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Yiyu Qiu
University of Wollongong

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A Framework of an effective online help system to support nurses using a nursing information system

A thesis submitted in fulfilment of the requirements for the award of the degree
Master of Information and Communication technology by Research

From

UNIVERSITY OF WOLLONGONG

By

Yiyu Qiu

Supervisor: Dr Ping Yu
Mr Richard Fleming

School of Information Systems and Technology

2007

Declaration

I, Yiyu Qiu, declare that this thesis, submitted in fulfillment of the requirements of the award of Master of Information and Communication Technology by research, in the School of Information Systems and Technology, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualification at any other academic institution.

Signature: _____

Date: _____

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Abstract

Research Aim and Questions: This research aims to develop a quality framework of an effective Online Help System (OHS) for a Nursing Information System (NIS). This involves the identification of the criteria for an effective OHS. The research questions are what content, structure, functions and aesthetics this OHS should have. The research will also provide guidelines about how to evaluate the usability of an OHS.

To learn unfamiliar features or functions of a Nursing Information System (NIS), nurses need effective and efficient assistances. An OHS, which aims to bridge the gap between the complexity of a NIS and nurse-users' need for simplicity, is one effective solution. However, systematic research on the design and evaluation of an OHS is not common. There is a lack of a comprehensive quality framework that could provide guidance on the design and evaluation of an OHS for a NIS. As nurses are important healthcare workers, their acceptance and usage of a NIS is important for the improvement of quality of healthcare data, it is imperative to conduct this research with strong potential to impact on the adoption of NIS by nurses.

Research Methodology: Two phases of investigation were carried out. Guided by a grounded theory approach, we first proposed a quality framework of an effective OHS for a NIS. In order to prove the validity of this framework, an experiment was carried out in which an OHS for an authentic NIS (the Care Planning and Assessment Tool) was developed and evaluated. Various research methods were employed in collecting data, i.e. laboratory-based usability testing, focus group discussion and questionnaire survey.

Results: The proposed framework was consisted of the five criteria (i.e. content, structure, functionality, aesthetics, and usability). The CPAT Online Help was designed according to the results of the needs assessment and the forty-three guidelines that reflect the quality indicators in the framework. The results of the heuristic evaluation of the CPAT Online Help shows that the help system highly reflect on the proposed framework. The results of

the usability testing suggest that the usability of both online help and hard-copy help manual is similar (i.e. no significant group difference was found for the results of both laboratory testing and the answers to the user satisfactory survey between online help and hard-copy help manual). However, in the laboratory experiment, the overall performances of the participants who used the CPAT Online Help were obviously better than those of the participants who used the hardcopy user manual. In addition, the survey responses from the former were more positive than those from the latter.

Discussion and Conclusion: The proposed quality framework and their indicators were validated and supported by our research results and findings. Our research suggested that 1) nurse users' basic computer skills, knowledge about an NIS, knowledge about procedures of nursing documentation should be covered in an OHS; 2) function-oriented and task-oriented structure are the effective structures of an OHS; 3) table of contents, frequently ask questions, search engine and video demonstration are effective functions; 4) visual-effectiveness can facilitate a nurse-user's problem solving 5) the indicators of the usability of an OHS is the 5Es: effectiveness, efficiency, error-tolerance, engaging and ease of learning.

Publications Arising from the Research

1. Qiu Y., Yu P. (2007), “Heuristic Evaluation of an Online Help System for a E-health Application”, Proceedings of 7th International Conference on Successes and Failures in Telehealth, Brisbane, Australia, published in *Special Supplement to the Journal of Telemedicine and Telecare*, Impact Factor: 0.75.
2. Qiu Y., Yu P. and Hyland P. (2007), “A Multi-method Approach to Assessing Health Information Systems End Users’ Training Needs”, in MedInfo2007 congress, Brisbane, Australia.
3. Qiu Y. and Yu P. (2006), “Nursing Information Systems—Applying Usability Testing to Assess the Training Needs for nursing students”, in *Methods of Information in Medicine*, 46 (4): 416-419, Impact Factor: 0.97.
4. Qiu Y., Yu P. and Fleming R. (2006), “A Comparison of Nurses’ Satisfaction with Online Help or Hardcopy User manuals to Facilitate Their Mastering and E-health Application”, Proceedings of 6th International Conference on Successes and Failures in Telehealth, Brisbane, Australia, published in Special Supplement to *the Journal of Telemedicine and Telecare*, Impact Factor: 0.75.
5. Qiu Y. and Yu P. (2005), “A Study of Characteristics of Effective Online Help System to Facilitate Nurse Interacting with Nursing Information System”, Health Informatics Conference 2005, Melbourne, Australia, HISA.

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Chapter 1 Introduction

1.1 Introduction

The title of this study is “*A Framework of an Effective Online Help System to Support Nurses Using a Nursing Information System*”. The aim of this research is to identify criteria of an effective online help system (OHS) that will facilitate nurses’ interacting with a nursing information system (NIS). This introductory chapter, firstly, introduces the background for this study. This leads to a discussion of the aim and objectives of the study. Afterwards the research methodology and design is covered briefly. Ethical issues for this study are also stated. Finally, an overview of the thesis is presented.

1.2 Research Background

Nurses have to spend a considerable amount of time documenting the care they give to their clients. In traditional practice, they have to write nursing notes by hand. These notes report on the treatments, medications, procedures, diagnostic tests, care plans and observations about the client’s health and responses to medication. With the emergence of nursing informatics, “the integration of nursing, its information, and information management with information processing and communication technology, to support the health of people world-wide” (IMIA 1998), the documentation process can be automated through the use of standard data entry, reporting forms and checklists that allow a nurse to use various computer interface modalities to quickly enter the information concerning the client. This automated documentation process not only saves time, but also increases accuracy and completeness of data entry and retrieval.

Despite the advantages of computerized nursing documentation systems, it is not commonplace in the current Australian healthcare sector for computer software to be used to ease the documentation burden and work practices of nurses (Yu and Comensolia 2004). On the one hand, one reason is that the usability of healthcare software is often not satisfactory (Gosbee and Ritchie 1997); on the other hand, ineffective user training is the major cause of the problem. This is because shifting from traditional paper-based documentation to electronic documentation requires nurse users to have basic computer skills and to learn a new way of information management (Yu 2005b). When faced with unfamiliar 'features' or functions of an nursing information system (NIS), nurse users require assistance to use the new NIS and get their data recording, retrieval and reporting tasks completed. Therefore, how to help nurses to effectively interact with computer software is vital to the successful adoption of IT into nursing profession (Yu and Comensoli 2004).

An online help system (OHS), which seamlessly bridges the gap between the complexity of the software and users' need for simplicity (Patrick and McGurgan 1993), is one of the best solutions. Online help offers numerous advantages over hardcopy delivery (Duffy et al. 1995), namely, greater availability, easier accessibility, more interaction, increased accuracy and reduced cost.

However, the majority of OHS in the current market is not as helpful as promised. Research evidence shows that an OHS can be unhelpful, even impair users' performance, if content and interface design are not appropriate (Reeves et al. 1996) or if mismatches of information and mismatches of use occur (Duffy et al. 1995), especially for novice users who do not have sufficient technical background to understand the help system designed by highly technical programmers (Galitz 1997). This implies that the designer must understand when users need help, how to give them the help, what information to present and how to present, and so on.

To date no research evidence regarding an effective OHS for a NIS has been reported. To guarantee the successful adoption of NISs by nursing professionals, it is imperative to identify criteria of an effective OHS which targets nurse users. Based on this knowledge, a quality framework consisting of the identified criteria could be developed. The validity of this framework can again be validated through empirical investigations.

1.3 Research Aims and Questions

Based on the above background and assumptions, the aim of this research is:

- *to construct an integrated, quality framework of an effective online help system to support nurses using a nursing information system.*

We first need to specify what we mean by an “effective” OHS. It means that we need to identify the criteria of an effective OHS for a NIS, more specifically, the attributes (i.e. sub-criteria) of each criterion component of an OHS. In order to have a comprehensive picture of an effective OHS, we can investigate these criteria from the quality aspect of an OHS itself as well as from the satisfaction aspect of its users. It is anticipated that this framework can be used as a tool to judge the quality of an OHS written for a NIS, it can also be used to explain what an effective OHS should be.

In order to achieve the above research aim, the following research questions need to be answer:

1.3.1 What Contents should an Effective Online Help System for a Nursing Information System Cover?

As mentioned above, content design is the crucial part in deciding the effectiveness of an OHS (Reeves et al. 1996). Therefore, this aspect is worth investigating. Considering the hectic, intense, interrupted nature of nursing work (Hegney and Plank 2003), the contents of an OHS must be concise but adequate, more specifically, they must be understandable by nurses.

1.3.2 What Structures should an Effective Online Help System for a Nursing Information System Apply to Organize the Content?

Structure means the organization of pieces of contents in an OHS. Well organized contents will facilitate the cognitive process of users solving problems (Dutke and Reimer 2000). Therefore, we must investigate what structures of an effective OHS can help nurses' problem solving.

1.3.3 What Functions should an Effective Online Help System Offer to Nurse-Users?

Not much evidence is available regarding what functions and features an OHS should offer to nurse users, and how sophisticated these functions should be to cater for this cohort of users. Our assumption is that technological sophistication alone does not lead to an effective OHS. Considering this, we need to investigate what kind of features and functions align best with the needs of nurse-users.

1.3.4 What Aesthetics should be Like to Present the Content of an Online Help System to Nurse-Users?

A poor interface design (e.g. visual layout) will increase the effort a user must expend in searching for information (Duffy et al. 1995). Therefore, we must investigate what kind of mechanism can help nurses in searching and understanding helpful information.

1.3.5 How is the Usability of an Effective Online Help for a Nursing Information System Measured?

Usability represents the overall performance of an OHS. A usable help system is one that aids the user in diagnosing and repairing his or her problem with a minimum expenditure of time or effort (Duffy *et al.* 1995). Therefore, we need to identify the indicators of the usability in order to conduct the usability testing of an OHS for a NIS.

1.4 Research Methodology and Research Design

It has been suggested by the previous researchers that a qualitative study should be undertaken when the characteristics of the phenomena are known to exist, yet one wants to be able to describe them more clearly by facts (Cavana et al. 2001). Some characteristics of an effective OHS are obvious, yet the researcher aims to clearly understand and articulate the comprehensive characteristics of an effective OHS for a NIS. Therefore, this research is mainly of a qualitative nature according to the above definition (Cavana et al. 2001), because our research aims at reaching a full understanding of the research phenomenon. To date little or no work has been done in the area of an effective OHS for a NIS. Therefore, the appropriateness of our research methodology is also supported by the argument put forward by Creswell (1998) that

qualitative research is appropriate for a study when the topic is new and has never been addressed in a certain setting or population, or the existing theory does not apply to it.

This study was conducted in two phases: development of a hypothesis framework and validation of the framework (see Figure 3.1). The following sections will briefly explain the design of each phase.

1.4.1 Phase 1: Development of Hypothesis Framework

The qualitative nature of the study leads the researcher to adopt an interpretive approach that is based on grounded theory, whose basic idea is to generate theory from data (Glaser and Strauss 1967). An intensive, systematic literature research was the main approach for data collection at this phase of the study. It paved the way for the development of benchmarking criteria of an effective OHS. This, again, contributed to the development of the final framework. After the completion of data collection through this extensive literature research, a constant comparative method was utilized to analyse and integrate the data. After that, a hypothesized framework was constructed on the theoretical basis derived from:

- understanding the categories of NISs;
- identifying the technical, psychological and social challenges for nurses to use NISs;
- clarifying the context of OHSs;
- analysing the usage problems a user encountered when interacting with an OHS;
- identifying the indicators of an effective OHS.

1.4.2 Phase 2: Validation of the Theoretical Framework

A descriptive framework has been developed as the outcome of the investigation in the first phase. However, as qualitative research understands the phenomena through assigning real-world meaning to them, which may be subjective to the view point of the researchers, the data assembled from the literature review may not be robust enough to support the validity of the framework (Merriam 1998). Therefore, empirical research has to be conducted to verify the validity of the framework in the next phase of the investigation.

Accordingly, an experiment for a particular OHS is the basis of this second phase of the investigation. This is clearly an experimental approach because a particular NIS had to be selected for our OHS; we personally developed the OHS, then we designed usability testing methods to test the OHS by a group of nurses in a semi-controlled environment. The findings of the experiment led to the verification and modification of the theoretical framework developed in Phase 1. Detailed descriptions of the methods of data collection and analysis will be provided in Chapter 3.

1.5 Ethical Considerations

It is the compulsory procedure that any research involving human participants needs to be approved by the Human Research Ethics Committee (HREC) before the data collection commences. This research project is one component of a big research project that has been granted approval (the ethics number is HE03/385) by the HREC in the University of Wollongong. The researcher has maintained the highest level of participants' rights, liberties and safety in complying with the terms of the National Statement on Ethical Conduct in Research Involving Humans 1999.

1.6 Thesis Overview

This thesis consists of six chapters. Following this introductory chapter, Chapter 2 reviews extensively the issues related to OHS for a NIS, including categories of NISs, socio-technical challenges for nurses to interact with NISs, and sets the context for researching OHSs. Chapter 3 outlines the research methodology, the process of the study and also justifies the suitability of the selected research methods. Chapter 4 presents the results drawn from the process of analysing the data gathered from the extensive literature research. Chapter 5 presents the research results and findings of the experiment. Chapter 6 provides an in-depth interpretation of the final research findings and concludes the outcome of the study – an integrated, quality framework of effective online help systems to support nurses using nursing information systems. It also addresses the limitations of the research. Finally, future research directions are suggested.

Chapter 2 Literature Review

2.1 Introduction

This chapter discusses the issues of concern to the research topic, including the factors impacting on nurses' use of nursing information systems and critical success factors for online help systems. It begins with an introduction on the contemporary need of nursing information systems and the challenges in training nurses to use a nursing information system. The previous findings about how nurses learn to use computer-based clinical applications and the common barriers they face are reviewed. This includes an investigation of the technical, psychological and social factors contributing to nurses' learning process.

Afterwards, an extensive review of the issues regarding online help systems is followed. This includes a review of the evolving definitions of online help, a comparison of the effectiveness of various types of online and paper-based help strategies, and a summary of the types of assistance and facilities offered by online help. A brief review of the research history of online help is provided, which suggests that the research on online help for health information systems is limited. Different views about why online help does not deliver its expectations are also examined. Finally, the problems that a user often encounters in interacting with online help are analysed.

2.2 A Contemporary Need for Nursing Information Systems

Today, Information and Communication Technology (ICT) plays an increasingly important role for health care service delivery. The health care sector increasingly views

ICT as a fundamental asset in providing health-related information services and decision support on demand (Coiera 2003). Nurses, as an important provider of health care, are rapidly increasing their use of ICT solutions to support their execution of increasingly sophisticated and complex duties (Hannah *et al.* 1985; Saba 2001).

A Nursing Information System (NIS) supports the use and documentation of nursing processes, activities, and provides tools for managing the delivery of nursing care (Hendrickson 1993). As Hebda *et al.* (2005) summarize, an effective NIS must accomplish two goals:

- to support the way that nurses function, allowing them the flexibility to use the system to view data and collect necessary information, provide quality client care, and document the client's condition and the care that was given;
- to support and enhance nursing practice through improved access to information and tools.

The specific set of elements of a NIS will be unique to each particular institution depending on the structure, size, and resources of the organization (Ball *et al.* 1995). However, a NIS model refined by Axford (1998) may be a useful tool for understanding common components, interrelationships, and purposes of information for nursing as a profession. According to Axford (1998), there are four common types of NISs:

- *Financial/Administrative systems* deal with such functions as cost accounting, receivables, payables, the general ledger, payroll, and property management.
- *Decision-support systems* assist management in the analysis of data produced by other computerized systems, such as diagnostic related group analysis, medical

records abstracting systems, incident reporting, workload management, and roster systems.

- *Clinical/departmental systems* assist a clinical department such as pathology, pharmacy, etc., with its information management and may serve any or all of the following functions for a specific department: planning, scheduling and documentation of services and quality monitoring and. These clinical systems can be seen to mirror nurses' unique professional needs and functions within hospitals: managing the patient environment and providing direct nursing care.
- *Office automation functions* are a key part of a NIS. These functions include word processing of supporting documents like policies and procedures, electronic scheduling, diaries and email. Now the nursing manager is more aware than in the past of the immediate value of inexpensive and accessible word processing, database management, spreadsheet and graphic applications.

2.3 A Need for Training and Supporting Nurses to Use Nursing Information Systems

It has been shown that an effective NIS could not only save nurses' time in entering and retrieving client data, but also increase accuracy and completeness of such data (Ball *et al.* 2000; Hersher 2000). However, the adoption of NISs is not common in the current Australian healthcare sector (Gosbee and Ritchie 1997; Hunt *et al.* 2004). One of the reasons is that shifting from the traditional paper-based documentation practice to electronic documentation practice requires nurses to have basic computer skills, and a certain level of familiarity with a particular NIS. It also brings in a substantial change of their practice of information management (Yu and Comensolia 2004). Many managers

are increasingly aware that end user training and support is an essential strategy to establish nurses' capabilities in using an NIS (Gjestland *et al.* 1997; Huang 2002).

On the other hand, computer applications are growing in complexity, for example, Baecker *et al.* (2000) identified three aspects of software complexity, i.e. functional complexity, data complexity and the complexity in learning about software. Even the most user-friendly software is not always easy to use. Users will require additional help in using software regardless of how much effort designers put into trying to make the interface transparent. Further, it is difficult to conceive of an interface that is transparent to users with different conceptualizations of the tasks they are attempting to perform (Duffy *et al.* 1995). This is specially the case for nurses who have different levels of documentation tasks. Certainly there must be additional help available to link nurse users especially when faced with an unfamiliar task. A field study observed how users handled errors during computer-supported office work (Brodbeck and Zapf 1993). The study found that in approximately 11% of all corrected errors the users needed external support, although they had considerable computer experience and task knowledge. On the other hand, this additional help reduced the errors caused by design flaws to improve the usability of software (Turk 1996; Galitz 1997).

Therefore, significant investment has to be made in training the nurse user population. Any failure to do so will cause staff's frustration and a sense of threat by the new system. In an extreme situation, the frustrated staff may even reject the new system or quit their job (Coiera 2003). This, in turn, will lead to the failure of system implementation. On the other hand, effective training and support, and rapport between the trainer and nurse trainees will increase nurse's interest and confidence in the new NIS that is being implemented (Hunt and Sproat 2004).

2.4 The Barriers for Nurses to Learn to Use Nursing Information Systems

In order to design effective training strategies to train nurses to use an NIS, it is essential to analyse and understand the barriers for nurses as a healthcare profession, as well as computer learners and users. In this section, a list of the barriers from the facets of technological, sociological, cultural, and organizational perspectives is summarized by extracting from reported research evidences. These barriers include the current status of nurses' computer and information literacy, the gender issue, the time-pressed shifts and heavy workload of nurses and nurses' attitudes to technology. The following subsections will examine these barriers in detail.

2.4.1 Nurses' Computer and Information Literacy

Basic computer literacy and information literacy are prerequisites for a person to learn to use computer-based information systems. If both literacy are not satisfactory, they could be a barrier to using information systems. The definition of nurses' computer and information literacy and their importance are first introduced in this section, and the current status of nurses' computer literacy is then presented.

2.4.1.1 The Definitions of Nurses' Computer and Information Literacy

Definitions of computer literacy and information literacy are evolving. The definitions given by Hunt and Sproat (2004, p 25) are tailored to the nursing profession:

“Computer literacy skills include using word processing, database, spreadsheet and e-mail messaging applications, as well as patient care documentation applications. Information literacy skills include being able to recognize what information is needed, when it is needed, and in what form it is needed and to be able to locate, evaluate, use and understand the social issues surrounding the use of information.”

Essentially, computer literacy is concerned with a person's capability to use a computer; whereas information literacy is concerned with a person's capability to search, access information and perform advanced information processing.

The importance of including ICT skills in nursing practice is well supported in the nursing literature. In her prediction of the future of nursing, Saba (2001) advised that ICT must be part of professional nursing practice. Bakken (2001) stated that informatics competencies are essential building blocks for evidence-based nursing practice. Many researchers have documented the importance of preparing nurses for informatics practice (Gassert 1998; McNeil and Odom 2000; Staggers and Gassert 2001).

2.4.1.2 The Current Status of Nurses' Computer and Information Literacy

A series of recent studies has indicated that the computer related skills of nurses are not satisfactory. Staggers and Gassert (2001) defined a concept of nursing informatics competencies. They believed that the valid and comprehensive nursing informatics competencies are currently lacking. A U.S survey revealed that nurses can use e-mail effectively and operate basic Windows applications, however, they lack the critical information technology skill such as searching databases (McCannon and O'Neal 2003). McCannon and O'Neal (2003) believe that the most critical information literacy skill is the knowledge about some nursing-specific software, such as bedside charting and computer-activated medication dispensers. Another survey indicates that the majority of nurses are at the novice or advanced beginner level in their use of information technology tools and skills, such as word processing, bibliographic retrieval, and graphics presentation software (McNeil *et al.* 2003). This is also the case for the nursing student. Cole and Kelsey (2003) raise the issue that there are clearly deficits in both computer and information literacy levels in the undergraduate student group. All of these studies recommended that the computer trainers should understand nurses' levels of computer and information literacy before designing effective training programs for them.

2.4.2 Gender

Gender has a significant influence on a learner's willingness and ability to respond to and make use of the teaching-learning situation (Barreffi and Lally 1999). The vast majority of nurses are women. Although the research evidence is not conclusive in regard to Barreffi and Lally's (1995) argument, it seems that women may be less enthusiastic than men in embracing new computer-based innovations in general. Though no significant difference was found in proficiency levels, men were found to use online media more often than women (Ono *et al.*, 2003). Women tend to be passive learners, sometimes may even openly express their anti-computer attitude (Grundy 1996). It appears that women, as a gender, is more disadvantaged than men in using computer technology in general (Washer 2001). This difference has nothing to do with physical access but is more likely to be culturally related. This different attitude towards computer technology between male and female has obvious implications for developing training strategies that teach nurses to use computers, as the success of a training program relies, to a certain extent, on how users respond to technology.

2.4.3 Lack of Time and Heavy Workload

To ensure a new NIS is fully utilized, obviously users need to be trained and know how to use its functionalities. Unfortunately, time is pressed and resources is scarce, which means training is often rushed or not undertaken at all (Coiera 2003). It is particularly the case for nurses who have extremely heavy workloads. There are numerous recent studies investigating the nurses' workload issue (Nuikka *et al.* 2001; Hegney and Plank 2003; West *et al.* 2004). A recent survey undertaken in Queensland required nursing respondents to assess the level of their workload using a seven-point Likert scale (Hegney and Plank 2003). Participants' overall comment was "extremely heavy workload". More than 50% of the nurses in the aged care sector selected this response, much more than

those in either public or private sectors (see Fig 2.1). Nurses in all sectors provided qualitative comments to express their dissatisfaction with workload, using the terms “too much work” and “high patient loads” to describe their current workload. Therefore, it is difficult for nurses to find time to learn how to use new NIS. The hectic, intense, interrupted nature of nursing work and lack of time in the workplace were thus identified as a major barrier for them to learning to use a particular NIS.

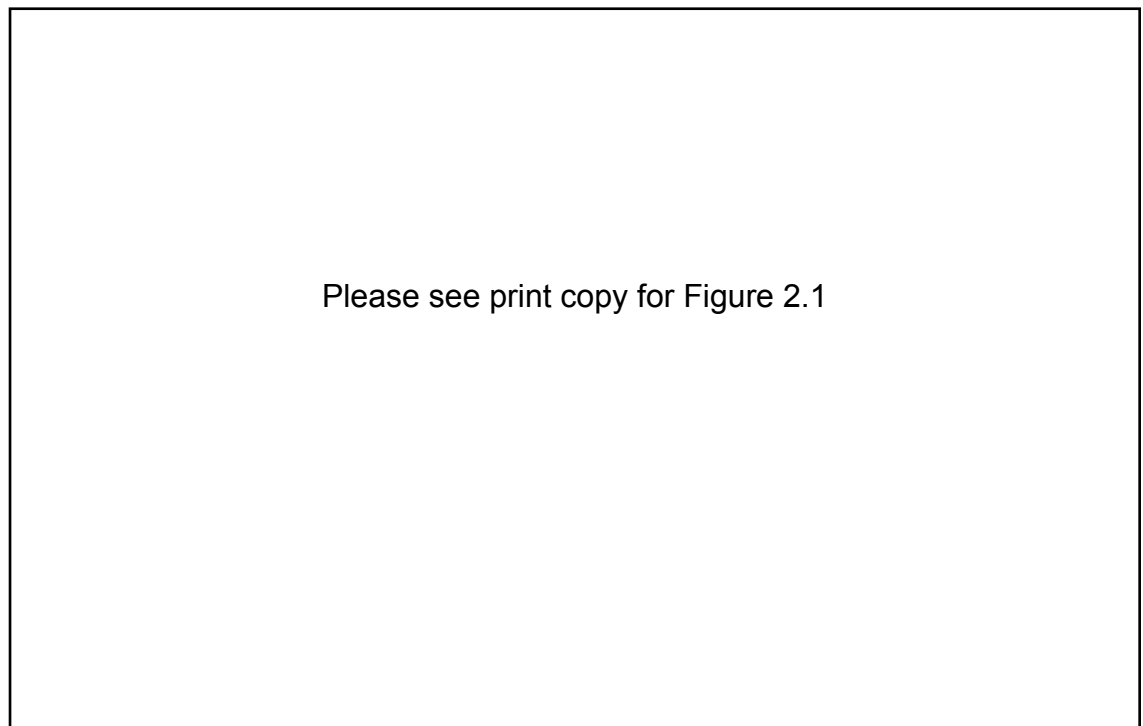


Figure 2.1 Heavy or light workload: comparison across sectors (Hegney and Plank 2003)

2.4.4 Nurses' Attitudes towards IT

Nurses' attitude towards IT directly influences the way in which they interact with computers (Burkes 1991). Anxiety, fear, apprehension and dread are the words often used by nurses to describe their feelings at the beginning of learning to use computers (Kenny 2000). Similar conclusions were reached in observing registered nurses' experiences of learning web-based systems (Atack 2002; Atack 2003). These studies found that nurses felt frustrated and overwhelmed by technology at the beginning of their interaction with

computers. Making things worse, some nurses reported that they did not like to contact the technical support staff because they did not know enough to ask for help or were afraid they would not understand the advice that they would be given. Essentially, almost all participants identified a huge gap between what they expected to get in computer skill training and what was actually provided. This result reflected a phenomenon found by Lawton (1997) that the novice faces a steep learning curve in the early stages of web-based learning.

2.5 Various Training and Support Mechanisms to Help Nurses Learn to Use Nursing Information Systems

The above-mentioned socio-technical barriers to nurses interacting with computers need to be taken into account in designing an effective training strategy. Lawton (1997) suggested that adequate planning and preparation are essential in training delivery so as to reduce the learners' anxiety and improve their learning experience. Moreover, the learning environment must be encouraging. An effective training and support mechanism should have the capacity to provide timely, effective, efficient and enjoyable learning experiences to the nurse users of a new NIS (Gjestland *et al.* 1997; RadhaKanta and Vincent 2005). In other words, it plays the role of closing the gap between the complexity of a NIS and nurse users' cognitive capacity to master it. Yu *et al.* (2004) suggest that how to help nurses to effectively interact with NISs is vital to the successful adoption of IT into the nursing profession.

Various training methods have been practiced to help nurses to learn computer applications, including:

- Traditional classroom-based instruction (Worthington and Clay 1995)
- Computer-based training, which can be self-paced and interactive (Dev 2001)

- Just-in-time performance support systems (Reeves *et al.* 1996)
- E-learning (training via the Internet) (Harun 2002)
- Audio-based and video-based training (Parer 1987)
- Print-based documents (Chang *et al.* 2002)
- Teleconferencing (Buch and Bartley 2002).

Most of these methods can be adapted into passive or interactive, teacher-led or self-paced modes. Among them, an approach of just-in-time performance support system, i.e. an effective Online Help System (OHS) embedded in a NIS, which seamlessly bridges the gap between the complexity of the NIS and users' need for simplicity (Patrick and McGurgan 1993), is one of the best and most cost-effective solutions. The following section will review the contemporary issues in OHS.

2.6 Online Help Systems

To reiterate, an effective Online Help System (OHS) could be one of the best solutions to helping nurses interact with an NIS. An extensive review of the research field of OHS is elaborated in this section to provide the context for this study. The evolving definition of online help is first introduced, followed by the comparison between online and paper-based help. Further, a summary of various types of assistances and facilities is provided. A brief review of the history of research in this field is also addressed, including reviewing its applications in e-health information systems. Different views about why online help does not delivery its expectations are also examined. Finally, the problems that a user often encounters in interacting with online help are analysed.

2.6.1 Evolving Definitions of Online Help Systems

In the 20th century, it was commonly recognized that training, often in the form of direct instruction, should always come before performance. This mental model of the relationship between training and performance is still prevalent across business and industrial sectors (Reeves and Raven 2002). Online help is a thriving industry of its own. Although the history of online help is obscure, there must be someone who wrote a computer program for use by others, who had to produce a help system to assist the end users to use that program shortly after its distribution (Bergman and Moore 1985). Online help has become an integral part of computer applications today, and most software is no longer distributed with heavy and costly paper manuals.

There are various definitions of OHS in literature. Duffy *et al.* (1995) defined online help as “the online delivery of performance-oriented information”. This definition emphasizes the task-oriented and problem-based features of an OHS. It is the information presented online that is designed to answer the question “What should I do?” The functions of an OHS (e.g. search engine, hyperlinks, index search and so on) are to facilitate end users to complete their tasks using an application. Turk (1996) and Galitz (1997) further stated that online help is intended to improve the usability of an IS and reduce the errors caused by design flaws and accommodate individual differences among users (e.g., novices, intermediates and experts). This definition highlights the tight relationship between online help and its embedding IS. In other words, online help must serve for the usability of its IS. More recently, Kantner *et al.* (2002) gave a more comprehensive definition of online help, which is a combination of learnability, ease of use, usefulness and pleasure. It is clear that online help needs to concern the learning needs of the end users and bridge the gap between the complexity of the software and the end users’ need for simplicity (Patrick and McGurgan 1993).

