CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

Since CD-ROM technology was introduced in libraries, many studies have been conducted on all aspects of CD-ROM technology. This study focuses on end-user seeking behavior: user reactions; need and level of assistance required by user, user searching techniques; user satisfaction and user preferences for type of CD-ROM databases. Other studies have examined the impact of CD-ROM databases on end-user searching in libraries as well as end-user response to CD-ROM products (Blumenthal, Howard and Kinyon, 1993).

2.1 CD-ROM Technology

Libraries and information centres have witnessed, in the second half of the last century until now a tremendous development in information technology. Various types of technological advancement in information technologies have emerged. These information technologies have helped librarians to acquire, organize and disseminate information to users, for example, microforms, computers and optical storage.

One of the most popular forms of optical storage used in libraries and information centres is the CD-ROM (or compact disc Read Only Memory) which was introduced commercially in 1985 (Dutton, 1990).

The CD-ROM is produced through a high-powered laser that burns pits into the disc. The computer reads the CD-ROM by a laser beam when it is inserted into a CD-ROM drive. CD-ROM has advantages that make it useful for libraries and information centres.
Oppenheim (1993) listed several advantages of CD-ROM:

a. High-capacity, for example, a CD-ROM disc of 4.75 inch with 600 megabytes of storage can store 200,000 single spaced pages.

b. Data-security-data cannot be destroyed by magnetic fields or mishandling and data is permanent and secure.

c. Cost effectiveness—CD-ROM technology is a spin off from the mass-market audio disc technology. Therefore, the components are cheap and readily available

d. Cost effective for publisher—a CD-ROM is reproduced by pressing from a master disc. Therefore, high volumes can be made at very low costs per disc.

e. Flexibility—it is a cheap alternative to traditional methods of information distribution, especially for databases. Libraries prefer the CD-ROM database to online databases because it requires no telecommunication linkage.

Blumenthal, Howard and Kinyon (1993) wrote about the impact of CD-ROM technology on the bibliographic instruction programme at George State University's Pullen Library which highlighted that the introduction of CD-ROM in the library since 1987 had forced the librarians to seriously reconsider their teaching role. The students and faculty members perceived three main advantages of CD-ROM compared to online databases: they could perform the searches themselves, there was no direct cost to them, and they could receive immediate results. A major observation was that the impact of CD-ROM called for more open communication between users and librarians and the communication was vital in order to inform and educate users about the service.
Furthermore, CD-ROM database users do not need to pay charges for computer connection to the database, or downloading of citation. Therefore, the end-users of CD-ROM databases do not have fear of extra or excessive charges for use of CD-ROM databases.

The CD-ROM has advantages when compared to printed materials. Its database is fast, efficient and convenient for accessing huge amount of information compared to printed indexes. It enables end-users to search effectively and efficiently and also provides end users many access points such as author, title, year of publication, etc. Furthermore, the searches can be manipulated easily according to the patrons’ preferences. The CD-ROM does not deteriorate easily with extensive use unlike printed materials where extensive use causes wear and tear.

Apart from the above mentioned advantages, the CD-ROM’s greatest advantage is that it is also light and space saving. Therefore, with its storage capacity, the size of a library building is no longer an indication of how much information the library possesses.

Juhl and Lowry (1990) studied 36 CD-ROM products, twenty-six of which were graphic databases and others were abstracting and indexing, numeric, and full-databases. Each CD-ROM product was evaluated using a combination of questionnaires, observations, and interviews, as well as reports and analysis by librarians and faculty members. Results indicated that users preferred CD-ROM as compared to printed sources due to its speed, ease of use, convenience, efficiency, and flexibility in searching. As CD-ROM databases provided citations to books and journals, there has been an increase in the number of new users and it has also resulted in increase in interlibrary loan. The reference desk received more than 2,300 CD-related questions.
Oppenheim (1993) reported that in 1992, the most popular type of CD-ROM database produced were full-text, and then followed by images, bibliographic, multimedia, reference, numeric, audio, and graphic. In terms of subject matter, Nicholls (1992) reported that 43% of the CD-ROM titles were in the field of social sciences, 35% in science and technology, 8% in art and humanities and 13% in general subjects.

CD-ROM is now highly accepted and welcomed in library daily operations and services. It is well integrated in reference work, cataloging and acquisition. Dictionaries and encyclopedias are among reference materials, which are available in libraries in the world in the form of CD-ROM. Many encyclopedias are currently available not only with images but also graphics as well as full text, sound and animation through multimedia technology.

There are CD-ROM databases, which help libraries to order and acquire new materials for the libraries. These CD-ROMs provide electronic order and through these CD-ROMs the staff can print purchase orders to send to publishers. All in all, CD-ROM databases are not only helpful to library patrons but also to the technical department because it speeds up its work and produces quick output of high quality.

2.2 End-Users

There is an increased interest in end user searching behaviour because of the development and evaluation of online databases. The increased availability of microcomputers and the development of optical information technology produced numerous definitions of the term end-user searching in the literature.
In a case study, Hindes (1990) examined the search processes of students accessing CD-ROM resources and described their attitudes concerning this approach to computer-based information retrieval. This study examined the use of CD-ROM technology in two high school media centers. Four media specialists and twenty-two students were observed and interviewed during March 1990. The researcher observed fifty-five cases of students accessing the available CD-ROM resources. Three categories came into sight from the analysis of the data concerning the students' search processes and two categories appeared from the data regarding students' attitudes towards computer-based searching of CD-ROM resources.

Over the past ten years, a great deal of literature regarding the impact of CD-ROM technology on the information professional has appeared primarily in the periodicals.

Faris (1992) identified three categories of CD-ROM end-users studies:

a. Studies that look at several libraries' initial impressions of CD-ROM databases.

b. Studies that focus on specific category of users, and

c. Studies that compare two or more CD-ROM databases by users.

