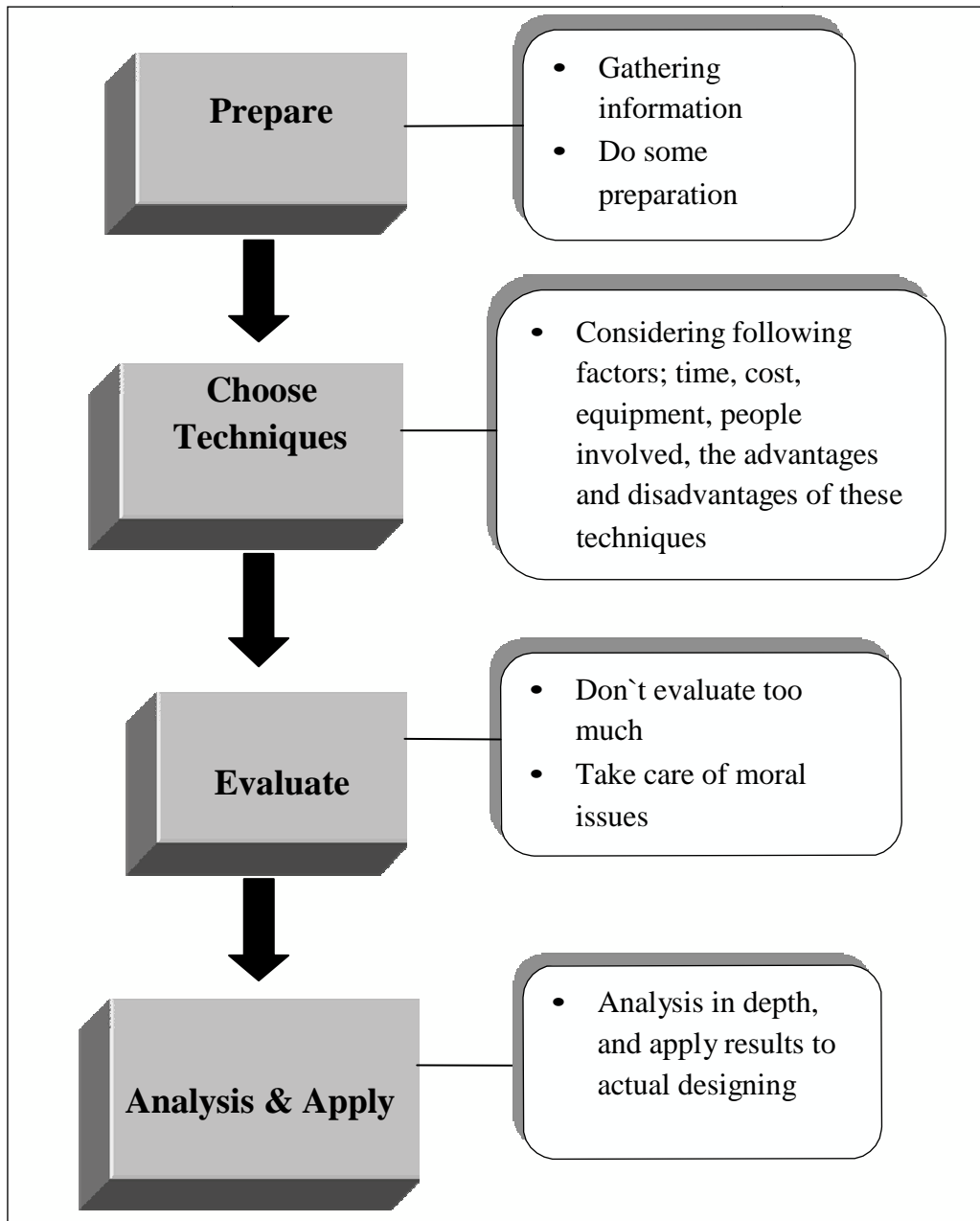
efficiency of the system. Thus, efficiency of use is the important aspect for evaluating usability test on digital library system.

### ***2.4.3 Usability Evaluation***

Usability evaluation can be defined as any object, product, system or service that will be used by humans has the potential for usability problems and should be subjected to some form of usability engineering (Nielsen, 1993). It covers many aspect of the use of the system. According to Conyer (1995), the need for evaluating usability in a product or system is to find out usability problems and make solution to fix the problems and thus to improve the usability of the design.

There are variety types of usability evaluation method. According to Preece, Rogers, and Sharp (2002), there are three types of usability evaluation methods which are inquiry, inspection and testing (see Table 2.2). The inquiry and testing involve real users, while inspection does not. Each method has its strength and limitations.

Usability evaluation is an emerging field; theory in this field is not perfect and means that there are many problems deserved to be explored (Liu, 2008). All the website designers should summarize their experiences for process designing and implement the usability evaluation techniques. Usability evaluation has increasingly become a part cannot be ignored in web site design (Liu, 2008). According to Liu (2008), designers should learn these techniques and use them in practice so that we can evaluate our web sites skillfully; generally speaking, we can evaluate a website as follows (see Figure 2.2):



**Figure 2.1: The Usability Evaluation Processes on Website** adopt from (Liu, 2008).

It involves testing studies because observation of real users. In this study, usability testing had been chosen as a method to collect data because of its popularity and involved real users in collecting data. In her article, Maurer (2004) believes that usability testing is the main way to determine the quality of the system.

In this study, quantitative data collection analyzed by using descriptive analysis method and qualitative data collection analyzed by using content analysis method. According to Hootman (1992), descriptive analysis a sensory method by which the attributes of a product are identified and quantified, using panellists specifically trained for this purpose.

The analysis can include all parameters of the product, or it can be limited to certain aspects, for example, aroma, taste, texture and aftertaste (Hootman, 1992). Content analysis is a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use (Krippendorff, 2004).

