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# User studies in the electronic environment: Review and brief analysis

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## Summary

The electronic information environment facilitates enhancement of the speed of service, number of users served, and the quantity and exhaustiveness of information provided. The way in which the people search information to support research, teaching and creative activities is changing as new technologies and information delivery systems emerge. The present paper summarizes the results of 101 user studies conducted in the electronic environment.

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## Introduction

The availability of information in the electronic media has created an opportunity for global access to information. As the web, the digital libraries, and information retrieval (IR) systems become a major form of information access for many users, it is necessary to learn more about their interactions with IR technologies during the information search process. The human society is undergoing a transformation due to the rapid development and diffusion of information technology in all walks of life. The application of computer and communication technologies in storage, retrieval and dissemination of information has brought new possibilities of automatic indexing and free text searching. The electronic information environment facilitates enhancement of the speed of service, number of users served, and the quantity and exhaustiveness of information provided. The way in which users search for information to support research, teaching and creative activities is chan-

ging as new technologies and information delivery systems emerge. Libraries and information centres are compelled to plan, organize and disseminate the large amount of information according to the needs of users with the help of information and communication technologies. We need a good understanding and assessment of users' interaction with IR technologies during their information search as well as an evaluation of electronic information sources. This paper reviews and provides selected highlights from 87 user studies by diverse authors around the world. The studies are arranged under the following headings: information search pattern, use of internet, use of electronic information services, information seeking behaviour and information need and use.

## Information search pattern

Charles and Clark (1990) conducted a study to evaluate the feasibility of providing an online updating service to end-user searching CD-ROM databases, which revealed that the majority of the respondents were eager to update their CD-ROM Agricola search with an online search. The respondents

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found problems in the formulation of the search strategy because the majority of the respondents did not understand the basic concepts of searching, such as selection of search terms, use of Boolean operators, truncation and limiting. Jakobovits and Nahl-Jakobovits (1990) studied skills in three domains of search behaviour (affective, cognitive, sensori motor) at three levels of competence (basic, intermediate, advance). The concept of affective library search errors recognizes that users' freedom of access to information was restricted by irrational fears or unreasonable frustrations. The widespread practice of focusing almost exclusively on cognitive skills relies on the individuals' own initiative to supply the affective and to keep up with the sensori motor. The value of diffusion of innovation theory for predicting the level of implementation of end-user online searching was analysed by Marshall (1990). The results show that three perceived attributes of the innovation were the strongest predictors of implementation level: relative advantage, compatibility and complexity. The study showed a wide variation in the level of implementation achieved by end-users and confirmed the predictive value of the perceived attributes from diffusion of innovation theory in accounting for this diversity.

A study focused on users' information seeking habits and use of online searching in county libraries of Aabenraa and Horsholm (Olepers, 1990) revealed that most of the users visited the library for performing research and only 10% of the respondents from Aabenraa used online searching possibilities when they had the option. The awareness of faculty members at King Abdulaziz University (KAU) towards online search services in the Jeddah main campus was investigated by Marghalani and Hafez (1993). The results indicate that 45% of the respondents used online search services to conduct personal searches. The largest number of requests was found to be made by the faculty of engineering. In regard to the subject distribution of online searches, medicine was found to be most prominent. The investigation regarding the information searching patterns of university administrators and non-faculty professional staff members in the Ohio State University (Sprague, 1994) revealed that administrators and non-faculty professional staff members preferred interpersonal providers and convenient print materials and most of the respondents reported using print materials. Few used access tools such as the online catalogue or electronic databases. Siddiqui (1996) analysed online searches conducted for faculty, graduate students, and researchers, in King Fahd University of Petroleum and Minerals (KFUPM) Library and revealed that the majority of the online searches were conducted for the engineering departments and the civil engineering department. Faculty requested the largest number of online searches followed by graduate students. The attitudes of the users of the National Ship Design Research Center (NSDRC) towards online information search and retrieval was assessed by Chaya Devi (1997) and discovered that the majority of the end-users preferred to search the information online rather than the manual method due to the reasons of immediate and global accessibility to information. The end-users preferred to search the information by subject/keywords, and natural language search was preferred over controlled vocabulary. Ray and Lang (1997) conducted a replicative study to analyse the search styles of

patrons and staff of two university libraries—University of Pacific and Adelphi University. The investigators pointed out an increase in subject searches and diminishment in keyword searches, and that the labeling of individual search option had an impact on search style.