Chen and Raitt (1991) indicated that 29.2% of the 295 surveyed academic libraries were using CD-ROM. When surveyed again in 1988, the percentage rose to 58.9%. *ERIC* was ranked as the most popular database while *InfoTrac* was second. *Books in Print* was the most heavily used database by librarians for bibliographical checking and acquisition purposes. Users found CD-ROM easy to use, faster, more flexible, and user-friendly in comparison with printed products. On the contrary, some comments about CD-ROM addressed the features of single-user occupation, insufficient information, update frequency, and technical and hardware maintenance.
Another study conducted by Chen and Raitt (1991) about CD-ROM use in the libraries and information centers of West Europe reported that 297 libraries were using CD-ROM and nearly half owned one to three products. The most popular databases among the librarians were Books in Print, BLN/BN Pilot Disk, Book Bank, Ulrich Plus, and Verzeichnis Lieferbarer Buecher (VIB).

A survey of research libraries in the U.S. and Canada found that database user prefer CD-ROM to print became it is free, convenient, and allows self-service use. Of the various options for electronic searching, CD-ROM was the most used in the majority of libraries surveyed (Tenopir & Neufang, 1992).

Keowmookdar (1993) concluded that the native English-speaking students at Oregon State University learned CD-ROM searching skills more effectively through the conventional instruction method than those students who were trained by self-instruction. The results of the study confirm the necessity to embark on extra efforts to develop the effectiveness of learning CD-ROM access instructional methods in higher educational settings.

Kanamugire (1994) again carried out studies on CD-ROM use at the King Fahd University of Petroleum and Minerals. He found substantial use of this service by postgraduate students. The users in his studies felt that the searching is useful and exciting. CD-ROMs are user-friendly and have massive storage capacity. They are able to conduct their searches without the need to worry about the time or cost incurred and achieved a high degree of satisfaction.
Use of CD-ROM databases is becoming very important for libraries which believe that the future for end-user CD-ROM database searching is bright and for the vendors who are gearing up their efforts to capture end-user market by introducing more CD-ROM databases which are more user friendly.

In a qualitative research, Branch (2000) examined the information-seeking processes employed by junior high school students when using CD-ROM encyclopedias. The participants, chosen by their teachers, vary in ages from 11 to 14 and with varying academic skills, in experiential and cultural backgrounds, and in knowledge of computers and CD-ROM encyclopedias. The study revealed that participants required both instruction and practice to expand the skills and strategies needed for full-text searching of CD-ROM encyclopedias. The participants were inclined to use search terms only from the original question, had difficulty choosing topics and articles from the retrieved list, and did not read long articles as cautiously as short articles. Factors which influenced the information-seeking processes of these participants included finding the correct keyword, knowing when to use a more general or specific term, computer experience, reading ability, time, and understanding encyclopedias, and the Internet.

Branch (2000) concluded that education linked to information seeking skills and strategies ought to focus on three main search tasks, that is, generating search terms, selecting topics from a retrieved list, and, skimming and scanning through text to find the answers. He added that instruction in skimming and scanning techniques to move through the long articles and in moving back and forth between screens would be useful for students of this age. He encouraged researchers to use the methods from his study to look at the information-seeking processes of individuals and small groups students of
different ages in different contexts, especially in multicultural and aboriginal communities, and with different reference tools in print and electronic form.

Farber and Shoham (2002) reported several definitions. They concluded that the fact that 'end-users' now means end user both outside and inside of the information professional community, is well reflected in a paper interview. Lin (2002) investigated the relationship between sports employee characteristics and the factors of self-efficiency for computer technology, attitudes toward computer technology, and use of computer technology in a national sports organization in Taiwan, Republic of China. The results indicated that there were no significant differences between gender groups and staff and manager groups in comfort/anxiety, usefulness, using email and CD-ROM databases; and no significant difference between younger and older groups in using CD-ROM databases. Additionally, significant differences were found between gender, staff and manager groups, and younger and older groups in using word processing. Female employees, the same as staff and younger groups, had more confidence in using word processing than males, manager and older groups.

Keowmookdar (1993) examined whether native English-speaking undergraduate students learn CD-ROM database search skills more effectively through the use of conventional instruction method or by training confined to a written manual self-instructional method. The participants were thirty-seven Oregon State University students. They were chosen randomly and assigned to two groups. The study employed an experimental pretest-posttest control group design. The length of the study was six weeks. All participants were pre-measured and post-measured using the CD-ROM Database Competency Test which was validated using the Delphi method. The subjects were trained using Wilsondisc and SilverPlatter databases. The study found that:
a. Subjects in both treatment groups experienced significant test score gains between pretest and posttest;
b. Those subjects which were assigned to the conventional instruction group had significantly higher scores than did subjects assigned to the self-instruction group;
c. Subject gender was determined not to be a factor when differences were considered from test results;
d. Interaction did not play a significant role in influencing the data results;
e. Students rated formal training as being very helpful in improving the effectiveness of their CD-ROM database searches.

The three categories of the Search Process actually reflect a process, that is, initiation of the search, modifications to the search, and selection of citations. The Search Initiation phase of the search process is described by the following properties which reflect the students’ approach: the Shotgun Approach, the Educated Guess, and the Resourceful Approach. The second phase of the search process, called Search Modification, addressed that part of the search involving students’ manner of Broadening the Search or Narrowing the Search. The third phase of the search process was the students’ Selection of Citations. Students selected citations based on the Availability of the full-text articles in their local media centers or solely on the seeming Atness of the information. From the data concerning students’ attitudes towards the use of CD-ROM resources, two major categories developed. Students felt Comfortable using CD-ROM technology and were enthusiastic about this form of computer-based information retrieval. Students considered the systems easy to access and developed a personalized relationship with
the computer. Enthusiastic responses were generated by the sense of independence students derived from using CD-ROM resources. Hindes (1990) concluded that:

a. Students experienced difficulty performing searches, a difficulty exacerbated by their failure to use the tutorials or help screens included in the search systems;

b. Despite the difficulties encountered and their failure to take advantage of the full capabilities of the systems, students liked this form of information retrieval, preferring it to print-based searching.