2.6.2 Online versus Paper-based Help

Assistance to the end user may be provided through a variety of media. Most common methods are delivering information online or in paper-based form. Understanding the difference between these two modes of delivery is essential for the designers and researchers of online help. In general, the physical differences between paper-based and online support systems are related to the resolution, display area, aspect ratio, and presence (see Table 2.1). There are also the rhetorical differences that are related to organizational, navigational and contextual structures (see Table 2.2).

An important difference noted between online help and hardcopy manuals was ontological difference (Abdullahi and Alty 1998). In other words, because of their familiarity with the physical feature of a paper, the hardcopy form gains users' preference. For example, online help information on a computer screen cannot be as easily browsed as a hardcopy manual. Hardcopy books can also provide more contextual information that can promote deeper reading comprehension. On the other hand, users can give queries to the online help systems, to which the system may give an unintelligible reply or absolutely no reply. Thus the user may make many attempts before a successful hit, which is discouraging (Turk 1996).

In order to overcome the above-mentioned ontological difficulties, online help is now providing more "book-like" features such as running page headers and footers on topic pages (Kantner *et al.* 2002). In addition, careful information design, thorough testing of possible task-oriented paths through the information, and clear pointers to the relevant information about a topic can give users a sense of control.

Table 2.1 Physical differences between print-based and online text data presence (Selber *et al.* 1996)

	Paper	Screen
Resolution	70-1200 dots per inch	50-100 dots per inch
Display area	Generally larger	Generally smaller
Aspect ratio	Generally taller than wide	Generally wider than tall
Presence	Physical Static Immutable	Virtual Static Dynamic Interactive Mutable

Table 2.2 Rhetorical differences between print-based and online mechanism (Selber *et al.* 1996)

	Paper	Screen
Organizational	Linear Familiar Hierarchical Logical/deductive Fixed	Linear and nonlinear Familiar and unfamiliar Hierarchical and non-hierarchical Logical/deductive Associative and dynamic
Navigational	Familiar Limited Static	Familiar and unfamiliar Robust Static and dynamic
Contextual	Generally rich	Generally poor

Although challenging, it is possible for an OHS to offer numerous advantages over hardcopy delivery. Duffy *et al.* (1995) summarized the possible advantages of a “good” OHS:

- *Greater availability*: as network and portable computers become more prevalent, online information can be a reliable assistance for any software package.

- *Easier accessibility*: OHS can provide easy access to the relevant information, especially in cases where that information might span many volumes of hardcopy documentation.
- *More interaction*: In an online environment, both the users and the system can interact with each other.
- *Increased accuracy*: hardcopy documents require much longer production cycles. Moreover, documentation and system updates are more easily conducted for online documentation.
- *Reduced cost*: in general, online information is less expensive to store, reproduce and distribute. The reproduction is also more easily accomplished for electronic information than for the printed one.
- *Multimedia and AI*: online information can be exploited through multiple media, for which processes techniques from Artificial Intelligence (AI) can be applied.

2.6.3 Types of Assistance and Facilities Provided by Online Help

Online help provides a range of assistance and facilities, from simple command assistance to elaboration and detailed tutoring, from passive facilities to active intelligent help. The types of assistance provided by online help are summarized as followings.

- *System status displays*: provide system parameters, e.g., swapping ratios or system performance metrics (Relles and Price 1981).
- *Question assistance*: explains a displayed question or prompt (Relles and Price 1981).

- *Command assistance*: is the most common type of assistance provided by an online help system. It is usually accessed by issuing a HELP command, pressing an explanation key, or typing a question mark (Houghton 1984).
- *Error assistance*: error messages are usually very brief and frequently need further clarification (Houghton 1984).
- *Menu assistance*: lists allowable commands based on the user's current status on the system (Houghton 1984).
- *Prompting*: instead of issuing an error message, some systems attempt to assist the user when an incomplete or incorrect command is detected (Carroll 1985).
- *Example presentation*: provides an example of correct or valid input (Goodall 1993).
- *Online tutorial*: the most difficult problem for new users is simply getting started. What new users need is a step-by-step tutorial with exercises that allow them to try out various commands (Selber *et al.* 1996).
- *Online documentation*: this approach is simply to make traditional user documentation available online (Selber *et al.* 1996).
- *Wizards*: break apart help procedures and present one step per page, providing extensive information about each step, so the user need not consult additional help to complete the task (Burton *et al.* 1999).
- *Embedded help*: is an attempt to provide help to the task at hand, although not truly embedded in the application's interface (Ames 2001).

- *Animation icons*: icon present functions, e.g., Microsoft Word (Baecker 2002).
- *Screen capture presentation*: allow a visual documentation specialist to select a region of a screen, to mimic a user's interaction with a program, and to capture an animated portrayal of that interaction (Baecker 2002).
- *Structure video*: is a "just-in-time" digital video presentation that demonstrate the software and show the users how to accomplish the desired tasks (Baecker 2002).

Online help also offers various types of facilities. They generally differ in the way how to help the users to identify a topic and how much information they contain. They range from simple systems with a single help display to complex systems.

- *Diagnostic help*: attempts to identify users' needs and supply information to meet those needs (Shapiro and Kwasny 1975). Help commands should be more user-oriented, allowing the user to describe in their own terms what they want to do. To diagnose users' needs, such systems typically engage users in a dialog.
- *Reference summary*: in using reference summary, a user selects help in a single action, and the help displayed is a short summary of the commands and options available (Horton 1990). This kind of summary overcomes the complaint of many users that it takes too long to find what they are looking for. Through removing irrelevant information and customizing documents for specific groups of users performing common tasks, and highlighting key points, the "summary" facilitates the user to find the relevant information.
- *Reference topic*: enables the user to select a specific topic on some specific subject (Sondheimer and Relles 1982). A user may do this in a single step when requesting help, typically by entering the title of the topic. For those users who request a topic by

name, the prerequisite for the success of the operation is to know the title of the available topics. A partial solution is to display a list of available topics when the user first requests help and let the user select from this list. Some reference topic help facilities display a list of topics.

- *Context-sensitive help*: the help provided to the user is related to where the user is in the program when the help is requested (Danielsen and Farrand 1993). If the user is executing a particular command, he/she would like to get help on that command. If an error has just occurred, then an explanation of that error will be given.
- *Active help*: facilities just-in-time correction if it is detected that the user appears confused or lost. For example, on many UNIX systems, if the user mistypes a command, the system displays a short message about the correct format for the command (Carey *et al.* 1992). More sophisticated systems maintain models of the user and the user's goals. The system will watch for actions by the user that clearly do not further those goals. Through detecting such "suboptimal behavior", active help can get the user back on track (Phelps 1997).
- *Component-oriented help*: allows users to extend or replace monolithic applications using components, software plug-ins that handle specific kinds of data and can be used to add functionality to documents (Sleeter 1996). With the support of the components, users can easily create multi-media documents by adding document components that handle the different data types (Chamberland 1999).

2.6.4 The History of Research on Online Help

Early research on online help focused on design elements such as the formatting of the text and the presentation of the text. Most of these were derived from the hardcopy format (Price 1988). Some researchers agreed that online information must be scannable, using list or tables instead of paragraphs whenever possible (Brockmann 1990; Coleman 1991). Another common finding was that highlighting for emphasis must be used consistently and carefully (Cherry 1989; Galitz 1989). These guidelines seemed like common sense to writers, as they built upon the print paradigm.

As the research continued, the navigational aspects of online information came under scrutiny (Smith 1994). However, there was not much research on how users actually use these functions to find information in online help. A great deal of research was focused on the use of hypertext to connect help panels together (Duffy *et al.* 1995). On the other hand, more and more researchers started to focus their efforts on the technology behind OHS instead of the text within the help panels (Selber *et al.* 1996; Turk 1996). Turk (1996) suggested that online help should not just be a repeat of the book's information online. The information it provides should be modular, concise and precise to the task at hand.

With the rapid development of high technology like AI (Artificial Intelligence) technologies, more researchers advocated *active online help* (Phelps 1997; Westendorp 1997; Skuce 2000), namely, matching users' knowledge model through applying AI. This cohort of researchers tried to improve knowledge storage and retrieval. Unfortunately, the technologies they developed were highly complex and fragile, but without sufficient payback, because novice users rarely possess sufficient technical background to interpret the help systems designed by highly technical programmers (Galitz 1997).

More recently, some researchers have focused on applying Carroll's minimalism (1990) and other learning theories (Hackos 1997; Dutke and Reimer 2000; Meij 2000; Foster 2002) to investigate effective online information. The principles of minimalism introduced by Carroll (1990) are:

- Focus on the user's need
- Ensure ease of access to the right information
- Provide just the right words and graphics to ensure successful performance
- Emphasize troubleshooting and correcting mistakes
- Provide for both novice and expert users through layering.

These researchers emphasized the more intrinsic side of OHS, i.e., performance-support and user-based. After all, supporting and improving user performance with software is the final goal of effective online help.

2.6.5 Online Help for e-Health Applications

The challenge of teaching nurses to use a new NIS is how to provide an effective training and support program (Kenny 2000). It was because of the problems of OHS itself, or cost issues, or not recognizing the effect of OHS, that somehow there are only limited OHSs for e-health applications. For example, the division of biomedical informatics at Cincinnati Hospital Medical Center offers OHS for a range of medical IS (see Figure 2.2). These online help facilities are diverse, including online tutorial, animation demo, task-based content, and graphic illustration. Online evaluations are provided as well to improve its effectiveness.

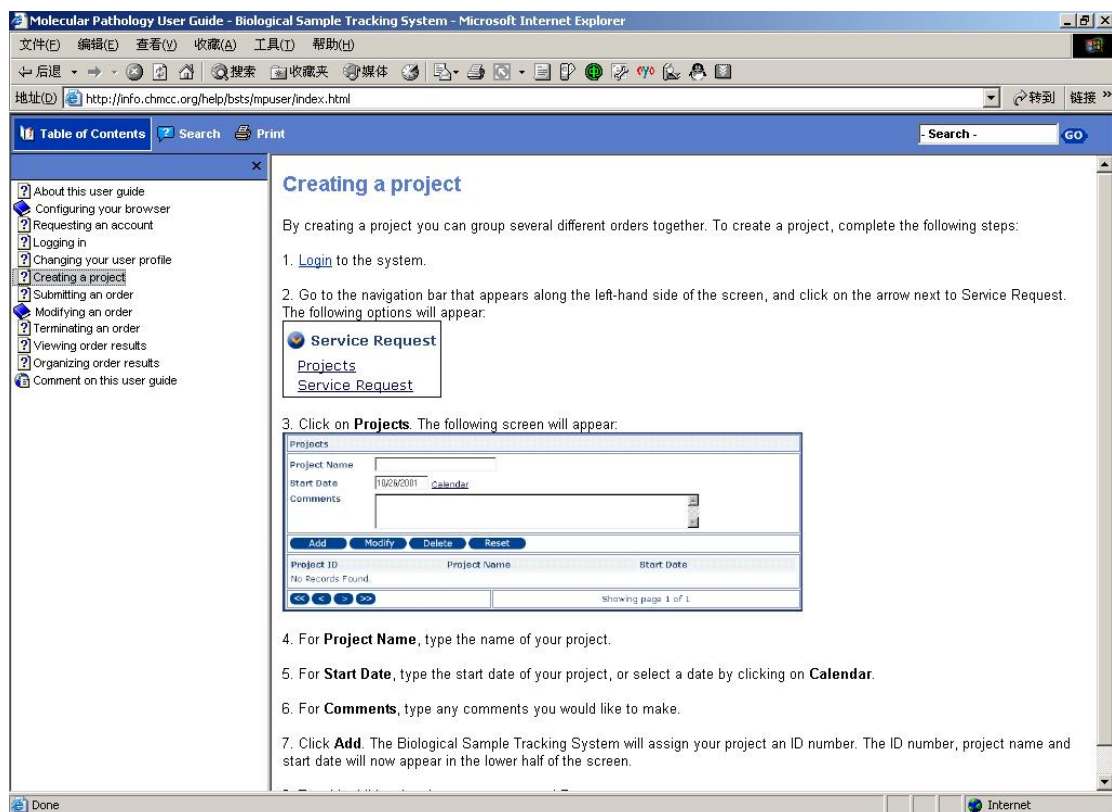


Figure 2.2 Affymetrix OHS (from <http://info.chmcc.org/help/bsts/mpuser/index.html>)

2.6.6 Is Online Help always Helpful?

Unfortunately, few people find online help particularly helpful, even when an OHS provides presumably friendly cartoon-like characters such as the *Office Assistant* that appears in the shape of a paperclip with eyes in the *Microsoft Word* word processing software (Grayling 2002). ZDNet (<http://www.zdnet.com>) has a page devoted to “How to kill Clippy”, the unofficial nickname for the annoying animated *Office Assistant*. *Microsoft* company thus developed a downloadable quiet logo to replace *Clippy*. This clearly shows that *Clippy* has not achieved its purpose, otherwise *Microsoft Office* would not have spent so much effort on eliminating or replacing it.

Why is online help not helpful? Carroll (1990) stated that “Problems are embedded in scenarios of behaviour and interaction; they occur in the context of personal goals,

personal understandings, and personal confusions.” Carroll (1990) attributed the failure of the traditional systems-style instruction to its provision of an un-imaginative sequence of exposition, practice, test, feedback, and remediation that was removed from the real needs, desires and experiences of people. Carroll (1998) proposed an alternative approach, called “minimalist design”, which was focused on helping people with the unique, personal problems they encounter with working with information technologies. More recently, Carroll (2000) recommended that computer applications and help systems be designed on the basis of scenarios that are detailed, realistic stories of what people want and need to accomplish when using an IS.

In addition, Duffy *et al.* (1995) recognized two areas of mismatches: *mismatches of information* and *mismatches of use*. According to their work, a mismatch of information occurs when the designer does not effectively anticipate the information that users want to find. A mismatch of use occurs when the designer does not provide an effective means for users to find information and apply it to the application. These imply that the designer must characterize the knowledge of users and understand their need for information, how to give them easy access when they need it and what to present to them. In addition, Abdullahi *et al.* (1998) revealed that even experienced users find some aspects of existing OHS difficult to use. They identified three problems with online help: ontology, compartmentalisation, and lacking an integrated base. Firstly, there is a problem of access, i.e., the ontological problem. Users, especially novices, cannot find the right term to express their problems in using the systems. The second problem is compartmentalisation, i.e., although some cross linking is provided, it often confuses. A high level linkage can be very confusing and tiring for the end user to follow. The third problem is the lack of an integrated base of information. The provision of such a base would enable the users to get around the ontological problems by having access to a rich set of terms in the context in which they can process, skip, or reread until a suitable match is found.

2.6.7 Users' Interaction with Online Help System

To design a user-centered OHS that solves the users' usage problems with NIS, the best approach is to understand the way in which a user uses a particular OHS because this determines the success of the OHS. Duffy *et al.* (1995) outlined eight steps conducted by a user when he/she interacts with an OHS. A model based on the work of Covi (1995) and Duffy *et al.* (1995) is built to illustrate this interaction (see Figure 2.3). Basically, when a user has a problem using a specific IS, he/she will access its OHS (Step 1) for information about the problem. When entering the environment of the OHS, the user expresses the problem in his/her terms (Step 2) based on his/her understanding of the problem and familiarity with the system. Afterwards, the user inputs his/her query in the dialogue box provided by the online help (Step 3). The job of selecting information is handled by the search engine of the online help. This selecting process involves understanding the semantics of the user's query and matching that stored in the database of search queries. Searching for the relevant information that matches the user's query is a critical component of the online help, because this function directly relates to the success or failure of the user's attempt to locate the help function. If the selection is successful, a list of relevant information will be presented to the user. The user can further browse (Step 4) to locate the targeted information (Step 5). If this action fails, the user may try to express the problem in another query. If the user obtains the information he/she needs, he/she will read through the instruction (Step 6), otherwise he/she will try another search with a redefined query. After understanding the information, the user also needs to ascertain whether the solution is helpful or not. In the best scenario the user transfers the helpful information to his/she operation on the system (Step 8). In the worst case, user finds the online help is not helpful and gives up using the system.

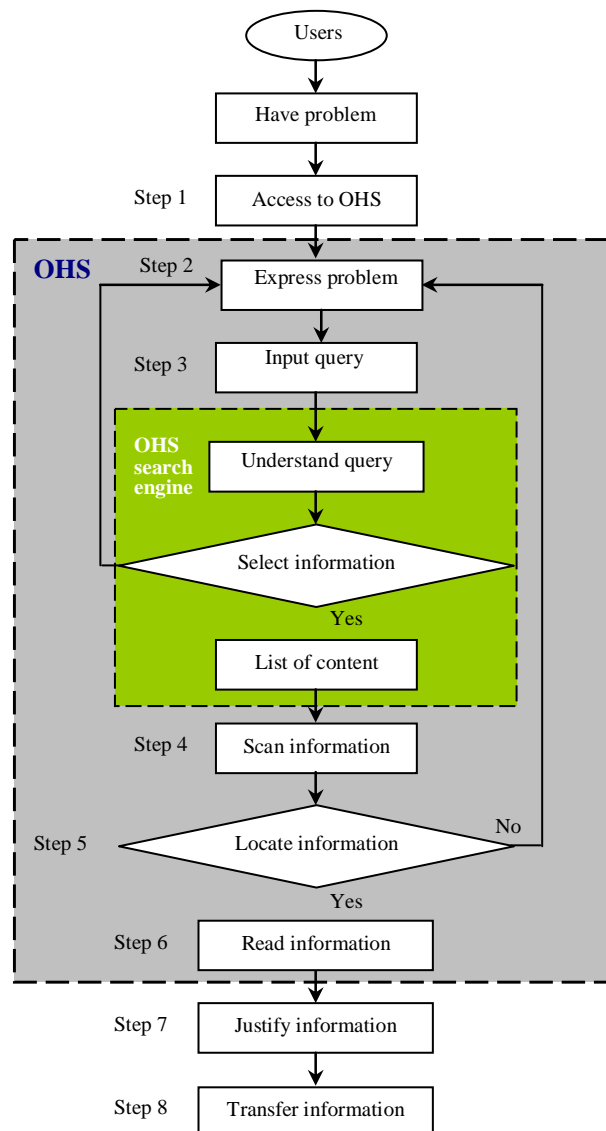


Figure 2.3 A model of a user's interaction with an online help system

2.6.8 The Possible Problems a User May Encounter in Interacting with an Online Help System

In the model of a user's interaction with an OHS depicted in section 6.8, the main problems a user may encounter in the process can be summarized as follows:

- a gap between a user's conceptual model and functional instruction provided by an OHS;
- problems of search engine function; and
- ineffectiveness of help information.

Detailed explanations of these problems are provided in the following sections:

2.6.8.1 A Gap between a User's Conceptual Framework and the Instruction Available in an Online Help System (in step 2 and 4):

A common failure of an OHS is a mismatch between a user's conceptual framework to the available instructions provided by the OHS (Quesenbery 1999; Krull *et al.* 2001). Facing an unfamiliar task in an IS, the users often find that they do not know how to express their problems. They may even find it difficult to identify the relevant information. This is especially the case for the novice users who lack experience with the software (Lawton 1997; Sein *et al.* 1998).

2.6.8.2 Search Engine Problems (step 3)

A possible serious problem for an OHS is its potential failure to understand the semantics of the user's query (Hackos 1997; Krull *et al.* 2001). An observation conducted by Roesler *et al.* (1997) found that only 32% of help requests given by users can be answered or found in OHSs. This explains why there are so many complaints made by the end users about their frustration in searching for help information. Krull *et al.* (2001) found that even when help information is displayed, it often contains too much information as search queries have produced a very large number of hits; therefore, the users are confused and do not know which information is the most relevant to their problems. The big table of contents and high hierarchy of the help can cause confusion as well, because users often have difficulty navigating successfully from the top of the table of contents to the bottom where the desired procedural information is found. Afterwards, the users are faced with

the problem of scrolling through the login list of hits to determine which item is the most relevant one for their needs.

2.6.8.3 Poor Quality of Help Information (step 6)

Sometimes, even though a user has located the help information he/she needs, he/she is still overwhelmed by the amount of redundant information presented to him/her. Besides, help topics are often expressed in product-specific vocabulary rather than user vocabulary ((Krull *et al.* 2001). In regard to the media for the presentation of the help information, a series of studies indicates that a combination of text, graph, audio and video can assist a user to understand help information more effectively and efficiently (Baecker *et al.* 2000; Baecker 2002).

Apart from the above possible problems with an OHS, users rarely possess sufficient technical knowledge to understand the OHS designed by the highly technical programmers (Galitz 1989). Take proactive help as an example: it provides a list of potential questions to a user to select before the user requests help (Ames 2001). If this kind of help fails to exactly anticipate the user's problems, it will block the user's view of the application problem that he/she is seeking to solve, as in Microsoft office's *Clippy*.

2.7 Summary

In this chapter, the benefits of NIS are first reviewed. The main effect of NISs is that they could facilitate the use and documentation of nursing processes, activities, and provide tools for managing the delivery of nursing care. However, significant investment has to be made in training and supporting the nurse user population. In addition, additional help is needed when nurses are facing unfamiliar tasks.

In order to understanding the difficulties a nurse user may encounter when learning to use a new NIS, a list of the social-technical barriers is also summarized. They are insufficient computer and information literacy, gender issues, time-pressed shifts and the heavy workload of nurses and nurses' attitudes of technology. These barriers should be taken into account in designing an effective training strategy. Contemporary training and support strategies are examined accordingly. Among them, an effective OHS could be one of the best solutions, which is also the subject of this study.

To date, substantial research has been conducted in OHS. Research in this field has shifted from hardcopy paradigm to technology based. Now the focus should be placed on effective online help, which is more subject to its intrinsic features. However, there are significant challenges in users' interaction with an OHS. These include a gap between a user's conceptual knowledge framework and the instructions provided by the system, search engine problems and the low quality of help information. The factors that contribute to the failure of online help also include some problems in contextual and technical design, particularly for novice users. The objective of this research is to identify the indicators of an effective online help system for the purpose of designing a quality framework of an OHS. The detailed research methodology will be discussed in the next chapter.

Chapter 3 Research Methodology

3.1 Introduction

This chapter defines the research methodology for this study and justifies them. The organization of the chapter is as follows: Section 3.2 briefly reviews the research objectives and questions. Section 3.3 justifies the qualitative nature of the research, and gives a brief overview of two research phases and the qualitative methods used for investigation in each phase. In the first phase, a preliminary framework according to the grounded theory approach was proposed. To verify the validity of this framework, in the second phase, a multi-method experiment was designed. The research methods and approaches in each phase are detailed in Section 3.4 and Section 3.5 respectively. The techniques used for data collection and analysis in both phases are also addressed. Section 3.6 will explain the process for acquiring ethical approval. The chapter finishes by outlining the timeframe for the study.

3.2 A Brief Review of the Research Aim and Questions

The aim of this research is to develop a quality framework for an effective online help system (OHS) to facilitate nurses' learning processes of a nursing information system (NIS). This requires identifying the key indicators for an effective OHS. Once the framework is developed, it can be used to assess the quality of an OHS for a particular NIS. To achieve the aim of the research, the following research questions are posed:

- *What content should an online help system for a nursing information system cover?*

- *What structures should an online help system for a nursing information system apply to organize the content?*
- *What functions should an online help system offer to nurse users?*
- *What aesthetics should be like to present the content of an online help system to nurse-users?*
- *How is the usability of an effective online help for a nursing information system measured?*

3.3 The Qualitative Research Methods in this Study

Creswell (1998) suggests that qualitative research is appropriate for research when the topic is relatively new and has hardly been addressed within a certain setting or sample, or existing theory does not apply to the particular sample under study. To date, little to no work has been done in the area of OHSs for NISs, so a qualitative method is suitable for this study.

In order to achieve the research aim, this study took a two-phased approach. The two phases are:

- **Phase 1:** development of a quality framework
- **Phase 2:** validation of the proposed framework

Two qualitative research methods were applied (see Figure 3.1): the grounded theory approach that guided the development of a quality framework (phase 1) and a multi-method experimental approach to validating the proposed framework (phase 2). The experiment involves the process of plan, design, implementation and evaluation of an OHS for an authentic NIS named Care Planning Assessment Tool (CPAT, owned by

Hammond Care Group). The following sections will first review the grounded theory approach applied in this study. It is followed by a description of the methods used.

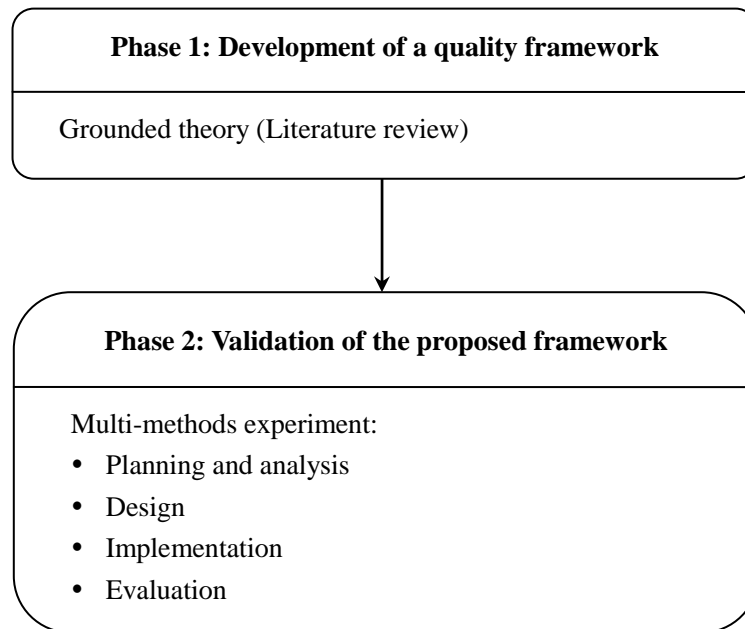


Figure 3.1 Research Phases

3.4 Grounded Theory Approach in Phase 1 Investigation

The aim of research in this phase was to develop indicators of an effective OHS that targets nurses as the end users. The indicators were identified based on analysing data gathered from the literature. We will first introduce the concept of the grounded theory approach, and then justify its use. Data collection and analysis techniques will follow.

3.4.1 Grounded Theory Approach

Grounded theory was developed by sociologists Glaser and Strauss (1967) to formulate a theory that is grounded in data systematically gathered and analysed. It becomes a general methodology for developing theory of a phenomenon under study. According to the grounded theory, theory may be generated initially from the data, or, if existing theories

explain the phenomena under investigation, then these theories should be elaborated and modified to provide explanation for the phenomena (Strauss and Corbin 1998). Researchers can also carry into the current studies any theory from their previous research, providing they are relevant to the current situation. Again the theory has to be rigorously matched with data (Strauss 1998).

According to grounded theory, new theory should be generated from the data, rely upon induction, and emphasize how individuals interact with the phenomenon under study (Glaser and Strauss 1967). Although so much theory has been established in the field of online help, the area concerned with nurses, who play significant roles in the adoption and implementation of NISs in healthcare, is not touched. Therefore, it is essential to build theory from data related to their characteristics. Through collecting and analysing data, grounded theory facilitates this theory building process (Heppner and Heppner 2004). Most importantly, the cognitive factors are incorporated into a grounded theory study (Glaser and Strauss 1967). As human factors have to be emphasized by an OHS, and as any limitations for the investigation of cognitive factors would greatly inhibit the effectiveness of the emerging framework (Heppner and Heppner 2004), grounded theory is considered a suitable method for our study. Another advantage of the grounded theory method is that it allows researchers without high technical background to examine the data and draw theory from data, thus it is more applicable for novice researchers without advanced experience (Glaser and Strauss 1967).

3.4.2 Detailed Description of the Grounded Theory Approach Used in Phase 1 Research

The grounded theory approach as the strategy of the inquiry in phase 1 research interpreted the process of data collection and analysis. The data was collected from the

peer-reviewed publications. A constant comparison method was used to analyse the data. The following sections will explain these two methods in detail.

3.4.2.1 Data Collection from the Peer-reviewed Literature

The data collection procedure was described as a “zigzag” process by Creswell (1998) “out to the field to gather information, analyse the data”. The literature review was the main approach for data collection. The purpose of the literature review was to deepen the researcher’s understanding and to provide a context for the research. A thorough literature review has several benefits. It functions as a guide that can introduce and lead the researcher into greater understanding and knowledge in the academic terrain (Pidgeon 1996). During this process, a fundamental awareness of the topic was established. In the ideal case, the literature review is a critical process that gives the investigator valuable concepts and information (McCracken 1988). Essentially this study’s extensive literature review paved the way for our development of criteria of an effective OHS. This contributed to the development of the final framework.

3.4.2.2 Data Analysis

The data gathered from the peer-reviewed literature is analysed by the constant comparative method proposed by Creswell (1998). A constant comparative method is the hallmark of grounded theory research. The purpose of comparison is to develop “many categories and properties about general problems” instead of to “ascertain either the universality or the proof of suggested causes or other properties” (Creswell 1998).

In grounded theory research, the constant comparative method is regarded as the method of generating and analysing data (Glaser and Strauss 1967). As Glaser and Strauss (1967) suggest, this method involves four “stages”, characterized as (1) generating and (2) integrating categories and their properties, before (3) delimiting and then (4) writing the

emerging theory. In our study, the initial analysis was conducted in stages (1) and (2). The core analysis was carried out in stages (3) and (4). The process of data storage was followed by core analysis, which also involved the previous analysis. This integration process was aimed at reflecting patterns of data integration. It was a crucial but challenging stage in this research; constant consultation with the supervisor facilitated the process.

The details of data revealed themselves as the research progressed. Since the data collection in this study was based on the previous research publications in this field, a quality framework for an effective OHS was derived from:

- understanding the categories of NISs;
- identifying the technical, psychological and social challenges for nurses to use NISs;
- clarifying the context of OHSs;
- analysing the usage problems a user may encounter when using an OHS;
- identifying the indicators of an effective OHS.

This section has provided an explanation about why a/the grounded theory approach was the qualitative research method used in phase 1. It was selected based on its feature of theory being grounded in the data, which aligns with the aim of phase 1 research. The literature review was the main method for data collection and constant comparative techniques were adopted to analyse these data. The next section will provide a blueprint of the second phase of the research, which utilized a multi-method experimental approach to validate the proposed framework.