Usability testing will help to improve quality of UUM Digital Library System and increase satisfaction for users. This study is including in empirical evaluation method of usability testing based on Table 2.2. According to Preece, Rogers, and Sharp (2002), the detail overviews of usability evaluation method are as follows (see Table 2.2):

**Table 2.2: Detailed Overview of Usability Evaluation Method** adopt from (Preece, Rogers, and Sharp, 2002)

Type of evaluation	Evaluation method	Purpose of evaluation	Data generation and collection techniques	Description of the method	Design and development stage	Evaluation performed by	Advantages	Disadvantages
<b>USABILITY INSPECTION</b>								
Analytic	Formal usability inspection	Examine usability of user interface; find design flaws early in design process	Specifications; questionnaire; observation; verbal protocols; video or audio recording	Inspections walk through tasks with the user`s goal and purpose in mind	Early in design and development process	Experts in the field, specially assigned inspectors	Can be held on early prototypes of design specifications of paper mock-ups	Does not provide insights into real user patterns of use and problems
Analytic	Heuristic evaluation	Find usability defects early in design process	Heuristics; checklist; verbal protocol; video or audio recording	Experts assess design guided by heuristics	Particularly well suited for earlier stages of the design process	Experts (usually 2-5)	Diagnostic; high potential return on investment; cost-effective	Subject to bias; locating experts may present a problem; no real user involved
Analytic	Cognitive walkthrough	Find interaction design flaws and user difficulties	Usability specifications; checklist; verbal protocol; video or audio recording	Experts role play users performing the real task on early prototype	Early in design process	Expert evaluators	Cost-effective; can be held specifications; can provide a typical usage scenario	Restrictions in role playing locating experts may be problematic; no real users involved
Analytic	Pluralistic walkthrough	Evaluate user interface on interaction	Verbal protocols; observation; critical incident taking; questionnaire	User developers` and usability professionals collaborate to analyze the system	Early in development process	Users together with developers and usability professionals	Interaction between users and developers helps resolve usability problems faster	Requires special organizations; involves high costs and time investments

Type of evaluation	Evaluation method	Purpose of evaluation	Data generation and collection techniques	Description of the method	Design and development stage	Evaluation performed by	Advantages	Disadvantages
<b>USABILITY INQUIRY</b>								
Empirical	Survey	Obtain information about users` preferences or understanding of the system	Questionnaire; user interview	Data collected from questionnaires or interviews	Implementation users and evaluation stage (late in design process)	Users	Can be diagnostics; can be used for large groups; replicable	Information is subjective; low response rates; time-consuming
Empirical	Interview; focus group; panel	Obtain information on users` needs; get user feedback on the system	User interview; retrospective verbal protocols	Data collected from user interviews, panels or focus groups	Analysis (formulation of users` needs); implementation and evaluation stage	Users	Flexible; allow in-depth attitude and experience probing	Information is subjective; time-consuming; requires special organization; data analysis may be complex
Empirical	Contextual inquiry	Gather information about problems experienced by users on product use	Contextual interviews; observation; verbal protocols; video or audio recording	Developers observe users performing real tasks and discuss the process with them	Early in development process	Users	Natural context of use; can help identify the causes of users` actions and decisions	High costs; difficult to analyze and interpret data



Type of evaluation	Evaluation method	Purpose of evaluation	Data generation and collection techniques	Description of the method	Design and development stage	Evaluation performed by	Advantages	Disadvantages
<b>USABILITY TESTING</b>								
Empirical	Experiments	Examine user performance on the structured tasks; gain insights into what users actually do	Logging of activities; performance measures; verbal protocols; observation; video-recording; questionnaires	Users perform clearly defined 'typical' user tasks in a controlled environment	Development implementation and evaluation stage (late in design process)	Users (5-20) or experts as user to distinguish patterns of use	Powerful; reliable; finds highly used (or in used) features	High costs; data analysis; time consuming; low ecological validity; can affect user's performance level
Empirical	Co-discovery	Gather information about problems experienced by users on product use	Participant observation; verbal protocols; video or audio recording	Developers observe 2 users who work together and verbalize the process	Any stage of design and development process	2 users	Can bring out more insights than a single participant vocalizing his or her thoughts	High cost; difficult to analyze and interpret
Empirical	Prototype evaluation/testing	Get feedback from users on the system 'under construction'	Verbal or written protocols or notes; informal feedback	Designers let users try out the product and get their feedback	Any stage of design and development process	1-2 users and/or experts	Provides data on user preferences and experiences; low cost; can be held in natural	Information can be subjective; provides incomplete picture

Type of evaluation	Evaluation method	Purpose of evaluation	Data generation and collection techniques	Description of the method	Design and development stage	Evaluation performed by	Advantages	Disadvantages
<b>USABILITY TESTING</b>								
Empirical	Trial-run	Reveal problem and improve usability of the system before release	Performance measures; logging of activities; questionnaires; interviews	User perform the whole range of tasks and activities they would in the real life	Implementation users and evaluation stages (late in the design process)	Users	Powerful; reliable; valid data; high ecological validity	High costs; time-consuming; requires special organization; user behavior can be effected by evaluation

#### **2.4.4 Usability Testing**

Usability testing refer to a process that employs people as testing participants who are representatives of the target audience to evaluate the degree to which a product meets specific usability criteria (Rubin and Chisnell, 2008). According to Preece, Rogers and Sharp (2002), usability testing which is defined as "observes real target users performing real tasks with the interface in a controlled setting" is one of the most common techniques in evaluating the usability of a website.

Usability testing has been shown to reduce development time, decrease the number of bugs, and produce a more usable product thereby increasing sales (Branaghan, 1999). The benefits of doing usability testing can support corporate to achieve their goal and provide insights for creating effective documentation and product (Corgan and Waiters, 1994). According to Prescott and Crichton (1999), usability testing is a quick, cheap and effective method to apply. According to Lazar, Feng and Hochheiser (2009), usability testing is to improve the quality of an interface by finding flaws in it and should discover interface flaws that cause problems for users.

The overall goal of usability testing is to inform design by gathering data from which to identify and rectify usability deficiencies existing in products and their accompanying support materials prior to release (Rubin and Chisnell, 2008). According to Rubin and Chisnell (2008), the intent is to ensure the creation of products that:

1. Are useful to and valued by the target audience
2. Are easy to learn
3. Help people be effective and efficient at what they want to do
4. Are satisfying (and possibly even delightful) to use

Usability testing is a research tool, with its roots in classical experimental methodology (Rubin and Chisnell, 2008). According to their book, Rubin and Chisnell (2008) explained that there were seven basic elements of usability testing as follows (see Table 2.3):

**Table 2.3: Basic Elements of Usability Testing**

1. Development of research questions or test objectives rather than hypotheses.
2. Use of a representative sample of end users which may or may not be randomly chosen.
3. Representation of the actual work environment.
4. Observation of end users who either use or review a representation of the product.
5. Controlled and sometimes extensive interviewing and probing of the participants by the test moderator.
6. Collection of quantitative and qualitative performance and preference measures.
7. Recommendation of improvements to the design of the product.

## **2.5 Summary**

In summary, second chapter provides a brief review of the relevant literature review on the digital library and usability concepts. The usability testing methods have been chosen to collect data because of the popularity as an evaluation method. The next chapter discusses the methodology used in this project.

## CHAPTER 3

### METHODOLOGY

Chapter three explains the methodology used in order to achieve the objectives of the project. There are eight main activities that have been followed to accomplish the study (see Table 3.1). The activities are fact gathering, questionnaire and task construction, preliminary study, conducting pilot study, sample selection, data collection, data analysis and evaluation and recommendation.