Wood, Wallingford and Siegel (1997) reported the results of a customer survey conducted by National Library of Medicine. For searching the NLM database, the majority of the respondents used the Grateful Med software, and Office was listed as the primary search location. NLM identified the Internet as the source of one of its major opportunities to improve service delivery, especially for information dissemination. The study conducted by Adeniran (1999) examines the various search engines, facilities to modify or fine tune preset database structure, import and export facilities, the operating environments and other tools available on all off-the-shelf packages in Southern Africa. Software ranked number one by search engine site availability count were Erudite, In magic plus, Cuadra Star, URICA, BIBLIOS and STYLIS and the leading search engines on software in the region were browse, Boolean, keyword-in-title and term proximity searches. Interface facilities on the software were SA MARC, ASCII, UK MARC, Windows, and LC MARC. Voorbij (1999) examined the searching of scientific information on the Internet by students and academics in Netherlands. The study reveals that the majority of the academic community was using the Internet for study or work-related purposes and e-mail was the most popular service. The World Wide Web was being used primarily to search general, factual, ephemeral or very specific information and the most used search engine was Alta Vista followed by Yahoo and the frequency of use of advanced search facilities was low. The study regarding the effects of query structure on retrieval by Web search services (Jansen, 2000) revealed that the search engines Excite, FAST Search, and Infoseek returned on average 7–9 results, exactly the same regardless of whether the query was simple or complex. Alta Vista and Northern Light means were slightly lower at six. This research indicates that the typical Web searcher was adhering to a very reasonable course of action by entering simple queries.

Use and evaluation of three search databases Yahoo, AskJeeves and MEDLINE by professional nurses were studied by Pajarillo (2001). The study shows that MEDLINE was superior in terms of scope of retrieval features and utility, and second for user friendliness. AskJeeves placed second for retrieval and usefulness and first for user friendliness, while Yahoo was consistently third in retrieval features, utility and user friendliness. Debowski (2001) conducted a survey to assess inexperienced information searchers working with the Silver Platter bibliographic database on CD-ROM, and the error-prone behaviours, which resulted and revealed that the major cause that affects search quality was the capacity to search at sufficient depth and with a satisfactory search sequence of commands. Zhang (2001) tested the effect of four user characteristics on search performance: educational level, academic background, native language, and computer experience and revealed that academic background had a significant effect on search performance measures. The science/engineering students achieved a much higher relevance score on search questions than that obtained by the social science students. World

Wide Web users' information searching behaviour in a higher education institution in UK was analysed by [Cothey \(2002\)](#). Analysis revealed that inexperienced users accessed the web less often, which gained in frequency as they became more experienced. Users relied more on a passive link clicking or browsing style of information searching. [Wolfram and Xie \(2002\)](#) investigated the end-user searching and response to a General Audience Digital Library (GADL). The impact of query term and operator usage on Web search results was examined by [Lucas and Topi \(2002\)](#). The results showed that the difference in the number of terms between expert and inexpert searches, the percentage of matching terms between those searches, and the erroneous use of unsupported operators in inexpert searches explain most of the variation in the relevancy of search results. The findings highlight the need for designing search engine interfaces that provide greater support in the areas of term selection and operator usage.

The multitasking information seeking and searching process was studied by [Spink, Ozmutlu, and Ozmutlu \(2002\)](#). The study shows that total of 114 Excite user sessions from an analysis of a data set of 1000 Excite user sessions included multitasking searching, and out of 246 topic changes, 63 changes were within the same category, where as 183 were among categories. IR multitasking search sessions were longer than single topic sessions. [Spink et al. \(2002\)](#) presented the results of a study on the progress of mediated IR searching during human information seeking process. The purpose of the study was to identify: successive mediated search topics, frequency of successive mediated searches, reasons for successive mediated searches, and characteristics of successive mediated searches. [Ford, Miller, and Moss \(2002\)](#) investigated the links between web search strategies and retrieval effectiveness. The study reveals that: Boolean-only was associated with poor retrieval and Boolean-only performed worse than best match and combined. There was no evidence that such effects were due to the number of errors, terms or any interaction between these, in Boolean as opposed to best match or combined.

The characteristics of certain popular search engines among the Internet users of Madurai Kamaraj University were studied by [Ally Sornam and Dhandapani \(2004\)](#). The majority of the respondents were aware of ERNET, NICNET, SIRNET and INFLIBNET. The most frequently used search engine among the respondents was AltaVista followed by Google, Yahoo and Lycos; the search engine features such as accessibility, user friendliness, currency of information and relevance were indicated as very good by the majority of the respondents. [Wouters, Helston, and Leydesdorff \(2004\)](#) studied the Internet time and reliability of search engines. The investigators intended to find out the set of methodological problems encountered when using search engines to gather data and construct time series. [Creaser et al. \(2006\)](#) said that online content had largely replaced traditional print-based resources as the primary tool for literature searching throughout much of the academic and research community. This paper presented the results of a small-scale study, commissioned by the JISC in 2004, to assess the potential efficiency gains that may be achieved through the use of online content by researchers.

