ACTION-BASED HELP TECHNIQUE TO IMPROVE LEARNABILITY AND UNDERSTANDABILITY OF WEB APPLICATIONS

NURUL AFIQAH BINTI SHAMSUDDIN

UNIVERSITI SAINS MALAYSIA

2014

ACTION-BASED HELP TECHNIQUE TO IMPROVE LEARNABILITY AND UNDERSTANDABILITY OF WEB APPLICATIONS

by

NURUL AFIQAH BINTI SHAMSUDDIN

Thesis submitted in fulfilment of the requirements for

the degree of Master of Science (Computer Science)

FEBRUARY 2014

ACKNOWLEDGEMENT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TEKNIK BANTUAN BERASASKAN TINDAKAN UNTUK MENINGKATKAN KEBOLEHBELAJARAN DAN KEBOLEHFAHAMAN APLIKASI WEB

ABSTRAK

Kemunculan Internet telah mewujudkan permintaan yang amat besar bagi aplikasi Web. Penerimaan suatu aplikasi Web amat bergantung pada faktor kebolehgunaannya. Aplikasi Web merupakan salah satu platfom di mana para pengguna kerap mengalami pengalaman yang mengecewakan ketika menggunakannya. Kekecewaan dalam menggunakan aplikasi Web ini akan lebih meningkat jika para pengguna berjaya menemukan fungsi-fungsi yang ingin digunakan tetapi mereka gagal dalam mempelajari dan memahami fungsi-fungsi tersebut. Kebolehbelajaran dan kebolehfahaman adalah antara dua faktor penting di dalam kebolehgunaan suatu aplikasi Web. Oleh itu, ia merupakan satu cabaran kepada pembangun dan pereka Web untuk memastikan bahawa aplikasi Web mereka akan berterusan membantu para pengguna semasa dalam proses pemahaman dan proses pembelajaran mereka terhadap aplikasi Web. Penyelidikan ini memberi fokus kepada peningkatan faktor kebolehbelajaran and kebolehfahaman aplikasi Web melalui teknik bantuan berasaskan tindakan (ABH). Teknik yang dicadangkan ini telah direka untuk merakam interaksi pengguna di atas papar muka aplikasi Web bagi mengenalpasti fungsi yang perlu diberi bantuan. Teknik ini juga menyediakan bimbingan melalui satu sistem bantuan yang menggunakan demonstrasi video dan teknologi tooltip sebagai medium untuk meningkatkan kefahaman para pengguna terhadap fungsi-fungsi yang telah disediakan di dalam aplikasi Web. Satu eksperimen terkawal telah dikendalikan untuk menilai keberkesanannya dalam

meningkatkan kefahaman para pengguna terhadap fungsi-fungsi yang disediakan di dalam aplikasi Web. Ujian mendapati bahawa melalui teknik yang dicadangkan, para pengguna mampu memahami fungsi-fungsi yang terdapat di dalam aplikasi Web lebih baik berbanding dengan bantuan dalam talian yang berasaskan teks. Para pengguna juga dapat menyelesaikan tugasan lebih pantas dan mencapai kekerapan akses kepada bantuan yang rendah berbanding dengan bantuan dalam talian yang berasaskan teks.

ACTION-BASED HELP TECHNIQUE TO IMPROVE LEARNABILITY AND UNDERSTANDABILITY OF WEB APPLICATIONS

ABSTRACT

The emergence of the Internet has created a tremendous demand for Web applications. Acceptability of Web applications is heavily dependent on its usability factor. A Web application is one of the platforms where users often experience frustration. This frustration accumulates once they encounter difficulties to learn and understand the functions after discovering the functions earlier. Learnability and understandability are two crucial factors of usability. Thus, it is a challenge for Web developers and designers to ensure that Web applications will continuously support users' understanding and learning processes. This research focuses on improving the learnability and understandability of Web applications through an Action-Based Help (ABH) technique. The proposed technique has been designed to capture users' interactions on a Graphical User Interface (GUI) in order to determine which of the functions that users require guidance. This technique also provides guidance through a help system that uses video demonstration and tooltip technology to enhance users understanding towards the functionality. A controlled experiment has been conducted to evaluate its effectiveness in enhancing users' understanding towards Web functionalities. It was discovered that through the adoption of the proposed technique, users are able to understand the functions better compared to the text-based online help. Users also able to complete tasks given in shorter time and obtained lower frequency in help accesses compared with text-based online help.