**Table 3.1: Methodology**

<b>Steps</b>	<b>Activities</b>	<b>Outcome</b>
1. Fact gathering	<ul style="list-style-type: none"><li>• Digital library system</li><li>• Usability Testing: Learnability</li><li>• Usability Testing: Efficiency</li></ul>	<ul style="list-style-type: none"><li>• Theory about usability testing on digital library system in terms of learnability and efficiency.</li></ul>
2. Questionnaire and task construction	<ul style="list-style-type: none"><li>• Construct questionnaires for preliminary study, qualitative, quantitative, and pilot study.</li><li>• Construct task for the three features: Catalogue, eResource, and UUM eThesis.</li></ul>	<ul style="list-style-type: none"><li>• Questionnaires for preliminary study, qualitative, quantitative, and pilot study.</li><li>• Tasks for the three features: Catalogue, eResource, and UUM eThesis.</li></ul>

3. Pre-test questionnaire for preliminary study	<ul style="list-style-type: none"> <li>• Distribute questionnaires to twenty postgraduate students.</li> </ul>	<ul style="list-style-type: none"> <li>• Statistics on most widely used features.</li> </ul>
4. Conducting pilot study	<ul style="list-style-type: none"> <li>• Choose five students randomly.</li> <li>• Test the reliability of the questionnaires.</li> </ul>	<ul style="list-style-type: none"> <li>• Reliability test.</li> <li>• Questionnaires will be acceptable to use in real study.</li> </ul>
5. Sample selection	<ul style="list-style-type: none"> <li>• Choose respondents by using random sampling.</li> </ul>	<ul style="list-style-type: none"> <li>• Twenty students for quantitative data collection and five students for qualitative data collection.</li> </ul>
6. Data Collection	<ul style="list-style-type: none"> <li>• Qualitative: questionnaire for open-ended</li> <li>• Quantitative: questionnaire for close-ended and task.</li> </ul>	<ul style="list-style-type: none"> <li>• Answers by questionnaire for open-ended and close-ended.</li> <li>• A performances measure of time respondents takes to complete each task.</li> </ul>
7. Data analysis and evaluation	<ul style="list-style-type: none"> <li>• Analysis data of quantitative by using descriptive analysis (Microsoft Excel).</li> <li>• Analysis data of qualitative by using content analysis.</li> </ul>	<ul style="list-style-type: none"> <li>• Analysis of quantitative and qualitative.</li> </ul>
8. Recommendation	<ul style="list-style-type: none"> <li>• Identify all the problems and provide recommendation after finding the results.</li> </ul>	<ul style="list-style-type: none"> <li>• Recommendation on digital library system for improvement.</li> </ul>

### **3.1 Fact Gathering**

As a starting point of this study, the activity of fact gathering was implemented to review the theories which are digital library and usability testing in terms of learnability and efficiency. Fact gathering is important to understand the details and explanations about the theory.

### **3.2 Questionnaire and Task Construction**

The task and questionnaire had been constructed to collect the information for learnability and efficiency. The goal of these activities is to capture information in achieving the objective of the project.

#### **3.2.1 Questionnaire**

Questionnaire is defined, in a more structural way as "a method for the elicitation, and recording and collecting information". The relatively inexpensive method allows flexible administration and describes characteristics of a large population but is devoid of direct observation (Bartek and Cheatham, 2003). Questionnaire was used to collect data for usability test in terms of learnability and efficiency. The questionnaire that has been used in the project was adapted from the Questionnaire for User Interaction Satisfaction (QUIS) and the Questionnaire for Perceive Usefulness of Ease-of-Use (PUEU). This questionnaire is based on Chin, Diehl, and Norman (1988) in Development of an Instrument Measuring User Satisfaction of the Human Computer Interface.

The QUIS consists of demographic questionnaire, a measure of overall system, and a measure of specific interface factors such as screen visibility, terminology and system feedback, learning factors, and system capabilities. Learning factors on questionnaires were adapted and some minor changes were made to achieve the objectives of this study. The questionnaire of PUEU was used to collect the information that needed for the efficiency usability attributes. PUEU is based on the work of Davis (1989) on perceive of usefulness, efficiency and usage of

information technology. In this study, five questions from efficiency were adapted and modified for quantitative data collection.

The questionnaire for quantitative data collection used a close-ended question on a four-point Likert-scale. The respondents should choose the appropriate answers about the digital library system that is based on the scale. A four-point Likert-scale was used because it forced the respondents to make a choice and the neutral central point is eliminated (Barnum, 2000). The respective score for close-ended question used score as follows (see Table 3.2):

**Table 3.2: Four-Point Likert-Scale**

Scale number	Scale statement
1	Strongly disagree
2	Disagree
3	Agree
4	Strongly agree

The questionnaire for quantitative data collection has been divided into two main sections for learnability and efficiency on post-test questionnaire. Both sections consist of five questions each. The quantitative questionnaires have the positive and negative questions as follows (see Table 3.3):

**Table 3.3: Positive and Negative Questions**

	Section	Questions Number
<b>Learnability</b>	Positive questions	1.4, 1.5
	Negative questions	1.1, 1.2, 1.3
<b>Efficiency</b>	Positive questions	2.1, 2.2, 2.3, 2.4, 2.5
	Negative questions	-

The qualitative data collection used an open-ended questionnaire. Respondents should fill in the blanks on open-ended questions with their feeling and thought after completing the tasks. There were five questions in qualitative on post-test questionnaire.



### 3.2.2 Task Construction

The task was constructed to measure the learnability and effectiveness of UUM Digital Library System. Tasks will be distributed with questionnaires for quantitative data collection. The task consists of three instructions that students must perform while using the system (see Figure 3.1). The purpose of the task is to ensure that selected respondents perform the activities that are available on Catalogue, eResource, and UUM eThesis in the Online Resources of UUM Digital Library System. All respondents should finish each task within 1 minute.

<b>Catalogue</b>	<b><u>Task 1:</u></b> Select catalogue. Insert the searching keyword and click 'search' button. Click 'select' for the record that you want to send and click 'email' button. Choose the format (HTML/ Plain Text), insert keyword for subject and insert email address. Then, click 'send' button and you will get the record by email.
<b>eResource</b>	<b><u>Task 2:</u></b> Select eResource. Login to the eResources system. Click 'Online Databases' and select 'Emerald Group Publishing'. Insert keyword and click 'go'. Then, select the journal and click 'View PDF'. Download and save the file.
<b>UUM eThesis</b>	<b><u>Task 3:</u></b> Select UUM eThesis. Search the UUM eThesis by typing keyword and click 'search'. Select and click the appropriate e-Thesis. Click 'PDF' and the UUM eThesis will appear. Then, start download and save the file.