3.5 Experimental Approach in Phase 2 Research

A descriptive theoretical framework for an effective OHS was proposed in the first phase through a/the grounded theory approach. However, as qualitative research understands

the phenomena under study through the meanings people assign to them, the data from qualitative literature data analysis are not robust enough to validate the feasibility of the framework (Merriam 1998). In fact, in grounded theory-based research, the theory is only validated after it has been developed (Pidgeon 1996). Therefore, a verification of the proposed framework was logically the next phase of research. Its main objective was to demonstrate how to apply the proposed theoretical framework into the planning, design, implementation and evaluation of an OHS for an authentic NIS named Care Planning Assessment Tool (CPAT). The findings would also lead to the verification and modification of the proposed framework. It is essentially about collecting and analysing empirical evidence. This section will first justify the experimental approach, and then introduce the CPAT software, and finally explain the strategy and process for the OHS development.

3.5.1 Justification of an Experimental Approach to Validating the Proposed Framework

There are several ways of collecting empirical data, namely, experiment, case study, archival analysis, history, etc (Yin 2003). As no existing online help for NISs was available to the researcher for testing the proposed framework, an experimental approach, in which the researcher developed a new OHS for particular NIS CPAT software, following the proposed quality criteria, was undertaken.

3.5.2 A Brief Description of the CPAT software

The Care Planning and Assessment Tool (CPAT) has a long history of existence. In 1979 an early version of it, the Psychogeriatric Rating Scale (PRS), was introduced to the psychiatric wards for the elderly in a hospital in New South Wales. The purpose of the

software was to help nursing staff carry out systematic and comprehensive assessments of patients in order to give clear and concise presentations at case reviews.

The provision of a checklist of common problems that were organized into groups, e.g. physical problems, self help problems, etc., enabled nurses to record and report their assessments of patient problems more comprehensively and objectively. The development of the scale continued for 10 years, with the number of items and their content modified according to needs and feedback. In 1988 the software was modified to suit the needs of nursing care in nursing homes and the PRS became the REPDS (Revised Elderly Persons Disability Scale).

In 2002 the software was finally named CPAT after several changes. The CPAT software is a tool used by direct care staff as an aid to their preparation for the development of care plans and a means of communicating their observations to other team members.

3.5.3 Design of the Experiment

The experiment includes the development of the CPAT Online Help guided by the design principles developed in phase 1 research. This included needs assessment, design, implementation and evaluation of the CPAT Online Help (see Figure 3.2). The following sections will detail the methods and research activities in each process.

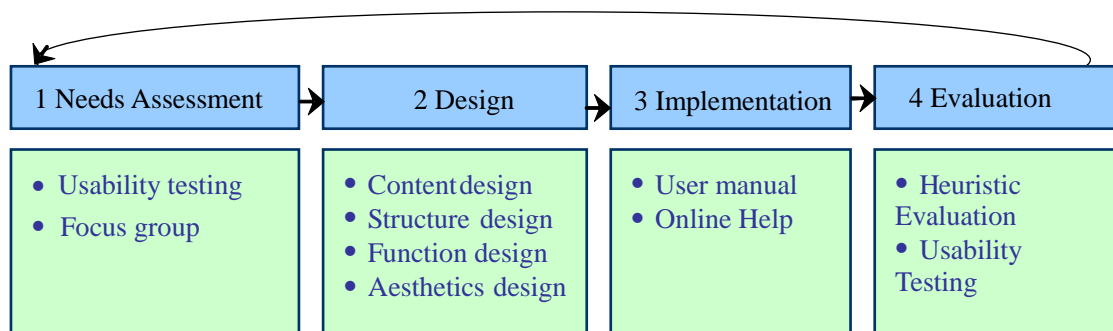


Figure 3.2 The system development cycle of the CPAT Online Help System

3.5.3.1 Needs Assessment

Designers must fully understand users to avoid the “misfit” between users’ needs and the delivered products (Tesch et al. 2005) during a user-centred development process. This rule also applies to the development of an OHS. Duffy *et al.* (1995, p60) emphasized that:

“Understanding users should drive the design of the help system. Designers should avoid two areas of mismatch: mismatches of information and mismatches of use. A mismatch of information occurs when the designer does not effectively anticipate the information that users want to find. A mismatch of use occurs when the designer does not provide an effective means for users to find information.”

To avoid these two ‘mismatches’, identifying users’ needs in learning to use CPAT, that is, training needs assessment, is the starting point (Allen 1996). Training needs assessment (TNA) is the process of assessing the training objectives (Ostroff and Ford 1989). The primary purpose of the TNA in our experiment was to identify what knowledge and skills users should have to enable them to effectively interact with the CPAT software. The significant role of TNA for the development of effective training or support programs is increasingly recognized by practitioners and researchers. For example, Nelson *et al.* (1995) propose that needs assessment sets the scene for training program development. They suggest that careful needs assessments are needed to guide improvements in training (Nelson 1991; Nelson et al. 1995). Besides, Boydell and Leary (1998) also emphasize the importance of building an effective training program by clearly and precisely identifying and analysing the needs that the training will address. Thorough processes of training needs assessment were needed in order to provide the learning opportunities required for nurse users to achieve their goals of using the CPAT software. The following subsections will introduce the methods for conducting TNA for the CPAT software.

3.5.3.1.1 Training Needs Analysis through Cognitive Usability Testing and Focus Group Discussion

Through identifying the problems a user encounters in mastering a new information system, the gap between the necessary and the actual knowledge or skill that a user has for effectively interacting with an information system can be inferred (Gupta and Bostrom 2006). In other words, users' usage problems, mistakes or inefficient behaviours are good indicators of what they do not know, which, in turn suggests what they need to know. Therefore, the aim of TNA in this study was to:

- observe how novice CPAT users complete a series of tasks by using the CPAT;
- interview a cohort of experienced CPAT users regarding the problems they have encountered in using the CPAT and their preferences of (in) help;
- analyse two sets of data to identify their knowledge gaps.

The common approaches to collecting the above desired data for needs assessment are interviews with end-users or self-reported questionnaire surveys (Nelson 1991; Howard 1995; Nelson *et al.* 1995; O'Brien and Hall 2004). These conventional methods provide opportunity for users to express their perceived difficulties in using an information system. However, these conventional methods are not adequate in assessing the needs of users with different levels of computer competency. Novice users may not have sufficient knowledge of a new information system to identify and express their usage problems (Sein et al. 1989; Lazonder 2000). Even for experienced users, they may not be able to clearly recall their problems (Smith 1994). Verbalizing the process about how they complete a task, which involves expression of sequences of psychomotor (i.e. computer skills) (Norton 2005), is also problematic.

In order to complement the weaknesses of the traditional methods of TNA, a multi-method approach is adopted. It combines traditionally methods like focus group

discussion and a cognitive usability testing approach introduced by Kushniruk (2001). This cognitive usability testing approach is used to identify the training needs of nurses in using CPAT software. Usability testing refers to “the evaluation of an IS that involves testing of participants who are representative of the target user population, as they perform representative tasks using an IS”(Kushniruk 2001). It encompasses a range of methods to identify how users actually interact with a complete software product by directly observing user’s interactions with the interface of the software (Kushniruk 2002). Cognitive task analysis is concerned with characterizing the decision making and reasoning skills, and the information processing needs of participants as they perform tasks involving the processing of complex information (Preece et al. 2002). According to Kushniruk (2001), the first step in such a cognitive task analysis is the development of a task hierarchy describing and cataloguing the individual work tasks. Once tasks have been identified, the method typically involves observation of participants with varying job roles as they perform selected tasks of interest. During the usability testing, all interactions a user has with an IS are recorded (e.g. video recordings are made of all computer screens or user activities and actions). This technique also includes the collection of ‘think aloud’ reports, the recording of users as they verbalize their thoughts while performing particular tasks (Kushniruk 2001). This rich human-computer interaction data suggests the training needs.

Focus group discussion is an efficient form of qualitative information gathering that could enable the researcher to understand how and why the participants react to an experience in a particular way. In addition, it provides the researcher with an opportunity to interact with the authentic end users. This interaction can give an “understanding of participants’ experiences and beliefs” (Morgan 1993). Focus group discussion is another common data collection technique for TNA (Courage and Baxter 2005). It is a carefully planned and moderated informal discussion where one person’s ideas bounce off another’s. This leads to a chain reaction of informative dialogue (Crowl 1996). Its purpose is to address a specific topic, in depth and in a comfortable environment, to elicit

a wide range of opinions, attitudes, feelings or perceptions from a group of individuals who share some common experience relative to the issue under study (Wilkinson and Birmingham 2003). Therefore, a focus group discussion is conducted as part of the TNA process.

3.5.3.1.2 Design of the Cognitive Usability Testing Experiment for Novice CPAT Users

- *Objective*

The cognitive usability experiment was attempting to identify the knowledge gap for the novice users to use the CPAT software.

- *Participants*

Kushniruk *et al.* (2004) suggests that up to 80% of usage problems with an information system can be detected through analysing the interaction of 8 to 12 participants with it. The participants for the experiment were recruited from third-year nursing undergraduate students (six female, 2 male) from University of Wollongong. All the participants were majoring in geriatrics and were aged from 22 to 57. They were the potential users of the CPAT but had no previous usage experience with the software.

- *Setting*

Environment: computer laboratory in the School of Nursing, Midwifery & Indigenous Health, University of Wollongong.

Screen capture software: Camtasia Studio 2.1.2 (Copyright ©2005, TechSmith Corporation, 2405 Woodlake Drive Okemos, MI 48864-5910 USA).

Materials: information sheet, consent sheet, description of the CPAT software, and the agenda of the experiment (see Appendix 1).

- *Procedure*

At the start, an information sheet was handed to every participant to explain the purpose of the study and the procedures that were followed to ensure confidentiality of participating in the study. Afterwards, the participants were asked to sign a consent form. To enable the participants to enter the results of a systematic and comprehensive assessment of residents in a long-term care facility into a computer using the CPAT software, they were given an oral introduction about the software by its designer. This included the general purpose of the software and basic concepts of recording assessment results using the software.

After the orientation session, the participants were asked to perform the following three representative tasks supported by the software:

- *Entering Data for a Resident:* The resident's demographic information had to be entered. The participants were expected to enter the information recorded in a hard-copy CPAT assessment sheet into the system.
- *Doing an Assessment for a Resident:* The resident had to be assigned a score for each item of the assessment criteria.
- *Generating a Change Monitoring Report:* A graph needed to be produced that indicated which assessment areas were showing improvement or deterioration (in comparison with the data that were already stored in the software).

The participants were encouraged to "think aloud" or verbalize their thoughts if they were uncertain about how to conduct the above tasks with the software.

- *Outcome measurement*

Kushniruk *et al.* (2004) suggest that to conduct usability testing, the recording equipment should firstly be set up that would allow for continuous recording of computer screens during the process of human-computer interaction. To achieve this goal, Camtasia Studio 2.1.2 was used to record each participant's mouse movement and keyboard strokes. In addition, participants' 'think aloud' reports were audio-taped. The data analysed included both the video and audio files thus captured.

There were eight sets of video and audio data gathered from this experiment. The richness of the video and audio data required application of a systematic method for coding and analysis. The first step was to transcribe the "think aloud" audio reports into a Microsoft Word document, based on the protocol designed by Ericsson and Simon (1993). This information served as supporting evidence for coding the video records while the user was "thinking aloud". Prior to analysing the video data, a coding scheme had to be refined for classifying specific user problems.

- *The Coding Scheme*

The coding scheme was adopted from Kushniruk's coding protocol for analyzing human computer interaction data (Kushniruk 2002; Kushniruk and Patel 2005):

- *Navigation*: used when the participant comments that s/he is navigating, or indicates that s/he is incapable of moving through the interface to find the relevant information or what s/he is supposed to do.
- *Understanding*: used when the participant comments on understanding the meaning of labels, instructions or errors.

- *Ease of use*: used when the participant comments on the level of “ease of use” of the system (from easy to hard) or any confusion or frustration that s/he experienced.

The above coding scheme was followed throughout the process to analyse the audio and video files captured in this experiment. The audio and video transcripts were entered into a database for storage and analysis.

3.5.3.1.3 Design of Focus Group Discussion

- *Participants*

The participants of the focus group were the actual users of the CPAT. They were staff in Hammond Care Group. Nine staff (all female) attended this meeting. Eight of them were Registered Nurses and one was an Enrolled Nurse. Their job roles included facility manager, trainer, consultant and RN in the facility. Their ages ranged from 30s to 50s. The majority of them have used the CPAT for more than 3 years.

- *Procedure*

The one-hour focus group discussion was semi-structured. Participants were prompted to provide their thoughts with regard to the following topics:

1. How did you learn to use the CPAT software?
2. Could you recall any problems when using the CPAT software?
3. What kind of online help features would you like to have when you encounter problems?

After the discussion about the above questions, a demonstration of various templates of online help was followed. The features of the templates were table of contents, search function, task-oriented and function-oriented structure, Frequently Asked Questions, and multimedia means of presenting help information.

- *Source of data*

The dialogue occurring in the session was audio taped.

3.5.3.2 Design and Implementation of the CPAT Online Help

The findings from the TNA provided valuable input into design of the CPAT Online Help. We applied the design guidelines according to the proposed framework into the actual design of the OHS (details about the design guidelines are described in Section 3, Chapter 4). The implementation process included writing a hard-copy user manual and the CPAT Online Help. The application tools used are displayed in Table 3.1.

Table 3.1 The application tools used for the development of the OHS and their tasks they undertake

Tools	Tasks
Microsoft Office Word 2003	User manual
MacroMedica Dreamweaver MX	Create html documents
Paint in Window XP	Graphic design and editing
FAR HTML 4.0	Compile html documents into .chm (a Microsoft Compressed HTML Help file)
Camtasia Studio 2.1	Produce video demonstration

3.5.3.3 Evaluation of the Effectiveness of the CPAT OHS

Once the CPAT Online Help was implemented, evaluation of the help system became the research focus. The goal of the evaluation was to determine the usability of the CPAT

Online Help. The evaluation data were collected from the following two types of stakeholders:

- Those who can modify the online help system, i.e. the designers
- Those who will use the online help system, i.e. the end users

Two methods of evaluation were applied, that is, a heuristic evaluation within a small set of evaluators a/the (omit this a/the “correction”) and a laboratory-based usability testing which involved comparison between paper-based manual and the online help system for the CPAT.

3.5.3.3.1 Heuristic Evaluation

Designers of the OHSs are primarily interested in data that will help them in designing or revising the OHS. The evaluation data from the designers would ultimately influence the design process, which would help the researcher to revise the CPAT Online Help system. This type of evaluation is a *formative evaluation* (Duffy et al. 1995). The goal of the formative evaluation here was to identify the strengths and weaknesses of the online help system.

In addition, as the design of the CPAT Online Help was guided by the proposed framework, the extent of the help system’s compliance with the proposed framework was another focus of this evaluation. Considering this, a formative evaluation strategy, heuristic evaluation was conducted. Heuristic evaluation is a usability engineering method for finding the usability problems in a user interface design so that they can be attended to as part of an iterative design process (Nielsen 1993). It involves having a small set of evaluators examine the interface and judge its compliance with recognized design principles (Nielsen 1994). For this study, the heuristic evaluation was about

having a group of evaluators judging the CPAT Online Help's compliance with the design guidelines generated from the proposed framework.

- *Participants*

Eight postgraduate students from computer sciences were recruited for the heuristic evaluation for the CPAT Online Help. They all had at least three-year experience in software engineering.

- *Measurement tool*

A five-point "Likert" scale (1=VeryPoor; 2=Poor;3=Satisfactory;4=Good; 5=Excellent) questionnaire was designed to measure the online help's compliance with the proposed framework. It structured in four design components of the CPAT Online Help (i.e. structure, functionality, aesthetics and content) along with forty-three design principles. The complete questionnaire is provided in Appendix 2.

- *Procedure*

The heuristic evaluation consisted of four phases: a pre-evaluation training session, the actual evaluation, a severity rating phase during which the individual evaluator assessed the severity of the compliance with the predetermined design guidelines, and a debriefing session to discuss the outcome of the evaluation. The researcher gave the evaluators an orientation of the CPAT software and the online help before the evaluation. During the actual evaluation, individual evaluator walked through the CPAT Online Help twice. The first time was for familiarisation with the software and the help system. The second time was for assessing the help system's compliance against each design guidelines. Finally each evaluator was invited to the debriefing. The session included the overall comments

about the experience of the evaluator using the help system, its significant weaknesses, and so on.

- *Data analysis*

The data collected were used to modify the online help based on evaluators' comments and suggestions, and to calculate the extent of the help system's compliance with the hypothesized framework.

3.5.3.3.2 Usability Testing to Compare the Effectiveness of the CPAT OHS and Hardcopy User Manual

Potential users of an online help are motivated to find out whether the help system will be useful to them (Duffy et al. 1995). The type of evaluation whose data are from end-users is often referred as a *summative evaluation* (Kushniruk 2001). A summative evaluations strategy, a usability testing experiment in which involved comparison of the CPAT user manual and online help was designed to assess the effectiveness of the CPAT Online Help. A laboratory-based usability testing suggested by Kushniruk (2001) was again utilized for the evaluation. Participants of the testing were randomly divided into two groups. One group of participants interacted with the CPAT with the help of paper-based user manual (UM) to do tasks (this group is referred as Group UM thereafter). The other group did the same tasks with the help of the CPAT Online Help (this group is referred as Group OH thereafter). After the tasks were completed or time expired (one hour), both groups of participants were asked to fill a post-test questionnaire respectively.

The aim of the evaluation was to test the following two hypotheses:

1. Participants who use the online help perform the tasks as quickly and correctly as the ones who use the user manual do.

2. Participants who use the online help feel as enjoyably as the ones who use the user manual do.

- *The Indicators used for the experiment*

The summative evaluation mainly adopted the usability framework devised by Quesenbery (2004). The five indicators of usability, namely, *effectiveness*, *efficiency*, *engagingness*, *error-tolerance* and *ease of learning*, are helpful in planning usability testing, because each suggests specific techniques. The following definitions of the 5E's are from her website (<http://www.wqusability.com/articles/getting-started.html>):

- *Effective* addresses whether the software is useful and helps users achieve their goals accurately.
- *Efficient* is the speed (with accuracy) with which work can be done.
- *Engaging* is simply how pleasant, satisfying, or interesting an interface is to use.
- *Error Tolerance* involves how well the product prevents errors and helps users recover from any errors that do occur.
- *Ease of Learning* concerns how well the product supports both initial orientation and deeper learning.

From literature on usability testing, there are various measurements available to measure the indicators of the usability. These criteria apply the ISO 9241 (1998) standard to online help. The measurement for the usability criteria of the CPAT Online Help is summarized in Table 3.2.

Table3.2 the measurement matrix for evaluating the usability of CPAT Online Help

Usability Criteria	Measurements	Evaluation techniques
Effectiveness (if the help system provides accurate and complete help for users remove their impasse)	<i>Accuracy</i> (quality of performance) Objective: Percentage of tasks completed successfully with the help system (Travis 2003). Subjective: Using the help system enhances my performance (Davis 1989).	Create scenarios with information-seeking tasks that are critical for successful use of the CPAT. Only provide the CPAT Online Help system for users to accomplish tasks. Record users' interaction with the help system. Post-test questionnaire.
	<i>Completeness</i> (quantity of performance) Objective: Percentage of users able to successfully complete the task (Travis 2003). Subjective: Using the help system enables me to accomplish more tasks than before (Chang et al. 1997).	
Efficiency (how quick and easy to solve a problem)	Human effort Subjective: It is easy to find the help information (DeBoard 2004).	Post-test questionnaire.
	Subjective: Using the help system enables me to accomplish tasks more quickly (DeBoard 2004).	
Engaging (how satisfying the help system is)	Attractiveness: I enjoy using the help system (Duffy et al. 1995). The help system has attractive presentation (DeBoard 2004).	Post-test user satisfaction questionnaire.
Error tolerance (how well the help system prevent errors)	Subjective: The help system keeps me away from trouble (Duffy et al. 1995).	Post-test user satisfaction questionnaire.
Easy to learn (only require basic skill to use the help system)	Time taken on being familiar with the help system (DeBoard 2004). Subjective: It is not difficult for me to use the help system with confidence (DeBoard 2004).	Collecting timing data.
		Post-test user satisfaction questionnaire.

- *Post-test questionnaire*

Post-test questionnaires are an important component of effective usability testing (Rubin 1994). Their advantage in usability testing is that feedback is gathered from the “point of view of the user” (Kushniruk 2002). Post-test questionnaires are normally used to gauge users’ overall satisfaction with the tested system (Lindgaard 1994). In addition, questionnaires can be used to obtain demographic information about the participants and to assess their level of computer literacy, as suggested by Kushniruk and Patel (2004). This is because this kind of information is important for understanding participants’ behaviors and performance during the test, as well as their capacity for adopting the IS.

Considering this, the post-test questionnaires used here were designed to gather demographic information of the participants, and to measure their computer literacy and satisfaction with User Manual or Online Help, see Table 3.3. Demographic information was about age, gender, employment, job role and usage of computers per week. The second part of the survey, computer literacy assessment was based on the Computer Skills Assessment Instrument for Adult Learners (Harmlett 2000). This part utilized a Yes/No scale to simplify the selection of alternatives, and collect some statistical quantifiable feedback. The third part of the questionnaire, i.e. Satisfaction with UM or OH, was designed on the basis of the work of Davis (1989), Duffy *et al.* (1995), Chang *et al.* (1997) and Deboard (2004). It utilized a five-point Likert scale (1=strongly agree, 5=strongly disagree) to measure participants’ agreement on the statements. A Man-Whitney U test was conducted to identify whether the differences in answers were significant between the two groups.

Table 3.3 the constructs for the questionnaire and the number of items used to test each of the construct

The Construct to be test	No. of Test Items
Demographic information	5
Computer Literacy Assessment	36
Satisfaction with User Manual	15
Satisfaction with Online Help	19

- *Participants*

Thirteen nursing staff (all female) from two sites of Hammond Care Group participated in the usability testing experiment. They were randomly assigned into two groups: seven of them used the Online Help and the other six used the paper-based User Manual to learn to conduct the same documentation tasks with the CPAT.

- *Tasks*

The performance evaluation consists of a series of tasks that were evaluated separately and sequentially.

Task 1: Add a new resident record into the CPAT database.

Task 2: Add an assessor's name into the CPAT database.

Task 3: Add a new site or location to the CPAT database.

Task 4: Enter the date of assessment, and select the name of the assessor, site and location that were just added.

Task 5: Enter the details of the assessment for the resident.

Task 6: Display the assessment results.

After the participants began working through the evaluation tasks, they were encouraged to work without human guidance. As mentioned previously, Group UM could only seek help from the UM while Group OH could only consult with the online help.

- *Materials*

The following materials were designed for use in the usability evaluation:

1. CPAT user manual (see Appendix 3)
2. Task scenario for the Group GM and Group OH (see Appendix 4 and 5).
3. Hand-written CPAT assessment sheet.
4. Post-test questionnaires: User manual user satisfaction questionnaire and Online Help user satisfaction questionnaire (see Appendix 6 and 7).

In summary, Section 5 examined the design process of the multi-method experiment in phase 2. This first process of the development was needs assessment, where a cognitive usability testing on assessing novice CPAT users' training needs and a focus group investigation on experienced users' learning difficulties on the CPAT and their preferences of help were conducted. After analysis of the data, the finding would be integrated into the design process where applied the designed guidelines suggested in the theoretical quality framework (developed in phase 1). In order to ascertain the extent of compliance of this OHS with the guidelines, formative evaluation was undertaken as a component of an iterative design process. Heuristic evaluation was the method used. Afterwards, summative evaluation was undertaken by applying laboratory-based usability testing. Finally, based on suggestions a modification of the quality framework would be made. The next section will provide information about the ethical issues.

3.6 Ethical Issues and Confidentiality

It is a compulsory procedure that every research involving human participants needed to be approved by the Human Research Ethics Committee (HREC) before commencing the data collection. Therefore, the approval of the HREC in University of Wollongong was sought for this research and granted in 2005 in order to protect the highest level of rights, liberties and safety of the participants under the terms of the National Statement on Ethical Conduct in Research Involving Humans 1999.

At the beginning of each experiment or interview, a participant information sheet, which contains the information about the study, was handed to each participant for their understanding of the general purpose, procedures, confidentiality, contact information and rights of withdrawal (a participant could or might freely withdraw from participating in the study at any time). If the participant agreed to join the study, the consent form was issued requesting a signature. The promise was given to the participants that all of the information that was collected during the study would be treated as confidential. All of the participants would remain anonymous and all of the information collected from the study would be safely stored.

3.7 The Timeline of the Study

This master research took the candidate two years. The summary of the timeframe spent on each research activity in the whole study is shown in Table 3.3.

Table 3.3 Research activities in this study along with timeframe

Research phase	Research activity	Timeframe
Phase 1: development of preliminary quality framework	Extensive literature review	February-April 2005
	Data analysis	May 2005
	Framework development	June 2005
Phase 2: validation of the hypothesis framework on the development of the CPAT Online help	Cognitive usability testing	July 2005
	Focus group discussion	August 2005
	Design of user manual	September–October 2005
	Implementation of CPAT Online Help	November–December 2005
	Heuristic evaluation	February 2006
	Usability testing	March–April 2006
	Enhancement of the framework	May 2006
Phase 3: Results reporting and thesis writing	Results reporting on several papers have submitted to health informatics journals or conferences. Thesis writing was undertaken.	June 2006- March 2007

3.8 Summary

This chapter presented the research design and approach. It then justified the research methods undertaken for this research. Two phases of investigation were undertaken for this research, i.e, the development of a hypothesis framework and the validation of the framework. The grounded theory approach guided the data collection and analysis in the first research phase. A theoretical framework of an effective online help system was designed through analysing and synthesizing the data collected through literature review. In order to demonstrate the feasibility of this framework, an experimental approach was conducted. A combination of various kinds of data collection and analysis was used, i.e. cognitive usability testing, focus group discussion and questionnaire survey. Finally, the strategies for addressing the ethical issues of the study and timeframe for each research activity were presented.

Chapter 4 Framework Development

4.1 Introduction

As mentioned in the last chapter, a grounded theory approach was utilized to guide the development of the framework of an effective Online Help System for a Nursing Information System. Text data analysis of the previous publications in this topic area was the method for data collection. A constant comparative method was used to generate and analyse data. This chapter reports the results of the analysis, and then discusses the results from the first phase of the investigation. A comparison of the results of the previous studies on effective online help is firstly given. Based on the related issues covered in chapter 2 and the information presented in this chapter, a framework consisting of five dimensions of criteria is generated. Afterwards, a detailed description of each criterion is given, along with design guidelines for how to build an OHS according to each criterion.

4.2 The Previous Research on Effective Online Help Systems

To date, the issues of how to design and evaluate an effective OHS have only been considered by a few experts who have extensive experience with the design and implementation of help systems. Some of their works can be adopted into our current project of developing a quality framework of OHS for a NIS.

A milestone in this topic area, a comprehensive study on how to design and evaluate online help, was conducted by Duffy *et al.* (1995). This study involved twenty-nine online help developers from twenty different hardware and software companies. They

devised an evaluation tool of quality online help called Help Design Evaluation Questionnaire (HDEQ), which contains four evaluation dimensions to determine a “Good” help system. Duffy *et al.* (1995) gave the following definition for each of these dimensions.

- *Usability criterion:* a good help system is one that is usable, that is, it serves the purpose of helping. A usable help system is one that aids the user in diagnosing and repairing his or her problem with a minimum expenditure of time or effort.
- *Functionality criterion:* common criterion is the number and sophistication of the help system’s features or functionality. Unfortunately, technological sophistication alone does not lead to usability. The technology must be adapted to and support the needs of users.
- *Aesthetic criterion:* help systems, like interfaces in general, may also be evaluated on a criterion of aesthetic quality. The visual appeal of their layout and the resolution of their graphics may all be used as indicators of how good the help system is. A poorly designed screen will increase the effort the user expends in searching for information. In most cases, an aesthetically pleasing design will also be a functional design.
- *System documentation criterion:* an OHS may be considered “good” if it provides comprehensive system documentation. This is indeed the criterion in the early definition of effective help systems. Help systems are meant to provide system documentation. Effective systems are the ones that provide complete documentation.

Duffy *et al.* (1995) argued that functionality, aesthetics and system documentation are the basic components of an OHS, while the usability criterion puts emphasis on the overall

performance of an OHS. Usability is the final arbiter, as an effective OHS should be usable in the first place. These criteria are the basic components of a quality framework. However, they lack specific and concrete attributes that are measurable and can be used by OHS developers or researchers to test the quality of an OHS. Therefore, there is an ambiguity in evaluating the effectiveness of an OHS if only applying these criteria.

Garzotto *et al.* (1995) proposed another set of criteria to judge the quality of an OHS, i.e. content, structure, presentation and dynamics. The following section will briefly explain the meaning of each criterion:

- *Content*: it refers to the pieces of information included in an application. Content analysis may be the most important dimension in assessing a hypermedia application's effectiveness.
- *Structure*: it means the organization and relationship between contents.
- *Presentation*: it includes visualization of each individual piece of information and its dynamic features, such as navigation. Presentation is essentially about how application content and functions are presented to the readers.
- *Dynamics*: it covers how users interact with each individual piece of information (e.g., control the playing of active media) and their movement among pieces of the information.

A comparison between the model proposed by Duffy *et al.* (1995) and that of Garzotto *et al.* (1995) finds a certain degree of similarity between the two models. Like Duffy *et al.* (1995), Garzotto *et al.* (1995) also emphasized the importance of system documentation, aesthetics and functionality, although they were described in different terms. Content and structure described by Garzotto *et al.* (1995) are similar to the system documentation, i.e.

document information, suggested by Duffy *et al.* (1995), whereas the presentation of information is more of an aesthetic criterion. The dynamics criterion describes the users' interaction with the system. In fact, the functionality of an online help handles the end users' interaction with the system. Therefore, these two criteria are essentially similar. However, Garzotto *et al.* (1995) does not consider usability as an important criterion to decide the overall performance of an OHS system. Summarising the work of Duffy *et al.* (1995) and Garzotto *et al.* (1995) leads to the formation of the following fundamental dimensions of the criteria for our quality framework: *content, structure, functionality, aesthetics and usability*.

Of use to our framework development is that Garzotto *et al.* (1995) also provided the detailed evaluation criteria that was not covered by the model of Duffy *et al.* (1995), they are:

- *Richness* expresses the adequacy of information items and the ways to reach them.
- *Ease* measures information accessibility and how easy it is to operate the system.
- *Consistency* measures the application regularity, and can be expressed by a simple, generic rule: treat conceptually similar elements in a similar fashion and vice versa.
- *Readability* expresses the overall "feeling" about an application's validity. Readability depends on all of the factors mentioned above.