## Use of Internet

Effective search and discovery over open and hidden digital resources on the Internet remains a problematic and challenging task. The difficulties are exacerbated by today's greatly distributed scholarly information landscape. This distributed information environment is populated by silos of: full-text repositories maintained by commercial and professional society publishers; preprint servers and Open Archive Initiative (OAI) provider sites; specialized Abstracting and Indexing (A&I) services; publisher and vendor vertical portals; local, regional, and national online catalogs; Web search and meta search engines; local e-resource registries and digital content databases; campus institutional repository systems; and learning management systems. In order to redesign the library and information centre services it is necessary to study the impact and use of Internet resources among the community.

[Moyo \(1996\)](#) conducted a study to determine the training needs of Internet users in an academic environment. The investigator found that there was underutilization of existing facility (i.e. usage of a limited number from a range of available features and limited areas of application) because basic IT skills were lacking among the academic staff and help provided by computer centre laboratory staff was neither adequate nor effective in assisting staff to learn about the existing facility. [Lazinger, Bar-Ilan, and Peritz \(1997\)](#) investigated the Internet use by faculty members in various disciplines in the Hebrew University of Jerusalem. The primary focus of the investigation was on the differences in usage, training and perceived importance of the Internet among two major groups of faculty members—those in the sciences and agriculture and those in humanities, social sciences or law. [Obst \(1998\)](#) conducted a survey on the use of Internet resources by German medical professionals. The study aimed to find out: intensity of Internet usage; preferred services and resources; and advantages of using the Internet. The analysis revealed that the majority of the respondents used the Internet from one hour a week to two hours a day. E-mail was used by all the respondents and 85.6% used news groups. [Zhang \(1999\)](#) studied library and information science researchers' use of Internet-based electronic resources. The investigator pointed out that the quality, reliability and stability of e-sources were the major problems in using e-sources. [Savolainen \(1999\)](#) investigated the role of the Internet among other sources and channels in information seeking. The study examined the motives for starting network use, current patterns of service utilization in job related and non-work contexts, major problems of use and the issues concerning the place of network services in everyday life. [Chandrakumar \(2000\)](#) dealt with the advantages and facilities offered by the Internet to doctors and scientists engaged in health care and research. In this paper he has listed the various core resources available on the Internet to health professionals. Services like MEDLINE, ENBASEM, Listserve, Telemedicine, etc. are described.

The uses and perceptions of the World Wide Web were analysed by [Dalgleish and Hall \(2000\)](#). The study examines how undergraduate students view their acquisition in terms of open resource model, where the web was accessed to retrieve information from diverse sources which may, or may

not, be educationally based. The investigators found that most of the students have only a vague understanding of the way search engines work, which resulted in a poor exploitation of their facilities. The students have a clear desire for better indexing of WWW sites and better descriptions to be provided of each site contents so that only relevant links would be followed allowing them to quickly obtain the information they wanted. The student use of web resources was investigated by Grimes and Boening (2001). The analysis shows that students were evaluating web resources only superficially and they were indeed using unauthenticated web resources. None of the students took advantage of the availability of databases or web guides provided by the library. There was a gap between what instructors expect and what students were actually doing with web resources. Byerely and Chambers (2002) analysed non-visual users' accessibility and utility of web-based library databases. The study examines the accessibility of two popular web-based abstracting and indexing services—periodical abstracts offered by OCLC First Search and Gale Group's Expanded Academic ASAP, when accessed by blind users using screen reading programs. Investigators pointed out that there was a need for web developers to conduct usability testing of commercial databases with people who rely on screen readers for access to the web and the librarians must be cognizant of accessibility issues and demand assurance from database vendors that their products were accessible.