**Figure 3.1: Tasks**

### 3.3 Preliminary Study

The activity that included in this phase was preliminary study to get respondents' opinion about the most widely used features in Online Resources of UUM Digital Library System. This preliminary study was conducted by using a questionnaire consists of six questions. The Online Resources in UUM Digital

Library System consists of Catalogue, eEquip, eResources, eJournal, eReference, UUM eThesis, and Institutional Repository. The Catalogue, eResource, and UUM eThesis have been chosen as three main features in Online Resources of UUM Digital Library System. It is because the three main features are most widely used by students based on the survey. The preliminary study was carried out to twenty postgraduate students in class population from College Arts and Sciences. The result of evaluation on pre-test questionnaire shows that 80% of postgraduate students chose the Catalogue, eResource, and UUM eThesis.

### **3.4 Conducting Pilot Study**

Pilot study is conduct to ensure the reliability of the questionnaire. A pilot study is a small trial run on the main study (Preece, Rogers, and Sharp, 2002) and should be done before running a usability test (Barnum, 2000). Thus, five postgraduate students from College Arts and Sciences that familiar with UUM Digital Library System were selected randomly for the pilot study. The objective of this pilot study was to ensure that there was no ambiguity. The pilot study was conducted to make sure that respondents easily understood all the questionnaires and tasks. The reliability of the questionnaires and tasks should be test and at the end, all the questionnaires and tasks were acceptable to use.

### **3.5 Sample selection**

A total of twenty students for quantitative data collection and five students for qualitative data collection are participated in the usability testing. They were selected by using random sampling and the selection was based on the suggestion by Faulkner (2003) that ninety five percent of the usability problems can be found through five to twenty users.

### **3.6 Data collection**

Usability testing allows tester to collect both qualitative and quantitative data as the end user performs a real task or set of tasks. Quantitative data collection consists of data that can be measured. Questionnaires of four-point Likert-scale and tasks for performance measure are categorized in quantitative data collection. Questionnaires of open-ended were categorized in qualitative data collection.

### **3.7 Data Analysis and Evaluation**

Usability evaluation is defined as “systematically process of collecting data, in order to have a better understanding of users and how user groups use the product to perform a specific task under specified conditions” (Preece, Rogers and Sharp, 2002). The data obtained from the questionnaires for quantitative were analyzed by using Microsoft Excel. The quantitative data has been analyzed by using descriptive analysis method. Descriptive analysis has been used in this project because it helps to describe the collection of data more generally and conveniently.

Frequencies and percentages have been used due to a small number of respondents. Performance measures used to measure the learnability and efficiency for quantitative data collection in tasks. In this study, twenty respondents' performances were measured from the time taken to complete each tasks. Every respondent only have time within 1 minute to finish each task. The qualitative data collection by open-ended questionnaire was analyzed by using content analysis. Content analysis entails a systematic reading of a body of texts, images, and symbolic matter, not necessary from an author`s or user`s perspective (Krippendorff, 2004).

### **3.8 Recommendation**

The specific objective of this study is to recommend improvement for UUM Digital Library System. It should be carried out to achieve the specific objective of this study. The recommendation will be included after finding all the problems on usability testing. The recommendation is important for improvement on UUM Digital Library System.

### **3.9 Summary**

Overall, chapter three described methodology and gave a brief explanation about fact gathering, questionnaire and task construction, preliminary study, conducting pilot study, sample selection, data collection, data analysis and evaluation and recommendation. The methodology is important in carrying out this study. The collected information for quantitative and qualitative will be analyzed and interpreted in the next chapter.

## CHAPTER 4

### RESULTS AND FINDINGS

The aim of this chapter is to present an analysis of data collection that collected during the usability test. The data has been analyzed to get the results and findings. The data collections divided into two categories which are quantitative and qualitative data collection.

#### 4.1 Quantitative Data

Quantitative data consists of the data that measured and expressed numerically. There were two parts in post-test questionnaire. The two parts included in quantitative data collection are learnability and efficiency on four-point Likert-scale. Quantitative data collections have been analyzed by using descriptive analysis. Due to a small number of respondents, only the frequencies and percentages have been used. The quantitative data collections have been analyzed by using Microsoft Excel. All the three tasks and pre-test questionnaire on learnability and efficiency were also categorized in quantitative data collections.

##### *4.1.1 Analysis of Pre-Test Questionnaire*

###### *4.1.1.1 Gender*

There are five questions of close-ended on pre-test questionnaire (see Appendix A). Table 4.1 shows the result of question one in pre-test questionnaire. There were twenty respondents that been selected randomly. In this result, the

highest percentage was male respondents and the lowest percentage was female respondents. There were twelve respondents of male (60%) and eight respondents of female (40%).

**Table 4.1: Frequency Distribution and Percentage of the Respondents  
According to Gender**

<b>Gender</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Male	12	60%
Female	8	40%
<b>Total</b>	<b>20</b>	<b>100%</b>

#### **4.1.1.2 Age Group**

Table 4.2 shows the result of question two in pre-test questionnaire. Twenty respondents already answered this question. The age group of 21-29 is the highest percentage with the frequency of thirteen respondents (65%). There were six respondents (30%) for the age group of 30-39 and only one respondent (5%) for the age group of 40-49.

**Table 4.2: Frequency Distribution and Percentage of the Respondents  
According to Age**

<b>Age</b>	<b>Frequency</b>	<b>Percentage (%)</b>
20 & under	0	0%
21 – 29	13	65%
30 – 39	6	30%
40 – 49	1	5%
50 & over	0	0%
<b>Total</b>	<b>20</b>	<b>100%</b>

#### **4.1.1.3 Three Main Features of Online Resources**

Table 4.3 explains the main three features of Online Resources that respondents always use. Twenty respondents already selected the main three features. In this result, 80% was the highest percentage for Catalogue, eResources, and UUM eThesis. This result shows that Catalogue, eResources, and UUM eThesis with the highest frequencies of forty-eight respondents were the most features that respondents always used. There were only two respondents (10%) for each features which are eEquip and Institutional Repository. There were three respondents (15%) for eReference and five respondents (25%) for eJournal.

**Table 4.3: Frequency Distribution and Percentage of the Respondents According to Features**

<b>Features (Online Resources)</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Catalogue	16	80%
eEquip	2	10%
eResources	16	80%
eJournal	5	25%
eReference	3	15%
UUM eThesis	16	80%
Institutional Repository	2	10%

#### **4.1.1.4 Rating for Overall Learning Operation**

Table 4.4 shows the result of rating for overall learning operation on UUM Digital Library System. The highest percentage was fourteen respondents with the percentage of 70% for 'easy'. There were five respondents (25%) for 'neither easy nor difficult' and only one respondent (5%) for 'very easy'.