However, these criteria still are not comprehensive enough to cover all the five dimensions. As research continued, assessing documentation quality has drawn researchers' attention. Producing Quality Technical Information (PQTI) was one of the

comprehensive discussions of the quality of documentations. For example, Hargis *et al.* (1997), in their revised edition *Developing Quality Technical Information*, defined three over-riding categories of quality technical information (i.e. easy to use, easy to understand, easy to find). Hargis *et al.* (1997) also identified and defined the specific characteristics or dimensions that are related to the three general elements or categories (see Figure 4.1). This is a comprehensive model to assess quality of information for a document. These characteristics can be utilized to address such fundamental criteria as *content, structure, functionality and aesthetics*. However, the usability issue was not discussed.

Figure 4.1 Quality dimensions for the technical information (Hargis *et al.* 1997)

There are several measurement matrices of usability in a generic context that can be adopted into the usability criteria of our framework. For example, Quesenbery (2004) defined five dimensions of usability, i.e. effective, efficient, engaging, error-tolerant, and easy to learn (the 5Es, see Figure 4.2). Her model is considered the most comprehensive and easy to use for measuring the usability of an IS. The definitions of the 5Es have been provided in Chapter 3 Section 5.3.3.2.

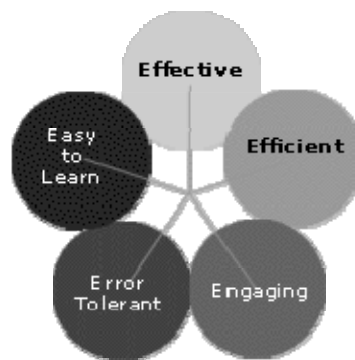


Figure 4.2 the 5Es of usability

In summary, this section provides a critical review of the previous research on the measurement criteria of an effective OHS. The data gathered from the published literature were analysed using a constant comparison method, i.e. generating, integrating categories, delimiting and writing the emerging theory (Glaser and Strauss 1967). Finally, the four dimensions (i.e. usability, system documentation, aesthetics and functionality) proposed by Duffy *et al.* (1995) to measure a “good” help system are adopted as the main elements in our framework. Two categories from another framework (Garzotto *et al.* 1995), content and structure criteria, are added to the system documentation criterion; even though they lack specific and concrete attributes to describe these two criteria. Although the researches of PQTI have identified specific characteristics (or dimensions)

that are related to the four criteria, *content, structure, functionality and aesthetics*, the usability issue has not been discussed in the field of online help. Considering this fact, Quesenbery's 5Es (2004) are utilized to measure the usability of an effective OHS. The next section will present our framework in detail.

4.3 A Framework of Effective Online Help Systems

A framework of an effective OHS for a NIS has been developed in consideration of the previous research findings on effective online help, and the challenges for nurses as computer learners and users (details see Chapter 2), such as:

- many of them do not have sufficient computer and information literacy;
- the majority of them are women;
- they have heavy workloads, so their time is limited;
- most of them are willing to adopt IT into workforce if it is beneficial;
- they often lack confidence in their initial attempt to use computers.

Our framework consists of five overriding dimensions - usability, content, structure, functionality and aesthetics – and has associated specific criteria with each dimension (see Figure 4.3). For the developers of an OHS to deliver quality OHS that satisfies the four dimensions of content, structure, functionality and aesthetics, forty-three design guidelines were assembled from the published literature. Usability is considered as the fundamental element of this framework because it determines the overall performance of an OHS (Duffy *et al.* 1995). The following sections give a detailed breakdown analysis of each component.

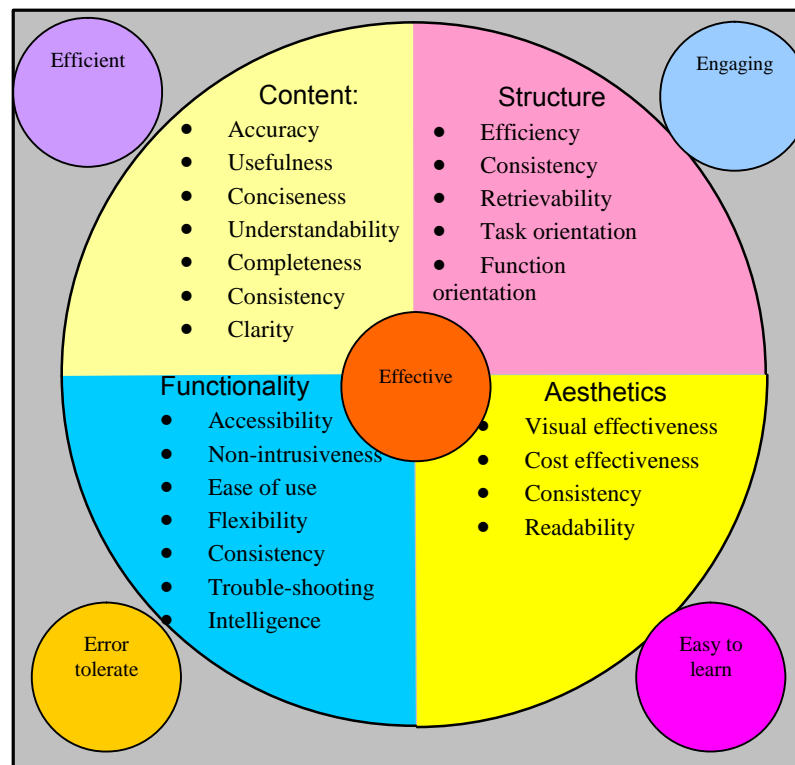


Figure 4.3 A framework of effective Online Help Systems

4.3.1 Content

Developing a design specification for the content of an online help system is one of the most important tasks that developers have to complete (Duffy *et al.* 1995). Content analysis is also a critical task in determining the effectiveness of an OHS. Content may consist of static media (such as formatted data, text strings, images and graphics) or active (dynamic) media (such as video clips, sound tracks and animations) (Garzotto *et al.* 1995). Numerous evaluation criteria (Nielsen 1994; Duffy *et al.* 1995; Hargis *et al.* 1997; Smart 2002), or heuristics (Krull *et al.* 2001; Kantner *et al.* 2002) can be applied in content analysis, such as accuracy, usefulness, conciseness, understandability, completeness, consistency, and clarity. Here are the definitions of these criteria:

- *Accuracy*: the content of information provided to nurse users must be correct and error-free.
- *Usefulness*: information presented to nurse users should be valuable and helpful. This is achieved either through task support or reference information or conceptual information. As nurses are always busy and some of them are novice computer users, it is not likely that they will spend enough time to explore a new system by themselves to solve task-related problems.
- *Conciseness*: a minimal but adequate guide should be provided to nurses. People do not have the patience to read lengthy texts from a computer monitor, especially the hectic nurses. If they have to spend a long time on understanding an online help, they would be frustrated and hate to use the system.
- *Understandability*: the vocabulary used should be the one that the users are familiar with instead of system-focused terms, which do not make sense to the end users. If nurses do not understand the information provided to them, they will lose confidence in using the online help.
- *Completeness*: comprehensive information should be provided to users who would like to seek in-depth explanations; in other words, the information needs of different competence levels of users should be catered for. There are diverse nurse users, i.e. novice, intermediate and experienced ones. Different levels of users have different needs for help.
- *Consistency*: the same information should have the same meaning within an online help system because this will reduce any confusion caused by inconsistent expressions and make it easier for nurses to understand the help information.
- *Clarity*: content should not contain ambiguous information. Otherwise, nurse

users will be led in the wrong direction.

After appreciating the above definitions, we suggest eight design guidelines that can be followed for the accomplishment of the above seven qualities in the content category. They are listed in Table 4.1.

Table 4.1 Design guidelines to address the criteria in the content category

Criteria of Contents	Design Guidelines
Accuracy	1. The contents of information are correct and contain no errors.
	2. Texts are grammatically correct.
Conciseness	3. Minimal but adequate guide is provided to users, i.e. avoiding lengthy texts.
Completeness	4. Comprehensive information is provided to cater for users in different levels.
Consistency	5. Terminology (terms, concepts, etc.) is used consistently throughout the help system.
Understandability	6. The user's language is used rather than the system-focused terms.
Clarity	7. The content contains no ambiguous information.
Usefulness	8. The content answers users' expected questions.

4.3.2 Structure

The second important component of an online help system is structure, which refers to the organization of content (Garzotto *et al.* 1995). The design of structure involves physically and conceptually organizing information (Duffy *et al.* 1995). For example, text, tables, bulleted lists, headings and other methods of emphasis are common ways of physically and conceptually organizing information. A number of criteria can be applied in the

structure category, such as efficiency, consistency, retrievability, task orientation and function orientation (Hargis *et al.* 1997; Dutke and Reimer 2000; Kantner *et al.* 2002). The detailed descriptions are provided below.

- *Efficiency*: content should be structured in a way that presents quality and concise information to users instead of a long list of hits. For example, the frequently sought information is located at a high level of the structure. Within headings, the most important words come first. Layering information and branching provide minimalist paths through information.
- *Consistency*: the structure of information is consistent throughout the online help system. Headings at the same level in a section use a parallel structure to help users identify the information they need. This helps to create an easy to use application for nurses and will thus reduce their anxiety with computers.
- *Retrievability*: information should be organised and provided to nurses so that they can find it quickly and easily. If a nurse user spends huge amounts of time finding the information they need, they will not use the OHS again because it would be easier for them to seeking help from humans instead of computers.
- *Task orientation*: content should be structured in a task-oriented format to facilitate the users to complete these tasks. Due to the heavy workload they carry, only when they encounter problems in operating an NIS, will nurses seek help? Therefore most of their problems relate to a specific task that can only be completed using the nursing information system. If information is organized in a task-oriented format, nurses will benefit from time saving through avoiding shifting from the conceptual model to the procedural model.
- *Function orientation*: content should be structured in a way that complies with the flow of functions of the application, for instance, in which condition a function

produces which effects that are interpreted in light of the relevant content. Task-based structure alone is not enough for nurse users, because when nurses read through a task-based description, it is likely to involve some specific function descriptions which require navigation to the function-based information.

Again, in order to ensure the delivery of these five criteria in the structure category, we suggest eleven design guidelines, see a summary in Table 4.2.

Table 4.2 Design guidelines to address the criteria in the structure category

Criteria of Structure	Design Guidelines
Efficiency	9. Within headings, the most important words come first.
	10. The important information is located at high levels of the structure.
	11. Layered information provides minimum paths through information.
Consistency	12. It applies the consistent mechanism to organize information into the levels of headings.
Retrievability	13. The information is organized in a logical way.
	14. Hyperlinks are attached to a meaningful phrase.
	15. Index keywords are easy to recognize and distinguish.
Task orientation	16. It structures information in a task-oriented format, i.e. providing procedural information.
	17. Each task provides an overview of a work process.
	18. The instructions of tasks follow the sequence of user actions.
Function orientation	19. It organizes content in a function-oriented format, i.e. providing descriptive information.

4.3.3 Functionality

This criterion includes how sophisticated an online help is, how well technology is adapted to support the needs of users, how well users interact with the help system, etc.. It is important to be aware that the level of sophistication of technology alone does not lead to usability (Duffy *et al.* 1995). Several criteria can be used to measure this category, such as, accessibility, non-intrusiveness, ease of use, flexibility, consistency, trouble-shooting and intelligence (Duffy *et al.* 1995; Garzotto *et al.* 1995; Hackos 1997; Salminen *et al.* 1999; Ames 2001; Grayling 2002; Kantner *et al.* 2002). Here are the definitions of these criteria:

- *Accessibility*: measures how online help information will be accessed, in other words, how efficient the system is for its users to navigate and access. This issue directly affects the usability of the online help system. For example, a nurse inputs her/his queries into a search engine, if the search function could not understand the nurse's semantics, it may provide a feedback message such as "no information has been found". In such a case, the end user will most likely to be frustrated. Even though the information has been retrieved, it might be presented as a long list of options, from which it is also difficult to select the relevant ones. Therefore, the access mechanism is critical for the design of an effective OHS.
- *Non-intrusiveness*: help function is better invoked when a user requests it. Proactive help is not always useful because sometimes the system may fail to anticipate a user's problems correctly. It should not distract a nurse's attention from her/his work.
- *Ease of use*: measures how easy it is for an end user to learn an OHS. For example, is the search engine easy to find the targeted information? It

acknowledges that an end user does not require extra effort to learn how to use an online help system.

- *Flexibility*: measures if the system offers several paths to the same information, like context sensitivity, index with alternative terms, content that reflects user's place, related topics linking, maps, short-cuts; and if simple and advanced searchings are available.
- *Consistency*: every function should follow the same pattern throughout the help system. For example, the navigation interface should be consistent throughout the help system.
- *Trouble-shooting*: provides solutions and troubleshooting tips to nurse users to prevent them from making errors, and also alert them when they make mistakes.
- *Intelligence*: measures how sophisticated the system is to handle users' interaction. For example, could the search engine understand users' queries? Could the system cater to different users with different levels of familiarity? Could the system provide tailored and premising information to its users?

Extracting from the above definitions, we suggest twelve design guidelines that can be used to ensure accomplishment of the above seven criteria in the functionality category, see a summary in Table 4.3.

Table 4.3 Design guidelines to address the criteria in the functionality category

Criteria of Function	Design Guidelines
Accessibility	20. Hyperlinks work correctly.
Non-intrusiveness	21. The help system is invoked only when the user requests it. It should not distract the user's attention from their work before being invoked.
Ease of use	22. The help for how to use the help system is provided.
	23. Users can navigate the system easily.
	24. Users can easily print needed information.
	25. Users can easily switch between the help system and the application.
Flexibility	26. Several paths are provided to the same information.
Consistency	27. Navigation follows the same pattern throughout the system.
Trouble-shooting	28. There is Frequently Asked Questions session that provides a remedial course of actions.
	29. The tips for potential pitfalls are included.
Intelligence	30. The search engine understands users' queries.
	31. The system caters to different level of users.

4.3.4 Aesthetics

In essence, aesthetics is about how content and functions are presented to the end users (Garzotto *et al.* 1995). It is a very important criterion, because a poorly designed screen will increase the effort; the user needs to spend more time on searching for information, which reduces the effectiveness of an online help system. Hackos (1997) predicted that the next generation of online help will begin with the user interface because the interface provides information directly to users through text, graphics, icons, animation, or even

audio and video. According to Duffy *et al.* (1995), the visual appeal of the layout and the resolution of their graphics may all be considered as indicators of how good the help system is. Aesthetics can also be described by an alternative approach that draws from the field of software visualization (Stasko *et al.* 1998). Software visualization has been defined as the use of the crafts of typography, graphic design, animation, and cinematography with modern human-computer interaction and computer graphics technology to facilitate both human understanding and effective use of computer software (Price and Baecker 1993). Several criteria can be used to measure this category, such as visual effectiveness, cost-effectiveness, consistency and readability (Price and Baecker 1993; Garzotto *et al.* 1995; Hackos 1997; Stasko *et al.* 1998; Baecker 2002). Detailed descriptions are given as follows.

- *Visual effectiveness*: includes the layout, illustrations, colour, type, icons, and other graphical utilities to enhance meaning and attractiveness, and effective use of multimedia to present information. Symbols and colour are used to reinforce the structure of the information. Effectiveness of presentation includes replacing paragraphs of text with tables and lists, applying animation or video techniques to present procedural information (i.e. showing instead of telling) (Baecker 2002). For example, the majority of nurse users are female. They have different aesthetic taste to male users, which means that the arrangement of colour, layout, type and other graphical utilities should be carefully considered. In addition, women can learn better by means of effective graphics presentation, animation or video techniques, therefore, effort should be made in this area to facilitate their learning (Kayany and Yelsma 1998).
- *Cost-effectiveness*: issues in regard to the cost of technology cannot be ignored. If graphics presentation can help users learn to use an IS, animation or video

techniques should be avoided because they are more expensive to produce and update.

- *Consistency*: the presentation of information on various pages should be consistent so that differences between pages are meaningful.
- *Readability*: information is presented in a size and colour that is easy to read. Context-sensitive help windows must not cover up the work area. Related-topic must be easy to identify. Also, information should be pleasing to the eye.

We suggest twelve design guidelines that can be used to ensure accomplishment of the above four criteria in the aesthetics category. They are summarised in Table 4.4.

Table 4.4 Design guidelines to address the criteria in the aesthetics category

Criteria of Aesthetics	Design Guidelines
Visual effectiveness	32. Replacing paragraphs of text with tables and lists to facilitate users' understanding of content.
	33. The graphical images enhance the meaning of information.
	34. The functional graphics are easy to understand.
	35. The video demonstrations facilitate users' understanding of the procedural information.
	36. Symbols and colours facilitate the users to understand the information.
	37. Related information links are placed in a position that could be easily noticed.
Cost-effectiveness	38. The cost of technology and maintenance is relatively low.
Consistency	39. The graphics follow the same pattern throughout the help system.
	40. The styles of information (layout, format, colour, and icon etc.) in the help system follow the same pattern.

Readability	41. Information is presented in size and colour that is easy to read and pleasing for users.
	42. Icons, labels and hyperlinks are recognizable for users.
	43. Different levels of headings are easy to distinguish.

4.3.5 Usability: the 5Es

A usable help system is one that aids a user in diagnosing and repairing his or her problems with minimum time and effort. To reiterate, as an effective online help system has to be one that is usable, usability is the final arbiter for the system (Duffy *et al.* 1995). Quesenberry's 5Es (2004) are the essentially indicators of usability. For the context of this research about an effective OHS, the 5Es can be understood as:

- *Effective*: It measures the completeness and accuracy of an OHS, such as what percent of users' goals were achieved successfully and how well a task is completed.
- *Efficient*: It measures the speed and accuracy of a user's interaction. The indicators include how quickly a user reaches his/her goals and how quickly a task is completed.
- *Engaging*: It measures how distinct and consistent the visual presentation is, such as graphic images, and colours. The indicators include how clear and distinct the design and readability of text on screen is.

- *Error tolerant*: It concerns if an OHS prevents a user from making errors. The measurement indicators include if information on how to recover from errors is provided.
- *Easy to Learn*: It measures if an OHS is predictable, such as whether anyone can use the help system with confidence, given the basic skill set required to use the system.

4.4 Summary

Although the framework for an effective OHS for a NIS is an important topic for the development of an effective OHS that helps its end users, to date, not much work has been done in this area. A relatively comprehensive study conducted by Duffy *et al.* (1995) defined four criteria to measure a “good” online help, that is, usability, functionality, aesthetics and system documentation. They suggested that usability is the final arbiter of an OHS. However, this study was limited by its lack of a specific and concrete attribute subset in each dimension to describe what the attributes and features a quality OHS should offer. In contrast, Garzotto *et al.* (1995) defined four evaluation criteria: content, structure, presentation and dynamics. In fact, Garzotto *et al.*’s model (1995) is similar to that of Duffy *et al.*’s (1995). A combination of content and structure defines the quality of system documentation; and the concept of presentation is similar as aesthetics; dynamics is similar to functionality in terms of its emphasis on the convenience of the system for the end user to interact. As the research on this topic continued, more specific criteria of an effective OHS including different aspects of its performance and attributes were defined. As for usability inspection, the 5Es model developed by Quesenbery (2004) is considered the most comprehensive and easy to use.

Based on the findings from the published literature on effective online help, a framework consisting of five dimensions has been proposed. These dimensions are content, structure, functionality, aesthetics, and usability. There are specific criteria under each dimension to

further specify each criterion. Forty-three design guidelines were extracted from the literature review for the quality delivery of content, structure, functionality and aesthetics category. Usability is the final arbiter for an OHS. In order to validate the hypothesized framework, an experiment was conducted as described in Chapter 3. Detailed results and discussion for the experiment will be covered by next chapter.

Chapter 5 Results of the Experiment

5.1 Introduction

This chapter presents in detail the results of the experiment in phase 2 investigation. Firstly, Section 5.2 will present the results of the cognitive usability testing experiment and focus group discussion. Section 5.3 will discuss how to apply the 43 design guidelines into the design of the CPAT Online Help, in consideration of the identified learning needs of the nurse users for the CPAT. Thirdly, the results of heuristic evaluation and comparative usability testing will be given in Section 5.4. The chapter concludes with a summary.

5.2 Results of Needs Assessment

As mentioned in Section 3.5.3.1, the first step of this experiment was training needs assessment, in which cognitive usability testing for novice CPAT users and focus group discussion among experienced users were conducted. This section will first present the results of cognitive usability testing, followed by that of focus group discussions.

5.2.1 Results from the Cognitive Usability Testing Experiment with the Novice CPAT Users

There were eight sets of video and audio data gathered from this experiment. Analysing the triangulation of the eight sets of audio and video data identified a series of problems

that novice CPAT users encountered in learning the CPAT software. An excerpt of a coded section of such triangulation is given below to show how users' interaction with the software was coded.

00: 00 – user starts entering the main menu of the CPAT, and playing with the system.

“Where should I start?”

Ease of use- being confused over how to start up the system.

02: 15 – user enters data into ‘location’ list box instead of selecting one from the drop-down list.

Understandability - not recognising the drop-down icon in the selection field.

02: 16 – a message box pops up to inform the user to select a location from a list.

“What does it mean?” “What do I do?”

Understandability - not understanding the language used in the message.

20:40 – user finished scoring “communication problems” and intended to answer the next group of assessment questions.

“How should I go to the next group of questions?”

Navigation - having problems navigating between assessment criteria.

By coding all of the participants' usage problems, the most salient usage problems were summarised into ten categories (see Table 5.1). As mentioned above, the problems users encountered in the process of using the software provide first-hand information about the knowledge or skill gaps that prohibit them from effectively using the CPAT. The ten

problems reflected the users' shortage of three types of knowledge (or skills). These are: basic computer skills, knowledge about the software and domain knowledge about nursing documentation itself (see Table 5.1).

Table 5.1 A classification of the novice CPAT users' usage problems, and the knowledge and skill gaps indicated by these problems

Categories of novice users' usage problems	Knowledge gap	Knowledge description
1. Users do not recognize the drop-down icon in the selection fields.	Basic computer skills	The ability to type, edit, browse, and select information, and so on.
2. Users do not understand the language used in the message boxes.		
3. Users do not recognize the scrolling bar in assessment form.		
4. Users are confused how to start up the system.	Knowledge about the software	Applying the functions of the CPAT to do tasks like data entry, assessment, and report generating.
5. Users are uncertain about the format of 'date'.		
6. Users do not know where to score questions of assessment criteria.		
7. Users do not know how to navigate through assessment criteria.		
8. Users do not know how to find out the unanswered questions.	Domain knowledge about nursing documentation	The concept of resident assessment, protocol of assessment, etc.
9. Users do not know the protocol of conducting a resident assessment.		
10. Users do not understand some assessment questions.		

5.2.2 Results of Focus Group Discussion

The minute taking of the focus group is provided in Appendix 8. The findings of the focus group discussion will be presented according to the questions to be asked.

5.2.2.1 The answers to the question “how did you learn to use the CPAT software?”

The implementation of the CPAT software into workplace in Hammond Care Group followed the process of nurse trainers’ first learning to use the software, then teach each of care managers, afterwards all levels of care staff. The education session not only delivered the “know-how” knowledge of the package but also the fundamental process of nursing documentation in the organization, as described by the participants:

RN: in putting the system in place, it was actually the process that was gone through nurse trainers and each of the managers...eventually all levels of staff.

Director: the training sessions not just introduce the software, but information about what is CPAT, what information we are trying to gather and how do we go about to do it. It is actually the total process of nursing documentation, not just using the software.

The normal method of learning to use the CPAT software was labour-intensive, one-by-one coaching, followed by self-directed practice, as described by various participants in the focus group discussion.

Nurse trainer: when I first did training for this software, I found that it was very easy to find your way through, and to just play around and then get what you want. ...We found it that

using one on one coaching approach and slightly intensive teaching has good results. If we had misconception, just re-teach (sic) them.

EN: *it is actually the process of how many times you use it, to remind you the right thing to keep on.*

5.2.2.2 The answers to the question “could you recall any problems when using the CPAT software?”

The majority of the participants reported that the CPAT was easy to learn and did not take them a long time to familiarize with it. However, they mentioned some internal and external barriers in the introduction of this software into nursing care. These included (1) basic computer skills; (2) anxiety experienced by some nurse users; (3) aged care work force; and (4) limited organizational support for the end users. If users encountered any problems, although they could approach the IT consultant, as the support was provided by an external company and was not easily accessible, most of the time, they had to solve the problems by themselves, which was difficult for the novice users. The above issues are supported by the comments made by various participants:

RN: *...less than one week to figure out how to use CPAT. ...But you have to have the basic computer skills first.*

Trainer: *I think you got (to have) basic skills. If people haven't, it is slow.*

RN: *sometimes it is reluctant to use the tool based on fear.*

RN: *in aged care, the directors or RNs are quite old.*

Director: *if having problems, mostly they have to figure out themselves.*

RN: *we have 24-hour help desk externally provided by an IT support company.*

Several participants reported some specific problems they would have like to be solved when using the software. These problems were:

- What are the features of this program?
- How do I use these features?
- How do I add a new assessment?
- Assessment does not follow through when entering data between fields
- I cannot locate the previous assessment.
- How do I monitor changes using this tool?
- How do I access individual assessments and manage them between different facilities and units?
- How do I transfer the information between facilities?
- When I enter the medication, it doesn't print it, why? And how to print?

5.2.2.3 The answers to the question “what kind of online help features would you like to have when encountering problems?”

To answer this question, the researcher first demonstrated several templates of online help, such as search engine, Frequent Asked Questions (FAQ), video clips, and Clippy (Microsoft Office Assistant that appears in the shape of a paperclip with eyes) to the focus group. Afterwards some participants provided their comments on the usability of these templates. FAQ seemed more favorable than the ‘search function’. In particular, the need for the accuracy of language and the readability of GUI (Graphic User Interface) were emphasized by the focus group participants. In respect to the use of a video clip to demonstrate operational information, the majority of the participants liked using this feature to find out how to use a particular widget or complete certain tasks using the software. The above findings are reflected by the following comments:

RN: *I think FAQ are important to have.*

Director: *with search and Clippy, the problem is that sometimes people don't know what to ask. It is better if you can give them some information and several options about what they could ask.*

RN: *If you know you are looking for something in particular area, you can go check from the content or index.*

Director: *The language used in the instruction should be understandable for us. I want to know how to enter a new resident, but I don't necessarily think it is "data entry".*

RN: *Yes, just common language rather than technical words.*

Consultant: *Is there any way that on the screen where the plus sign is, which is you push when you enter a new resident, it can say "new resident" instead of the plus sign.*

EN: *Video demo is fine. If you show everything, I don't think it takes long to learn.*

5.2.3 Conclusion of the Results of the Needs Assessment

The findings from the needs assessment provided valuable insight for the next step of the research, i.e. design of the CPAT Online Help. In other words, the CPAT Online Help was designed to address the identified problems of both novice and experienced CPAT users, i.e. training needs. Firstly, the results of the cognitive usability testing gave certain indications about what the CPAT Online Help should provide for the novice users, that is, the ten users' usage problems. They should be emphasized and addressed in the CPAT Online Help. Secondly, a summary of FAQ was gained from the focus group discussion. As FAQ was acceptable to nurse users, it can be implemented in the CPAT OH. Thirdly, the language used in the OHS should communicate a meaningful instruction to nurse users. Last but not least, interactive video clips can also be implemented in the CPAT OH as users preferred to be shown how to do things instead of telling them.

5.3. Design and Implementation

As addressed in Section 3.5.3.2, forty-three design guidelines were applied. The design and implementation of the CPAT Online Help were the practice of both applying the design guidelines and addressing the training needs. There are two results of implementation:

- The production of paper-based user manual (see Appendix 3), which is the base for the development of the online help. The length of the user manual is 51-pages. It covers all of the necessary information about the CPAT software, including its background, the context of care planning, function-based instruction as well as procedural (i.e. task-oriented) instructions for using the software.
- The development of the CPAT Online Help: a Microsoft Compressed HTML Help file (a proprietary format of online help files, as defined in WIKIPEDIA from http://en.wikipedia.org/wiki/Microsoft_Compressed_HTML_Help). The CPAT Online Help contains 53 HTML files. The content of the help information is similar to that of the user manual, but is more concise than the paper-based one. In addition, the way to present the help content is different to that of the user manual. For example, functions such as hyperlink, video demonstrations, index, FAQ and search engine are used to facilitate users' searching the relevant information.

The following section will describe how the forty-three design guidelines were applied in the design and implementation of the CPAT Online Help according to the four categories of the theoretical framework (i.e. content, structures, functions and aesthetics).

5.3.1 Content

The process of content design involved synthesis and interpretation of the needs assessment results and the application of the relevant design guidelines to ensure the conformance of the final product with the proposed framework. For example, the identified usage problems became the main focus of the content. Information about how to avoid pitfalls of some specific tasks was provided in a format of hints or notes. In addition, users' feedback was the main source of the Frequent Asked Question session. Eight design guidelines were applied in order to accomplish the seven criteria in the "content" dimension, that is, accuracy, conciseness, completeness, consistency, understandability, clarity and usefulness (for details see Table 4.1).

Design guideline 1 (accuracy): The content of information is correct and contains no errors.

The manuscript of the CPAT Online Help was adapted based on the original paper-based user manual owned by the Hammond Care Group. As this user manual has been used for eight years, it is recognized as a reliable source. Although there were differences between the current version and the previous version of CPAT in terms of functionality, the contents of the manuscript for the new version (i.e. CPAT) were assessed as having "no errors" by the owner and developer of the CPAT.

Design guideline 2 (accuracy): Texts are grammatically correct.

The manuscript of the CPAT Online Help was proof read by both the supervisor and the academic support staff in University of Wollongong. Their acceptance of the grammar and flow of the manuscript justified the accuracy of the texts in the manuscript.

Design guideline 3 (conciseness): It provides minimal but adequate guide to users, i.e. avoiding lengthy texts.

Effective utilization of tables and figures significantly reduced the length of the help manual. For example, in order to explain the interface of the Clients Screen, an illustration of the interface was used (see Figure 5.2). In addition, fourteen self-controlled video clips were created to help users to understand the procedure of doing various tasks in the CPAT (see a list of video clips in Figure 5.3). For example, the video clip named “video demo of displaying results” was created to demonstrate the procedure of displaying residential assessment results (see Figure 5.4). The mouse in the clip was highlighted by a yellow circle in order to draw the user’s attention to the mouse movement. This way of presenting procedural information is straightforward, and the user can control her/his pace to follow the demonstration.