Di Paolo (2002) investigated the learning strategies adopted by students using a computer-assisted learning system as part of their studies. Furthermore, the thesis examines the extent to which these computer-based strategies differ from learning strategies related to traditional teaching methods and tools. The computer-based learning strategies of a population of distance education students were investigated using a CD-ROM. The students were studying Biology, Brain and Behaviour at the Open University and the Human Brain CD-ROM was an optional component of their learning materials. Data collected from questionnaires, interviews and observations over four studies led to the proposal of a framework of computer-based strategies. This framework comprises ten strategies that cover motivation, information processing and management of resources on the CD-ROM. When these strategies were compared to a framework of strategies related to the study of traditional teaching materials a number of differences emerged between the strategies used in the computer and traditional learning contexts.

Nasir (1996) studied the Malaysian postgraduate students in Leeds in 1995 with regard to their use of CD-ROM databases. She found that only 58.3% of the participants used
CD-ROM databases. The participants reported that the CD-ROM databases were useful for writing research papers, articles, books, and can help in thesis preparation. Nasir asserted that there was a hopeful and vivid future for CD-ROM databases in Malaysia. She concluded by urging librarians and information scientists to upgrade their utilization of information sources.

Libraries are welcoming CD-ROM databases and they are integrated into their collections. However, the central question for the librarian contemplating the purchase of a CD-ROM system is, can the system be used effectively by the patrons? If this question cannot be answered in the affirmative, then one must question the acquisition of the system. However, one should be clear how users are going to use the system and what they need in order to use the system effectively.

2.3 User Instruction

User instructions are vital for end-users. Discussing “Concepts for End-user Training”, Adams and Plosker (1995) concluded that “innovative instructional programs designed to train end users unfamiliar with electronic database searching should draw upon traditional techniques successfully applied by the professional information community. With direction and guidance from the information professional, the end-user can learn to independently analyze a research need, formulate a search strategy, and successfully identify information solution.” Hence, a large portion of the end-user literature deals with evaluation of end-user searching, accomplished by either surveying patrons on their level of satisfaction with their searches or actually analyzing the results of their searches. Others used searchers responses to determine the appropriate content for instructional sessions and materials. There are also studies that assess the impact of instructions on end-user searching.
Bostan and Rebbins (1991) studied *PsyCLIT* search results from students who had a range of instructional experiences. They concluded that the only instruction that caused a significant difference in search capability was a live search demonstration. A user study on *MEDLINE* CD-ROM database was conducted at St. Louis University Medical Center Library by Plutchak (1990). The study revealed that the level of satisfaction amongst the respondents was very high. There were no significant differences among the group participants in terms of how they rated satisfaction. The study concluded that "it did not seem to matter how well the system met someone's particular needs or even how easy they perceived its use to be - most users loved it". The study found that user satisfaction could not be used to determine whether the database is meeting the users' needs.

A survey carried out by Schultz and Salomon (1990) at Oakland University compared students' attitudes to CD-ROM and print indexes. The results showed a strong preference for CD-ROM over print versions of the databases. Most students found CD-ROM products easy to use and were satisfied with their results. About 36% of the students felt the need of assistance from library staff. However, observations indicated that 86% of the students were actually using on-line help, and 67% of this group found the on-line help very helpful. Participants tend to use the *HELP* screens of the products rather than asking librarians for assistance. However, the survey also indicated that students were generally unsophisticated in their search strategies, the authors suggested that there is a need for librarians to be able to provide bibliographic instructions.

In the Penn State, Faris (1992) examined the users' reactions to CD-ROM. The study surveyed users of CD-ROMs for a two-week period. The results revealed that both
juniors and seniors were by far the heaviest group of users, almost 56%, followed by master's student, doctoral students, and then freshmen and sophomores. The most popular database used by the end users was *Readers' Guide, Social Sciences Index*, and *Business Periodicals Index*. The study showed that over 70% of the users found the instructions to be very or moderately helpful, and only slightly over 1% did not find the instructions useful. The study also indicated that graduate students asked for assistance more frequently than undergraduates. To the question of whether the users would attend a fifty-minute class on effective CD-ROM searching, 56% of the respondents answered positively. As to the system, the study found over 86% of the users found that the systems are easy to use.

Bucknall and Mangrum (1992) conducted an electronic survey of users of fifteen different CD-ROM databases connected to a local area network at the University of North Carolina at Chapel Hill. The study revealed that the level of experience (number of prior databases used) was a relatively small portion of the total study. The study also showed that the library staff was the preferred source for searching assistance, whereby 40% of the users asked questions from the library staff, 25% used trial and error to solve problems, 21% referred to documentation, 8% relied on on-line screen help, 1% asked for help from other users, and 5% stated that they never had any problem.

Spragg (1992) observed forty students using different hardware and software systems. The results revealed that experienced users performed better than novice users especially when they searched on Macintosh. Fourteen out of forty participants preferred Macintosh, three *IBM* or neutral. Only 53% of them successfully displayed citations using *PCSPIRS* and 55% with *MacSPIRS*. No evidence was found that a graphic-user-interface could significantly enhance user performance over textual interface. The users were also not very successful in searching
bibliographic databases on CD-ROM, suggesting that libraries had to take serious measures for end-user education. Kenny and Schroeder (1992) carried out an evaluation of CD-ROM service in 1989 to investigate the system-provided training, instructional sessions, and on-site assistance given to users of CD-ROM databases in education, psychology, sports, social sciences, and applied sciences in a library of a middle-sized liberal arts college.

Reese (1993) reported the experience of the Vanderbilt University Library about CD-ROM instructions. The instructions included many elements about the use of this technology. The library noted significant decrease in online searches with the introduction of free end-user CD-ROM service. The number of online searches in 1983 was 493 which fell to 203 (58%) in 1987. In 1992, only 18 online searches were conducted. The library carried out extensive end-user instruction programme. Among the methods used were point-of-use, group instructions, demonstrations, workshops, class/integrated classes, written materials, tutorials, and videotapes.

Tumlin (1993) had further refined the point-of-use instructions method by outlining four ways to conduct them. First, the "overkill method" which provided unlimited assistance by reference librarians. Second, the "underkill method", offered no instructions whatsoever and by letting patrons leisurely teach themselves. Third, the "prohibitive method", which offered instructions only during scheduled seminars and by appointment, i.e., no point-of-use on demand. Finally, the "minimal method", which offered as much instructions as necessary to address specific information needs.