The public's use of the library and Internet was studied by D'Elia et al. (2002). The main aim of the study was to investigate the characteristics of the current consumer market for public library services and Internet services. Nicholas, Hunbington, and Williams (2002) compared the use of two consumer health web sites—NHS Direct Online and Surgery Door. The use of Internet resources and services in Gulbarga city was studied by Maheswarappa and Ebnazar (2003). Slow accessibility, getting connectivity and lack of training were the main difficulties faced in the use of Internet. Kumbar and Shirur (2003) conducted a study to elicit opinions from the users of Sree Jayachamarajendra College of Engineering (SJCE) regarding the exploitation of Internet resources. Vaughan and Thelwall (2003) investigated the factors that influence the creation of links to journal websites, including the impact of the journal websites within the scholarly community, journal website content level and journal website age. Shoham and Baruchso-Arbib (2006) examined Internet usage and its evaluation as a source of information amongst 92 entrepreneurs of Israeli start-ups and compared the results to the usage of traditional information sources. Entrepreneurs' independent versus mediated use in Internet searches was also examined. Ninety percent of the entrepreneurs in this study described the Internet as an important tool, while 71% believed that they were skilled in the use of the Internet, despite the fact that they primarily used basic Internet services including access of a repertoire of websites and search engines.

### Electronic information services

The availability of information in the electronic media has created an opportunity for global access to information.

Electronic information environment facilitates enhancement in the speed of service, number of users served, the quantity and exhaustiveness of information provided. The electronic media, by their very nature and characteristics, provide new and exciting opportunities for doctoral students in finding the information related to their investigation.

Winship (1986) examined various aspects of use, operation and effects of online services in libraries attached to universities, polytechnics and other institutions of higher education in the United Kingdom. The investigator concluded that the availability of online searching has not led to any widespread cancellation of printed abstracts, and online and manual searching were seen as complementary. Abels, Liebscher, and Denman (1996) conducted a study to explore factors that influence the adoption and use of electronic networks and network services by Science and Engineering faculty in small universities and colleges. The investigators pointed out that there was a relationship between users' perceived expertise and the number of network service used, and the majority of network users were using the services for research and teaching. E-mail, electronic databases, run programs and file transfer were considered most useful for research and e-mail was the most used service among the respondents. Mc Murdo and Meadows (1996) investigated the acceptance and use of computer-mediated communication (CMC) by information students. The investigation reveals that most of the students used e-mail 1–7 times per week, and the majority of them used it for sending messages to other students. Students' expectations of CMC increase with time. Increasing popular awareness of the Internet, World Wide Web and information superhighway may reinforce this. Philip (1996) investigated the current use of automated chemical information systems by academic chemists in the UK. The investigator found that research prowess was correlated with progressive use of leading-edge information systems. The reasons for not using leading-edge systems were: unawareness of systems; expense and hard/software constraints.

Liebscher, Abels, and Denman (1997) investigated the factors influencing the adoption and use of electronic networks by Science and Engineering faculty in six small universities in the Southeastern US. The investigators found that a connection to the Internet was an important communication tool for faculty members on small campuses. Tomney and Burton (1998) assessed university academics' attitudes towards electronic journals and examined the current level of use of these publications in a British University. Analysis reveals that the use of e-journals was highest among the Business, Science and Engineering faculties. Both users and non-users of e-journals made use of other electronic information resources, especially the Internet. The impact of local factors on the use of electronic journals was studied by Pullinger (1999). According to the investigator the local factors which affect the use of e-journals were: holdings of print journals, accessibility of library as place, distance to library, opening hours, promotion of availability of e-journals, technical infrastructures, training and support for IR and user authentication.

Ashcroft (2000) studied the areas of promotion and evaluation, discussing findings of a recent Liverpool-based study of electronic journals in academic libraries in the UK and North America. It also traced the growth of electronic

journals and their impact on the role of information professionals. Although information professionals adapted to these technical developments, there are indications from the study that the transition was incomplete in the areas of evaluation and promotion. Eason et al. (2000) examined the general value of electronic journal functions and their usefulness in the specific context of the Super Journal Project. The analysis showed that basic browsing, printing and search make up the core functions of electronic journals; other functions, such as saving of bibliographic data, alerting, customizing, links with external resources and communication, serve as peripheral functions. The usefulness of both the core functions and the peripheral functions in a specific service is influenced by various implementation factors. However, it is the realized usefulness of the core functions which determines the use of a service.

Mahé et al. (2000) described how research scientists were making use of electronic journals. There have been few studies to date on how French research scientists were using electronic journals in their work. Under a national programme for document digitization in higher education and research, a qualitative study was conducted at the Jussieu Campus in Paris among 25 researchers and doctoral students and nine documentalists. Costa and Meadows (2000) examined the effects of using information technology on the communication of research by social scientists in Brazil. Differences have been found between economists and sociologists, with the former more active in their use of electronic facilities. Monopoli and Nicholas (2000) conducted an evaluation of Social Science Information Gateway (SOSIG). The study was intended to find out the frequency of SOSIG uses, reasons for using SOSIG and search or browse options used. The analysis shows that majority of the respondents were regular Internet users. The online help function seemed to have been used by all occupation groups, but mostly by information scientists. The investigators pointed out the need for providing training and guidance in using the information system.