**Table 4.4: Frequency Distribution and Percentage of the Respondents  
According to Learnability**

<b>Learnability</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Very easy	1	5%
Easy	14	70%
Neither easy nor difficult	5	25%
Difficult	0	0%
Very difficult	0	0%
<b>Total</b>	<b>20</b>	<b>100%</b>

**4.1.1.5 Rating for Overall Efficiency Aspect**

Table 4.5 shows the result of rating for overall efficiency aspect on UUM Digital Library System. The highest percentage was thirteen respondents with the percentage of 65% for 'easy'. There were four respondents (20%) for 'neither easy nor difficult' and two respondents (10%) for 'very easy'. There was only one respondent (5%) for 'difficult' and it was the lowest percentage.

**Table 4.5: Frequency Distribution and Percentage of the Respondents  
According to Efficiency**

<b>Efficiency</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Very easy	2	10%
Easy	13	65%
Neither easy nor difficult	4	20%
Difficult	1	5%
Very difficult	0	0%
<b>Total</b>	<b>20</b>	<b>100%</b>



**4.1.2 Analysis of Task**

There are three tasks based on Catalogue, eResource, and UUM eThesis (see Appendix D). The twenty respondents already completed all the tasks as follows (see Table 4.6):

**Table 4.6: Time to Complete Each Task**

<b>Respondents</b>	<b>Task 1 (1 min)</b>	<b>Task 2 (1 min)</b>	<b>Task 3 (1 min)</b>
# 1	0:57	0:51	1:02
# 2	0:51	0:55	1:00
# 3	0:40	0:58	0:57
# 4	0:45	0:46	0:40
# 5	1:10	0:56	0:47
# 6	0:44	0:51	0:39
# 7	0:42	0:52	0:45
# 8	0:52	0:42	0:58
# 9	0:57	1:00	0:55
# 10	0:59	0:44	0:43
# 11	0:55	0:59	1:00
# 12	0:45	0:43	0:50
# 13	0:41	1:07	0:49
# 14	0:48	0:52	0:57
# 15	0:50	0:49	0:55
# 16	0:47	0:56	0:52
# 17	0:59	0:55	0:53
# 18	0:45	0:59	0:44
# 19	0:59	0:47	0:47
# 20	0:59	0:50	0:59

Table 4.6 shows the time taken to complete all the tasks. Twenty respondents were already completed all the three tasks for performance measure. The three tasks based on Catalogue, e-Resource, and UUM e-Thesis. All task are allocate time

within 1 minute to finish each for every respondents. The result shows that seventeen respondents (85%) were able to complete the task successfully and the other three respondents (15%) exceeded the time limit.

In task 1, respondent 5 exceeded the time limit (1:10). Respondent 5 faced problem when selecting the 'plain text' format in Catalogue. The error page appeared when the respondents clicking 'send' button. The 'plain text' format button not functions. Lastly, respondent 5 overcomes the problem by clicking 'back' button for previous page and selecting 'html' format (see Figure 4.1).

Meanwhile, in task 2, respondent 13 exceeded the time limit (1:07). Respondent 13 faced problem of the system response. The system response was slow when downloading the journal at that time. In task 3, respondent 1 also faced the problem of the system response. The UUM e-Thesis was very slow to appear at that time. Respondent 1 exceeded the time limit (1:02).

In conclusion, the UUM Digital Library System will reflect the learnability and efficiency aspect in their tasks while user using the system. However, Table 4.6 seems that most respondents with the percentage of 85% completed all the three tasks in allocated time. Thus, it is possible to summarize that the UUM Digital Library System was easy to use and to learn.



**Figure 4.1: The Screen of Error Page on UUM Digital Library System**

### 4.1.3 Analysis of Post-Test Questionnaire

#### 4.1.3.1 Learnability

Learnability contains of two questions in positive statement and three questions in negative statement (see Appendix B). The three negative statements were changed to the positive statements to make it easier in the analysis process of data. The questionnaire used Four-point Likert-scale which are “1 - strongly disagree”, “2 - disagree”, “3 - agree”, and “4 - strongly agree”.

**Table 4.7: The Analysis on Learning to Operate UUM Digital Library System**

<b>Learning to operate UUM Digital Library System</b>					
	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>	<b>Result</b>
1.1 Learning to use the UUM Digital Library System is easy for me.	0 (0%)	1 (5%)	12 (60%)	7 (35%)	Agree
1.2 Exploring new features by trial and error is easy for me.	0 (0%)	0 (0%)	11 (55%)	9 (45%)	Agree
1.3 Performing tasks are not confusing.	0 (0%)	1 (5%)	13 (65%)	6 (30%)	Agree
1.4 Frequently Asked Questions (FAQ) on the UUM Digital Library System is helpful.	0 (0%)	1 (5%)	12 (60%)	7 (35%)	Agree
1.5 Selecting and searching by using navigation button are easy and compatible to use.	0 (0%)	0 (0%)	11 (55%)	9 (45%)	Agree
<b>Group Mean Percentage</b>	<b>0%</b>	<b>3%</b>	<b>59%</b>	<b>38%</b>	<b>Agree</b>

Table 4.7 shows the result on learnability of UUM Digital Library System. There were 60% respondents agree, 35% respondents strongly agree, and 5% respondents disagree with statement 1.1. Twelve respondents (60%) agree that “Learning to use the UUM Digital Library System is easy for me” and seven

respondents (35%) strongly agree with that statement. Only one respondent (5%) disagrees that “UUM Digital Library System is easy for me”.

In statement 1.2, there were eleven respondents (55%) agree and nine respondents (45%) strongly agree that “Exploring new features by trial and error is easy for me”. Meanwhile, in statement 1.3, thirteen respondents (65%) agree and six respondents (30%) strongly agree that “Performing tasks are not confusing”. Only one respondent (5%) disagrees with that statement.

In statement 1.4, there were twelve respondents (60%) agree and seven respondents (35%) strongly agree that “Frequently Asked Questions (FAQ) on the UUM Digital Library System is helpful”. Only one respondent (5%) disagrees with that statement. In statement 1.5, eleven respondents (55%) agree and nine respondents (45%) strongly agree that “Selecting and searching by using navigation button are easy and compatible to use”.

As a conclusion, Table 4.7 shows the highest percentage is 59% that given by 'agree' on Likert-scale. Group mean percentage used to analyze the total of overall frequencies. The result shows and implies that learning process is easy for respondents.

#### **4.1.3.2      *Efficiency***

Efficiency or ease-of use contains of five questions in positive statement (see Appendix B). The questionnaire for efficiency also used Four-point Likert-scale which are “1 - strongly disagree”, “2 - disagree”, “3 - agree”, and “4 - strongly agree”.