Sullivan-Windle (1993) conducted a study at the Kelvin Grove campus Library of Queensland University of Technology to discover the factors in a library environment that hindered or encouraged students from using the library effectively. It was found that most
of the observations about students' perception of the library facilities centered mainly on CD-ROM. They indicated that absence of instructions hampered their effort to use the facility effectively. CD-ROM was normally used to locate journal articles and students wished to be able to use the service effectively. The students also learned about CD-ROM from the information passed to them. This study revealed that students at that university were at the stage of CD-ROM awareness, i.e., the students were aware of the CD-ROM service, but their attempts to use it were not very successful.

Another study on *PsyCLIT* was conducted by Davis (1993) who studied the effectiveness of different types of *PsyCLIT* CD-ROM instruction. He suggested that video instruction as the most effective method of instruction.

Leach (1994) used the workstation sign-tip records to determine use patterns for individuals searching CD-ROM databases in the Biological Sciences Library at the Ohio State University between January 1987 and June 1991. Data were gathered for the number of database used, interval between first and last database use, and number of academic quarters in which databases were used. More than half the individuals recorded usage within one month. Over one-third recorded one day use only. The study suggested that the library should emphasize basic point-of-use instruction for first-time searchers and de-emphasize workshops.

In terms of the effects of CD-ROM instructions on search operators, Jacobson and Newkirk (1996) reported the results of a survey of 675 CD-ROM users, obtaining data from both questionnaires and actual search strategies. One of the study's primary concern involved investigating the effects of prior instructions or assistance on search strategy. The study was statistically significant, but there was a weak relationship

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between prior instructions and level of search skills. Other measures such as user status, department affiliation/major, age, sex, and number of previous CD-ROM uses were compared to search skills. Only user status and department affiliation/major were significantly correlated to search skills.

2.4 Studies Conducted in Asia

A study was conducted in China by Wang (1992). He reported that a Chinese postgraduate student, who was studying library science in the United States, wrote about CD-ROMs and their usefulness to librarians in China. This generated sufficient interest in China and by 1989, there were 30 CD-ROM applications used in 56 libraries in China. By 1990, there were 100 CD-ROM facilities and this is expected to double in 1991 and again double in 1992. As in developed countries, major subscribers are universities and specialized information institutes situated in big cities such as Beijing, Shanghai, Tianjing, Nanjing and Dalian.

Yan and Lin (1990) noted that the development and implementation of CD-ROM technologies in Chinese libraries is favourable, due to its reasonable price, ease-of-use, and its large storage capability. An increasing numbers of libraries and information centers are interested in purchasing the equipment. At that time no Chinese company can manufacture and maintain CD-ROM equipment so CD-ROM drives have to be imported. This limitation is likely to slowdown the speed of CD-ROM development in China. Databases on CD-ROM in Chinese libraries are also foreign-made. Although many libraries have built databases of various sizes on magnetic media, no library at present has the ability to convert them into CD-ROM, nor has any library indicated an interest to do so. Due to economical factors, libraries and information centers in the same geographic area may share a CD-ROM database for information retrieval services.
In terms of application of CD-ROM technology in Malaysian libraries and information centers, Yaacob (1993) mentioned that the growing importance of CD-ROM in Malaysia is shown by an increasing number of librarians opting for the system and also the increasing number of databases that are being required. The large number of CD-ROM-based information system products that have entered the market could offer exciting opportunities for both librarians and users of information. However, it also presents challenges in the form of changing to the new system and also managerial issues, such as the cost of CD-ROM products, space, personnel training, user instruction, collection development, keeping abreast with new trends, as well as maintenance of the hardware and software.

Nasir (1996) conducted a study of Malaysian postgraduate students in Leeds to determine the extent and ease of use of CD-ROM databases. The results of the study revealed that only 58.3% of the Malaysian postgraduate students used CD-ROM databases. The users found CD-ROM databases as useful information sources for thesis preparation, writing research papers, articles, books etc. They unanimously agreed that the CD-ROM databases should be introduced to their organizations' libraries and information centers in Malaysia as they allow for quick access to worldwide literature, are very comprehensive, speed up literature searching and prove to be an asset to research work. The remaining Malaysian postgraduate students (41.7%) did not use CD-ROM databases for a variety of reasons such as ignorance about their existence or techniques of use, easily available facilities for on-line search, non-availability of databases at their workplace, etc. In some cases, searching CD-ROM databases was not found essential for their study or research.
2.5 Characteristics of End-User

End-user characteristics have a great impact on the end-users searching behavior. Bellangar and Hoffman (1990) examined factors that could influence user’s search. Factors such as sex, age, computer affinity and level of education and how these factors affect the use frequency of the ERIC CD-ROM database. Their data on prior CD-ROM users were gathered via a questionnaire. The study revealed that sex and frequency of CD-ROM use had a fairly strong relationship; males in the 25 to 34 age group were more likely to use and continue to use CD-ROM databases. The findings indicated that use patterns vary for males and females in different age groups. They also found a strong relationship between level of familiarity with computers and frequency of CD-ROM use. In terms of level of education, the study illustrated that graduate students used CD-ROMs more frequently than undergraduates.

Kamal (1991) reported that sex, age, and language did not show a significant effect on searching performance. However, academic majors did affect the performance on certain type of databases. The author stated that applied science and technology, as well as business major students performed well for the complex searches while humanities did not. In the case of Business Periodical Index, the majority of the science major (60%) performed well, followed by business major (45%) and humanities major (31%). Similarly, for the Humanities Index, the science major (65%) performed well compared to humanities (46%) and business major (27%). However, the science major scored lower than humanities major in the first search even though they were performing the best searches. Kamal mentioned in his dissertation that visual ability is another variable that affect the performance of end-user performance. The study showed that 71% of the high visual end-users and 39% among the low visual scored high in their searching
performance. The high visual end-users were better in visualizing the affect of searching techniques than those with low visual ability.

In terms of time taken for CD-ROM searching, Faris (1992) found that there were differences between postgraduate and undergraduate students. The two week study showed that the doctoral and master students took more time for searching. Due to the type of databases used, which required more time to learn and to use. The author concluded that the majority of users took fifteen to thirty minutes to finish their searches.