CHAPTER 1

INTRODUCTION

1.1   Overview of Usability in Web Applications

The migration of traditional software to Web applications has increased developers' aspirations in building high quality applications for their clients. The acceptability of Web applications is strictly dependent on its usability (Matera *et al.*, 2006). Usability is one of the quality factors that have been defined by Shackel (1991) as "The capability in human functional terms to be used easily and effectively by specified range of users, given specified training and user support, to fulfil the specified range of tasks, within the specified range of environmental scenarios". A few standard definitions for usability were also introduced. In ISO 9126-1, the definition of usability is given as "The capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions" (ISO/IEC 9126-1, 2001). Furthermore, ISO 9241-11 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" (ISO 9241-11, 1998) and in IEEE Std. 610.12 usability has been defined as "The ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or component".

Many researches have been carried out to identify ways that can improve usability in Web applications such as via refactoring technique (Garrido *et al.*, 2011) and visualization technique (Jianli and Ning, 2007). However, getting started with unfamiliar interfaces and learning new functionality have always remained as

1

challenges to novices (Kang *et al.*, 2003). Learnability is an important aspect of usability (Nielsen, 1994). Despite available current techniques that tackle issues of learnability in Human-Computer Interaction (HCI), studies have shown that software engineers are still struggling during the process of implementing the recommended practices or guidelines as introduced in HCI (Carjaval, 2013) or even in standard guidelines such as in ISO 9124-151(2005).

Furthermore, recent studies show that users lose up to forty per cent of their time due to frustrations during Web browsing, E-mailing and Word processing. One of the common causes of these frustrations is the difficulty to find features (Ceaparu *et al.*, 2002, Lazar *et al.*, 2006). This frustration accumulates if they have found the features but encounter difficulties to learn and understand the concerned features. Learnability and understandability are important and the most fundamental sub factors under usability (Nielsen, 1994). Learnability and understandability factors are strongly related to each other (Lew *et al.*, 2012). The potential of learnability of Web applications can be indicated from understandability measurement (ISO/IEC 9126-2, 2002).

Improving learnability and understandability can be an alternative in improving usability of Web applications. Learnability factor in Web applications plays an important role in guiding users on the optimal use of Web functions provided, and understandability of Web applications is related to the information quality, which is one of the factors included in choosing the best Web site (Bindu-Madhuri *et al.*, 2010). It is a challenge for Web developers to ensure that the features and functionalities of Web applications are visible to users and able to continuously support users' understanding and learning processes. This in turn can convince the

users that the Web applications will ease their tasks instead of burdening them with the functions provided.

Help systems or user documentations are common methods in improving learnability (Grossman *et al.*, 2009). The content of a help system must be context-sensitive with the users' Graphical User Interface (GUI) layout in order to let users learn and understand quickly through the help system or user documentation. Additionally, help systems or user documentations must not cause any obstruction to users' working flow on GUI and must be able to convey guidance to the end users efficiently. In order to deliver guidance to the end users efficiently, the delivered guidance must match with users' interactions on the GUI.

There are a number of studies done to learn users' interactions on the GUI (Mueller and Lockerd, 2001, Paganelli and Paterno, 2002, Atterer *et al.*, 2006, Chen *et al.*, 2008, Li *et al.*, 2010, MartÃnez *et al.*, 2011). By studying the users' interactions on GUI, any problems that users encountered in the GUI can be identified, such as on which functions that they use and even on which functions that they are trying to explore. From here, this research tries to deliver a possible guidance or information that users' might need by studying and analysing users' interactions with the GUI.

This research focuses on learnability and understandability factors in Web applications. The main challenge of this research is how to let users learn and understand all the functions provided in Web applications while working on the Web applications, through the improvement of learnability and understandability of Web applications. Hence, this research attempts to address the issue by proposing a technique to improve users' learnability and understandability by studying users'

interactions while they interact with the user interface of Web applications. Users will be guided based on their interactions on the GUI in order to support their learning and understanding process while interacting with Web applications. This technique will improve users' learnability and understandability by delivering guidance on GUI on how to operate and use the functions provided in Web applications successfully. The technique is also implemented in a help system in order to measure its effectiveness in improving learnability and understandability of Web applications. Users can benefit from this technique, as they will be continuously exposed to the knowledge on using all the functions provided in the Web applications whilst interacting with it.

1.2   Background of the Problem

Vast development of today's Web applications has introduced many functions to the end users. However, learning how to use the functions (Chilana *et al.*, 2012) and using the function (Hollinworth and Hwang, 2011) seem to be challenging. In addition, this has led the users to experience frustrations (Lang and Nothdurft, 2012) and they became inefficient in doing the task (Lasecki *et al.*, 2011) since they had spent most of their time in experimenting and exploring the functions instead of completing their tasks.

Learnability factor is important in order to help users start using the system with fewer obstacles. However, lack of function understanding may cause users to easily leave or even reject the Web applications (Offutt, 2002). Thus, the effort spent in creating the functions in the system will become useless if users cannot appreciate and utilize the functions as intended by the developers.