**Table 4.8: The Analysis on Efficiency of UUM Digital Library System**

<b>Efficiency of UUM Digital Library System</b>					
	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>	<b>Result</b>
2.1 Learning to operate the UUM Digital Library System is easy for me.	0 (0%)	0 (0%)	11 (55%)	9 (45%)	Agree
2.2 I find it is easy to get the online thesis on UUM Digital Library System.	0 (0%)	1 (5%)	13 (65%)	6 (30%)	Agree
2.3 I find it is easy to get the online journal on UUM Digital Library System.	0 (0%)	1 (5%)	11 (55%)	8 (40%)	Agree
2.4 I find that the UUM Digital Library System is user-friendly and easy to use.	0 (0%)	1 (5%)	12 (60%)	7 (35%)	Agree
2.5 I find that the UUM Digital Library System is flexible to interact with.	0 (0%)	0 (0%)	13 (65%)	7 (35%)	Agree
<b>Group Mean Percentage</b>	<b>0%</b>	<b>3%</b>	<b>60%</b>	<b>37%</b>	<b>Agree</b>

Table 4.8 shows the result on ease-of-use or efficiency of UUM Digital Library System. There were eleven respondents (55%) agree and nine respondents (45%) strongly agree with statement 2.1. In statement 2.2, there were thirteen respondents (65%) agree and six respondents (30%) strongly agree that “I find it is easy to get the online thesis on UUM Digital Library System”. Only one respondent (5%) disagrees with statement 2.2.

In statement 2.3, there were eleven respondents (55%) agree and eight respondents (40%) strongly agree that “I find it is easy to get the online journal on UUM Digital Library System”. Only one respondent (5%) disagrees with statement 2.3. There were twelve respondents (60%) agree and seven respondents (35%) strongly agree with statement 2.4. Only one respondent (5%) disagrees with statement 2.4. In statement 2.5, there were thirteen respondents (65%) agree and seven respondents (35%) strongly agree that “I find that the UUM Digital Library System is flexible to interact with”.

In conclusion, Table 4.8 shows the result of group mean percentage that most of the respondents, 60% agree and 37% strongly agree with the efficiency of UUM Digital Library System. There were 3% of the respondents disagree with the efficiency of UUM Digital Library System. The overall result from Table 4.8 shows that many respondents felt the UUM Digital Library System is easy to use.

## **4.2 Qualitative Data**

The qualitative data is usually in the form of words rather than numbers that contain the record of impressions, comments and opinion during the testing. The data was collected by using an open-ended questionnaire in post-test questionnaire (see Appendix C). There were five questions in open-ended questionnaire that the respondents have been answered. The qualitative data collection was analyzed by using content analysis. Content analysis interpretation was based on the work of Graneheim and Lundman (2003).

### ***4.2.1 Analysis of Post-Test Questionnaire***

The result for content analysis on Catalogue, eResources and UUM eThesis shows that there are four problems. The four problems which are 'plain text' format on Catalogue button not functions, sometimes the result cannot be found and failed to get the information on the system, sometimes the system response is slow, and confuse with all the above and below buttons on UUM eThesis. Respondents also give opinion on improvement for UUM Digital Library System. Table 4.11 shows the result for font size and style. All the respondents agreed that the font size and style are easy to read.

Thus, it is possible to summarize and say that the results of content analysis on Catalogue, e-Resource, and UUM eThesis in the Online Resources of UUM Digital Library System are easy to use and to learn. The results of content analysis for Catalogue, eResources and UUM eThesis are as follows (see Table 4.9, Table 4.10, Table 4.11, Table 4.12, and Table 4.13):

**Table 4.9: The Content Analysis for Question 3.1**

<b>Meaning Unit</b>	<b>Condensed meaning unit Description close to the text</b>	<b>Condensed meaning unit Interpretation of the underlying meaning</b>	<b>Sub-theme</b>	<b>Theme</b>
<b>Respondent 1:</b> She feel like need to do more step and sometimes when completed the task, the result cannot be found and failed to get the information	Many steps and sometime failed to get the information from the three features by performing tasks	The three features are not efficient because failed to get the information by performing tasks	The three features on the system do not have efficiency aspect	The feeling as attempted to complete the tasks
<b>Respondent 2:</b> He feel so easy to use and do not have any problem to completed all the tasks	Easy to use and do not have any problem to completed all that the tasks	The three features is efficient	The three features on the system have efficiency aspect	
<b>Respondent 3:</b> He feel that sometimes the system response is too slow	Sometimes the system response is too slow	The system response on the three features are not efficient because too slow	The three features on the system do not have efficiency aspect	
<b>Respondent 4:</b> He feel that it is so easy to perform all the three tasks	Easy to perform all tasks	The tasks on the three features are efficient	The three features on the system have efficiency aspect	
<b>Respondent 5:</b> She feel that the tasks on three features are not confusing and navigation buttons are compatible to use	Learning to use all tasks without confusing and navigation buttons are compatible to use.	Learnability aspect by performing all the tasks because not confusing and navigation buttons are compatible to use	The three features on the system have learnability aspect	

**Table 4.10: The Content Analysis for Question 3.2**

<b>Meaning Unit</b>	<b>Condensed meaning unit Description close to the text</b>	<b>Condensed meaning unit Interpretation of the underlying meaning</b>	<b>Sub-theme</b>	<b>Theme</b>
<b>Respondent 1:</b> The most confuse aspect and problem of the application is on Catalogue. It is because the 'plain text' format button not functions	The 'plain text' format button not functions on the application of Catalogue	Do not have ease of use aspect on Catalogue because 'plain text' format button not functions	Catalogue do not have efficiency aspect	The most confuse aspect and problem of the application on three features.
<b>Respondent 2:</b> It is so easy to use all the three features without having any confuse aspect and problem	Easy to use all the three features without having any confuse aspect and problem	Ease of use on the three features	The three features on the system have efficiency aspect	
<b>Respondent 3:</b> The most confuse aspect and problem of the application is on UUM eThesis. Confuse with all the above and below buttons.	Confuse with all the above and below buttons	The process of learning on UUM eThesis is confusing	UUM eThesis do not have learnability aspect	
<b>Respondent 4:</b> Learning to use the application on three features is not difficult to me	It is not difficult to learn on the three features	The process of learning is not difficult	The three features on the system have learnability aspect	
<b>Respondent 5:</b> There are no problem and no confusing aspect of the application on the following three features	Do not have any problem and confusing aspect on the following three features	Ease of use on the following three features	The three features on the system have efficiency aspect	



**Table 4.11: The Content Analysis for Question 3.3**

<b>Meaning Unit</b>	<b>Condensed meaning unit Description close to the text</b>	<b>Condensed meaning unit Interpretation of the underlying meaning</b>	<b>Sub-theme</b>	<b>Theme</b>
<b>Respondent 1:</b> Yes, the font size and style are easy to read and understand	The font size and style are easy to read and understand	The font size and style are ease of use	The UUM Digital Library System have efficiency aspect	Font size and style on UUM Digital Library
<b>Respondent 2:</b> Yes. easy to read	The font size and style are easy to read	The font size and style are ease of use	The UUM Digital Library System have efficiency aspect	
<b>Respondent 3:</b> Yes, the font size and style are easy to read	The font size and style are easy to read	The font size and style are ease of use	The UUM Digital Library System have efficiency aspect	
<b>Respondent 4:</b> Yes	The font size and style are easy to read	The font size and style are ease of use	The UUM Digital Library System have efficiency aspect	
<b>Respondent 5:</b> Yes, easy to read	The font size and style are easy to read	The font size and style are ease of use	The UUM Digital Library System have efficiency aspect	