2.6 Search Techniques

A survey was conducted by Barbuto and Cevallos (1991) to determine how well end-user services satisfy information needs and the extent to which end-user applies the concepts and techniques emphasized in the program. The results indicate that end-users were very satisfied with the services offered, but they do not differentiate between keywords and descriptor searching despite the emphasis placed on these concepts in the formal training.

Various studies have been conducted with online databases. Searching with online databases are similar with those of CD-ROM databases. The Getty Art History Information Program carried out a 2 year project, the Getty Online Searching Project, to study how humanities scholars operate as end users of online databases. According to the project report (Siegfried et al., 1993), visiting scholars at the Getty Center for the History of Art and the Humanities, California, were offered the opportunity to perform unlimited subsidized online searching of DIALOG online databases. The first report of the project analysed the vocabulary terms 22 scholars used in their natural language
description of their information needs and in their online searches. The second report analyzed and profiled the online searching record itself, drawing on complete transaction log data captured for the study. In particular the study analyzed how much searching the scholars did, the kinds of search techniques and the DIALOG features they used, and their learning curves. Overall, the results of the study agree well with those from other studies of online end user searchers. The scholars succeeded reasonably well in constructing searches and getting results, but there are indications that their one day's training and their relatively few hours of search experience were not enough to make them into sophisticated searchers.

Spink et al. (1999) explored aspects of successive DIALOG searches conducted by intermediaries for information seekers. A total of 47 intermediaries conducted as many online searches for their information seekers who were working on a particular information problem. The results indicated that successive searches were generally requested by information seekers to expand or extend, or refine the result of previous searches. Most successive searches involved some change in search terms and databases from the previous searches. Interestingly, precision did not necessarily increase over successive searches and the percentage of partially relevant items decreased significantly after three searches.

Peat and Willett (1991) examined the limitations of using term co-occurrence data from automatic query expansion. The results indicate that similarity coefficient based on term co-occurrence used for automatic query expansion should only be used for the identification of alternative query terms that occur infrequently in the database.
The selection of appropriate hardware also has an impact on the user search output. Spragg (1992) conducted a study at Cornell University to determine whether system interface design had a major effect on a library's effort to develop an electronic library. The existing CD-ROM system was studied to identify the characteristics of good interfaces by comparing two different software and hardware packages using ERIC database. The study included Silver Platter's PCSPIRS software (version 1.6) for IBM and MacSPIRS for Macintosh machines. The PCSPIRS, running on IBM PCs and compatibles, was text-based while the MacSPIRS was using a combination of text and graphical user-interface technology. Forty students were observed to perform given tasks on both the systems. The results revealed that experienced users performed better than those with minimal level of experience especially when they searched on Macintosh. Fourteen preferred Macintosh, 3 preferred IBM, and 3 were neutral. Only 53% of them successfully displayed citations using PCSPIRS and 55% with MacSPIRS. No evidence was found that a graphic-user-interface could significantly enhance user performance over textual interface. The users were also not very successful in searching bibliographic databases on CD-ROM, suggesting that libraries had to take serious measures for end-user education.

Kenny and Schroeder (1992) found that most of the user in their study did not use logical operators (Boolean "and", "or", "not"). They also did not know how to use thesaurus and often lacked a search strategy or even a good research question. Wood, Ford, and Walsh (1994) surveyed 67 post-graduate students at the Department of Information Studies, University of Sheffield (1991-1992), using the March 1991 LISA database. This study investigated how posting information, the display on the screen of the number of references in a set, is used for inverted file searching by comparing searches made by the students with and without postings. The results showed no difference in the performance (the number of relevant references, precision, and recall), but searches with
posting took more time and more sets were viewed as compared to searches without posting. Users declared a search satisfactory based on the search results, and consequently many searches conducted without postings were still considered satisfactory. Based on the search printouts, posting information was only used to a noticeable extent in just over half of the searches. It was used to decide for narrowing or broadening a search. This highlighted the importance of teaching novice users the potential value of posting information at all the stages of a search. Thus the cognitive style of CD-ROM users has an impact on the searching behavior and can also have an influence on the search outcome. It is therefore imperative that user-instruction methods must be flexible enough to take care of users with different learning habits.

Siegfried et al. (1993) analyzed the search histories of 27 humanities scholars who visited the Getty Center for the History of Art and Humanities over a two-year period and who searched as end-users on the DIALOG search service. The authors examined how much searching the humanities scholars did, the kind of search techniques and DIALOG features they used, and their learning curves. Search features studied included commands, Boolean logic, and types of vocabulary and proximity operators. In addition, the study investigated how often the searchers used elementary search formulations and introduced new search features and capabilities into their search. The amount of searching done ranged from none to dozens of hours. A typical search tended to be simple, using one-word search terms and little or no Boolean logic. Scholars were found to make heavy use of proper terms in subject searching, just over 5% of their search terms were for author searches. About 63% of their search terms were single words, and, coincidently, more than one-quarters of the scholars never used a Boolean "OR" at any time in their searching, consequently they may have entered many terms at a time, and then combined them with an "AND" at the end.
Lancaster, et al. (1994) compared the results of 35 end user searching ERIC and those obtained by a team of skilled librarian. The result of this study suggested that end-users encountered many difficulties when searching the CD-ROM database. The study recommended three ways to improve the quality of the end-user searches:

a) User instruction based on use of appropriate examples
b) Creating further search tools to aid the user
c) Use more sophisticated interfaces incorporating unconventional search approaches.

As to search techniques, DiMartino et al. (1995) compared the CD-ROM search techniques of 42 undergraduate native speakers of English with those of 34 undergraduate English-as-a-Second-Language speakers in a controlled experiment. The results of this study revealed that native speakers were significantly more likely to use plural word forms when searching and to experiment with synonyms and alternative words to search for topics. Both groups of students underutilized basic search techniques, such as Boolean operations and indexing, and searched inefficiently.