Lack of help and support in the system had also caused difficulties to end users in using Web applications, which resulted in the industry having to spend time and costly training courses for their users (Faisal, 2012). By assisting end users in learning and understanding Web functions, the problems in using Web functions can be avoided and, learnability and understandability factor in Web applications can be improved indirectly. Both factors can educate users in using the Web functions provided and ease the end users in using the Web applications.

Help systems are common methods in overcoming the issues in learnability and understandability of Web applications. It is a support component to end users, which is provided by the system or Web developers. The main goal of this help system is to provide user understanding of the application (Baecker, 2002). It is also to support user exploratory and user self-paced learning (Dutke and Reimer, 2000). There are a few limitations on the existing help system that provide interactive real-time support to the end users. Some of these limitations are related to distracting features created in the help system (Grossman and Fitzmaurice, 2010, Lang and Nothdurft, 2012, Chilana *et al.*, 2012) and the asynchronous activities between users and the technical support staff during a task-related help session (Karam and Abou Ibrahim, 2009). Furthermore, most of the help system still require users to search and query to find answers while interacting with the Web applications.

While a help system or user documentation can be useful in improving learnability and understandability factor of Web applications, it must not cause any obstruction to users' working flow on GUI and it must also be able to convey guidance to the end users efficiently. By matching the guidance with users'

interactions on the GUI, it is expected that guidance can be delivered more efficiently.

1.3   Statement of the Problem

For this research, the main question focuses on ***what is the effective technique to improve learnability and understandability aspects of Web applications?*** The sub-questions are as follows:

(i)   What are the issues associated with learnability and understandability aspects in Web applications?

(ii)   What are the techniques or approaches associated in overcoming the issues with learnability and understandability aspects in Web applications?

(iii)   How to validate the effectiveness of the proposed technique?

1.4   Research Objectives

The aim of this research is to improve the aspects of learnability and understandability of Web applications. The objectives are:

(i)   To investigate existing techniques associated with learnability and understandability factors of Web applications.

(ii)   To propose and materialise a technique that can improve learnability and understandability of Web applications.

(iii)   To measure the effectiveness of the proposed technique.

1.5   Importance of the Research

Learnability and understandability are among the many important aspects of usability. Empirical studies have shown that many users get frustrated with computer applications due to missing, hard to find and unusable features of applications (Lazar *et al.*, 2006). The learnability of Web applications has a distinctive importance. According to Rafique *et al.* (2012), learnability factor in Web applications will lead to reasonable learning times, adequate productivity during the learning phase, thus it gives better satisfaction to new users. It also has a significant effect on the success of Web applications.

Understanding of the functionalities which are provided in Web applications remains a challenge to the end users, leading to frustrations in using the Web applications. Thus, learnability and understandability of Web applications is the main factor that contributes to the users' functions understanding. Grossman *et al.*(2009) conducted a survey in software learnability and identified five learnability issues in the study, namely, task flow's understanding, functions awareness, functions locating, functions understanding and application's transition. Based on the guidelines suggested, help system or user documentation are often the method of choice in overcoming these issues (Grossman *et al.*, 2009). Thus, the learnability factor in Web applications can be improved by providing a help system in it.

Current Web assistance such as online help and tutorials only assist users in completing their tasks but not much in assisting users to explore more new functions in the Web application which might be useful to them in the future. Therefore, this research focuses on assisting users to use Web functions in real-time by providing a direct guidance based on their interactions on the GUI. This measure does not require

users to spend extra effort to state their inquiries to get guidance on how to use certain functions. Thus, this research proposes the Action-Based Help (ABH) technique employed in a help system that allows users to learn the functionalities of Web applications, and guidance on using certain functions are delivered based on users' interactions on the GUI.

Learnability is strongly related to understandability, and the potential of the learnability factor can be indicated from understandability measurement (ISO/IEC 9126-2, 2002, Lew *et al.*, 2012). Furthermore, understandability factor is related to the information quality, which is one of the factors included in choosing the best Web site (Bindu-Madhuri *et al.*, 2010). These two factors have been taken into account since understandability factor is encountered when assessing whether Web applications are suitable and how it can be used for particular tasks.

By focusing on these two factors, users can enhance their understanding towards each function in the Web applications and assisted by a help system. Thus, this research is important as the proposed technique may improve learnability and understandability of Web applications by delivering relevant guidance to end users through a help system based on their interactions with the GUI.

1.6   Research Scope

The scopes of this research are as follows:

(i)   **Users' interactions**: This research proposes a technique that captures users' interactions on a Web application's GUI. It captures all related users' interactions on any interactive artefacts on GUI. There are only three types of interactive artefacts involved in this capturing process, which are buttons,

links, and text fields. Measures taken on the proposed work in capturing users' interactions are only focusing on activities that occur on these interactive artefacts on the GUI. As such, other activities such as mouse movements and browser related activities are not captured.