Morse (2000) conducted a study in an academic biomedical library setting to compare the usage of a matched set of biomedical literature available to users both in print and on the web. The results showed that for journal volumes in the study subset (the 1998 volumes of 194 titles), users accessed the electronic versions more than 10 times as often as the print versions during the 6-month study period. The results further revealed a remarkably similar usage curve in the print and electronic data, with just (20%) of titles accounting for nearly 60% of usage in both study sets. Conversely, the bottom (40%) of ranked titles in both the print and electronic study sets accounted for just (9%) of total usage. Studies like this one demonstrate the overwhelming preference of users for electronic access when it is available to them, especially when they can link directly from databases to the full text of the articles indexed. Belecis et al. (2001) studied the use of web-based information resources. The study was intended to find out: the variability of International Coalition of Library Consortia's (ICOLC) data elements over time; the ratios of queries per session for searchable databases; and use of e-journal collections. The study shows that electronic resource use exhibited a great deal of variance over time and ratios of

queries per session showed more stability over time than individual ICOLC elements. Music scholars' use and perceptions of the helpfulness of e-mail and electronic discussion groups were studied by Brown (2001). Music scholars rated e-mail as consistently more helpful than discussion groups for selected activities in the research process. Scholars who found discussion groups unhelpful in their research reacted by periodically unsubscribing: a pattern of intermittent discontinuance consistent with diffusion theory. These modes of CMC were found to play marginal roles in the music scholar's research process. Cooper (2001) investigated the usage patterns of a web based catalogue that can be accessed through the Internet. The investigator found that there were major differences in usage (number of searches, search time, number of display actions and display time), depending upon the databases accessed. Monopoli and Nicholas (2001) evaluated the use of ADAM—a Subject Based Information Gateway in the Art, Design, Architecture and Media information. The investigator found that more than 38% of the respondents gained access to ADAM from the university and writing up a term paper or a thesis was their main reason for using the service. The most popular search method among the respondents was direct searching. Rogers (2001) investigated the electronic journal usage at Ohio State University. The study examined: the awareness and use of electronic research and reference databases and e-journals and printed journals provided by the library, the advantages and disadvantages of e-journals and the frequency of use of electronic journals and databases. The study showed that there was significant progress in the acceptance and use of e-journals with more than half of the faculty and graduate students at Ohio State University. Pettigrew, Durrance, and Unruh (2002) studied how public libraries were using online community networks to facilitate the public's information seeking and use in everyday situations. The investigators pointed out that the Internet was responsible for the strong emphasis on employment opportunities, health information and other international community information as well as the emergence of new community information categories. Monopoli et al. (2002) evaluated the use of the electronic journals service of the library and information service of the University of Patras, Greece. The investigators proposed to find out: the number of users; personal characteristics of users (age, gender and occupation); frequency of use; purpose of use; search method and service provided; obstacles preventing users accessing a digital library; and preferred form of subscription to a journal title—electronic or print. The online help function had been used by all the occupational groups, but was most used by research associates/visiting lectures. Hewitson (2002) studied the awareness and extent to which academic staff at Leeds Metropolitan University (LMU) use and assimilate electronic information services into their work. The investigation reveals that the Internet was the most extensively used electronic information source by university staff. The majority of the staff were using the electronic information sources, to keep up to date in their own subject area. Franklin and Plum (2004) examined the library usage patterns in the electronic information environment. Sponsored researchers at the health sciences libraries appeared to use networked electronic services most intensively from on-campus, but not from in the

library. The purpose of use for networked electronic resources by patrons within the library was different from the purpose of use of those resources by patrons using the resources remotely.

Abdulla (2005) conducted a case study which examined the short history and rapid development of electronic journals (e-journals) at the United Arab Emirates University (UAEU). It described the scope of the journal migration project and its impact on library operations. UAEU (with over 16,000 students) is the flagship university in the UAE, and much farther along in the transition to electronic-only access to journal literature than most libraries in the Arab world. The study indicates the challenges of offering e-journals as "bundled" packages and UAEU's concern about the library's inability to remove irrelevant titles, control cost, and retain the freedom to make changes on its journal collection. Jamali et al. (2005) conducted a study to provide a review of the log analysis studies of use and users of scholarly electronic journals. The advantages and limitations of log analysis are described and then past studies of e-journals' use and users that applied this methodology are critiqued. The results of these studies will be very briefly compared with some survey studies. Both the benefits and the drawbacks of log analysis of online journals' use and users studies are highlighted.