Moscoso and Nogales (1995) investigated the use of online and CD-ROM databases in Spanish university centralized bibliographic services. The data were collected through survey questionnaire. Thirty-three universities replied out of a total of 40. Findings showed that, end-users carry out their own searches using an online database. However, the majority of participants can do this with CD-ROM databases. While all the services carry out retrospective searches, less than half carry out selective dissemination of the information.
Anderson (1996) compared the searching habits of graduates and undergraduates students using both CD-ROM and online databases at Arizona State University. The result of the study revealed that simple searches were used in most cases by both groups of students, even if they had been instructed in more advance techniques. Time spend per session was greater for CD-ROM databases, which included abstracts, than for the online catalog, without abstracts. Familiarity with the software was found to decrease the time spent at the terminal as well. Approximately one-quarter of the students required either online help or professional assistance in relatively equal proportions.

Using the Excite search engine, Spink et al. (1999) investigated searcher behaviors. This study was based on a 50,000 queries set. The result revealed that there were empirical regularities in the usage of query terms and the query size. Query modification was not widely used. More than half of the users (58%) did not access results that appeared beyond the first page of the site. Fewer than 10% of queries submitted used Boolean operators. Half the users that used Boolean operators had incorrectly used the “AND” operator. Based on these findings, the authors concluded that the web searchers differ significantly from users of more traditional IR systems provided by vendors such as DIALOG.

In an empirical study of end-user Sutcliffe et al. (2000) used 17 medical students as subjects, and searched 4 topics on MEDLINE using WinSPIRS. Subject notes, search strategies and search histories were recorded and their actions and thoughts subjected to video and audio recording. Recall made use of a standard relevant set; chosen by experts from a union of subject outputs; precision was defined as both subject relevant and independent judge relevant over subject relevant documents. Average recall was 14%. Novices significantly out-performed experienced searchers on one question only.
However, experienced searchers had significantly similar ranking orders of the queries for recall; novices seemed to find all questions equally difficult. No differences were apparent for precision. There were no significant differences in retrieval times or evaluation times overall but some questions indicated differences. Evaluation time was positively correlated with query complexity. More experienced searchers used more query iterations and used broadening and narrowing strategies while novices favored trial and error. Novice searchers used only the AND operator. These results are seen as indicating the failure of current user interfaces to assist the searchers.

Sutcliffe et al. (2002) conducted an empirical study of information retrieval using the MEDLINE database to study user behavior, performance and to investigate the reasons for sub-optimal searches. The experimental subjects were selected from two groups of final year medical students who differed on their knowledge of the system. The subjects carried out four search tasks and their recall and precision performance was recorded. The data of this study captured the search strategies used, duration, and log submitted queries. The over-all performance of the study was poor. Analysis of strategies, timing data, and query log showed that there were many different causes for search failure or success. Poor searchers either gave up too quickly or employed fewer search terms. Good searchers persisted longer, used a larger, richer set of terms, constructed more complex queries, and were more diligent in evaluating the retrieved result.

2.7 End-User Responses

The CD-ROM databases are growing very fast and complicated because of its contents and powerful storage and retrieval capabilities. Most of the studies indicate that the CD-ROM databases are user friendly and easy to use.
One of the primary concerns related to the management decisions of CD-ROM is the excessive demand on the role of reference librarians. Seago (1993) conducted a study at the Tomkins-McCaw Library Medical College of Virginia to compare user responses to CD-ROM and librarian-mediated search service. Surveyed users were those who had completed their own CD-ROM searches using MEDLINE database as well as those who had requested librarian-mediated searches. The study was conducted during August 1988 to July 1989 showed that the total number of CD-ROM searches conducted was 609. Reasons listed for requesting librarian-mediated search were: the librarians were more familiar with the medical subject heading terms, and users had time constraints. Users who did their own searches referred to the cost-free nature of the service and that they preferred doing their own searching. In terms of quality of relevant citations, 54% supported the librarian-mediated searching for retrieving higher quality and relevant citations, while 31% preferred conducting own searching, and 8% were indifferent.

Chen and Raitt (1991) indicated Users found CD-ROM easy to use, faster, more flexible, and user-friendly in comparison with printed products. On the contrary, some comments about CD-ROM addressed the features of single-user occupation, insufficient information, update frequency, and technical and hardware maintenance.

A study conducted by Bucknall and Magrum (1992) indicated that the main reason for students to use CD-ROM databases was due to their ease of use rather than the superiority of information available in the CD-ROM databases.

Bucknall and Mangrum (1992) evaluated 1,135 responses to a variety of questions pertaining to public service issues, user attitudes towards CD-ROM searching, and place of CD-ROM within the overall research strategy. The results showed that the majority
of the participants depend on the CD-ROM as their first source when conducting research. The two major reasons for this reliance on CD-ROM are speed and ease of use. Bucknall and Mangrum mentioned that the overall popularity of CD-ROM is attested to not only by an enormous rise in usage, but also by the high satisfaction levels attained by users.

Hart and Miller (1997) compared CD-ROM and Internet versions of Aquatic Sciences and Fisheries Abstracts (ASFA) to assist reference librarians/bibliographers in the selection of electronic formats of indexes and abstracts. The results indicate that CD-ROM technology, in spite of its user friendliness, has a limitation. The Internet version has more current records, offers more comprehensive coverage, and allows unlimited remote access by faculty, staff, and students.

Allen (1990) found that users who conducted simple searches supported the view that CD-ROM databases were easy to use. However, students spending more time on comprehensive searching were less confident with their searching skills and results of their searches. They felt that they needed training and assistance in CD-ROM database searching.

A survey conducted by Short (1999) on Eastern Washington rural family physicians showed that 59.5% owned a personal computer with a CD-ROM drive. Those physicians who owned a computer used their CD-ROM for entertainment (52.6%), medical textbooks (44.9%), literature searching software (25.6%), drug information (17.9%), continuing medical education (15.4%), and journals on CD-ROM (11.5%). Many rural doctors who owned computers felt that CD-ROM software helped them
provide better patient care (46.8%) and kept them current on new information and techniques (48.4%).

A postal survey conducted by Khalid (2000) confirms lesser usage of CD-ROM databases in university libraries of Saudi Arabia when compared to UK and Malaysia, for example, for housekeeping and bibliographic searching. The literature review points out a number of reasons. For example, non-existence of a national information policy and the lack of trained staff. Use can be increased through initiatives taken by professional organizations and Government agencies. Among these, planning for technology, implementing information policy, developing broader awareness for the use of technology in libraries, establishing staff training and development and user education programs are particularly important.