(ii) **Webmail**: This research focuses on the common yet complex Web applications, which is Web-based Email Applications (Webmails). Webmails has been selected as the platform for the implementation of the proposed work of this research. Webmail is a common Web application that people deal with every day. Through Webmails, a pool of users with diverse level of experience can be reached. This research utilizes a Webmail called Automated Re-organisation of Mailing System (my@RMS) as a platform to test and measure the effectiveness of the proposed technique. In addition, my@RMS is a new Webmail used in an organization.

(iii) **Novices**: This research focuses on beginners or novices as the target users. Users are treated as beginners or novices. This research does not concern users' background of knowledge or past experiences. This is because, even though they may have some experience with any Webmails, the environment and experience that they undergo are proprietary different when using the Webmails. Furthermore, any assistance or guidance provided by the Web applications are more meaningful to the beginners or novices compared to the experienced users.

1.7 Theoretical Framework

This research aims to provide end users with a help system that aids them in learning and understanding Web functions while using the Web applications. The

help system delivers guidance on using certain functions based on users' interactions on GUI. User interactions infer the users' interests and reflect users' knowledge of Web applications. Thus, based on the designer's description, the term "interactive artefacts" is used throughout this research. The term 'artefacts' refers to an object that is used by users to perform activities (Bannon and Bødker, 1991). Since this research focuses on Web applications, the interactive artefacts term refers to the artefacts that are located on the GUI and those artefacts, which form part of users' interactions in the Web applications. There are numerous interactive artefacts that can be found in the Web applications' GUI. However, this research only focuses on capturing users' interactions on these interactive artefacts that are, buttons, links, and text fields. Capturing these parameters will help in determining which functions in the Web application that users attempt to use and what suitable guidance that can be delivered to them.

This research focuses on delivering guidance through the ABH technique that is installed in a help system. Based on the inputs obtained from the interactions that occur on the interactive artefacts, video demonstrations are used as the medium to assist end users on using the functions that they are trying to explore in real-time. Furthermore, this research uses the tooltip technology to allow end users to learn while working on the Web applications. Thus, having this type of users support in Web applications can help users in completing their tasks faster and easier for novices to learn and understand the Web application, which in turn improves learnability and understandability of Web applications as part of the usability factors in Web applications.

Having Web applications that can deliver guidance based on users' needs is a suitable approach to improve learnability and understandability factors in Web applications. Figure 1.1 illustrates the factors and parameters which are involved in this research that forms the theoretical framework.
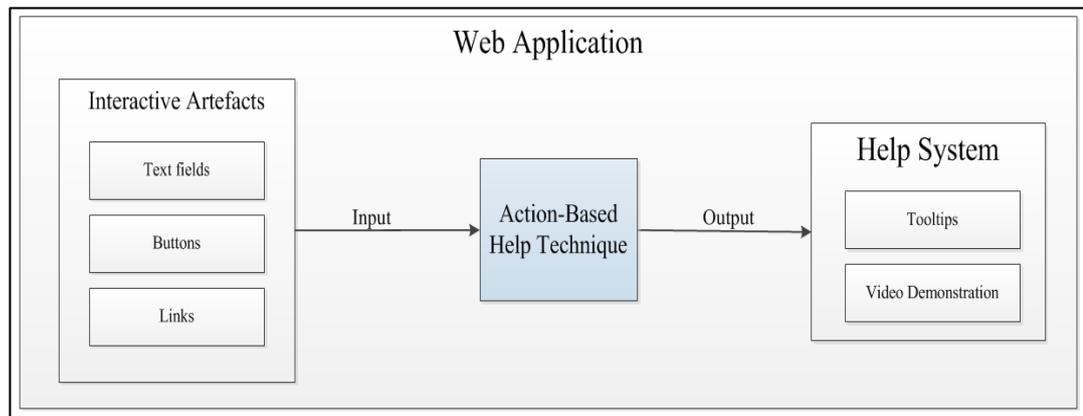
Figure 1.1 : Theoretical frameworks as the basis in this research

1.8 Contributions

There are two contributions that can be obtained from this study. Firstly, the ability of the proposed technique to enhance users' understanding towards Web functionalities. Additionally, this research also contributes to a new way of designing a more usable help system for Web applications.

In using the Web applications, users face a lot of problems in trying to learn and understand the Web application. Failure to learn and understand the Web applications has led frustrations in using the Web applications. Although there are numerous researches being carried out to overcome the learnability and understandability issues in Web applications, most of them merely focuses on assisting novices to navigate through the applications, locating functions and

understand the informations on Web applications. There is a lack of studies that assist users in understanding the Web functionalities. If users failed to understand the purpose of the provided functions, they would not be able to complete their tasks successfully.