Medeiros (2005) described the challenges and the promises involved with the use of electronic resources. The study discussed the ways in which libraries could take better advantage of usage statistics with the help of systems. The study also provided an insight into the challenges and potential uses of electronic resource usage statistics. Dadzie (2005) set out to investigate the use of electronic resources by students and faculty of Ashesi University, Ghana, in order to determine the level of use, the type of information accessed and the effectiveness of the library's communication tools for information research. The study found that general computer usage for information access was high because of the University's state-of-the-art IT infrastructure. Usage of some Internet resources was also very high, whilst the use of scholarly databases was quite low. Conyers (2006) considered the importance of statistical measures for any study of the impact of electronic services and to describe how relevant statistics can be collected and analysed. It was based on the results of two complementary research projects at evidence base. The first, the e-measures project, working with UK higher education libraries on establishing a set of national and local measures for electronic services, and the second, a study and analysis of usage statistics for four publisher deals within the NESLi2 initiative. The e-measures project has demonstrated some of the issues involved in the collection of reliable usage statistics, while the NESLi2 study has developed a framework for analysis which can be applied more widely. Levine-Clark (2007) identified levels of awareness and patterns of usage of electronic books by scholars in the humanities. A survey of the University of Denver community assessed knowledge about and usage of electronic books. The results indicated that scholars in the humanities have a higher level of awareness of e-books than their colleagues across campus but use e-books at the same rate. Their patterns of use are different, with humanists using less of the e-book than do other groups.

The humanists participating in the study preferred printed books to electronic texts at a higher rate than the other groups, and cared less about added features, such as searchability, than they did about content.

## Information seeking behaviour

In the electronic environment the studies which are conducted in order to find out the mode of interaction of the user community with the information system are very important. The information seeking behaviour means the manner in which a user conducts himself in relation to a given information environment. These studies play a vital role in planning, designing and introducing new information services and their utilities. This section contains reviews on the information seeking behaviour studies in the electronic environment.

Wiberley and Jones (1989) surveyed information seeking pattern of humanities scholars. The study reveals that most of the respondents had begun to use computers recently within the past 2 or 3 years. Investigators found that most of the respondents ignore online and seldom consult reference librarians, but rather rely on archivists and special collections librarians. Berger and Hines (1994) studied the characteristics of user groups and their current information seeking behaviour, including non-library resources used in Duke University. The kinds of online resources most of the respondents wanted were: journal articles, catalogues, bibliographies, newspapers, conference proceedings and books. Hsieh-Yee (1996) investigated the information seeking behaviour of students at American University (AU) and the University of the District of Columbia (UDC). Analysis of selected characteristics of students showed that race, school, and economic background contributed to their information seeking behaviour. Curtis et al. (1997) analysed the information seeking behaviour of the teachers of the Health Science faculty, including their use of new information technologies. A survey administered to all of the faculties in medicine, nursing and pharmacy at the University of Illinois at Chicago revealed that the faculty used electronic resources in higher percentages and used a wider variety of electronic resources. Information seeking behaviour of securities analysts was studied by Baldwin and Rice (1997). The investigators examined the influence of individual characteristics on the use of information sources and communication channels, and the influence of information sources and communication channels on outcomes. The study indicated that individual characteristics have little influence on the information sources and communication channels used by analysts, and thereby do not have a significant influence on the outcomes of analysts' information activities. Pelzer, Wise, and Leysen (1998) studied the library use and information seeking behaviour of Veterinary Medical students in the electronic environment. The investigators noticed that in the electronic environment most of the students were interested in using computerized products, including the Internet, for finding current information.

Jange and Maheswarappa (1998) analysed the information seeking behaviour of physical scientists in the Gulbarga University. The study indicated no correlation between the