Majid (2001) explores the use of CD-ROM in academic libraries of three South Asian countries, namely Pakistan, Bangladesh and Sri Lanka. A questionnaire was used for data collection and 39 academic libraries participated in the study. It was found that only one-half of the libraries were using CD-ROM technology and 65% of these were facing financial difficulties in sustaining it. Two-thirds of the libraries have only up to two CD-ROM workstations and, on average, libraries have just over four CD-ROM titles. Most of the library staff were self trained and only libraries were undertaking promotional and user education activities. Many suggest that donor agencies and leading publishers should pool their resources to develop full-text CD-ROM products to help sustain the flow of digital information to these countries.

Majid and Tan (2002) investigated the information needs and information seeking behavior of computer engineering undergraduate students at Nanyang Technological
University (NTU), Singapore. The purpose was to investigate the types of information sources used by the students, their preferred information formats, the importance of and reasons for using certain information sources and the use of various electronic information sources. A questionnaire was distributed to 200 randomly selected students and 102 completed questionnaires were returned. The study found that printed materials were the most preferred information format among the students. The top five most preferred information sources, in the order of importance, were books, lecturers, the Internet, friends and manuals. Unexpectedly, the use of databases and electronic journals was quite low among the computer-engineering students.

2.8 CD-ROM in Developing Countries

Chen and Chen (1990) conducted a survey on the use of CD-ROM and other optical products in Western Europe. They found that there is a high level of user enthusiasm for CD-ROM in academic and college libraries. The end-users felt that CD-ROM technology is viable because it increases access to information. The libraries found that it increases library usage and photocopying load as well as decreasing the use of the print equivalents. Both the users and library staff agreed that it is a timesaving technology. East (1991) noted the same trend in his study. He concluded that the undergraduates have a higher preference for CD-ROM databases when compared to research or graduate students.

Kanamugire (1993) conducted a study at the King Fahd University of Petroleum and Minerals Library in Saudi Arabia to determine whether there was an increase in interlibrary loan requests since the introduction of CD-ROM. Data collected from the interlibrary loan requests received between August 1991 and September 1992 were analyzed. The results indicated that 21 % of all interlibrary loan requests were prompted by CD-
ROM searching. The number of interlibrary loan requests from September 1991 to August 1992 were 728, out of which 153 (21%) were submitted as direct result of CD-ROM database searching. The increase in CD-ROM search-initiated interlibrary loan requests resulted in more workload on reference staff.

The Royal Tropical Institute sponsored Keylard (1993) to conduct a study on CD-ROM implementation in developing countries. Keylard noted that when implementing CD-ROM in a library or institution, the potential pitfalls should be addressed prior to the supply of hardware and discs. These pitfalls are certainly not only technology-related. The difficulties that arise from handling a large amount of information, and the new forms of service delivery that can be afforded, can often cause complex problems, especially for information units operating in information-isolated areas, CD-ROM based information services seldom fall into existing structures of services delivery by the unit. In most cases CD-ROM will have an impact in terms of time and skills of information personnel operating the CD-ROM workstation, which has to be recognized by management of these units. A commitment to optimize personnel management in terms of training and ways and means of service delivery to the end-user community is vital to the success of effective information services based on CD-ROM. Personnel, networking and information marketing from the key elements to achieve this success and therefore must be in the implementation of CD-ROM based information.

Phiri (1993) discusses the implications of the changes in information production for developing countries, with special reference to Zambia. The author argues that if developing countries are to continue to source their information materials from developed countries, they have to keep abreast with these changes by adopting the same technologies. The study compared the relative appropriateness to developing countries
of the two electronic publishing technologies with a print on paper equivalent which can be obtained commercially (i.e. CD-ROM and online databases). Finally the study recommended the adoption of CD-ROM technologies for developing countries because it is an intermediate technology bridging the gap between the advanced expensive online systems and paper based systems which still predominate in most developing countries.

Mills (1994), in his study, mentioned that the Pacific region, as in any other developing country, there remain obstacles to the free availability of CD-ROM technology. Telecommunications outside the home country are still beyond the financial reach of most users, impeding networking beyond the home country. The non-standard and ageing range of computer hardware used and lack of trained backup staff are among the difficulties. Individual CD-ROM subscriptions also are barely affordable. Potential users in this region are less aware of the possibilities of CD-ROM because of lack of exposure to communications technology. The University of the South Pacific Library, as a leader in such technology in its region of twelve member Pacific Island nations, has had some success with working to bridge these gaps; but there is a long way to go before CD-ROM is used in the region to the best advantage.

A study of CD-ROM use at the King Fahd University of Petroleum and Minerals at Saudi Arabia, conducted by Kanamugire (1994) noted that there was a substantial use of this service by postgraduate students. The users were very pleased and very satisfied with the search, they were able to conduct their searches without the need to worry about the time or cost incurred and achieved a high degree of satisfaction. The study participants agreed that the CD-ROMs are user-friendly, and have massive storage capacity. The study revealed that, in 1991/1992, 770 CD-ROM searches were
conducted and the number increased to 2884 in 1992/1993. About 75% of CD-ROM users printed citations. Nevertheless, 79 online searches were conducted in 1991/1992 and this dropped to only 29 in 1992/1993. The extensive increase in CD-ROM searching further emphasizes the importance of CD-ROM databases. In developing countries, it is the cheaper alternative and the references obtained only lack up-to-dateness which can be easily compensated by conducting online searching for that particular period only. Kanamugire also noted that for 1992/1993, 52% of CD-ROM searches were carried out by undergraduates and the remaining 48% by graduates, faculty, research assistants and staff.

In the study of CD-ROM in developing countries, Abid and Pellissier's (1994) survey of needs showed a strong demand for CD-ROM, and the success of a prototype, UNESCO Databases, encouraged them to prepare a new edition and plan two more CD-ROMs, Index Translationum and World Heritage. In order to promote CD-ROM activities in developing countries another program involves full text CD-ROMs as a means of helping less developed countries to obtain affordable economic access to literature. An agreement has been reached with ACDONIS whereby free subscription to the ACDONIS discs for 1991 and 1992 are given to ten selected institutions in Africa, the Arab states, Asia, and Latin America and the Caribbean. A further initiative is the joint ICSU/UNESCO International Network for the availability of Scientific Publications, a cooperative network of donors and recipients. Training workshops were also held in different parts of the world, and an inventory of CD-ROM in developing countries was prepared.