Thus, the technique called Action-Based Help (ABH) is proposed to enhance users' understanding towards Web functionalities while the users interact with the Web applications. The ABH technique utilises users' interactions on the GUI to identify which functions that users are trying to explore in order to dispatch relevant functional guidance to the users at the moment they are trying to use it through a help system. The guidance is displayed in the form of tooltip on the GUI using video demonstrations as a medium to deliver important information regarding a function. The details of the technique are discussed in Chapter 4.

This research utilises users' interactions on the GUI as the input for the technique because through users' interactions on the GUI, the functions that users are trying to explore, their current state of activities and guidance that they might need during the interactions with the Web application can be identified. This technique also provides a help system that uses video demonstration and tooltip technology to enhance users understanding towards the functionality as it is one of the most effective mediums to foster users' learning process. This technique helps users to understand the Web functionality by guiding them on how to use the function and the purposes of the function are also clearly stated in the guidance.

The technique is produced in an effort to provide an action-based help system to address problems faced by novices in understanding Web functionalities. This study hopes to provide valuable input to other researchers on the aspects of designing

and developing the help systems to assist users in using the Web applications as well as to improve learnability and understandability factors of Web applications. Most importantly, it provides relevant information to the end users in an effort to enhance their understanding towards Web functionalities.

1.9   Organisation of Thesis

This thesis has six chapters that are presented in a chronological order consisting of an introduction, literature review, research methodology, the ABH technique, evaluation, and discussion respectively. The organization of this thesis is as follows:

Chapter 1 introduces the overview of usability in Web applications and background of problems in usability of Web applications. Additionally, this chapter also explains on the research objectives and statement of the problem of this research. This chapter also describes the importance of this research, followed by the scope of this research. The theoretical framework for this research is designed and followed by a research contribution list.

Chapter 2 reports on the literature reviews that are related to this research. Systematic literature review on learnability and understandability are explained in detail. In addition, this chapter also explains on usability challenges in Web applications, features in Webmail, and users' interactions with the Web application. The final part of this chapter explains help systems in Web applications and provides a detailed explanation of video demonstrations and tooltip in help systems.

Chapter 3 outlines the research methodology. It provides details on the procedures taken from the beginning to the end of the conducted research. Research

procedures conducted in this study are illustrated and followed by explanations for choosing Goal-Questions-Metric (GQM) approach in creating the questionnaires for the evaluation phase of this research. Limitations and assumptions made in this research are detailed out in this chapter. The next section of the chapter describes the research design and followed by the hypotheses used in this research.

Chapter 4 explains the proposed work of this research that is ABH Technique. This chapter covers a detailed explanation of the proposed work and the algorithm involved in each component in the technique. Explanations on the design of the tool that is applied to the technique are also discussed in this chapter.

Chapter 5 presents in detail the procedures taken to evaluate the proposed technique and the results from the evaluation conducted. The evaluation procedures include explanations on the experiment conducted, the sample selection for the experiment and the design of the questionnaires. This research adopts a lab experiment to study the usability of the help system, learnability of the Web application and understandability of the Web application. It includes the analysis and findings of the lab experiment as the evaluation of the proposed technique.

Chapter 6 concludes the research by summarizing the thesis. The contribution of the study is determined based on the findings. It also provides suggestions for future research work at the end of the chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides a discussion on the concepts related to usability factor of software. Usability represents an important acceptance criterion for interactive types of software. This chapter also provides an explanation on the usability factor in Web applications. Improving the learnability and understandability factors can be an alternative in improving the usability of Web applications. A detailed discussion on these two quality factors, as well as the inherent challenges in achieving usability in Web applications are provided in this chapter. This research also provides a discussion on the features of a Web-Based email application (Webmail) which has been used as a platform to test the effectiveness of the proposed technique. This chapter ends with a discussion on finding better ways to deliver the most effective help system as well as a discussion on the systematic literature review (SLR) of the related work.

2.2 Software Quality

Usability is one of the quality attributes proposed by many researchers (McCall *et al.*, 1977, Boehm, 1978). The quality models introduced in both researches are one of the basic and founding predecessors of today's quality models (Berander *et al.*, 2005). ISO 9126-1 is based on McCall and Boehm's quality model. Researchers in the field of Web applications commonly referred to the ISO 9126-1 usability standard (Olsina *et al.*, 2009, Tripathi *et al.*, 2010, Orehovacki, 2010). The

quality model introduced in ISO 9126-1 is also more appropriate for Web products (Calero *et al.*, 2005). Furthermore, the quality model proposed in ISO/IEC 9126 (2001) consists of two major parts that are internal and external quality model, and quality in-use model. Internal and external quality model determines the quality of a software product through six characteristics, namely: functionality, reliability, usability, efficiency, maintainability and portability. Each characteristic is subdivided into related sub-characteristics. Each sub-characteristic is further described by appropriate external and internal quality attributes that can be measured by specified metrics. Figure 2.1 shows the quality model introduced by ISO 9126-1.