**Table 4.12: The Content Analysis for Question 3.4**

<b>Meaning Unit</b>	<b>Condensed meaning unit Description close to the text</b>	<b>Condensed meaning unit Interpretation of the underlying meaning</b>	<b>Sub-theme</b>	<b>Theme</b>
<b>Respondent 1:</b> It can be made easier by improving efficient aspect with 'A-Z' searching buttons on UUM Digital Library System so that the user do not need to key in so many times before get the actual result	Improve the efficient aspect with 'A-Z' searching buttons on UUM Digital Library System	Advise to improve efficiency aspect with 'A-Z' searching buttons	Opinion for improvement on efficiency aspect	The ways to make easier for UUM Digital Library system application on the three features
<b>Respondent 2:</b> -	-	-	-	
<b>Respondent 3:</b> It can be made easier by improving the efficiency aspect. Increase network speed so that the user will get the faster response without wasting their times.	Improve the efficiency aspect by increase network speed	Advise to improve efficiency aspect by increase network speed	Opinion for improvement on efficiency aspect	
<b>Respondent 4:</b> It can be made easier by updating the layout for more user friendly and compatible to use	Update the layout for more user friendly and compatible to use	Advise to improve the layout for more user friendly and compatible to use	Opinion for improvement on layout aspect	
<b>Respondent 5:</b> It can be made easier by reducing the problem of 'error page' on the system for the improvement on efficiency aspect	Improve efficiency by reduce the problem of 'error page' on the system	Advise to improve the efficiency aspect on the system	Opinion for improvement on efficiency aspect	

**Table 4.13: The Content Analysis for Question 3.5**

<b>Meaning Unit</b>	<b>Condensed meaning unit Description close to the text</b>	<b>Condensed meaning unit Interpretation of the underlying meaning</b>	<b>Sub-theme</b>	<b>Theme</b>
<b>Respondent 1:</b> -	-	-	-	Additional comments (optional)
<b>Respondent 2:</b> Overall, he feels so easy to use all the three features by performing tasks	Overall, it is so easy to use all the three features by performing tasks	All the tasks are ease of use	All tasks on the system have efficiency aspect	
<b>Respondent 3:</b> -	-	-	-	
<b>Respondent 4:</b> He feels that learning to operate all the three tasks is so easy.	It is easy on learning to operate all the three tasks.	All the tasks are learnability	All tasks on the system have learnability aspect	
<b>Respondent 5:</b> -	-	-	-	

### **4.3 Summary**

Chapter four summarized the data that has been collected during usability test. It has been collected by using questionnaires and tasks for quantitative data and qualitative data. All the data collected has been analyzed and interpreted by using descriptive and content analysis. The result shows generally that UUM Digital Library System was easy to use and to learn by using usability testing in terms of learnability and efficiency.

## **CHAPTER 5**

### **CONCLUSIONS AND RECOMMENDATIONS**

Chapter five discusses the findings of the study based on the objectives and research questions as mentioned in chapter one. The problems, limitations and contributions were explained in this chapter. In this chapter, there are also presents some recommendations for the future research.

#### **5.1 Discussion of Findings**

The aim of this project is to test usability of UUM Digital Library System in terms of learnability and efficiency. The usability for UUM Digital Library System has been tested by qualitative and quantitative data collection for postgraduate students in class population from College Arts and Sciences. Five respondents for qualitative data collection and twenty respondents for quantitative data collection have been selected randomly. The discussions of specific objectives on this project are as follows:

##### **1. Research objective 1**

The first specific objective is to analyze and evaluate the overall feedback from respondents for learnability and efficiency on UUM Digital Library System. The quantitative data has been analyzed and evaluated by using Microsoft Excel and the qualitative data collection has been analyzed and evaluated by using content analysis. The findings for the first specific objective in line with the literature review by Nielson (1993). According to Nielson (1993), learnability refer to the system that should be easy to learn so that the user can rapidly start getting some work done with

the system and efficiency refer to the system that should be efficient, so that once the user has learned the system; a high level of productivity is possible. Thus, the overall feedback seems that UUM Digital Library System was easy to use and to learn. The first specific objective has been achieved.

## 2. Research objective 2

Furthermore, the second specific objective is to discover the usability flaws on UUM Digital Library System. The usability flaws on UUM Digital Library System such as 'plain text' format button in Catalogue not functions, sometimes the system response was slow for downloading and sometimes the UUM e-Thesis page was very slow to appear. The findings for the second specific objective in line with the literature review by Lazar, Feng and Hochheiser (2009). According to Lazar, Feng and Hochheiser (2009), usability testing is to improve the quality of an interface by finding flaws in it and should discover interface flaws that cause problems for users. Thus, the usability flaws have been discovered by analysis and evaluation on the system. The second objective has been achieved.

## 2. Research objective 3

The third specific objective is to recommend improvement for UUM Digital Library System. The recommendations should be discussed after findings all the problems based on the methodology aspect. The recommendations are important for improvement and as references for future studies. This third objective has been achieved and discussed in details on recommendations topic of this chapter (see Topic 5.3).

## **5.2 Problems and Limitations**

Every research study has own problems and limitations, and this research study is also no exception. The problems and limitations of this study are as follows:

1. The respondent just only focuses on postgraduate students in class from College Arts and Sciences. It was carried out in a small range of population and not involved many users.

2. The limitation for time consuming where it is difficult to find the free time of respondents to answer all the questions.
3. Concentrated on two usability attributes only which are learnability and efficiency. Thus, not much usability problems can be identified.

### **5.3 Recommendations**

The recommendations for future study on UUM Digital Library System are as follows:

1. The next future study should be done in larger sample population size that also involves lecturers and students from other faculties in UUM.
2. If possible, the next study should be done by using all five usability attributes which are learnability, efficiency, memorability, errors, and satisfaction. It will help to improve and cover the quality of usability aspects in UUM Digital Library System.
3. The next future study should expand scale on usability test in UUM Digital Library System. This study just only focused on three features in Online Resources which are Catalogue, eResource, and UUM eThesis. It is because of the time limitation.

The recommendations for improvement on UUM Digital Library System are as follows:

1. Committee members should improve the aspect of usability in terms of learnability and efficiency so that it will help to increase satisfaction for users when using UUM Digital Library System.
2. Committee members should alert with the problems that might be happened to all the buttons that not functions in UUM Digital Library System.
3. Committee members should make improvement for time response in the UUM Digital Library System to make it faster and efficient without having any problems.