A study on CD-ROM usage data from developing countries conducted by Kaser (1998), confirmed that the Johns Hopkins University Population Information Program's
POPLINE bibliographic database is reaching its intended audience. POPLINE, created in 1974, contains over 250,000 abstracts of scientific reports, books, and papers on population, family planning, and reproductive health issues. The study, sponsored by the National Federation of Abstracting and Information Services, reviewed and analyzed POPLINE Usage Reporting System (PURS) data on human-computer interactions in 1992-96. PURS usage data were collected every 6 months from each site currently participating in the program. During the 5-year study period, 1075 users—predominantly from Africa (32%), Asia (35%), and Latin America (21%)—submitted a total of 158,117 usage reports; 462 (43%) were from academic institutions, 169 (16%) from governments, 300 (28%) from nongovernmental organizations (NGOs), and 144 (13%) from UN agencies. The overall volume of searches is at about the median level compared with other specialized medical databases in the Medlars system. The majority (61%) of total searches was GLOBAL (default setting); 13% entailed more sophisticated KEYWORD searching. Academic institutions and UN agencies were most likely to search with keywords (15% and 12%, respectively), while NGOs were least likely to select this option (8%). Users in Asia and the Near East also employed more sophisticated search techniques on a regular basis than those from other parts of the world. The impression that POPLINE CD-ROM users are not necessarily expert at using the POPLINE controlled vocabulary was confirmed by the finding "the term is not listed in the index" was the most frequent error message. A supplementary direct-mail survey of POPLINE CD-ROM users in 1997 indicated that POPLINE is used most frequently to plan or implement a program or to prepare an article, book, report, or manual. Eighty four percent survey respondents stated they would use POPLINE again, suggesting high satisfaction with the database. Overall, the findings suggest that POPLINE CD-ROM users tend to conduct simple searches and have problems interacting with systems—classic search behavior for new or infrequent database users.
Although additional training might be useful, especially for NGOs, it is unlikely that end-users who access *POPLINE* will ever mimic the sophisticated search behavior typical of trained information professionals in the developed world.

2.9 Methodology & Evaluation

The studies done on end-user CD-ROM searching behavior are few compared to other studies of CD-ROM technology in libraries. This may be due to the fact that CD-ROM databases did not have the facility of transaction logs that enable the computer to automatically record end-users' search strategies for critical examination by researchers.

Ankeny (1991) compared two method of assessing the success of end-user searches. The first method was rating the satisfaction with a search technique through a response to a single question that uses Likert-type scale. The other method uses responses to three questions using a six point anchored scale for success in conjunction with a three point scale for satisfaction and a section listing 10 possible reasons for dissatisfaction. The results revealed that actual success rate of end-user searches (38.8%) are quite low.

Kenny and Schroeder (1992) used four methods (post-activity survey, semi-structured interview with individual librarians, judgmental ratings of searches by experts, and a log of system used) in their evaluation of training, instructional sessions, and on-site assistance given to users of CD-ROM databases from different disciplines. A week was selected in the middle of the semester, assuming that users would have time to become familiar with the library facilities. Each individual who sat down at the system was given a questionnaire to be filled out after the completion of search.
Okuma (1994) conducted a study on selecting CD-ROM databases for nursing students by comparing *MEDLINE* and Cumulative Index to Nursing and Allied Health Literature (*CINAHL*). The comparison focused on the usefulness of the databases for an academic library serving nursing students at the Hawaii Loa College. The criteria used to compare the two databases were number of retrieved records, overlapping and unique records, relevance, and appropriateness of the retrieved records to the user. Silver Platter was chosen as the database vendor for the study as it was the first to produce *CINAHL* on CD-ROM. Results of each of the eight searches in both databases were compared for uniqueness and overlap of citations. *MEDLINE* had the highest number of citations retrieved for all questions. Many records in *CINAHL* were also expected to appear in *MEDLINE* which included the Instructional Nursing Index. *MEDLINE* had much higher percentage of records with abstracts (88.6 %) followed by *CINAHL* (43%). Searches conducted on *CINAHL* provided better precision than *MEDLINE*. The study suggested that although *CINAHL* was the preferred database for nursing students, *MEDLINE* also needed to be considered because of its high percentage of unique citations.

Another survey by Watson and Perrin (1994) was conducted at the Ferris State University, Michigan, to compare the *CINAHL* and *MEDLINE* CD-ROM in four allied health areas, i.e. medical or laboratory technology, medical records, radiology technology, and respiratory therapy. This was done using three methods of evaluation, i.e., a journal-article comparison using the list from Brandon and Hill's "Selected Lists of Books and Journals in Allied health Sciences", a database preference survey to 18 full-time teaching faculty, and a literature search opinion survey of the faculty after they had searched both the databases.
The results of the search opinion survey showed that 30% of the faculty preferred to search CINAHL first, while 60% said database preference depended on the search topic. Although CINAHL was different from MEDLINE as it had only English articles and fewer abstracts, 90% of the faculty were only interested in English articles, and 60% felt that lack of abstracts was not a limiting factor. The mean for the frequency of use for MEDLINE was 3.5 and 3.6 for CINAHL. Twenty percent of the faculty preferred their students to use CINAHL, while 80% said they preferred them to search both the databases. The mean time spent was 45 minutes and 20 minutes for MEDLINE and CINAHL respectively. Majority of the respondents felt that both CD-ROM databases were easy to use by students and faculty, and should be owned by the library.

2.8 Summary

Chapter two discusses the literature review of CD-ROM searching behavior of end-user since the early 1980's. This chapter is divided into eight sections namely: user instruction, studies conducted in Asia, characteristics of end-user, search techniques, end-user responses, error rates, CD-ROM in developing countries as well as methodology and evaluation. Some researchers have focused their studies on each of the mentioned areas. Others have done studies encompassing all aspects of the above topics.