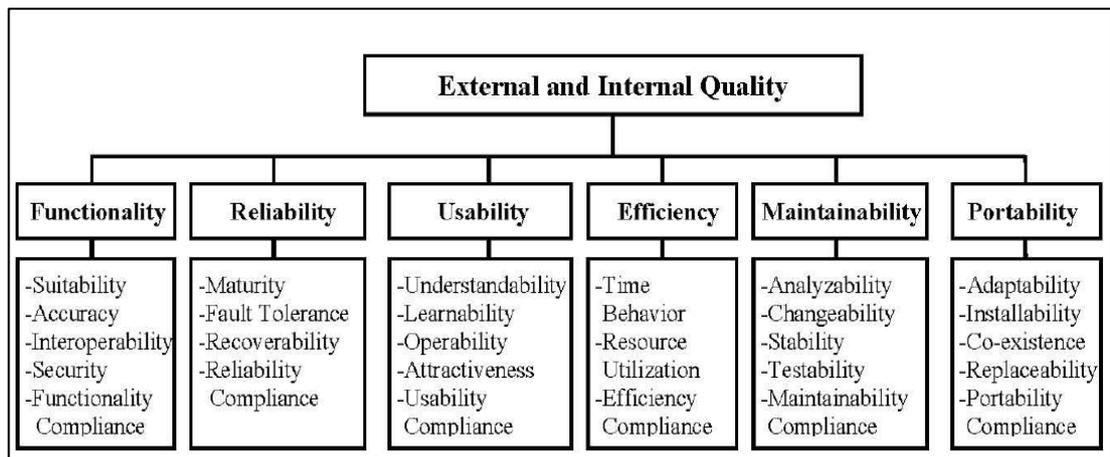|		**External and Internal Quality**			
Functionality	**Reliability**	**Usability**	**Efficiency**	**Maintainability**	**Portability**
-Suitability -Accuracy -Interoperability -Security -Functionality Compliance	-Maturity -Fault Tolerance -Recoverability -Reliability Compliance	-Understandability -Learnability -Operability -Attractiveness -Usability Compliance	-Time Behavior -Resource Utilization -Efficiency Compliance	-Analyzability -Changeability -Stability -Testability -Maintainability Compliance	-Adaptability -Installability -Co-existence -Replaceability -Portability Compliance

Figure 2.1: ISO 9126-1 quality model (ISO/IEC 9126-1, 2001)

This research uses reference from ISO/IEC 9126 standard quality model as this standard covers the internal and external quality of Web applications (Olsina *et al.*, 2009). The next section explains on the usability factor in Web applications based on ISO 9126-1 standard usability factor.

2.3 Usability of Web Applications

Usability represents one of the important acceptance criteria for an interactive software system and Web applications (Tripathi *et al.*, 2010). Quality in Web applications is easily recognized but it is hard to define or to explain (Matera *et al.*, 2006). Usability is one of the quality factors which has been defined by Shackel and Richardson (1991) as "*The capability in human functional terms to be used easily and effectively by specified range of users, given specified training and user support, to fulfil the specified range of tasks, within the specified range of environmental scenarios*"

This definition seems irrelevant to today's level of usability, as users nowadays would prefer something easier for them and not burdening them by forcing them to undergo special training in order to use the Web application. Usability in Web applications has important factors such as learnability and understandability, which can ensure users to be able to start using the Web applications.

The ISO 9126-1 (2001) and ISO 9241-11 (1998) are two major ISO standards relating to usability. However, ISO 9126-1 has a refined quality model compared to ISO 9241-11 (Berander *et al.*, 2005). According to ISO 9126-1, the definition for usability is "*the capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions*" (ISO/IEC 9126-1, 2001).

According to ISO/IEC 9126 (2001) quality models, there are five factors under usability that is learnability, understandability, operability, usability compliance and attractiveness. Figure 2.2 shows the ISO 9126-1 usability model.