The screenshot shows the 'Clients' screen in the CPAT Online Help system. The title bar reads 'FrmClient : Form'. The main heading is 'Clients'. The form is divided into several sections:

- Demographic information:** Includes fields for Surname (Ad), Given Names (Elizabeth), Preferred Name, Sex (Female), Date of Birth (25/04/1921), First Contact, Discharge, Date of Death, and Current Location (Wide Bay3, BUN NUH). There is also a Photo placeholder.
- Function tabs:** A row of tabs including 'Personal Details', 'Appearance', 'Assessments', 'Carer / Guardian', 'Next of Kin', 'History', and 'Comment'.
- Select Existing Client:** A button with a magnifying glass icon.
- Report generating:** A vertical list of report types: 'Absconding Report', 'Emergency Report', 'Monitoring Report - Line', and 'Monitoring Report - Bar'.
- Add a record:** A button with a '+' icon.
- Delete a record:** A button with a trash can icon.
- Exit to main menu:** A button with a home icon.

The main content area is divided into three columns:

- Current Address:** Fields for Address, Postal code, and Phone.
- Medical Aid:** Fields for Doctor and Phone.
- Social Security:** Fields for Medicare No and Pension No.
- Private Health Insurance:** Fields for Health Fund, Table, and Insurance No.
- Administration:** Fields for Code and LGA.

Annotations on the left side of the screen point to various elements:

- Demographic information:** Points to the top section of the form.
- Function tabs:** Points to the row of tabs.
- Select a record:** Points to the 'Select Existing Client' button.
- Report generating:** Points to the list of report types.
- Add a record:** Points to the '+' button.
- Delete a record:** Points to the trash can button.
- Exit to main menu:** Points to the home button.

Figure 5.2 Illustration of the Clients Screen interface in CPAT Online Help

Video demo of adding a location
 Video demo of adding an assessment
 Video demo of adding an assessor
 Video demo of adding diagnosis/medication
 Video demo of creating a facility profile
 Video demo of displaying results
 Video demo of generate Compare to Facility report
 Video demo of generating Common Problems report
 Video demo of generating Compare Facilities report
 Video demo of generating Monitoring report
 Video demo of generating Specific Problem report
 Video demo of generating Summary report
 Video demo of generating Who Fits Profile report
 Video demo of rating assessment

Figure 5.3 A list of video demo in the CPAT Online Help

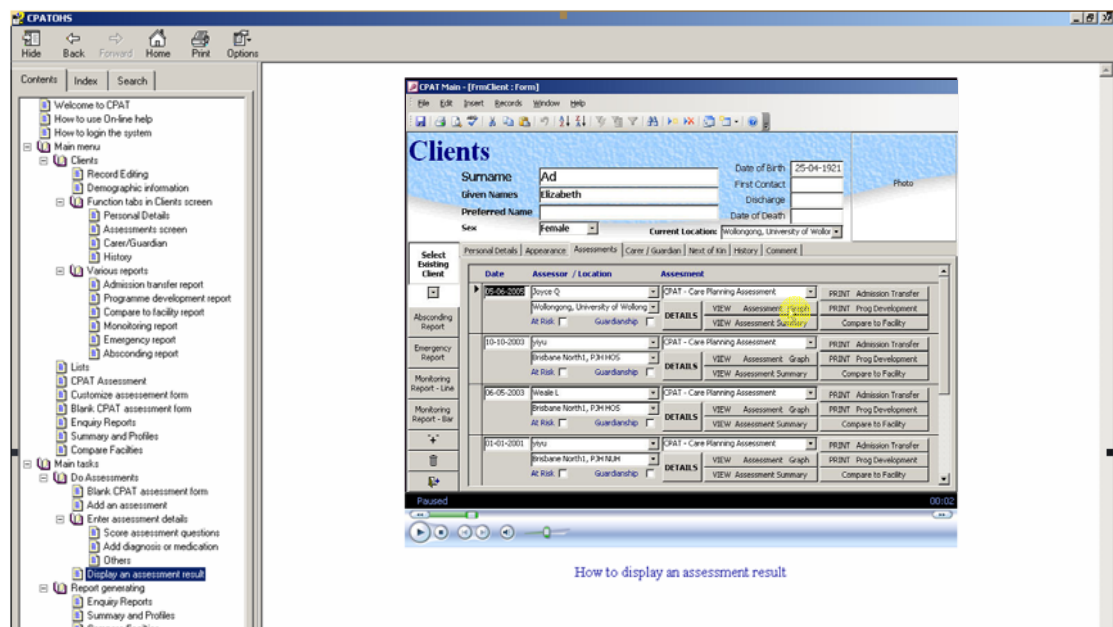


Figure 5.4 Video demonstration of “Displaying an assessment result”

Design guideline 4 (completeness): Comprehensive information is provided to cater for users in different levels.

The contents of the help information cover all functions for different roles of users (see Figure 5.5). Users with different roles have different levels of tasks which are accomplished by performing a series of functions. For example, normally RNs do

assessments for residents including entering demographic details and assessment details, after a period of time of nursing intervention; they can review residents' status by generating a Monitoring report; while managers who need to transfer residents to another facility can generate a Compare Facilities report to facilitate this transformation.

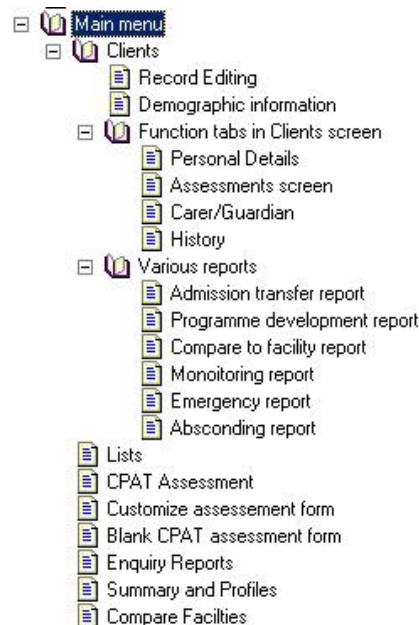


Figure 5.5 a screenshot of the main functions in the CPAT Online Help

In addition, the content of help information was designed to cater for users with different levels of experience with the CPAT. As suggested by the needs assessment, for novice users, basic computer skills should be addressed in the help system. Both instruction and video clips were designed to satisfy this need. For example, every video clip highlights the mouse movement with yellow circle and keyboard strokes with sound. For experienced users, optimal ways of performing tasks were provided in order to assist them to complete their documentation task efficiently. For example:

.....The alternative way to check the unanswered questions is to simply check the status bar which indicates the number of questions to answer.

Assesment Result

Client: Co, Malcolm Date: 24/01/2003 Location: Gold Coast1, CUR SCU
 Assessment: CPAT - Care Planning Assessment Assessor: Kellor J Referred for Guardianship: ☐
 Client is At Risk: ☐

Score: Diagnosis / Medication Others

Assessment Group: << F5 Communication Problems F8 >> Refresh

No.	Question	Score	Responses
1	The person's hearing is	1	0 Apparently good 1 Slightly impaired 2 Moderately impaired 3 Extremely poor
2	The person understands what is said to them		0 Everything, responses always indicate understanding 1 Most things, usually shows understanding 2 A few things, occasionally shows understanding 3 Almost nothing, no sign of understanding
3	The person has a speech problem caused by physical defects or illness		0 No problems 1 Some additional time required to understand what i 2 A lot of time required to understand what is said 3 Other methods of communication have to be used
4	The person is unable to use the correct words		0 No problems 1 Occasionally has difficulty finding the correct wo 2 Often has difficulty finding the correct word 3 Always has difficulty finding the correct word

Check Unanswered Questions

Questions 4 To Answer 3 Group Score 1 % Score 8%

There are 3 questions to be answer in this group

Design guideline 5 (consistency): Terminology (terms, concepts, etc.) is used consistently throughout the help system.

The terminology used in the manuscript followed a consistent manner. The terminology includes names of buttons, tabs and fields (e.g. *Clients*, *Lists*, *Assessor/Location* and so on), names of functions (e.g. Compare to Facility, Compare Facilities and so on) and nursing terms (e.g. assessment, resident, medication and so on). They appeared the same in both the hard-copy user manual and online help.

Design guideline 6 (understandability): It uses the user's language rather than the system-focused terms.

Difficulty in understanding system-based language was perceived by the focus group participants as a barrier to nurse users learning nursing information systems. In order to ensure the language of the Online Help is written in a nurse's language, a language support academic, who has nursing work experience in nursing homes, was involved in

the design of the content of the Online help. With her constant assistance, the understandability of the language used in the help system was significantly improved. It was confirmed that the language was straightforward for nurse readers. In addition, the manuscript was proof read by a consultant and the original developer of the CPAT software. Most of them commented no difficulty in understanding the content.

An excerpt of the instruction of “Blank Assessment Form” is given below as an example of using nursing terms to explain the purpose of the form.

The blank assessment form has been designed specifically for use in conjunction with the CPAT software as a “paper and pencil” assessment tool. Further, it assists you to fill in the electronic assessment form by printing it out as a hard copy version. It eases those nurses who may not be comfortable to use computer to enter assessment data.

The first three pages of the form may be used to collect basic information on the person being assessed. The remaining pages which contain eight groupings of questions may be used to record the resident’s problems. Many of the questions require a judgement to be made on whether a problem can be seen at least once or twice a week.

Design guideline 7 (clarity): The content contains no ambiguous information.

In order to achieve this, reused information should retain meaning in any context, that is, meaning should hold no matter how the user combines the information pieces.

Design guideline 8 (usefulness): The content answers users' expected questions.

Ten usage problems and a list of FAQ were gathered from two needs assessment. With the assistance of the owner of the CPAT and the staff in Hammond Care Group, solutions

to these questions were designed and provided in the online help system. An excerpt of FAQ is given below as an example of answering users' expected questions.

Question: *When I type data in the "location" field, a message box "The text you entered isn't an item on the list" pops up. The program then disables me to operate any other functions. What can I do?*

Answer: *When you enter a location that is not one of the existing valid locations, this message will come out to ask you to select an item from the list. Failure to do so will result in this message's continuous popping, so that you cannot do anything at all.*



To solve this hassle, here is a tip. If you just made a typing error, check the list if the location exists in the list. If not, you need to add this location to the list, the system does not accept typing a new item in the field. How to add a new item, see Lists. However, before you add a new location, you can temporally select one item from the list, so that you can go to the List menu. After adding a location in the list, you can relocate the record you operated to select or type the location added.

5.3.2 Structure

The challenge of the structure design was organising the help information in a way that helped users to search for it as quickly and easily as possible. In order to conquer this difficulty, the structure of the online information had to follow the cognitive process of users. Information from the needs assessment and eleven design guidelines (refer to Table

4.2) facilitated the design process of the structure of the help system. The findings of needs assessment gave an indication about users' documentation work flow with CPAT as well as the usage problems they encountered.

Physically and conceptually organizing help information was the concern of the structure design. The organization of information included a hierarchy of 53 html files (table of content), organization of headings (within a web page) and navigation design (hyperlinks), see Figure 5.6.

Eleven design guidelines were applied in order to accomplish the five criteria in the "structure" dimension, that is, efficiency, consistency, retrievability, task orientation and function orientation (refer to Table 5.2).

Design guideline 9 (efficiency): within headings, the most important words come first.

Each heading was concise and attached to a meaningful term or phrase. Take the instruction of "Entering an assessment" as an instance, the heading was the name of the task, which informs the user that this instruction is focused on how to enter an assessment (see Figure 5.7).

Design guideline 10 (efficiency): the important information is located at high levels of the structure.

The structure of both functions and tasks were designed based on this principle. As shown in Figure 5.8, the main menu was designed in the highest level (Level 1) as it contained all functions of the CPAT. On the main menu screen, Clients, Lists, etc. were functions buttons, therefore they were placed in Level 2, and the rest may be used by analogy. The same principle was applied in organizing the hierarchy of main tasks (see Figure 5.9).

Design guideline 11 (efficiency): layered information provides minimum paths through information.

Information was layered based on its position in the hierarchy, which was the optimal path to access information. The maximum number of layers is three.

Design guideline 12 (consistency): it applies the consistent mechanism to organize information into levels of headings.

Each heading in Table of Contents in CPAT Online Help represents its html file. In other words, the ways to organizing headings are the same as the ones to organizing html files, i.e. function-orientation and task-orientation (refer to Figure 5.8 and Figure 5.9).

Design guideline 13 (retrievability): the information is organized in a logical way.

Information was grouped in function-oriented and task-oriented format. The logical meaning of help information was either descriptive or procedural.

Design guideline 14 (retrievability): hyperlinks are attached to a meaningful phrase.

Phrases with hyperlinks were designed as names of functions, tabs, buttons and tasks. The meanings of the phrases were straightforward. For example, the instruction for the main menu is:

There are eight buttons in the main menu:

- *Clients*
- *Lists*
- *CPAT assessment*
- *Custom Assessments*
- *Blank CPAT assessment Form*
- *Enquiry Reports*
- *Summary and Profiles*
- *Compare Facilities*

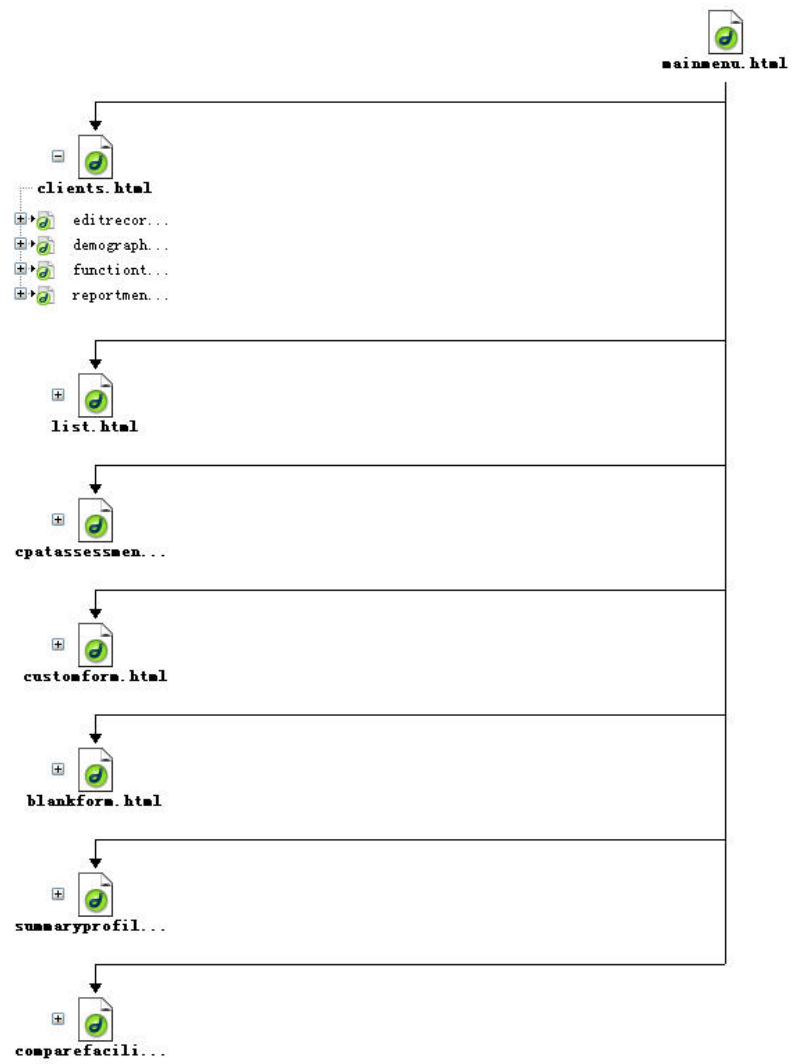


Figure 5.6 Map of html files of CPAT Online Help



CPAT ON-LINE HELP

Enter an assessment

Press the *DETAILS* button in the *Assessments* screen, the assessment results screen, where you score the assessment questions, enter diagnosis and medication, will be displayed.

How to enter the detailed assessment screen

Clients

Surname	No	Date of Birth	03/07/1911	Photo
Given Names	Clover Frances	First Contact	15/05/1998	
Preferred Name		Discharge		
Sex	Female	Date of Death		
		Current Location	North Queensland, CRN/HOS	

Select Existing Client

Personal Details | Appearance | Assessments | Carer / Guardian | Next of Kin | History | Comment

Assessment

Date	Assessor / Location	Assessment	
	Assessor	CPAT - Care Planning Assessment	PRINT Admission Transfer
	At Risk	Guardianship	VIEW Assessment Graph PRINT Prog Development
		DETAILS	VIEW Assessment Summary Compare to Facility

Press DETAILS button to enter details of assessment

Figure 5.7 an example of heading

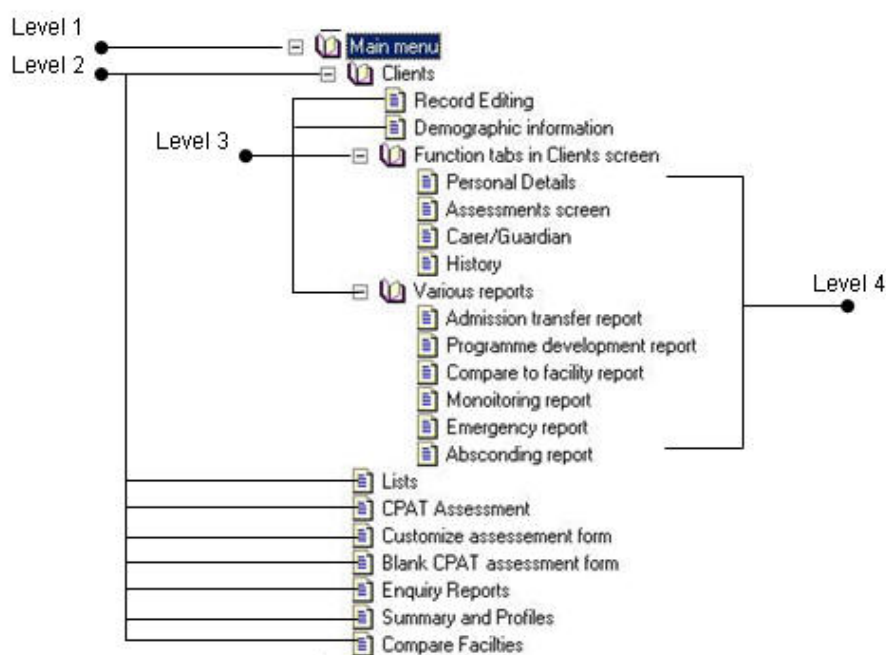


Figure 5.8 Hierarchy of main functions of CPAT

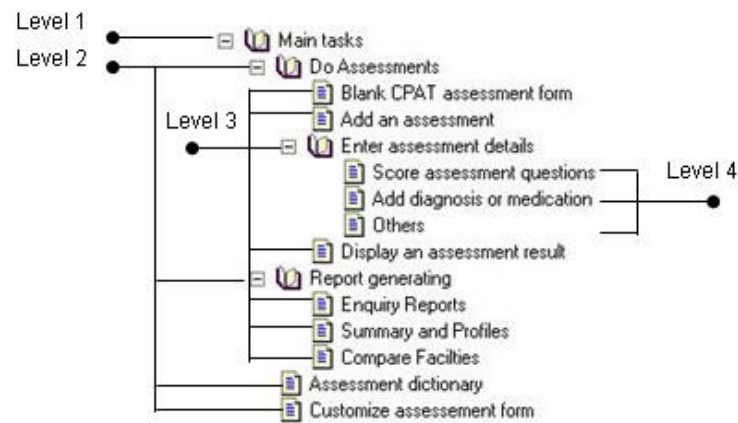


Figure 5.9 Hierarchy of main tasks of nurses

Design guideline 15 (retrievability): index keywords are easy to recognize and distinguish.

The keywords of index in CPAT Online Help were designed to be both concise and distinguishable. They are names of functions, tasks, tabs, buttons and video demonstration, and are arranged in alphabet order (see Figure 5.10).

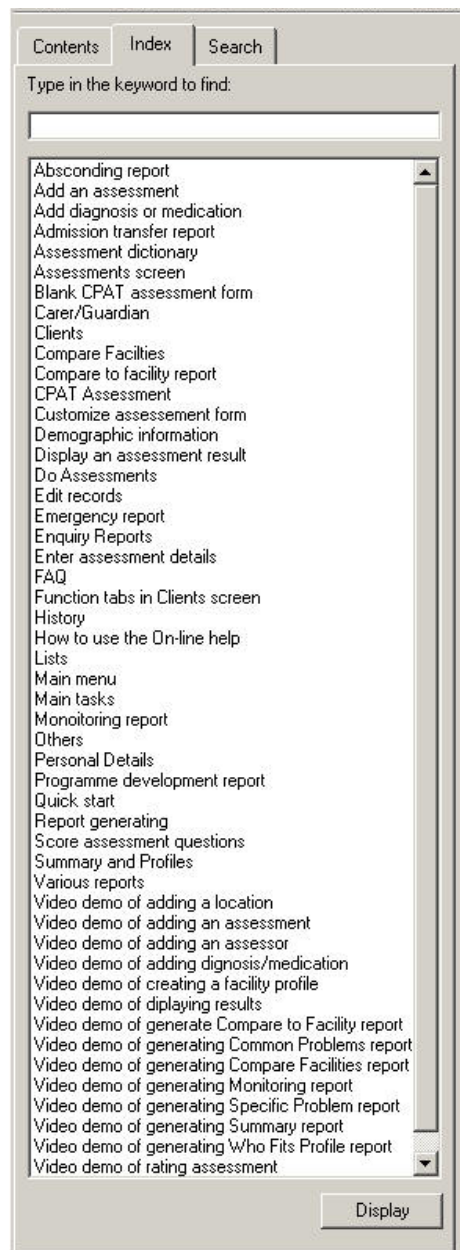


Figure 5.10 the index page in CPAT Online Help

Design guideline 16 (task orientation): it structures information in a task-oriented format, i.e. providing procedural information.

As suggested by the participants of the focus group discussion and previous peer-reviewed publications, task-oriented instruction facilitates users' shifting from conceptual models to procedural ones. The main tasks enabled by the CPAT are illustrated in Figure 5.11.

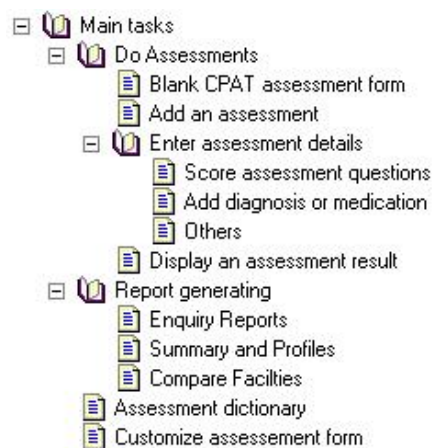


Figure 5.11 Main tasks of nursing documentation enabled by the CPAT

Design guideline 17 (task orientation): each task provides an overview of a work process.

Step-by-step instruction provides users with a conceptual model for a particular task. Take “Doing Assessment” instruction as an instance to demonstrate how to provide users with an overview of doing residential assessment by CPAT:

Doing residents' assessments is the most crucial part of CPAT. The CPAT provides you an opportunity of doing assessments with simplicity. The whole process follows the following steps.

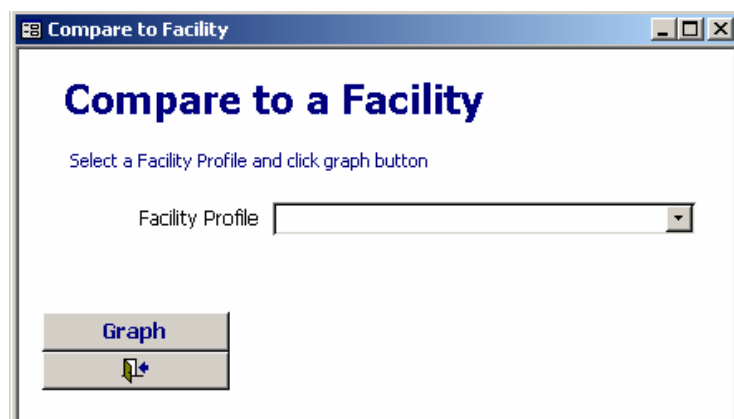
- *Blank CPAT assessment form*
- *Add an assessment*
- *Enter details for the assessment*

- *Display the assessment results*

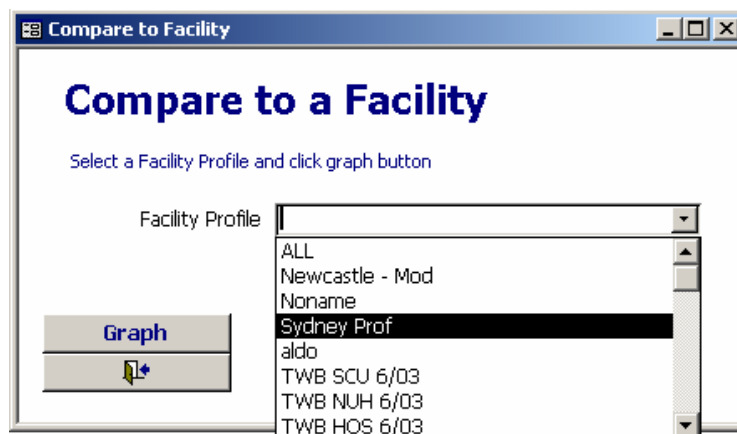
Design guideline 18 (task orientation): the instructions of tasks follow the sequence of user actions.

Both the written instruction and video clips were designed to follow the sequence of user actions. Take instruction for generating a “Compare to Facility” report as an example:

*Click on the **Compare to Facility** button in the **Assessments** platform, a message box will pop up.*



*Click on arrow at the end of **Facility Profile** field and select a facility name from list or type a specific facility.*



*Click on the **Graph** button, the values will be displayed in a graphical format.*

Design guideline 19 (function orientation): It organizes content in a function-oriented format, i.e. providing descriptive information.

Apart from the task-oriented structure, the contents of the CPAT Online Help were also organized in a function-oriented format (refer to Figure 5.8).

5.3.3 Functions

As suggested by the participants of the focus group discussion, Table of Contents, FAQ, video demonstration, Index and Search function should be main functions of CPAT Online Help. Twelve design guidelines were applied in order to conform to the seven criteria in the “functions” dimension, namely, accessibility, non-intrusiveness, ease of use, flexibility, consistency, trouble-shooting and intelligence (see Table 4.3).

Design guideline 20 (accessibility): Hyperlinks work correctly

The links of hyperlinks in CPAT Online Help were checked by Macromedia Dreamweaver 8. The result showed that there were no dead links among 225 links.

Design guideline 21 (non-intrusiveness): The help system is invoked only when the user requests it. It should not distract the user's attention from their work before being invoked.

Because of a limitation of resources, the researcher was unable to access the source code of CPAT software (IP issue). Therefore the researcher was unable to integrate the CPAT Online Help into the application. For this reason, CPAT Online Help was designed as an independent .chm file. Unlike proactive help, execution of the CPATOH.S.chm is needed before seeking help.

Design guideline 22 (ease of use): The help for how to use the help system is provided.

Instruction of CPAT Online Help was provided. An excerpt of this instruction is given below.

How to use the CPAT On-line Help


The help system consists of a set of concise and well-structured information about the functions and common tasks of CPAT and how to solve the common usage problems. It strived to make it easy for you to find out what you need.

There are three ways to use this help system:


- *Use the Table of Contents to view the Help system like a book.*
- *A complete index - alphabetical by subject.*
- *The Search feature lets you search for specific text.*

.....

Design guideline 23(ease of use): Users can navigate the system easily.

At any time users can use the navigation bar , which is on the top of each page, to move through the help system hierarchy. Within html pages, hyperlinks to next pages were provided. For example, in the bottom of the “Add an assessment” instruction, there is a hyperlink which links to next step of this process: “See next: How to enter the details of an assessment”.

Design guideline 24 (ease of use): Users can easily print needed information.

When users want to print the topics they are interested, click on the  on the top of each page or stroke Ctrl+P, a message box will pop up (see Figure 5.12). This function was designed to facilitate printing users' desired information.

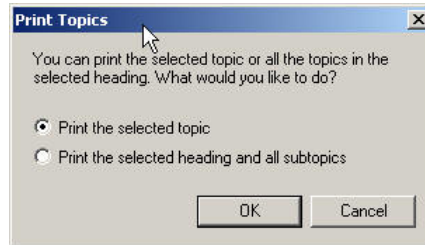


Figure 5.12 Message box of Print Topics

Design guideline 25 (ease of use): Users can easily switch between the help system and the CPAT application.


As mentioned before, CPAT Online Help is independent of CPAT application. Users can switch between the help system and the application by clicking on either



Design guideline 26 (flexibility): Several paths are provided to the same information.

Related topics linking, video demonstrations, well-organized Table of Contents, Index, simple and advanced search were designed to provide the same information to the users.

Design guideline 27 (consistency): Navigation follows the same pattern throughout the system.

Hyperlinks were attached to meaningful phrases like names of functions, tasks, tabs and buttons. A navigation bar  facilitates users to navigate between pages.

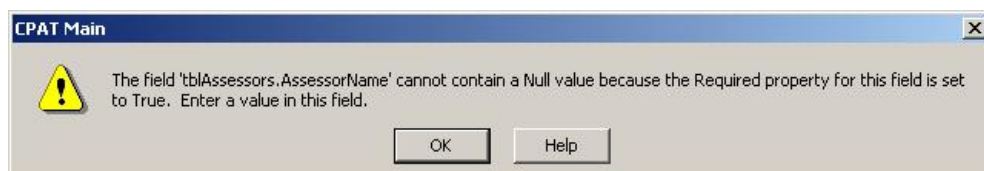
Design guideline 28 (trouble-shouting): There is Frequently Asked Questions session that provides a remedial course of actions.

See an example of FAQ in design guideline 8.

Design guideline 29 (trouble-shouting): The information about the tips for the potential pitfalls is included

Data from the first needs assessment showed that there were some easy-to-make-mistakes. In order to avoid these pitfalls, “Note” solutions were provided. For example, in the task of “Add an assessment”, there is a pitfall:

Note: To add a new assessment, three fields (Date, Assessor and Location) are required. Otherwise an error message will pop up to suspend you for further operation.



Design guideline 30 (intelligence): The search engine understands users' queries.