use of information sources and attributes of the scientists. Bruce (1998) investigated user satisfaction with information seeking on the Internet. The principal objective of this study was to establish the reliability and validity of magnitude estimates of user satisfaction with information seeking on the Internet. The study indicates that Australian academic users generally have high expectations of success and were satisfied with information seeking, regardless of how frequently they used the Internet or whether they received formal training. Brown (1999) assessed the information seeking behaviour of Astronomers, Chemists, Mathematicians and Physicists at the University of Oklahoma (OU). The results indicated that the scientists embraced electronic bibliographic databases and wanted access to and capabilities of these databases expanded. The investigator suggests that the primary goal of science libraries should be to obtain access to as many appropriate electronic bibliographic finding aids and databases possible. Grag (2000) conducted a study on information seeking patterns of users of engineering institutions in Rajasthan. The most used electronic sources of information were computers, followed by radio and television, e-mail, audio visual sources, compact discs, online databases and multimedia, and the main sources for generating ideas were 'thinking' followed by 'reading' and 'conversation'. Julien and Michels (2000) examined the information seeking behaviour of individuals in the context of daily life. Ease and speed of use were considered as the most important criteria for selecting particular ideal sources. The investigators found that there was variation in information behaviour by gender. Kuffalikar and Mahakulkar (2003) analysed the information seeking behaviour of different categories of users using Bio Chemistry and Microbiology department libraries of Nagpur University. There was a clear indication of "invisible college" and user dependence was more on informal modes of communication, than the formal. Internet surfing, attending conferences/workshops/seminars/refresher courses have widely helped the users in seeking current, updated information in their respective fields.

### Information need and use studies

Understanding the electronic information environment requires an awareness of the information system, the user needs, and the technologies that are available to support user interaction with information. Attention to users of digital information systems and their needs from an IR perspective is very important. This section reviews the studies related to information need and use.

Sanjeev Kumar and Mishra (1993) studied the use of the National Institute of Fashion Technology Library. The study examined the suitability of the library opening hours, frequency of library use by the members, users' information requirements, users' information search/strategy, the most frequently used services, and the periodicals/forecasting journals most frequently used. Issuing of books was the major reason of library use followed by use of reference materials. VijayaLakshmi and Kanakachary (1994) studied the information needs and use pattern in humanities. The investigators suggested that there should be resource sharing and inter-linking or networking of humanities

libraries to ensure effective and efficient access to information. Markusova, Giljarevskij, and Cherny (1994) conducted a study that presents a sociological, and bibliometrical approach to the assessment of information use and output on research activity. The results of the study confirm the poor state of Russian science in that the scientists have been cut off from the main flow of information and must rely on the generosity of foreign colleagues to obtain information. Ockocha (1995) studied the socio-cultural factors that enhanced the use and the transfer of scientific information among Agricultural Scientists in Southeastern Nigeria. The factors which influenced respondents use and transfer of scientific information were: development in 'information technology', 'relevant and adequate information sources', and 'previous information attitudes'. Scientists also indicated preference for computerization of information services as serial management control and circulation control as areas of high priority. Wilkins and Leckie (1997) investigated the work-related information needed and sought by professional and managerial staff of the University of Western Ontario. The majority of the respondents felt that coworkers were their most important source of information and the majority used the library for job related research. Nicholas and Martin (1997) conducted a study on the information needs of journalists. The study explored the characteristics of information needs, such as subject, nature, function, viewpoint, authority, quantity, quality and place of origin, and the obstacles that stand in the way of people meeting their information needs. The investigators pointed out that lack of time, information overload, and lack of training were the major obstacles to meeting information needs. The study found there were big changes taking place in journalists' information needs and information seeking behaviour and computerization was largely seen to be the agent of this change. Crabtree and Crawford (1997) assessed the library needs of health care personnel in a large regional hospital in Springfield. Investigators found that the motivations for using the library were preparation of a talk, paper or proposal, job related issues, decision-making, self-instruction, teaching and managerial problems. Medical students' information needs and resource selection were investigated by Cogdill et al. (1997). The information medical students needed pertained to diagnosis, treatment and disease and the most frequently identified resources were MEDLINE and textbooks. Results of the study suggest that librarians serving the information needs of medical students cannot overlook the importance of textbooks, increasingly available in both print and electronic formats.

Mendes and Meadows (1997) studied the ways in which four groups of health professionals (consultants, junior medical staff, nurses and administrators) working in three hospitals in Brazil and the UK, use libraries and information resources. The study reveals that the information activities of health professionals in Brazil and the UK followed a similar pattern. However, UK health professionals clearly have better access to publications than their Brazilian counterparts, due to the latter's problem of acquiring foreign publications, the language barrier, poor access to electronic information sources and greater difficulty in attending conferences. Suriya and Abdul Raheem (1998) analysed the development of Information and Communication Technology