The following sub-section describes the challenges that motivate the research in this thesis.
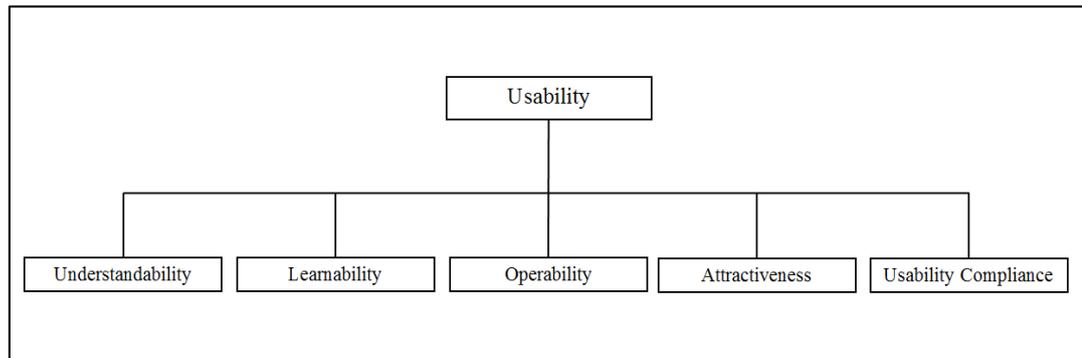
Figure 2.2: ISO 9126-1 usability models (ISO/IEC 9126-1, 2001)

2.3.1 Usability Challenges in Web Applications

The introduction of World-Wide Web in 1990's has made it a ubiquitous medium to deliver information and interactive application. Kappel (2006) defines Web applications as "a software system based on technologies and standards of the World Wide Web consortium (W3C) that provides Web specific resources such as content and services through a user interface". As Web applications evolves, the scope and complexity of the Web applications also vary widely (Murugesan *et al.*, 2001). This may be due to the fact that a Web application offers numerous advantages to its users, such as lower computer costs, improved performance, reduced software costs, instant software updates, increased data reliability and device independence (Miller, 2009).

Numerous advantages of Web applications have attracted users in converting a software application into a Web application. Due to this matter, the increasing scale of Web applications' users has forced Web developers to face various issues and

18

challenges regarding their users. A recent study showed that over forty per cent of users' time are wasted when they interact with Web browsers, emails and word processing due to frustrations, and one of the reasons for the frustrations is that they encounter difficulties in finding provided features (Ceaparu *et al.*, 2002, Lazar *et al.*, 2006). Furthermore, one of the usability problems in Web application is the difficulty to learn and use the Web application. Learnability factor in Web application is interpreted as the ease of which users are able to understand the contents and functions that are available through the application, and the ability to use the Web application properly (Matera *et al.*, 2006). In order to provide better quality information on the content of the Web applications, understandability factor of Web applications needs to be considered. Thus, improving learnability and understandability factors of Web applications can be the way to improve Web applications' usability. The following sub-sections will elaborate in detail the two afore-mentioned factors.

2.4 Software Learnability

Over the past twenty-five years, researchers in software engineering field have considered the learning factor in software. A number of definitions have been introduced, and many other factors are related to the learnability of software. As early as 1980, Michelsen (1980) defines learnability, as "*the system should be easy to learn by the class of users for whom it is intended*". This definition is one of the learnability definitions that is related to the difficulty of software. In 1994, studies in learnability of software were related to time. Nielsen (1994) defines learnability as "*allowing users to reach a reasonable level of usage proficiency within a short time*" and Bevan (1994) also defines it as related with time that is "quality of use for users

over time". These "*reasonable level of usage proficiency*" and the "*quality of use*" have remained unclear. Clearly, time factor in these definitions is more relevant in the learnability measurement process.

Getting started with unfamiliar interfaces and learning advanced functions have always remained as challenges to novices and even to the experts (Kang *et al.*, 2003). Even though today's user interface designs have significantly evolved further in order to provide usable interface to users, helping novices and even the experts to optimally use the functions in Web applications remains an unsolved problem. Current Web assistance such as online help and tutorials (Chilana *et al.*, 2012, Lang and Nothdurft, 2012) only assist users in completing their tasks and not much in assisting users to explore more advanced functions in the Web application that might be useful to them in the future. Developers create most of the advanced functions to ease the end users in completing their tasks. Usefulness of Web applications can deteriorate if the users fail to make full use of it. Thus, in this situation, learnability factor in a Web application plays an important role in guiding users on how to use those provided functions at an optimum level.

ISO/IEC 9126 (2001) introduces a standard definition of learnability that is, "*the capability of a software product to enable its users to learn how to use it*". Through this definition, users' learning abilities of Web applications elements are a non-issue; instead, it raises the question of the ability of the Web application itself in enabling users to learn the elements. There is no doubt that measuring learnability level of a Web application is through the users. However, at best, this ISO definition allows for a more general definition that can be delivered.

The evaluation for learnability factor has also been defined and conducted in various ways. Grossman *et al*. (2010) adopted a controlled method to evaluate the learnability level of its proposed approach. The users were given fixed amount of time to complete the tasks using their proposed approach and existing approach. They evaluated the number of successfully completed task within the given time. Elliott *et al*. (2002) also used this method of evaluation with an addition that they gave the users 25 learnability related question survey after they completed the given task in order to get more subjective learnability feedback. An earlier work by Butler (1985) also applied this evaluation approach in learnability but with recorded time for each user to complete the task. Thus, time spent in completing a task is a suitable factor to be measured in learnability evaluation.