The search engine was designed to be sensitive for terms, concepts of nursing documentation as well as names of tasks, functions, tabs and buttons of the software. These help users in searching for information. For example, if a user does not know how to check the unanswered assessment questions, he/she can type this problem into the

search field. As Figure 5.13 shows, there are two topics that may contain helpful information.

Design guideline 31 (intelligence): The system caters the needs of the different levels of users

Examples see design guideline 4.

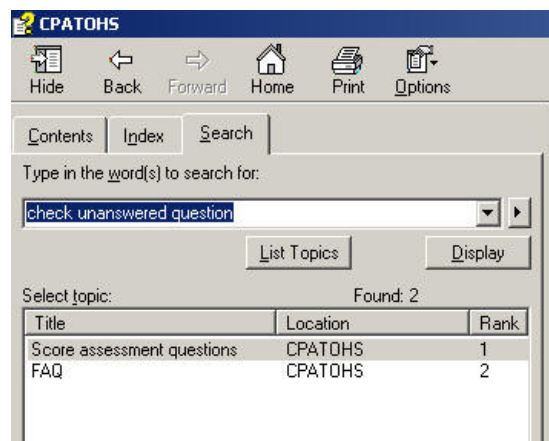


Figure 5.13 Search Engine of the CPAT Online Help

5.3.4 Aesthetics

The factors to consider in user interface design include style of text, graphics and video clips. Twelve design guidelines were applied in satisfy the four criteria in the “Aesthetics” dimension, namely, visual effectiveness, cost-effectiveness, consistency and readability (see Table 4.4).

Design guideline 32 (visual effectiveness): Replacing paragraphs of text with tables and lists to facilitate users to understand content.

Tables and lists were frequently used to describe the meanings of fields in the software. For example, Table 5.2 was designed to explain how to enter demographic information for a resident.


Table 5.2 Fields for entering demographic information

Field	Description
Surname	Family name (required field).
Given names	First name or other given names (required field).
Preferred name	The name this person is usually known as by friends or relatives. It could be a nick-name.
Sex	Click on arrow at the end of field and select female or male from list or type in female or male (identifying field).
Date of birth	Date of birth in the format dd/mm/yyyy (required field).

Design guideline 33 (visual effectiveness): The graphical images used enhance the meaning of information.

Graphical images easily provide straightforward, meaningful information to users. Apart from Figure 5.2, there is another example graphical image use for instruction (see Figure 5.14).

Design guideline 34 (visual effectiveness): The functional graphics are easy to understand.

Functional graphics consistently use a combination of arrows “•” and definitions of functions, fields, tabs and buttons, which is easy to understand.

Assesment Result

Client: Si, Gladys Date: 02/05/2003 Location: Sunshine Coast1, CAB HOS
 Assessment: CPAT - Care Planning Assessment Assessor: Gardiner J Referred for Guardianship: ☐ Client is At Risk: ☐

Function tabs: Score | Diagnosis / Medication | Others

Assessment group: Assessment Group << FF Communication Problems F8 >> Refresh

No.	Question	Score	Responses
1	The person's hearing is	2	0 Apparently good 1 Slightly impaired 2 Moderately impaired 3 Extremely poor
2	The person understands what is said to them	1	0 Everything, responses always indicate understanding 1 Most things, usually shows understanding 2 A few things, occasionally shows understanding 3 Almost nothing, no sign of understanding
3	The person has a speech problem caused by physical defects or illness	1	0 No problems 1 Some additional time required to understand what is said 2 A lot of time required to understand what is said 3 Other methods of communication have to be used
4	The person is unable to use the correct words	2	0 No problems 1 Occasionally has difficulty finding the correct word 2 Often has difficulty finding the correct word 3 Always has difficulty finding the correct word

Questions 4 To Answer 0 Group Score 6 % Score 50%

Status bar

Figure 5.14 Illustration of the Assessment Result

Design guideline 35 (visual effectiveness): The video demonstrations facilitate users' understanding of the procedural information.

Examples see design guideline 3.

Design guideline 36 (visual effectiveness): Symbols and colours facilitate the users to understand the information.

Take an example of a "Note" session. This session was designed to provide tips for potential pitfalls. In order to attract users' attention to this session, the colour coding 'red' is used for the heading "Note".

Design guideline 37 (visual effectiveness): The related information are placed together.

The related information was hyperlinked and placed in a table format, see Figure 5.15

These fields are required before adding an assessment:

- Surname
- Given name
- Date of birth
- Current location

Figure 5.15 an example of placing the related information in one place

Design guideline 38 (cost-effectiveness): The cost of applied technology and maintenance is relatively low.

The costs of technology are shown in Table 5.3. Although the sum comes to above A\$1000, there is still room for saving. An alternative tool to author html file is Microsoft FrontPage, which costs A\$292. It will reduce the software cost to under A\$1000. The cost for maintenance is also low because the updated information is mainly the FAQ session.

Table 5.3 A list of prices of tools used to implement CPAT Online Help (from <http://www.softwaretime.com.au>)

Tools	Price (A\$)
Microsoft Word Process	353
MacroMedica Dreamweaver MX	539
Paint in Window XP	0
FAR HTML 4.0	65
Camtasia Studio 2.1	220
	1177 (Sum)

Design guideline 39 (consistency): The graphics follow the same pattern throughout the help system.

Examples see design guideline 34.

Design guideline 40 (consistency): The style of information (layout, format, colour and icon etc.) in the help system follows the same pattern.

Each html file of CPAT Online Help was created based on a pre-defined template file (see Figure 5.16).

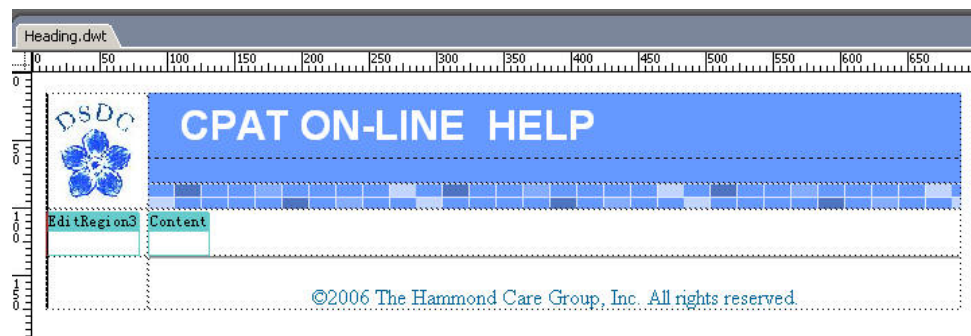


Figure 5.16 Template of CPAT Online Help

Within this template, the style of the content, including layout, format, colour and icon, was defined in a font.css file, see Appendix 9. Examples of the layout of information see Table 5.4.


Design guideline 41 (readability): Information is presented in size and colour that is easy to read and pleasant for users.

As shown in Table 5.4, information was presented in an easy to read manner. The colour used was mainly feminine tone, such as light blue and purple, which is pleasant for users.

Design guideline 42 (readability): Icons, labels and hyperlinks are recognizable for users.

See examples in Table 5.4

Table 5.4 Examples of layout

Name	Examples						
Heading 1	Care Planning Assessment Tool (CPAT)						
Heading 2	Delete a record						
Body text	To delete a record, click on the  button under the "+" button.						
Bullet	• and ■						
Note	Note						
Table	<table> <tr> <th>Field</th><th>Description</th></tr> <tr> <td>Surname</td><td>Family name (required field).</td></tr> <tr> <td>Given names</td><td>First name or other given names (required field).</td></tr> </table>	Field	Description	Surname	Family name (required field).	Given names	First name or other given names (required field).
Field	Description						
Surname	Family name (required field).						
Given names	First name or other given names (required field).						
Hyperlink	Before visit See a video demo.						
	Mouse hover See a video demo						
	After visit See a video demo						

Design guideline 43 (readability): Different levels of headings are easy to distinguish.

Heading 1 was presented in a highlight background (see examples in Table 5.4), which attracts users' attention that the information was important, while heading 2 was presented without background colour.

5.4 Evaluation

After the Online Help has been built, the next step of the experiment was to evaluate it, using two evaluation methods: heuristic evaluation and usability testing. This section will firstly present the results of the two evaluations, and then draw conclusions from both.

5.4.1 Results of the Heuristics Evaluation

As stated in Section 3.5.3.3, the goal of this heuristics evaluation was to judge the CPAT Online Help's compliance with the forty-three design guidelines by utilizing a five-point "Likert" scale questionnaire. The assessment items were the exact design guidelines, and the sequences of the items followed that of the guidelines. There were eight questionnaires gathered from the peer evaluation, the return rate was 100%. The result for each assessment category was tabulated in Table 5.5. Most answers given to the assessment items were "good". On the whole, the CPAT Online Help was seen as a "good" system by the assessors in software design community. The comments for improvement were also received. The respective modifications were made according to these comments. The following sections will present the results of this questionnaire survey according to the four evaluation criteria: *content*, *structure*, *functionality* and *aesthetics*.

Table 5.5 Mean Rank of answers given by the participants with the assessment items on a five-point Likert scale (1=VeryPoor;2=Poor;3=Satisfactory;4=Good; 5=Excellent)

Evaluation Category	Mean (n=8)
Content (8 items)	4.16
Structure (11 items)	4.16
Functionality (12 items)	4.21
Aesthetics (12 items)	4.23

5.4.1.1 Content

There were eight assessment items in this category (see Appendix 2). The degree of compliance with seven design guidelines were better than "good", only the result of one

out of eight assessment items was less than 4 (see Figure 5.17). This item reflects Design Guideline 1: “The content of information is correct and contains no errors.” One fourth of the evaluators gave negative responses (“Poor”) for this item. In briefing session, one evaluator commented:

There is room for improving the expressions of headings and terms. For example, terms like “WYSISYG” and “platform” is inappropriate for nurses.

Considering this suggestion, headings and terms were double-checked and some inappropriate expressions were revised. For example, “platform” was replaced by “screen” which makes more sense for nurse users, and “WYSISYG” was deleted.

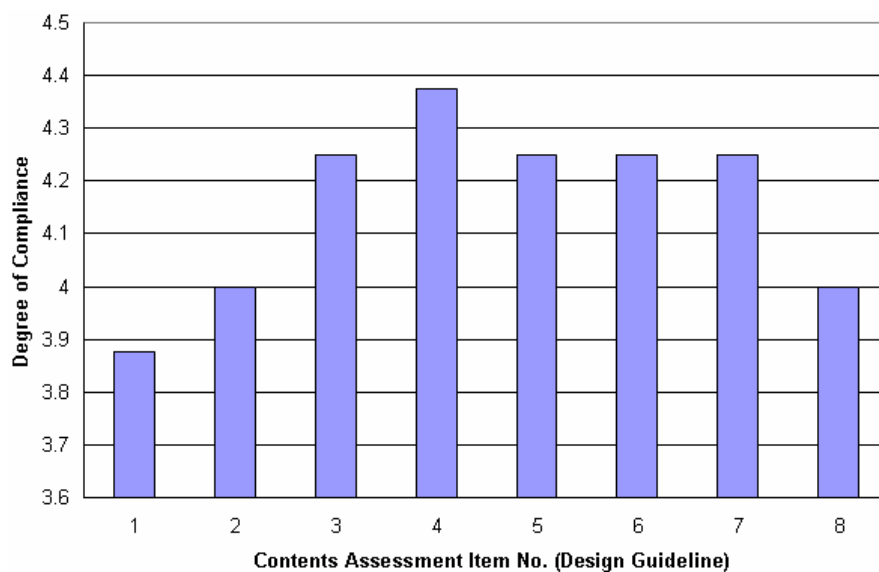


Figure 5.17 Answers given to assessment items in the “Content” category (n=8)

5.4.1.2 Structure

There were eleven assessment items in this category (see Appendix 2). The result of this category was also positive. The degree of compliance with ten design guidelines were

better than “good”, only the result of one among eleven assessment items was less than 4 (see Figure 5.18). This item was corresponding to Design guideline 16: “it structures information in a task-oriented format, i.e. providing procedural information”. 37.5% of evaluators marked “Satisfactory” for this item. One evaluator suggested:

It would be better to divide sections under "main tasks" into more details.

Revision of “Main Tasks” session was made based on the suggestions raised by the evaluators. Step-by-step instruction was added in this session in order to provide a more detailed explanation of tasks.

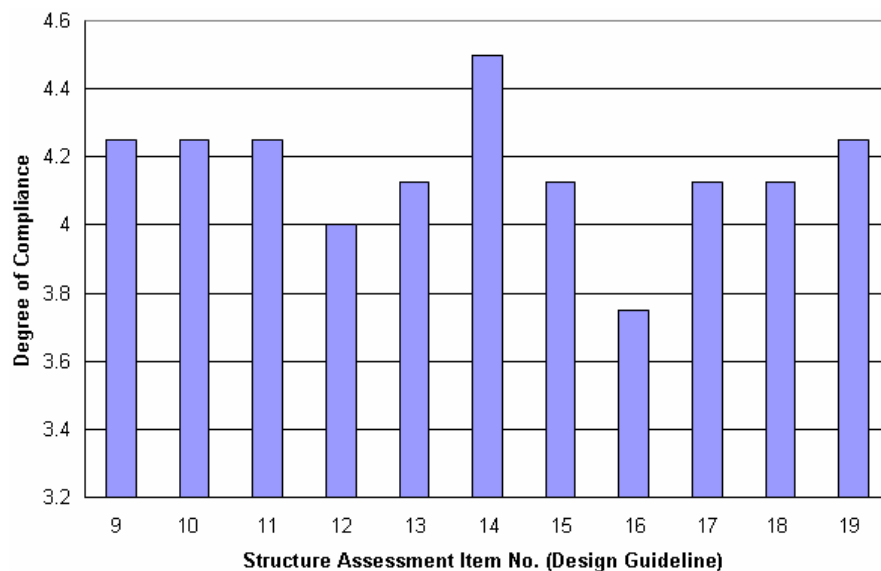


Figure 5.18 Answers given to assessment items in the “Structure” category (n=8)

5.4.1.3 Functionality

There were twelve assessment items in this category (see Appendix 2). The assessment result for this category was slightly less satisfactory than those of the above two categories. The mean rank given for three out of twelve assessment items were below 4

(“good”), see Figure 5.19. These three items were Design guideline 22, 25 and 29, and the mean ranks of their results were 3.625, 3.75 and 3.75 respectively.

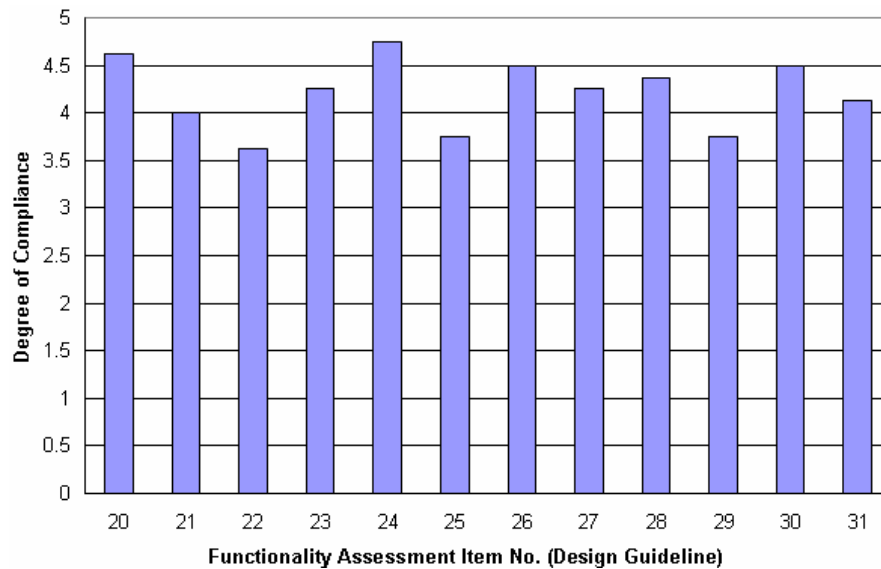


Figure 5.19 Answers given to assessment items in the “Functionality” category (n=8)

The first item corresponds to Design guideline 22: “The help for how to use the help system is provided.” Two evaluators gave “Poor” for this item. One commented that it was difficult to find the instruction for online help, the other suggested that:

Yes, it is in the welcome page, but doesn't explain what “main menu”, “main tasks” “FAQ” are about.

The original instruction of online help was part of the welcome page. If users did not scroll down the page, they would not find this information. In order to make the help for online help more obvious, the researcher created a new html file entitled “how to use the CPAT Online Help” and put it right under the welcome page in Table of Contents. In regard to the second comment, the researcher responded that the explanation for “main

menu”, “main tasks” and “FAQ” was not intended as the instruction for(in) how to use the online help, because such instruction was actually provided in their respective pages. Therefore, the researcher insisted on staying with the original design and implementation.

The second item corresponded to Design guideline 25: “Users can easily switch between the help system and the CPAT application.” Two evaluators gave “Poor” to this item. Their comments were:

The help system can't be logged in from the CPAT application.

There is actually no tool to launch the help from within the application but can only be started separately. There should be a way to launch help from within the application.

This problem was noticed by the researcher as addressed in Design guideline 21 in Section 3.3. As no access to the source code of the original application was given to the researcher, the researcher made no change on this matter.

The last item corresponded to Design guideline 29: “The information about the tips for potential pitfalls is included.” One evaluator assessed “Poor” on this item. He commented:

The information is not clearly visible. Potential pitfalls should be very visible.

This visibility problem was an interface design problem. Highlighting the heading of tips with red colour was a way to improve it.

5.4.1.4 Aesthetics

There were also twelve assessment items in this category (see Appendix 2). The assessment result for this category was slightly better than that for the “Functionality” category. The mean rank given for 16.7% of the assessment items in this category were below 4 (“good”), see Figure 5.20. The two items were Design guideline 37 and 42, and both had a mean ranking of 3.75. The first item corresponded to Design guideline 37: “Related information is placed in one place.” One evaluator suggested: “Links should be more distinctive.” Considering this, the style of hyperlink was redesigned to be more distinctive. In addition, the researcher removed all underlines for those phrases that were not hyperlinked. The second item corresponded to Design guideline 42: “Icons, labels and hyperlinks are recognizable for users.” Two evaluators commented:

It is a bit tricky when I click at bold face in violet colour rather than click at menu in hyperlink at the beginning of using the system. I came to realize later that it is a part of explanation.

It'd better to add underline to all links.

This problem was similar to the first one. Again, layout of hyperlink was redesigned according to the suggestions given by the evaluators.

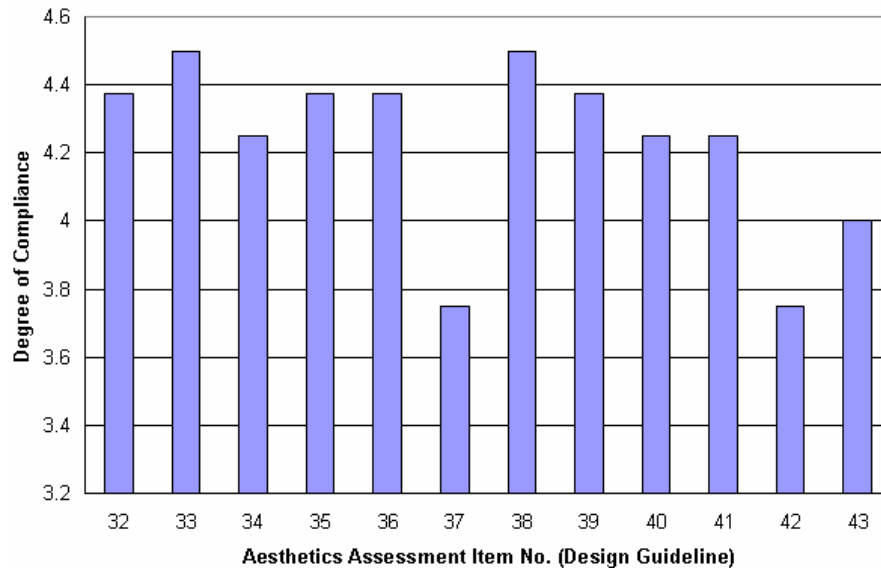


Figure 5.20 Answers given to assessment items in the “Aesthetics” category (n=8)

5.4.2 Results of Usability Testing of the Effectiveness of the CPAT OHS in Comparison with the Hardcopy User Manual

Qualitative and quantitative data were gathered from the usability experiment. Thirteen participants’ video and audio files were gathered. The quantitative data were the results from the users’ satisfactory survey, with a 100% return rate. As mentioned in Section 3.5.3.3, this usability testing was designed to measure and compare the 5Es (i.e. effectiveness, efficiency, engaging, error tolerance and easy to learn) of the CPAT Online Help and User Manual. The post-test survey was designed to gather participants’ demographic information, their computer literacy and their satisfaction with either the online or paper-based help system. In this section, firstly, the results of the survey will be presented; and then the triangulation of the laboratory data and user satisfaction survey data will be interpreted in terms of their conformance to the 5Es, the end users’ overall satisfaction and their preferences for help.

5.4.2.1 Demographic Information

Five items were used to gather the survey participants' basic demographic information, i.e. age, gender, employment, job role, and time to use computers per week. Only one out of five items, "how many hours do you use a computer per week", was found to be significantly different between the groups that used the paper-based user manual (UM) and the Online Help (OH) ($p=0.012<0.05$), whereas the responses to the remaining four questions were similar. The participants of Group UM seemed to spend more time on computers per week, see Figure 5.21. Half of the participants in Group UM stated that they used computers more than 4 hours per week, and the rest 33% spent 2 to 4 hours. One participant (16.7%) did not answer this question; however, no participants were found in Group OH who spent 4 hours per week on computer. The majority of people in this group (57.1%) spent 1 to 2 hours per week on computer.

The participants in both groups were females (100%). The majority of the participants (85.7%) in Group OH worked part time, and similarly 66.7% in Group UM were part time employers. The participants in Group UM were all above 40 years old, whereas the participants in Group OH were 21 to 60 years old; with 42.9% of them below 40 years of age (see Figure 5.22). Half of the participants in Group UM were RNs (50%), and the rest were one PCW, one manager and an administrative officer. Five out of seven participants in Group OH were PCWs, and the rest were one EN and an administrative officer (see Figure 5.23). The demographic information suggested that the RNs were older than PCWs, and also the RNs spend more time on computers than PCWs.

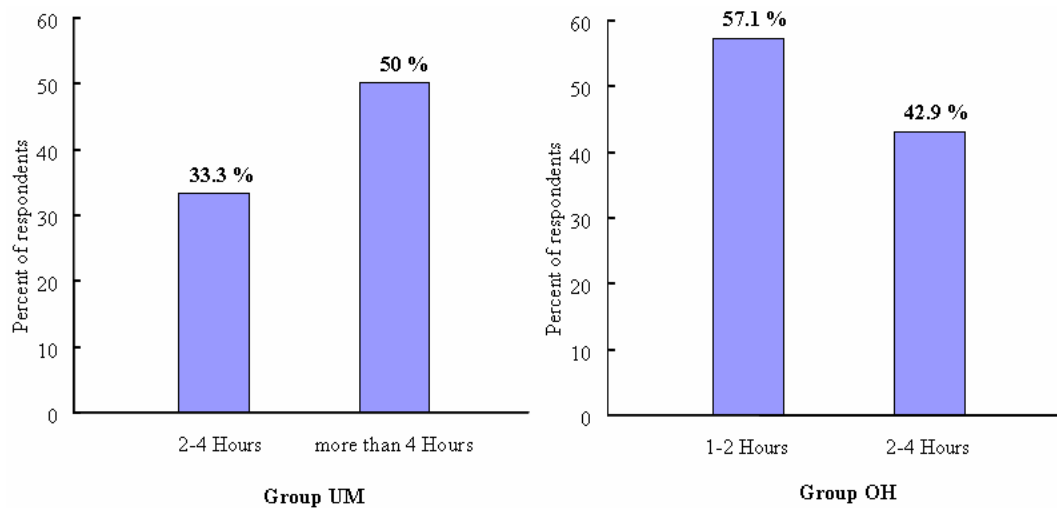


Figure 5.21 the percentage of respondents who gave various answers to the question “How many hours do you use a computer per week?”

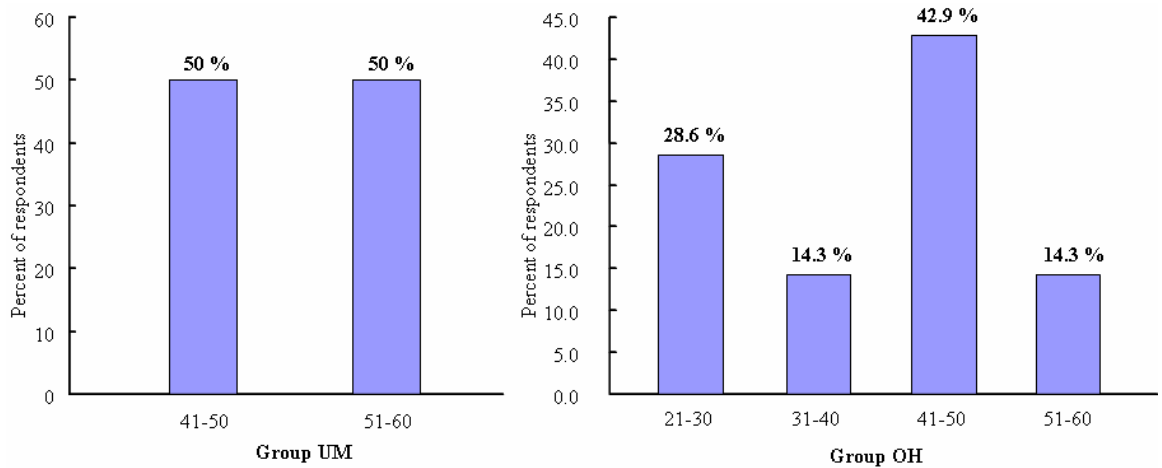


Figure 5.22 the percentage of respondents who gave various answers to “age”



Figure 5.23 the percentage of respondents who gave various answers to job role

5.4.2.2 Computer Literacy Assessment

This part of questionnaire was designed to firstly gather general information about resource issues and participants' attitudes toward computers, and then to assess participants' basic computer skills and knowledge of word processing, the Internet and E-mail. On the whole, the degrees of computer literacy of participants from both groups were higher than was previously anticipated. Most answers given to the assessment items were positive (i.e. "Yes"), see Table 5.6. Answers to two questions (5%) "Does your work place have a computer learning laboratory" and "Can you recognize a URL" were negative (i.e. "No"). The respondents' answers to the first question reflected that there were only limited support resources available in the residential aged care of this management group. Actually most of the participants recognized a URL, they just did not know what the term "URL" stands for. It is inferred that most nurses lacked basic computer training that introduces them to basic computer terminology

Only one out of 36 assessment items was found to be significantly different ($p=0.04<0.05$) between Group UM and Group OH, whereas no significant group difference was found in the results for the remaining 35 items (see Table 5.7). The item with significant group difference asked: "Would you like to improve your ability to use computer?" This item was designed to assess participants' attitude towards computers. 100% of the participants in Group OH were willing to improve their computer skills, whereas only 50% in Group UM wished to do so. It appears that the participants in Group UM were more reluctant to learn to use computers than those in Group OH. It may be because the people in this group were older, all of them were above 40 years of age, see Figure 5.22. The majority of this population group had missed the opportunity of formal computer education at school in Australia.

Interestingly, although Group UM were more reluctant in using computers, the survey results suggested that the overall computer literacy level of Group UM was slightly higher than that of Group OH (see Table 5.7). It has resulted from the fact that Group UM used computers more frequently than Group OH (see Figure 5.21). In addition, 66.7 % of Group UM “use computers at work” while only 28.6% of Group OH did.

In brief, the results from this section suggested that RNs (represented by Group UM) use computers at work more frequently than PCWs (Group OH), which resulted in RNs’ computer literacy levels being slightly higher than those of PCWs, although RNs are more reluctant to learn computer skills further.

Table 5.6 The percentage of respondents in Group UM or Group OH who answered “Yes” to computer literacy assessment items, and the p value to suggest if group significant difference

Assessment Questions	Percentage of respondents who answered “Yes”		p value
	Group UM (n=6)	Group OH (n=7)	
General information			
Do you use computer at work?	66.7	28.6	0.187
Do you use computer at home?	100	85.7	0.355
Does your computer have Internet access?	100	71.4	0.171
Do you have any access to any nursing information systems?	50	57.1	0.805
Does your work place have a computer learning laboratory?	0	0	1.000
Have you ever taken a “basic computer” course?	33.3	71.4	0.187
Do you feel that you do not have enough computer skills?	83.3	57.1	0.327
Would you like to improve ability to use computer?	50	100	0.040
Computer Skills			
Can you turn on/off computer?	100	100	1.000
Can you use a mouse?	100	100	1.000

Can you use a keyboard?	100	100	1.000
Can you type (not with two fingers)?	83.3	71.4	0.626
Can you open a desktop (icon) software program?	100	85.7	0.355
Can you open a software program using START menu?	100	100	1.000
Can you successfully Exit a software program?	100	100	1.000
Can you recognize menu in a software program?	100	100	1.000
Can you minimize/maximize open programs?	100	71.4	0.171
Do you use help screens in software programs?	66.7	57.1	0.735
Word Processing			
Can you create a new document?	100	71.4	0.171
Can you open/close a document?	100	100	1.000
Can you check spelling and grammar?	100	100	1.000
Can you move insertion point using mouse/arrow keys?	100	100	1.000
Can you correct errors using backspace/delete keys?	100	100	1.000
Can you cut and paste text/graph?	50	57.1	0.805
Can you print document?	100	100	1.000
Internet skills			
Can you recognize a URL?	33.3	28.6	0.859
Can you use Back and Forward commands?	66.7	71.4	0.859
Can you locate and click on Links on a web page?	100	57.1	0.079
Can you use search engines to search for information?	100	57.1	0.079
Can you print a web page?	66.7	57.1	0.735
E-mail			
Do you have a personal e-mail account?	100	71.4	0.171
Can you login to read your e-mails?	83.3	57.1	0.327
Do you send e-mail to individuals?	100	57.1	0.079
Can you send attachments?	66.7	42.9	0.409
Can you open attachments?	100	57.1	0.079
Can you respond to e-mail received?	100	57.1	0.079

Table 5.7 Mean rank of answers to the computer skill assessment given by the participants on a Yes/No scale (1=Yes; 2=No)

Evaluation Category	Group UM (n=6)	Group OH (n=7)
General information (8 items)	1.40	1.40
Computer skills (10 items)	1.05	1.11
Word Processing (7 items)	1.07	1.10
Internet Skills (5 items)	1.27	1.46
E-mail (6 items)	1.08	1.43

5.4.2.3 Effectiveness

Objective and subjective measurements were conducted to assess the effectiveness of OH. The objective measurements were the percentage of tasks completed successfully with the OH in comparison with the UM (i.e. accuracy rate) and the percentage of users successfully completed a task (i.e. completion rate). Six sets of audio and video data were collected from Group UM and seven sets were gathered from Group OH. Analysing the triangulation of audio and video data identified the two percentages from both groups. Table 5.8 and 5.9 present the accuracy rate and completeness rate of Group UM and Group OH respectively. The “✓” indicates that a user has completed a task. The average accuracy rate for Group UM was 63.9%, and similarly the rate for Group OH was 78.6%. It appeared that the participants from Group OH completed slightly more tasks than those from Group UM. A similar result was achieved for the completeness rates of all six tasks (for the task description, please see Section 3.5.3.3.2). Overall, the rates of Group OH was slightly higher than those of Group UM, as Table 5.8 and 5.9.