(ICT) infrastructure among four different groups of nations. The investigators found that the relationship between ICT and the GNP was highly positive and the ICT variables affecting the educational performance of the nations were different. [Agada \(1999\)](#) describes the Information Use Environment (IUE) of African-American gatekeepers in Harambee, an inner city neighbourhood in Milwaukee, Wisconsin. Most preferred information sources among the gatekeepers were personal information sources and the least preferred information sources were: search computer files (the Internet), monitor information on TV, and the use of specialized resource directories. [Biradar and Sampath Kumar \(2000\)](#) analysed the use pattern of periodicals by teachers and research scholars of Kuvempu University. The investigators studied the use pattern of periodicals by teachers and research scholars, the importance of different sources of information, the possible impact personal attributes of users, such as designation, qualification, sex, age, nature of work, had on the use of periodicals, the areas of interest for teachers and research scholars in magazines and newspapers, and respondents' opinions about the availability of sources in the parent organization. Use pattern of information sources among postgraduate students in the Gulbarga University was studied by [Tadasad and Metesheela \(2001\)](#). The study reveals that personal attributes, viz. gender, year of study, medium of instruction at undergraduate and post graduate level, area of habitation, stay at hostels, marital status and frequency of visits to university library, have no bearing on the use of specific sources of information. [Rowland and Rubbert \(2001\)](#) evaluated the needs and practices of part-time and distance-learning students in higher education in the UK. Analysis reveals that the university libraries considered in the study often do not cater to the specialized needs of part-time and distance learners, which leads to an increasing use of the Internet and employer resources as a substitute for traditional information channels. The biggest barriers in using the university libraries for all students were time and geographical constraints. [Xie and Wolfram \(2002\)](#) studied the contributing factors for the organizational usability of state digital libraries. The results show that the highest percentage of daily usage came from libraries affiliated with educational environments and the factors that influence organizational usability were access, promotion and training, content and format usage, and design. The study reveals that the influence of digital libraries and physical libraries on each other was significant. The investigators pointed out that it becomes essential to set up new channels to attract non-library users who wish to access state digital libraries from home or the work place and bypass libraries as access locations and training centres.

[Marchionini \(2002\)](#) describes how user interfaces for the Bureau of Labor Statistics (BLS) website evolved over a 5-year period along with the larger organizational interface and how this co-evolution has influenced the institution itself. The investigation reveals that the work at BLS had changed due to Internet technology. There was a continued growth in usage since the introduction of the BLS website, but a decreasing acceleration in growth. Technological migration and consolidation toward Wintel platforms and software usage was strongly related to site structure. From the study it was evident that electronic dissemination of

statistical information and user interfaces devoted to non-specialists not only leads to more usage by non-specialists but also begins to change the data provider itself. [Sridhar, Sampath Kumar, and Anil Kumar \(2003\)](#) studied the usefulness of library collections for Sericulture scientists and examined their information use patterns. The study explored: opinions of the library's collection, present information use patterns of library resources and services, and the most preferred journals of the scientists and research scholars. The study shows that Sericulture scientists not only depend upon their own institute library collection but also depend upon agriculture libraries and sericulture libraries. The reading habits of public library users in two branches of the public library of Mysore city was studied by [Nikam and Rajashekara \(2003\)](#). One of the major factors that influenced reading habits was the socio economic background of the public library users. [Ikhizama and Oduwole \(2003\)](#) studied the use of information sources by agriculture scientists in Nigerian Universities of Agriculture (UOA). The study was carried out to investigate the use of information sources, activities on which information was being sought, and the constraints faced by agricultural scientist in the three Nigerian Universities of Agriculture. Major constraints to the use of information sources include gaps in publications in their institutions' libraries and inadequate up to date reference sources. [Geetha \(2004\)](#) conducted a study to examine the information needs and information gathering behaviour of research scholars in the Pure Science departments of the University of Kerala. The analysis reveals that the collection of reference sources, indexing and abstracting sources, as well as computer-based information sources in the Kerala University library system was only partially adequate to meet research scholars' needs. [Gardiner et al. \(2006\)](#) examined information behaviour of academics in the digital age. The study compared information behaviour of British university academics in three disciplines—computer and information sciences, business/management, and English literature. English academics made higher use of printed information resources (such as text and reference books) than academics of any other discipline included in this study; they generally tended to be the least frequent users of electronic resources such as full-text databases, indexing and abstracting databases, search engines, and Internet sites.

## Conclusion

Taking into account the constant development in the provision of recent electronic systems, the lack of understanding of the information search pattern is an obstacle to the process of interpreting the way in which electronic information services are being delivered. There is a need for additional studies, perhaps using alternative research methods and conceptual frameworks, to provide to the information science community additional evidence to foster a more in-depth understanding of the users of information services.

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