The evaluation for learnability factors is conducted to prove its effectiveness. Effectiveness in learnability of software applications is defined as the ease of learning the software applications (Hui *et al*., 2008). ISO 9126 has introduced external metrics for the quality model to measure the 'ease of learning' in software applications. This standardization also covers all metrics that need to be measured in order to evaluate the learnability factor. ISO 9126-2 (2002) introduced externals metric to measure the factors and sub-factors identified in ISO 9126. It also provides guidelines on measuring each sub-factor under usability. This research conducted the evaluation phase to measure the learnability of the Web application based on the metrics introduced in ISO 9126-2. There are five learnability metrics as introduced by ISO 9126-2 (2002). They are as follows:

(i)   Ease of function learning

(ii)   Help Accessibility

(iii)   Effectiveness of the user documentation and/or help system

(iv)   Effectiveness of user documentation and help systems in use

(v)   Help frequency

Learnability is strongly related to understandability, and the potential of the learnability of a Web application can be indicated from understandability measurement (ISO/IEC 9126-2, 2002, Lew *et al.*, 2012). This means that, if a Web application is understandable of its usage, purposes and goals, users will be able to learn to use it easily. The next section will elaborate details of understandability factor.

2.5   Software Understandability

Researchers in software engineering field have come into a consensus in defining understandability in software. Boehm (1978) defined understandability as "*ease of understanding software systems*". Standard definition of understandability was introduced through ISO/IEC 9126 (2001) as "*the ability of a user to understand the capabilities of the software and if it is suited to accomplish specific goals. It is measured by providing the user with a tutorial or software documentation and then evaluating the users' knowledge to determine the users' level of understanding of the software's functionality, operation, and data input and output*". It covers throughout the software understandability from users' point of view. The metric to measure understandability had also been introduced through this standard.

Users assess a Website for simplicity, understandability and ease of use (Powell, 2002). Thus, a good Website depends on how far users can understand the overall elements of a Web interface. Understanding the application domain concept remains a challenge to users (Kang *et al.*, 2003). The understandability factor of Web

applications is also related to the information quality and it is one of the factors included in choosing the best Web site in their research (Bindu-Madhuri *et al.*, 2010). This shows that understandability factor is as important as learnability factor in Web applications. Understandability factor in a Web application can ensure the quality of the information that users can get while interacting with the application.

In software development process, understandability factor is measured through questionnaires such as GQM (Ghani *et al.*, 2008) and understandability related question survey (Melcher *et al.*, 2010). The understandability factor is measured to prove its effectiveness. Effectiveness of understandability factor is referring to the ability of the presented material to be understood by the end users (Cruz-Lemus *et al.*, 2007). This research conducted the evaluation phase to measure the effectiveness of the understandability factor of the Web application based on the metrics introduced in ISO 9126-2. There are seven understandability metrics as introduced by ISO 9126-2 (2002). The metrics are as follows:

(i)   Evident functions

(ii)   Function understandability

(iii)   Completeness of description

(iv)   Demonstration Accessibility

(v)   Demonstration Accessibility in use

(vi)   Demonstration effectiveness

(vii)   Understandable Input and Output

This research focuses on the learnability and understandability of a Web application. It proposes a technique that can deliver a live guidance to the end users.

The next section elaborates on the help system that is involved in delivering the live guidance to the end users.

2.6   Help Systems

This section explains on the help systems in Web applications. Help system is common in Human Computer Interaction (HCI) field, as numbers of guidelines are available in providing the support component (Ames, 2001, Baecker, 2002). The main goal of this user support is to provide user understanding towards the application (Baecker, 2002). It is also to support user exploratory and user self-paced learning (Dutke and Reimer, 2000). Many studies report on the support components that are effective in helping users in using the application (Jackson, 2001) and some are proven to effectively assist novices to start using the application (Kelleher and Pausch, 2005).

Existing help systems that provide interactive real-time supports to the end users have a few limitations. Some of these limitations are related to the disturbing features created in the help systems and the asynchronous activities between users and the technical support staff during a task-related help session. There are two types of technical support namely, intrusive and non-intrusive technical support (Karam and Abou Ibrahim, 2009). The intrusive technical support allows the technical support staff to have access to the end users' workstation remotely. These types of technical support require users' consent in accessing their workstations before the technical staff can start any technical support services. The other type of technical support is non-intrusive technical support. Examples of non-intrusive technical support are online tutorial, live annotation, usage of multimedia elements and live