Table 5.8 The percentage of participants who completed a task by the help of the hardcopy user manual and the percentage of tasks each participant completed accurately

Group UM Task No.	P1	P2	P3	P4	P5	P6	Task completion rate
Task 1	✓	✓	✓	✓	✓	✓	100%
Task 2	✓	✓	✓				50%
Task 3	✓		✓				33.3%
Task 4	✓		✓				33.3%
Task 5	✓	✓	✓	✓	✓		83.3%
Task 6	✓	✓	✓	✓	✓		83.3%
The Percentage of tasks completed accurately	100%	66.7%	100%	50%	50%	16.7%	

Table 5.9 The percentage of participants who completed a task by the help of the CPAT online help and the percentage of tasks each participant completed accurately

Group OH Task No.	P1	P2	P3	P4	P5	P6	P7	Task completion rate
Task 1	✓	✓	✓	✓	✓	✓	✓	100%
Task 2		✓	✓	✓			✓	57.1%
Task 3		✓	✓	✓				42.9%
Task 4	✓	✓	✓	✓			✓	71.4%
Task 5	✓	✓	✓	✓	✓	✓	✓	100%
Task 6	✓	✓	✓	✓	✓	✓	✓	100%
The Percentage of tasks completed accurately	66.7%	100%	100%	100%	50%	50%	83.3%	

In regard to the subjective measurement, there were four comparable items in the post-test questionnaire. No significant group difference was found for the answers to the four statements. However, the overall responses from Group OH were more positive than those from Group UM. The following paragraphs will present the results of the four assessment items.

Only 16.7% of the respondents in Group UM agreed with the statement “the user manual was useful in solving my problem”, whereas 57.2% of those in Group OH agreed that “the online help was useful in solving my problem”, see Figure 5.24. The result suggested that the online help was more helpful than the hardcopy one.

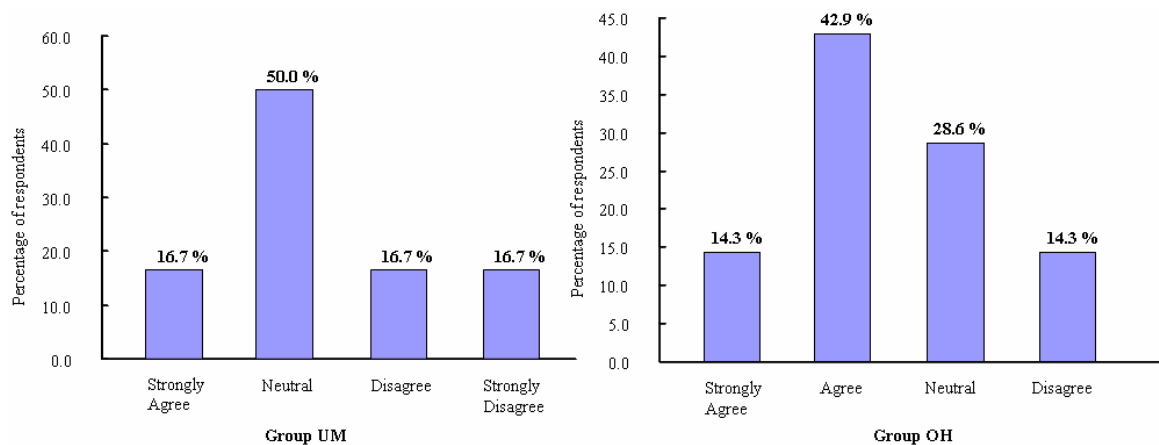


Figure 5.24 the percentage of the respondents who agreed with the statement “The user manual (or online help) was useful in solving my problem” on a five-point Likert scale

Again, only 33.4% (3 people) of the participants in Group UM agreed “using the user manual enabled me to do more tasks than before”, whereas up to 71.4% of those in Group OH agreed with the statement (see Figure 5.25). This provided further evidence to suggest that the OH had helped the care workers to learn the CPAT software.

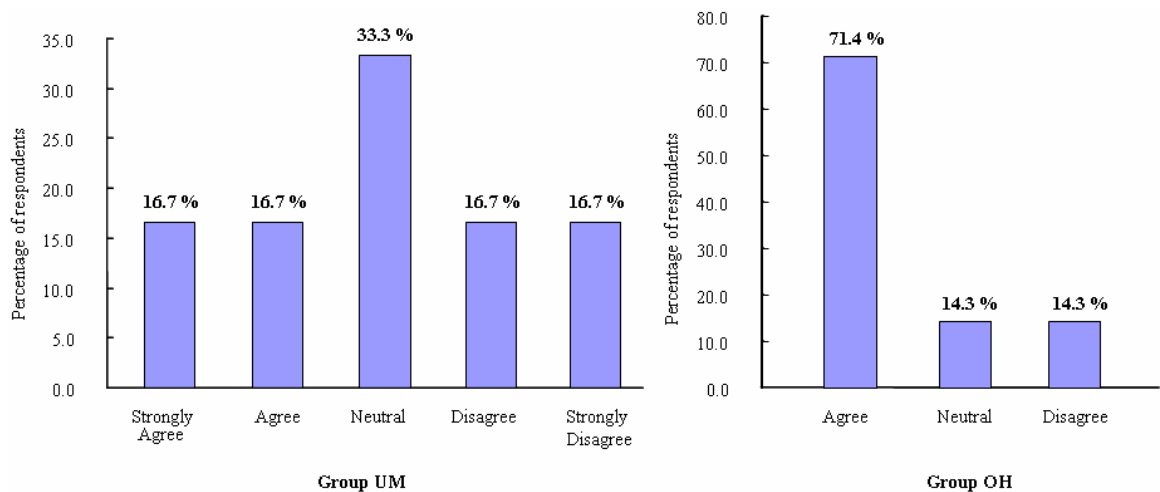


Figure 5.25 the percentage of respondents who agreed with the statement “Using the user manual (or online help) has enabled me to do more tasks than before” on a five-point Likert scale

In regard with the participants’ understanding of the help information, slightly more participants (57.2%) in Group OH expressed that they understood the help content well than those (33.3%) in Group UM did, see Figure 5.26. This result suggested that the OH was better than the UM in terms of following the audience’s workflow because of its usage of diverse presentation of content, for example, interactive video demonstration, task-oriented structure, etc.

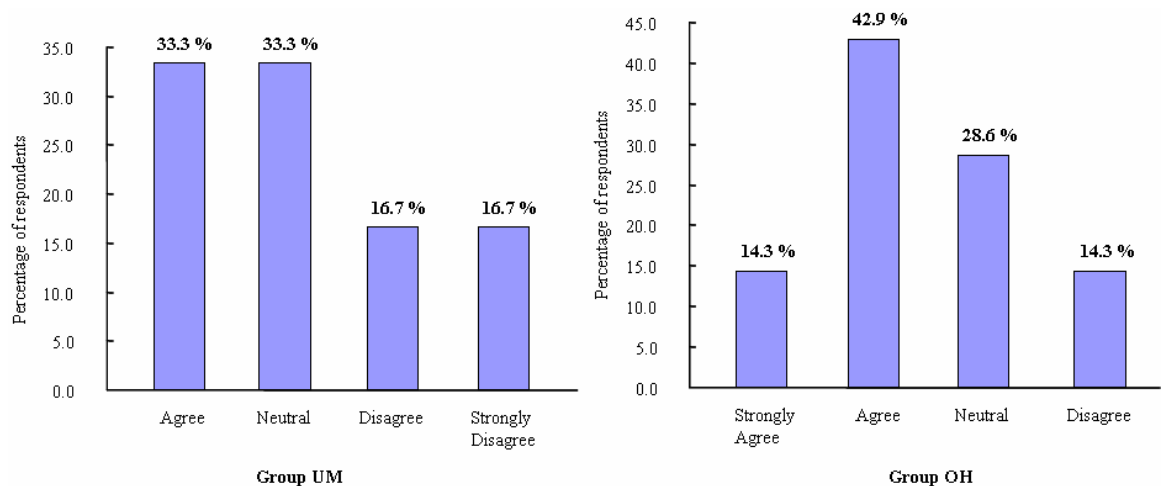


Figure 5.26 the percentage of respondents who agreed with the statement “I understood the help information provided in the user manual (or online help)” on a five-point Likert scale

For the performance of the graphics in both UM and OH, only 33.3% of the participants in Group UM were happy with the graphics expression, while 71.4% of those in Group OH were impressed by this feature, see Figure 5.27. It may result from the colourful presentation of the graphics in the OH, whereas the user manual was only printed in black and white to save cost.

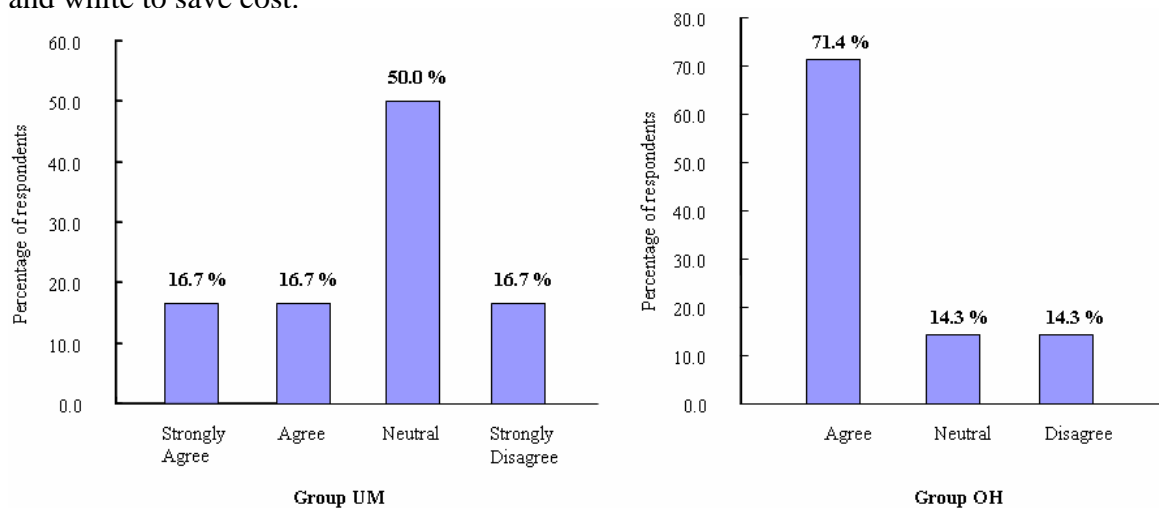


Figure 5.27 the percentage of respondents who agreed with the statement “The graphics facilitated my understanding of content in the user manual (or online help)” on a five-point Likert scale

Besides, additional four assessment items were designed to assess the effectiveness of features offered by the CPAT OH. An optimistic finding was that 85.7%, 71.4%, 85.7% and 85.7% of the respondents respectively were fond of these features: task-oriented structure, FAQ, search function and video demonstration, see Table 5.10. One participant specifically commented on the video clips:

The video is very straightforward, I like it. I don't need to ask anybody because it already tells me how to do it (task).

Table 5.10 the percentage of respondents who used the online help and agreed with the statements on a five-point Likert scale

Assessment statements	Percentage of respondents in Group OH (n=7)				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The task-oriented structure facilitated me to find the information I need.		85.7%		14.3%	
The FAQ helped me to solve my problem.		71.4%	14.3%	14.3%	
The search function helped me to find the information I need.		85.7%		14.3%	
The video demonstrations facilitated my understanding of procedural information.	28.6%	57.1%		14.3%	

In brief, the effectiveness of the CPAT OH and UM was similar as the objective measurements showed. Also the participants from both groups were equally happy with the effectiveness of their help system, but the overall responses from Group OH were slightly more positive than those from Group UM. In addition, the majority of the users of the OHS (more than 71.4%) accepted and liked the features of the OH because these features had helped the users to identify and learn the relevant contents.

5.4.2.4 Efficiency

There were three comparable items in the user satisfaction survey. Although no significant group difference was found for the answers to the three statements, the overall responses from Group OH were more positive than those from Group UM, which was a

similar to that for the effectiveness category. The following paragraphs will present the answers for the three assessment items, respectively.

Only 33.3% of the respondents in Group UM agreed with the statement “finding information in the user manual was easy”, whereas 71.4% of those in Group OH agreed that finding information in the online help was easy, see Figure 5.28. The same response to another similar statement “I can navigate the user manual (or online help) easily” was found, see Figure 5.29. Although there were no significant differences found in the agreements on both statements, yet the figures (i.e. the percentages of the respondents in both group) themselves adequately showed that the performances of the OH was much more positive than the UM on the aspect of navigation and finding information easily. These suggested that navigation between electronic hyperlinked pages may be easier, although the participants were more familiar with the physical feature of a paper.

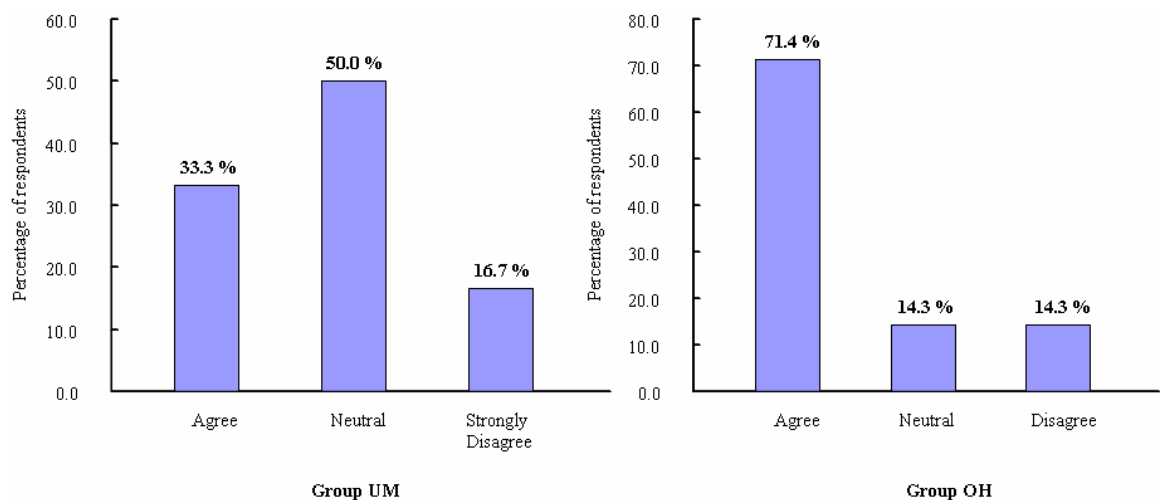


Figure 5.28 the percentage of the respondents who agreed with the statement “Finding information in the user manual (or online help) was easy” on a five-point Likert scale

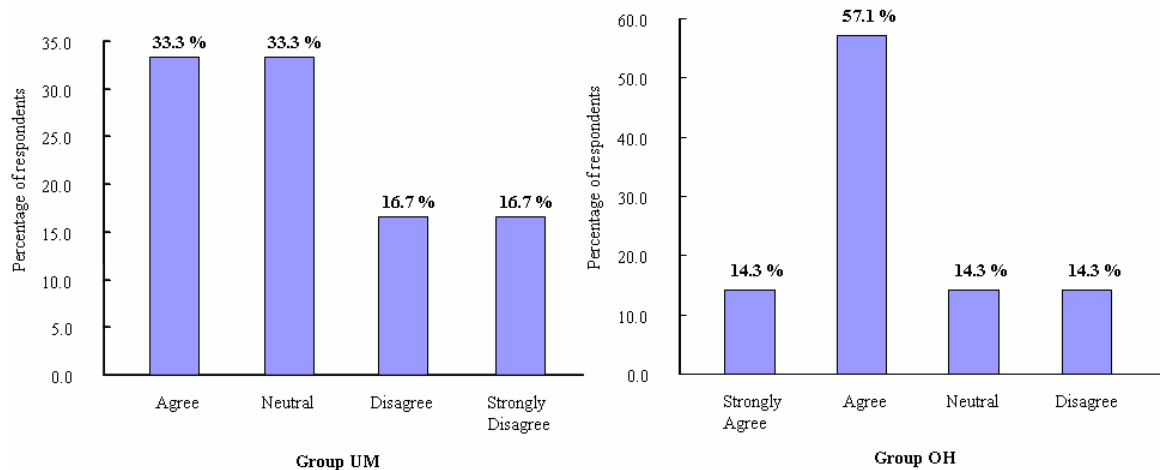


Figure 5.29 the percentage of respondents who agreed with the statement “I can navigate the user manual (or online help) easily” on a five-point Likert scale

Slightly more participants (57.2%) in Group OH agreed with the statement “using the online help enabled me to do tasks more quickly” than those (33.3%) in Group UM did, see Figure 5.30. In other words, the OH did a slightly better job than the UM did in terms of increasing users’ efficiency of performing tasks. In brief, most responses from Group UM were negative, whereas over half of responses from Group OH were positive, although there was no significant difference between both responses. These results lead to the conclusion that the OH was slightly more efficient than the UM.

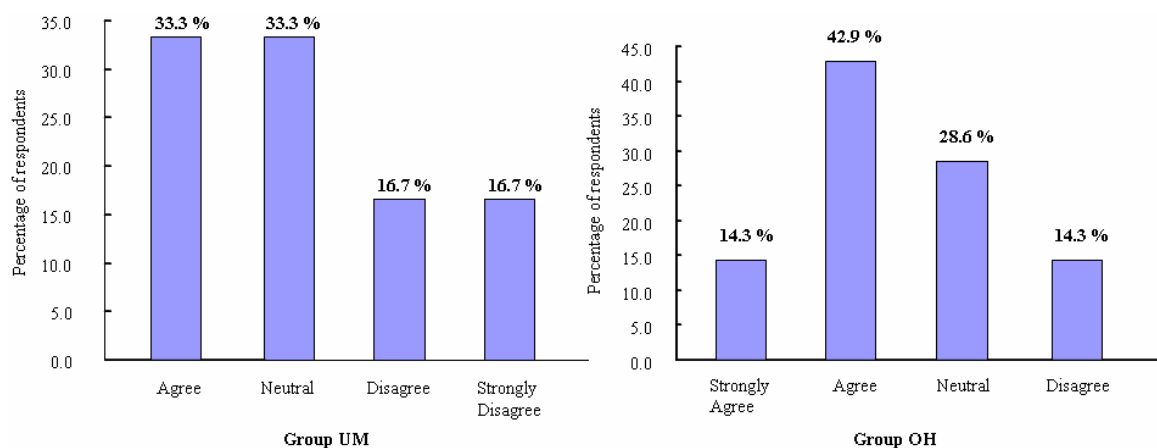


Figure 5.30 the percentage of respondents who agreed with the statement “Using the user manual (or online help) enabled me to do tasks more quickly” on a five-point Likert scale

5.4.2.5 Engaging

The definition of “engaging” itself, i.e. attractiveness, determined that it only can be assessed by subjective measurements. There were two items in the user satisfaction survey for measuring this construct. Again, no significant group difference was found for the answers to the two statements.

Only one out of six respondents enjoyed using the UM while three of them reserved their opinions and the remained two were not happy with their experience of the UM; on the other hand, two out of seven in Group OH expressed their positive experience with the OH, and the rest held neutral opinions, see Figure 5.31. It seems that neither group enjoyed using their own help system although the group using the OH was slightly more favourable than the hardcopy one.

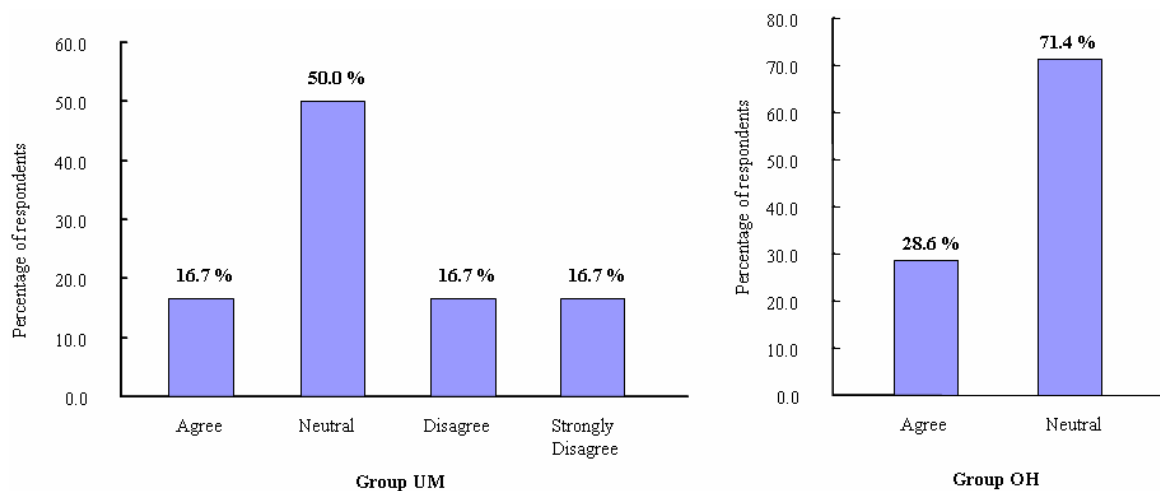


Figure 5.31 the percentage of respondents who agreed with the statement “I enjoyed using the user manual (or online help)” on a five-point Likert scale

Better results were found for the responses to the second statement “the user manual (or online help) has attractive presentation”. 50% of the respondents in Group UM were fond

of the presentation of the UM; whereas slightly more respondents (71.4%) in Group OH found the presentation of the OH was attractive, see Figure 5.32.

On the whole, responses of Group OH were again more positive than those of Group UM. These results suggest that the OH was slightly more engaging than the UM. It may result from the diversity of features provided by the OHS. All of them were positively accepted by the participants as discussed in the effectiveness section.

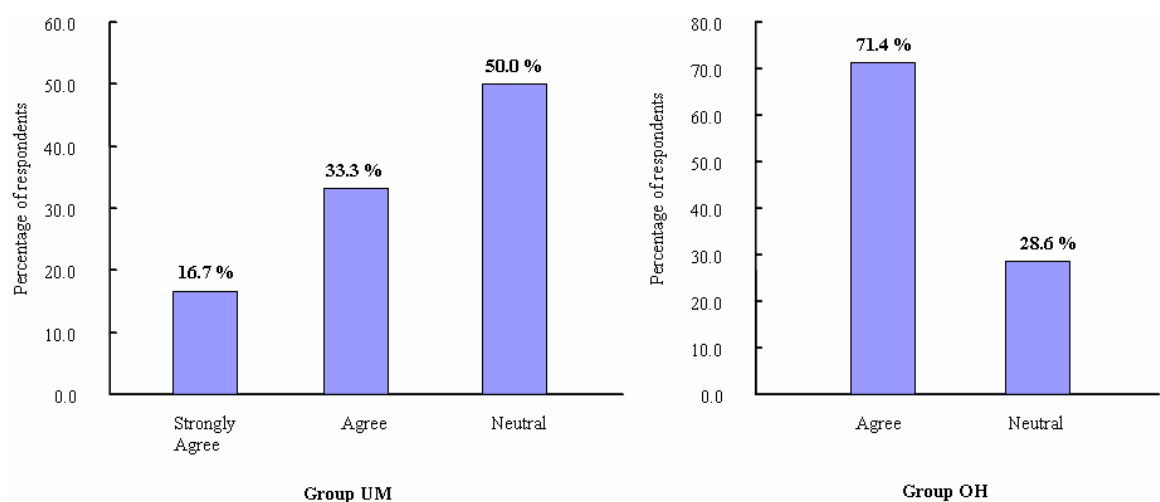


Figure 5.32 the percentage of respondents who agreed with the statement “The user manual (or online help) has attractive presentation” on a five-point Likert scale

5.4.2.6 Error Tolerance

In respect with error prevention, again, the OH performed better than the UM. Only one out of the six respondents agreed that the UM kept her away from trouble; while up to five out of seven in Group OH gave the positive responses (see Figure 5.33). The reason might be the information in the OH about how to prevent pitfalls was more visually distinguishable than the one in the UM. In other words, the OH was more visual effective than the UM.

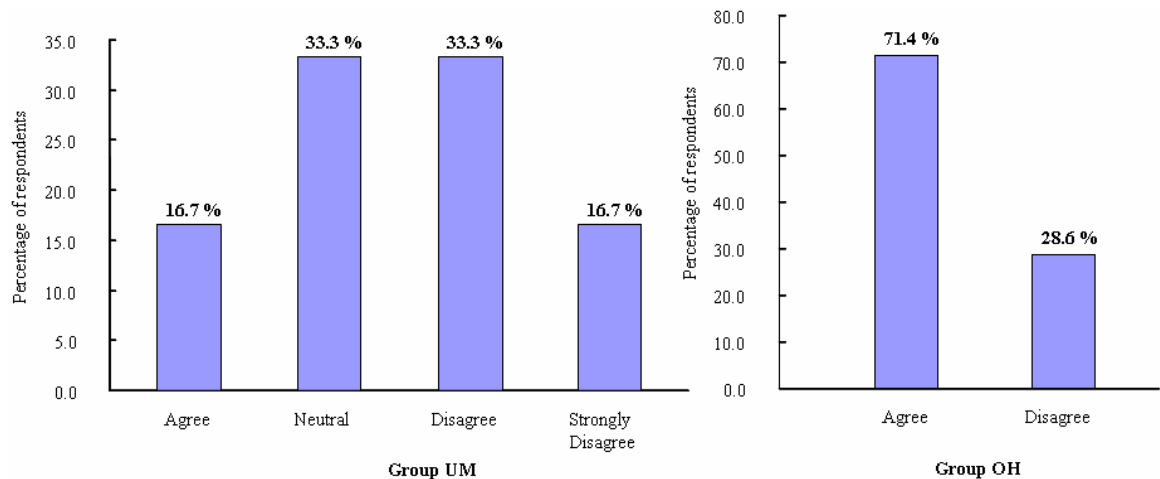


Figure 5.33 the percentage of respondents who agreed with the statement “The ‘Note’ in the user manual (or online help) kept me away from trouble” on a five-point Likert scale

5.4.2.7 Easy to Learn

Objective and subjective measurements were designed to assess this criterion. The objective measurement was the time taken to be familiarize with the UM (or OH). The data on time spent to learn CPAT using the OH were calculated from the seven videos of Group OH, whereas the time spent to learn CPAT using the UM was estimated from our observation because the users’ interaction with the hardcopy manual could not be recorded by a non-obtrusive recording method. The average time spent on familiarizing with the interface of the OH was 6 to 10 minutes; whereas it only took about 2 minutes for Group UM to understand how to find the relevant help information in the paper-based user manual. This was reasonable because people are already familiar with reading papers. Most users in Group UM understood the structure of the UM by simply browsing through *Table of Contents*, while the ones in Group OH needed to know how to use to hyperlinks, how to watch video demonstration, and how to search information in the *Index* and *Search Engineer* provided by the OH, etc. However, the responses of the participants in Group OH suggest that it was not difficult for them to learn.

In regard to the subjective measurement, there were three comparable items in the post-test user satisfaction questionnaire. No significant group difference was found for the answers to the three statements. Slightly more positive responses to the statement “Using the user manual (or online help) was easy” were given by the participants in Group UM, see Figure 5.34. 33.3% of respondents from Group UM agreed with “using the user manual was easy”, similarly 28.6% of the respondents in Group OH gave the positive responses. Again, because of people’s familiarity with the physical features of a paper, the hardcopy form is easier for the users to learn than the online one is.

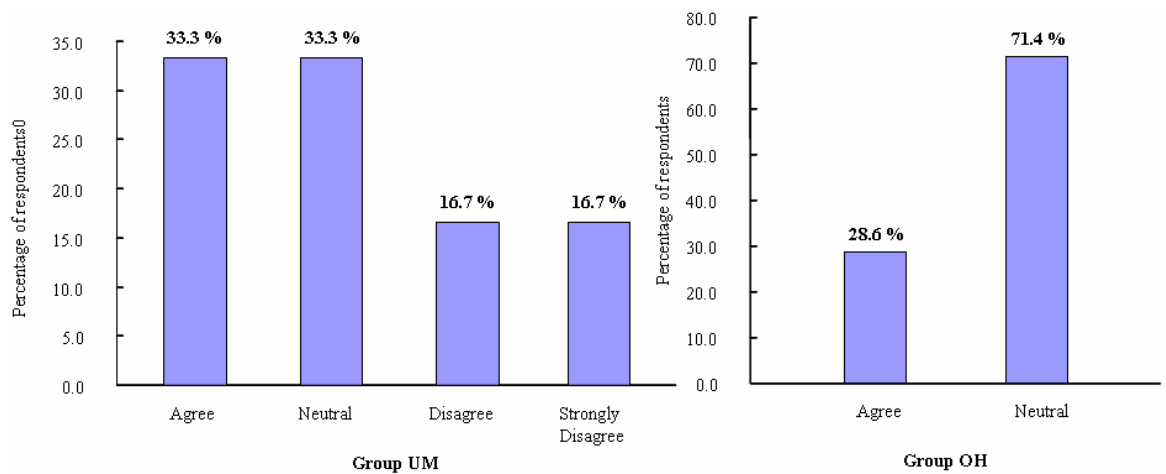


Figure 5.34 the percentage of respondents who agreed with the statement “Using the user manual (or online help) was easy” on a five-point Likert scale

However, because the OH was more interactive than the UM was, 71.4% of users in Group OH agreed with the statement “my interaction with the online help was clear and understandable”, whereas only one out of six users in Group UM gave this positive answer, see Figure 5.35.