#### **5.4 Contributions to the Study**

This project provides a deep analysis of usability testing on two attributes which are learnability and efficiency. The quantitative and qualitative data have been analyzed and the objectives have been achieved. Moreover, this study provides recommendation for improving the UUM Digital Library System based on usability testing results. It also provides recommendation and reference for future studies.

#### **5.5 Conclusion**

Overall, the aim of this project is to test the usability on UUM Digital Library System in terms of learnability and efficiency. This research project used the usability test technique because of its popularity as an evaluation tool for quantitative and qualitative data collection. The advantage of using usability test technique is due to the usefulness on identifying problems and involving the end users to use the system. Meanwhile, work done by Prescott and Crichton (1999) and Ebling and John (2000) showed the usability testing could identify usability problems with a system and collects quantitative and qualitative data. The descriptive analysis has been used to analyze and evaluate the quantitative data. The content analysis has been used to analyze and evaluate the qualitative data. All the research objectives for this project have been achieved. The recommendations for improvement and future study have been provided after findings all the problems on UUM Digital Library System. The result from the usability testing shows that UUM Digital Library System is a usable system in terms of learnability and efficiency. However, there were several usability problems that have been identified and need to be improved so that the users can use UUM Digital Library System without having any problems. Thus, the quality of UUM Digital Library System can be further improved when the usability aspect are enhanced.



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## APPENDIX A

### DIGITAL LIBRARY SYSTEM SURVEY QUESTIONNAIRE

#### Pre-Test Questionnaire

Dear postgraduate students,

I wish to ask for your co-operation in completing this survey. This survey is a part of my research project on the topic of “Usability Testing for Learnability and Efficiency on UUM Digital Library System”. Your co-operation on this survey is highly appreciated.

Please answer all questions below and tick (✓) one of your preferred choices for each item.

1. Please select your gender:

- Male
- Female

2. Please select your age group:

- 20 & under
- 21 – 29
- 30 – 39
- 40 – 49
- 50 & over

3. Please select three of the following features in UUM Digital Library System of Online Resources that you always use:

- Catalogue
- eEquip
- eResources

- eJournal
- eReference
- UUM eThesis
- Institutional Repository

4. How do you rate the overall learning operation on UUM Digital Library System?

- Very easy
- Easy
- Neither easy nor difficult
- Difficult
- Very difficult

5. How do you rate the overall efficiency aspect on UUM Digital Library System?

- Very easy
- Easy
- Neither easy nor difficult
- Difficult
- Very difficult

Thank you for sharing your time to answer all the questions.

## APPENDIX B

### DIGITAL LIBRARY SYSTEM SURVEY QUESTIONNAIRE

#### Post-Test Questionnaire 1

Dear postgraduate students,

I wish to ask for your co-operation in completing this survey. This survey is a part of my research project on the topic of “Usability Testing for Learnability and Efficiency on UUM Digital Library System”. Your co-operation on this survey is highly appreciated. This questionnaire was designed to tell us how you feel about the product based on the tasks you just performed.

#### **PART 1:**

Please circle the answer that most clearly expresses how you feel about a particular topic.

Scale number:

1- Strongly disagree

2- Disagree

3- Agree

4- Strongly agree



## 1.0 The Process of Learning/ Learnability

	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
1.1 Learning to use the UUM Digital Library System is difficult to me.	1	2	3	4
1.2 Exploring new features by trial and error is difficult to me.	1	2	3	4
1.3 Performing tasks are confusing.	1	2	3	4
1.4 Frequently Asked Questions (FAQ) on the UUM Digital Library System is helpful.	1	2	3	4
1.5 Selecting and searching by using navigation button are easy and compatible to use.	1	2	3	4

### **PART 2:**

Please circle the answer that most clearly expresses how you feel about a particular topic.

Scale number:

1- Strongly disagree

2- Disagree

3- Agree

4- Strongly agree

## 2.0 Efficiency/ Ease of Use

	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
2.1 Learning to operate the UUM Digital Library System is easy for me.	1	2	3	4
2.2 I find it is easy to get the online thesis on UUM Digital Library System.	1	2	3	4
2.3 I find it is easy to get the online journal on UUM Digital Library System.	1	2	3	4
2.4 I find that the UUM Digital Library System is user-friendly and easy to use.	1	2	3	4
2.5 I find that the UUM Digital Library System is flexible to interact with.	1	2	3	4

## APPENDIX C

### DIGITAL LIBRARY SYSTEM SURVEY QUESTIONNAIRE

#### Post-Test Questionnaire 2

Dear postgraduate students,

I wish to ask for your co-operation in completing this survey. This survey is a part of my research project on the topic of “Usability Testing for Learnability and Efficiency on UUM Digital Library System”. Your co-operation on this survey is highly appreciated. This questionnaire was designed to tell us how you feel about the product based on the tasks you just performed.

Please answer all the questions.

3.1 How did you feel as you attempted to complete the tasks?

---

---

---

3.2 What was the most confuse aspect and problem of the application on the following three features (Catalogue, eResource, UUM eThesis)?

---

---

---

---

3.3 Was the font size and style on UUM Digital Library System easy to read?

---

---

---

3.4 How could the UUM Digital Library System application on the three features (Catalogue, eResource, UUM eThesis) can be made easier?

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3.5 Feel free to list any additional comments (optional):

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Thank you for sharing your time to answer all the questions.

## APPENDIX D

### DIGITAL LIBRARY SYSTEM SURVEY

#### Task

Dear postgraduate students,

I wish to ask for your co-operation in completing this survey. This survey is a part of my research project on the topic of “Usability Testing for Learnability and Efficiency on UUM Digital Library System”. Your co-operation on this survey is highly appreciated. This questionnaire was designed to tell us how you feel about the product based on the tasks you just performed.

Please complete all the tasks within 1 minute each.

<b>Catalogue</b>	<b><u>Task 1:</u></b> Select catalogue. Insert the searching keyword and click ‘search’ button. Click ‘select’ for the record that you want to send and click ‘email’ button. Choose the format (HTML/ Plain Text), insert keyword for subject and insert email address. Then, click ‘send’ button and you will get the record by email.
<b>eResource</b>	<b><u>Task 2:</u></b> Select eResource. Login to the eResources system. Click ‘Online Databases’ and select ‘Emerald Group Publishing’. Insert keyword and click ‘go’. Then, select the journal and click ‘View PDF’. Download and save the file.
<b>UUM eThesis</b>	<b><u>Task 3:</u></b> Select UUM eThesis. Search the UUM eThesis by typing keyword and click ‘search’. Select and click the appropriate UUM eThesis. Click ‘PDF’ and the UUM eThesis will appear. Then, start download and save the file.