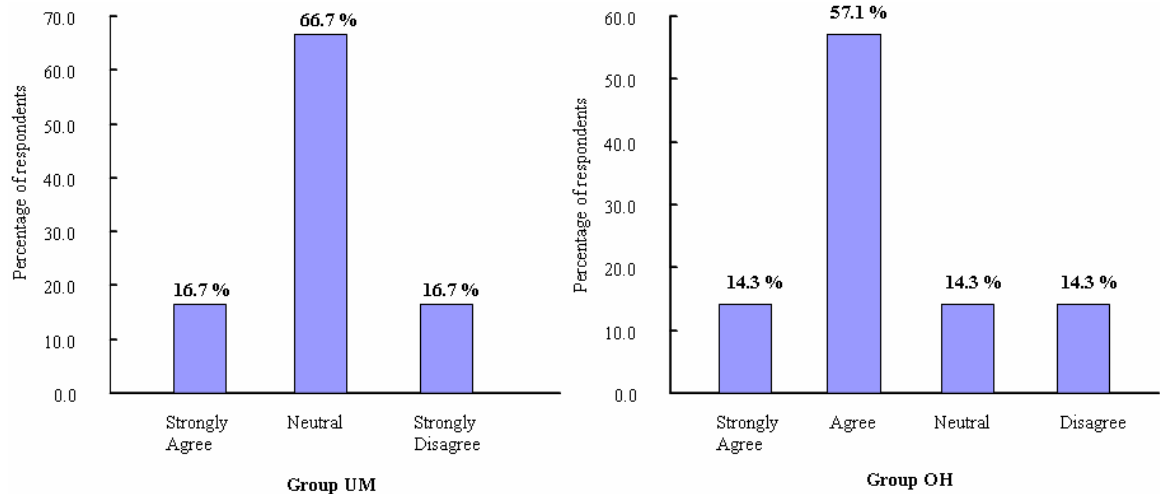


Figure 5.35 the percentage of respondents who agreed with the statement “My interaction with the user manual (or online help) was clear and understandable” on a five-point Likert scale

In regard with the participants’ confidence of using the two kinds of help, slightly more participants (42.9%) in Group OH agreed with “it was not difficult for me to use the online help with confidence” than those (33.4%) in Group UM did, see Figure 5.36.

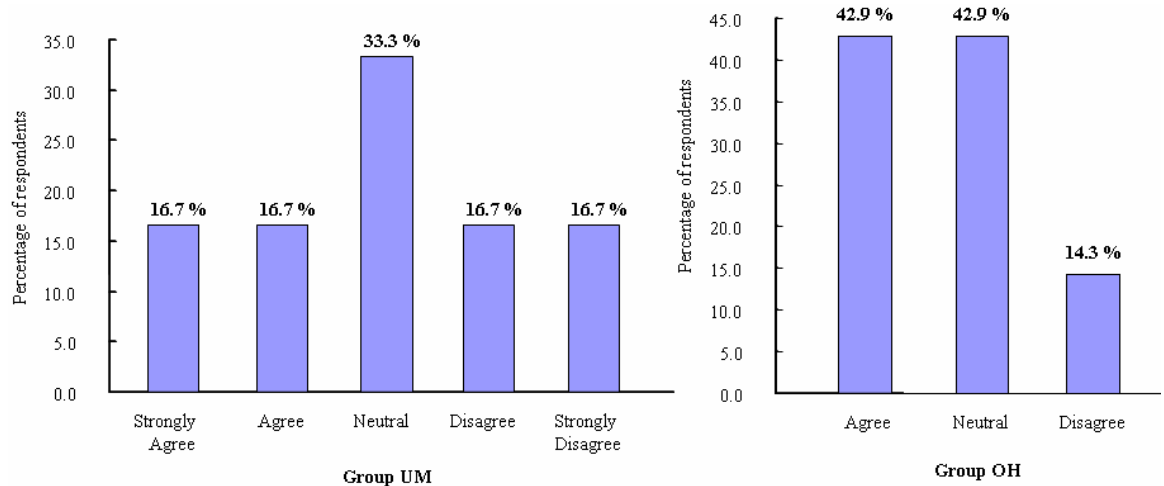


Figure 5.36 the percentage of respondents who agreed with the statement “It was not difficult for me to use the user manual (or online help) with confidence” on a five-point Likert scale

In brief, negative responses (above half proportion) towards the “easy of use” of the UM and the OH were given by both groups. In terms of interactiveness, Group OH gave more positive answers. Nearly half of the respondents in Group OH were confident on using the OH, although they spent more time than Group UM to become familiar with the OH.

5.4.2.8 Overall Satisfaction

One item was designed to specifically assess users’ overall satisfaction with the UM or the OH. The participants in both groups were similarly satisfied with either the UM or the OH. 33.3% of the respondents in Group UM were not satisfied with the UM, slightly less respondents (14.3%) in Group OH gave negative responses, see Figure 5.37.

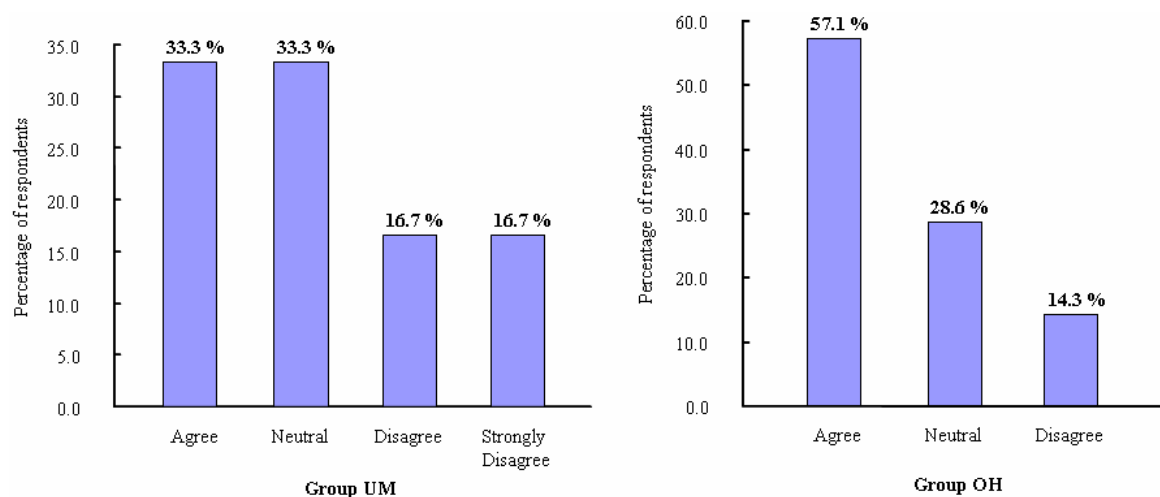


Figure 5.37 the percentage of respondents who agreed with the statement “Overall, you are satisfied with the user manual (or online help)” on a five-point Likert scale

5.4.2.9 User Preferences

One item in user satisfaction survey was designed to specifically assess the users’ preferences of the OH or the UM. The respondents were equally happy with either the OH or the UM, although the other sources of data suggested that the OH were more popular.

The similar responses for this measurement were given by the participants in Group UM (33.4%) and Group OH (28.6%), see Figure 5.38.

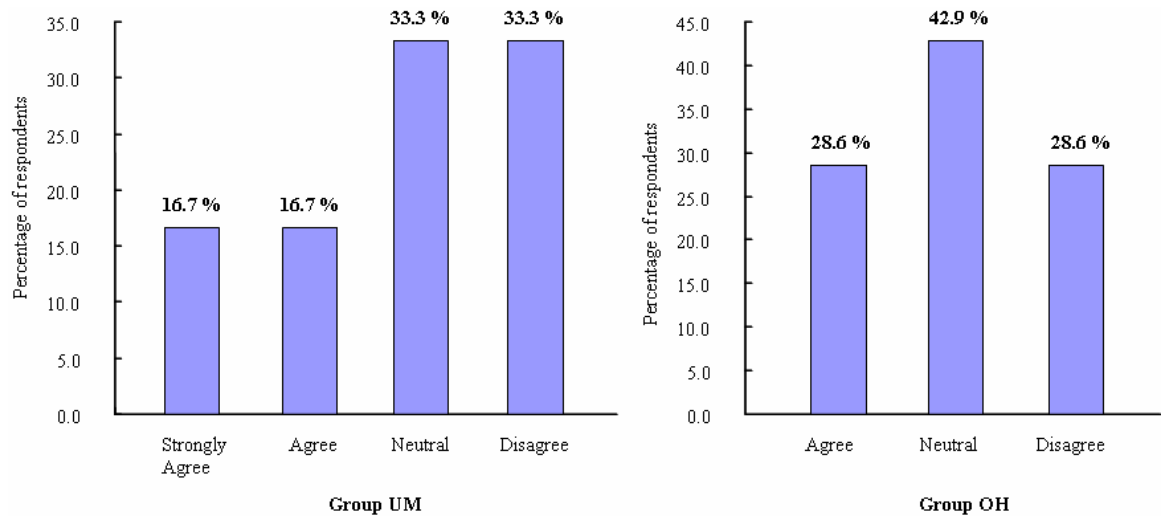


Figure 5.38 the percentage of respondents who agreed with the statement “I prefer using paper-based user manual rather than the online help” on a five-point Likert scale

5.4.3 Conclusion of the Evaluation

The results of the heuristics evaluation suggested that the degree of the CPAT OH compliance with the 43 design guidelines was high (above 80% averagely). In other words, the CPAT OH as an empirical application of our proposed framework of an effective OHS was successful. No significant group differences was found for responses to the 5Es of the UM and the OH. Therefore, we conclude that two hypotheses of the usability testing were tested: (1) Participants who used the OH performed the tasks as quick and correctly as the ones who use the user manual do and (2) Participants who used the online help felt as comfortable as the ones who used the user manual. In general, the performance of the OH was slightly better than that of the UM as rated by the end users.

The results suggested that the OHS developed following the guidance of our quality framework is an effective OHS. It offered effective means for the nurse users to learn their nursing information system CPAT.

5.5. Summary

This chapter presented the results of the experiment, including needs assessment, design and implementation, heuristic evaluation and comparative usability testing. The two needs assessment studies identified the training needs for both novice and experienced CPAT users. Thus they paved the way for the design and implementation of the CPAT OHS. The 43 design guidelines were applied in order to ensure the quality delivery of the four components of the OHS, namely, content, structure, functionality and aesthetics. The outcomes of the implementation were the production of the hardcopy user manual and online help of the CPAT. The result of the formative evaluation involving eight postgraduate students showed that the CPAT Online Help was a “good” system, although a few modifications were needed. Finally, a usability testing was conducted to compare the 5Es of the hardcopy UM and the OH. The results suggested although the participating nurse users were equally satisfied with either the OH or hardcopy UM, providing that they were well-designed and easy to use, the participants who used the OH preferred most of its features, i.e. search function, FAQ and the video demonstration. The results of the experiment certainly prove that it is a good practice to apply our quality framework as a guideline for the development of an online help system. The next chapter will provide an in-depth discussion of the research findings.

Chapter 6 Discussion and Conclusion

6.1 Introduction

After completing the two-phase investigation, then we can integrate and incorporate the research results and findings in order to answer the research questions in regard to what content, structure, functions and aesthetics this OHS should have and how to evaluate its usability. This chapter discusses the results and findings presented in the previous chapters and how they provide answers to the research questions. The limitations of the study and the future research directions are also presented.

6.2 Premises of the Framework Validation: the CPAT Online Help's Compliance with the Proposed Framework and the Users' Satisfaction

To reiterate, the research aim in this study was to construct a quality framework of an effective online help system (OHS) for a nursing information system (NIS). It is a descriptive framework where consisted of criteria of such an OHS. In order to achieve our research aim, our investigations involved answering the research questions specified in Section 1.3.

We first proposed a quality framework of an effective OHS for a NIS. The framework consists of five criteria and the indicators for each one of the criteria (see Figure 4.3). To prove the validity of this framework, an experiment was conducted in which an OHS

for an authentic NIS (i.e. the CPAT), the CPAT Online Help was developed and evaluated (see Figure 3.2). The validation of our framework is based on the assumption of: if the CPAT Online Help was developed by strict following the criteria of the proposed framework, the user acceptance and satisfaction with the CPAT Online Help could indirectly prove the validity of the proposed framework and its criteria; and vice versa.

Our experimental data suggests that the CPAT Online Help complies with the design guidelines according to our proposed framework. Firstly, as an empirical application of our proposed framework, the CPAT Online Help was designed according to the forty-three guidelines reflecting the quality indicators of *content, structure, functionality and aesthetics* aspects of an effective OHS. A survey was conducted to test the compliance of the CPAT Online Help with the design guidelines. The survey responses given by the eight heuristic evaluators, all with software engineering background, were above four in five-point Likert scale (the bigger the value, the more desirable the results). This shows that the evaluators were happy with the compliance of the CPAT Online Help with the forty-three design guidelines. It thus implies that the CPAT Online Help highly reflected the principles of the framework. In the following sections, we will discuss how our proposed framework were validated according to the research questions.

6.3 Content of an Effective Online Help System for a Nursing Information System

Content refers to the pieces of information included in an OHS. Content directly determines the effectiveness of an OHS. We have identified seven criteria to evaluate quality of the content of an OHS. They are *accuracy, conciseness, completeness,*

understandability, clarity and usefulness. The significance of these criteria for the effectiveness of an OHS can be inferred from the research evidences presented below.

Some participants in the focus group complained that use of computer specific language rather than nurses' language was a major problem for them to learn most information systems. This problem is also reported in a series of studies in the field of online help (Krull *et al.* 2001; Kantner *et al.* 2002). Language is the vehicle for the communication between a user and a help system, hence, not using user-oriented language will certainly hinder the communication between a nurse-user and a help system. This infers that *accuracy, understandability and clarity* of help information are critical for the success of an OHS. Needs assessment is critical for understanding the context of nurses' work practice and the language they use in their work practice. This task was accomplished in our study by interviews and discussions with a group of nurses, and through involving the nurses who are experienced users of the CPAT software to proof read the content of the CPAT Online Help. As a result of the above attempts, 57.2% of the participants in usability testing of the CPAT Online Help stated that the help information was understandable.

The second quality criterion of content is conciseness. To avoid giving lengthy information on a computer screen, the help information in the CPAT Online Help was presented in multimedia format. This also complies with the suggestion given by Baecker *et al.* (2000) that graphical illustration can disambiguate the heavy load of text in the help system (Baecker *et al.* 2000). In our study, up to 71.4% of the participants who used the CPAT Online Help agreed that the graphics facilitated their understanding of the content in the help system. This suggests that using graphical presentation is an effective way to present concise information.

The third criterion about content of an OHS is completeness of information. As different levels of users have different needs for help, all of these needs should be satisfied (Crown 1992). Therefore, we conducted a thorough needs assessment in order to provide the comprehensive and targeted information for both novice and experienced CPAT users. The ten possible usage problems faced by a novice user were identified, and the frequently asked questions (FAQ) were gathered from the focus group discussion. It covered the comprehensive information about end users' basic computer knowledge, the problems they face in conducting nursing documentation and their knowledge gaps in nursing documentation. The resulting OHS has provided solutions for the above problems. This led to 57.2% of the participants in usability testing of the CPAT Online Help perceiving that "the online help was useful in solving my problems", and 71.4% of them stating that "using the online help enabled me to do more tasks than before." These comments suggest that the above strategies for developing an OHS that complies with the criteria of quality of content had improved the effectiveness of the OHS.

6.4 Structure of an Effective Online Help System for a Nursing Information System

Structure means the organization of pieces of contents of an OHS. The organization of the help information should be logically meaningful to assist the nurse-users to search their needed information as quick and easy as possible. We have identified five criteria to evaluate quality of the structure of an OH. They are *efficiency*, *consistency*, *retrievability*, *task-orientation* and *function-orientation*. The following paragraph will discuss how these criteria were satisfied in the CPAT Online Help.

The structure of help information can be either *function-oriented* or *task-oriented* (Dutke and Reimer 2000). The CPAT Online Help was structured in both *function-oriented* and *task-oriented manner*. Both novice and experienced users wish to understand how a function works, as suggested by the results of the needs assessment. Therefore, a function-oriented structure should be provided in the CPAT Online Help. We found that up to 85.7% of the participants in who used the CPAT Online Help liked the *task-oriented structure* to help them find the information they need, similar as that found by (Dutke and Reimer 2000) that software training should incorporates phases of task-oriented exploration and transfer phases. Task-oriented structure is specifically useful for the novice users because it gives them familiarity with the authentic electronic documentation tasks. Therefore, a task-orientated structure also contributes to the effectiveness of an OHS.

Apart from the logical organization of content, the structural design should also consider the physical organization of information, because it will impact on the efficiency of users' information search. The previous researchers (Hackos 1997; Krull *et al.* 2001) also suggested that within headings, the most important words should come first to facilitate *efficiency* in information acquisition and hyperlinks should be attached to a meaningful phrase to improve information *retrievability*. These principles were followed in building the CPAT Online Help. Consequently, up to 71.4% of participants in the usability testing of the CPAT Online Help perceived that it was easy to finding information in the help system.

6.5 Functions of an Effective Online Help System for a Nursing Information System

Functionality of an OHS for a NIS essentially concerns how well technology is aligned with the needs of the nurse-users. The appropriate strategies should be applied to facilitate the nurse-users to access helpful information. We have identified seven criteria to evaluate quality of the functionality of an OHS. They are *accessibility*, *non-intrusiveness*, *ease of use*, *flexibility*, *consistency*, *trouble-shooting*, and *intelligence*. The significance of these criteria for the effectiveness of an OHS can be inferred by the research evidence presented below.

Several paths should be provided for accessing the same information for improving the *accessability* of information and providing *flexibility* for a user (Merrienboer 2000). Literature research and needs assessment were conducted to understand the core functions that nurse users need for solving their usage problems. Our investigations suggested that table of contents, frequent asked questions (FAQ), search engine and video demonstrations were the acceptable paths to access information. The positive feedbacks from participants who used the CPAT Online Help were received in regard to the effectiveness of these functions (see Table 5.10). In addition, *ease of use* is also an identified priority for the nurse-users as suggested in the focus group discussion. The following sections will discuss how each of the functions that have enhanced the effectiveness of this OHS.

6.5.1 Table of Contents Gives a Nurse-User a Straightforward Outline of the Content in an OHS

Browse is the most common strategy for users when they are approaching information (Canter *et al.* 1985). The feedbacks from the focus group participants show that table of content is one of the acceptable functions should be offered in the CPAT OH. The reasons of why it was acceptable for the participants in the study are: 1) it tells them what information is available quickly; 2) it facilitates them to make connections between individual items; 3) it also facilitated them to navigate between hyperlinked pages.

6.5.2 FAQ Assists a Nurse-User to Trouble Shooting

FAQ is also acceptable for nurses as indicated in the focus group discussion and the usability testing of the CPAT Online Help. Five out of seven participants who used the CPAT Online Help perceived the FAQ helped them solve problems. The significance and effectiveness of FAQ can be supported by adult learning theories. Learning from mistakes may be one of the major methods an adult use to learn (Atolagbe *et al.* 1997). Therefore, an effective OHS should provide FAQ session in order to facilitate nurse-users' *trouble shooting* and prevention of potential pitfalls.

6.5.3 Search Engine Helps a Nurse-User to search for Information

We had a contradictory finding about the nurse-users' perceptions of search function. *Intelligence* is the criterion of measuring the usability of search engine because the effectiveness of search function is based on the system's understanding of a user's

query. The results of the usability testing of the CPAT Online Help show that 85.7% of the participants who used the OHS agreed with the performance of the search function; however, participants in the focus group discussion provided negative feedback about the 'search' function of many help systems. The problem the end users encounter in searching for information is an inability to ask the question that they intended to ask. A series of studies found that novice users may not have sufficient knowledge of a new information system to diagnose and express their usage problems (Sein *et al.* 1989; Lazonder 2000). We suggest that this feature is more suitable for the experienced users because they have more sufficient knowledge about the software than the novices. Therefore the experienced users are able to use more effective query strategies. The participants in our usability testing understood well of the concepts, terms of the CPAT software, therefore, they had no difficulty of using the search function. This result suggests that the search function should also be provided in an OHS providing that the function itself is well-designed and effective for all levels of users.

6.5.4 Video Demonstration Enhances a Nurse-User's Comprehension of Procedural Information

It was suggested by the focus group participants that the common training strategies for training aged care nurses to use a nursing information system were mainly one-on-one coaching and self-directed practice. Most of the participants accepted the video demonstration to show them how to do things instead of telling them because it was suitable for their learning pattern. This is the common psychology of computer learners (Baecker 2002). Up to 71.4% of the participants who used the CPAT Online Help stated that the video facilitated their understanding of procedural information. This finding suggests that utilization of interactive video clips facilitated the nurse-users' mastering

of task-oriented knowledge.

On the other hand, some participants in the focus group discussion complained about the *Clippy* (Microsoft Office assistant) because this proactive help is often invoked even when a user does not need help. This finding implies that an OHS should be *non-intrusive*.

6.6 Aesthetics of an Effective Online Help System for a Nursing Information System

Aesthetics concerns how content and functions are presented to the end users of an OHS. We have identified four criteria to evaluate quality of the aesthetics of an OHS. They are *visual-effectiveness*, *cost efficiency*, *consistency* and *readability*. The significance of these criteria for the effectiveness of an OHS can be inferred from the research evidences presented below.

As *visual-effectiveness* can facilitate a nurse-user's problem solving (Baecker 2002), when providing the end users with the "Note" information in the CPAT Online Help to prevent the miscarriage of a task with the CPAT, the colour coding "red" was *consistently* used for the heading for the purpose of attracting a user's attention and facilitating their understanding of this information,. To save cost, we did not colour-print the hardcopy user manual, so the "Note" was bold in the user manual for achieving visual effectiveness. Up to five out of seven the participants who used the CPAT Online Help stated "the 'Note' in the online help system kept me away from trouble", while only one out of the six respondents gave this appraisal to their hardcopy user manual. This is because some of the users who used the hardcopy manual were not

aware of the feature “Note” because this note is not as visually catching as the CPAT Online Help. Another means of achieving visual effectiveness is through the implementation of a multimedia interface that integrates text, table, graphics and video in the CPAT Online Help. This has led to the positive feedback by 71.4% of the participants in the usability testing of the CPAT Online Help about the attractiveness and clarity of the help system. The above results suggest that *visual-effectiveness* of an interface can improve the effectiveness of an OHS for a NIS.

The *readability* and *consistency* of GUI were emphasized by the participants in the focus group discussion. To achieving these goals, a consistent presentation of GUI, including the navigation bar, was provided. Gender was perceived as one of the barriers for nurses to use computers. As the majority of nurse users are female, the colour used in the CPAT Online Help was mainly feminine tone, such as light blue and purple to cater the female’s preference of colour. It was suggested that women could learn better by means of effective graphics presentation and video techniques (Kayany and Yelsma 1998); therefore, we implemented graphics and video demonstrations in order to help the nurses to learn the CPAT. As mentioned before, the quality of these features were appraised by the majority of the participants who used the CPAT Online Help.

6.7 Measurement of the Usability of an Effective Online Help System for a Nursing Information System

A usable help system is one that aids the user in diagnosing and repairing his or her problem with a minimum expenditure of time or effort (Duffy *et al.* 1995). Usability highly depends on the above four mentioned factors: content, structure, functionality and aesthetics; and it represents the overall performance of an OHS. From the focus

group discussion, we understood that most of the time when the nurses encountered problems in documentation using the CPAT, the support was limited and not easily accessible for them. This difficulty could potentially be solved by online help because of its easy accessibility and dynamic interactive potential for a nurse user. Usability addresses whether an OHS is a usable vehicle to overcome on the above difficulties the nurses encounter in their documentation.

The measurement of usability of an OHS in our proposed quality framework is adopted from Quesenberry's 5Es (2004), namely, *effectiveness*, *efficiency*, *error-tolerance*, *engagingness* and *ease of learning*. Each indicator is reflected in certain requirements for an OHS and requires specific evaluation techniques to assess. The following sections will discuss how each "E" has been evaluated in our usability testing experiment.

6.7.1 Effectiveness

The first E is "effective", which is the most important one, because the motivation of a nurse to use an OHS is that she/he needs effective helps from the help system to solve the problems when doing documentation tasks enabled by her/his nursing information system. The evaluation techniques we used to assess the effectiveness of the CPAT Online Help were a laboratory-based usability testing where users perform scenario-based CPAT tasks, supported by the CPAT Online Help. The effectiveness of the OHS was evaluated by task output (video data) during usability testing and a post-test user satisfaction questionnaire. Triangulation of the qualitative and quantitative data is valid for evaluating the effectiveness of an OHS as addressed in Section 5.4.2.3 . Contrary to Duffy *et al.*'s Help Design Evaluation Kits (1995) that was focused on the weaknesses of an OHS, the techniques we used are focused on gathering users'

performance data, as well as asking their perceptions about the statements used to measure the effectiveness of an OHS in a rather positive manner.

6.7.2 Efficiency

Both literature review and focus group discussion in this study has identified that time is always limited for nurses. Hence, spending the least time and effort on using an OHS for solving a problem is also one of nurse users' requirements. A few researchers in the field of online help have been aware of the efficiency criterion. For example, Carroll (1990) advocated the importance of providing minimal but adequate help for users, which is well-known as minimalism. Empirical researches indicate that these minimal help systems have been quite successful in making the training effective and efficient (Lazonder 1994; Carroll. 1998; Foster 2002). In essence, minimalism emphasizes training on real tasks, getting start fast and reducing the amount of reading. This principle also suits an OHS developed for nurse users as our empirical investigation demonstrated.

To evaluate the efficiency of the CPAT Online Help, we utilized such subjective judgements as "using the help system enabled me to do tasks more quickly", "finding information and navigation in the help system was easy", etc. Because different people have different definition of "efficiency", it is a practical and reasonable technique asking participants' subjective judgements about their experience with the help system if it is taking "too long" or "too many clicks" (Quesenbery 2004). We found that 71.4% of the participants in the usability testing of the CPAT Online Help were quite happy with the hyperlinked navigation if the person is familiar with it. As hyperlink gives an end user the convenience of easily browsing information, which is not achievable by a

paper-based system, this appears to improve the efficiency of online help in comparison with paper-based system.

6.7.3 Error-tolerance

This criterion is particularly suitable for evaluating the quality of an OHS. It is because preventing the nurse-users making errors or mistakes in using a NIS is one of the purposes of an OHS, besides helping them solve problems. This criterion is especially important for the novice nurse users who have limited knowledge about their NIS to diagnose their problems. Possible techniques could be providing solutions and troubleshooting tips to nurse users to prevent them from making errors, and to alert them when mistakes occur.

We utilized such subjective judgment as “the help system kept me away from troubles” to gauge the participants’ perception about our OHS’s error-tolerance. 71.4% of the participants who used the CPAT Online Help agreed with the statement. The finding indicates that the CPAT Online Help is able to successfully prevent users’ pitfalls.

6.7.4 Engagingness

Nurses’ attitudes towards IT directly influence the way in which they interact with computers (Burkes 1991). In this study, one of the barriers to use the CPAT software was perceived by the participants as the end users’ reluctance, even fear to use the system. One of the causes of the reluctance is lack of confidence to interact with computer. Similar findings were found in the other studies about nurses’ experiences of web-based learning (Atack 2002; Atack 2003), in that nurses felt frustrated and overwhelmed by the

technology at the beginning of their interaction with computer. Attack's findings (2002, 2003) were similar with that of Lawton (1997) that the novice faces a steep learning curve in the early stages of learning computer. The finding suggests that the learning environment must be encouraging. Adult learning theories also emphasized that computer training must reduce the anxiety level of the learner (Jones 2003). As the interface of an OHS directly impact on users' experiences of using the help system. The visual presentation of information and the style of the interface of an OHS have to be engaging to attract the nurse users to use them.

The technique we used for assess this criterion of the CPAT Online Help was subjective judgment, which asked the users' perception about their usage experience and the interface design. Unfortunately, the results suggested low levels of satisfaction with both hardcopy (33.3% were satisfied) and online help system (28.6% were satisfied). One novice participant mentioned that using either system made her nervous because it was the first time for her to be exposed to the CPAT software. She would prefer this experience to be facilitated by an instructor on a one-by-one basis. This computer anxiety directly impacted such users' subjective judgments about their usage experiences; even though they were satisfied with the interfaces of an OHS as their responses suggested. Therefore, creating an encouraging environment for the users is crucial for the successful adoption of an OHS.

6.7.5 Ease of Learning

The last "E" concerns how well an OHS supports users' initial learning of the help system. If it takes a nurse user extra lot of time and effort on learning how to use the help system, it definitely increases her/his burden, which will eventually results in their

rejection of the help system. In other words, this factor impacts on all the above mentioned four criteria. Therefore, it is crucial to ensure the nurse users to use the help system with confidence.

Objective measurement like calculating the time taken on learning to use the OHS as well as subjective judgment on the ease of use and ease of learning the OHS were utilized for evaluating the criterion of ease of learning. The participants spent more time to familiarizing themselves with the OHS than the hardcopy one. However, half of the participants who used the OHS stated that it was not difficult to use the OHS, perhaps this cohort of the participants had already had sufficient knowledge about web pages as the results of computer literacy assessment showed (see Table 5.6).

6.8 Limitations of the Study

The limitations of this study include the length of time for the study, availability of resource, the interference of the researchers, and the limited generalisability of the experiment to other settings. Firstly, a short time frame and limited cost for the study resulted in a cross sectional data collection. A longitudinal study of nurse users' experience of an OHS would provide further insights and evidence about whether the OHS supports users effectively as their knowledge of a NIS grow. Secondly, because there is not any existing OHS for a NIS, we developed the CPAT Online Help for our experiment. Our interference attempted to be excessive. Bias from research is inevitable. Lastly, because of lack of the access to other NISs, the CPAT is the only subject of our study. Thus, the generalisability of the experiment to other help system for a NIS is limited.

6.9 Future Research Directions

Future research on this topic can be extended to develop an instrument that is reliable and valid to measure the effectiveness of an OHS for a NIS. The design of the instrument involves the process of translating the effective criteria into observable indicators, namely, item construction and descriptive section. The categories and items can be generated from the quality framework developed in this study. Reviewing in the fields of effectiveness of measurements of online documentation and computer-based learning packages can provide valuable concepts and information. The population to be administered can be users, designers, educators of NIS.

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