6 SEARCHING, PUBLISHING AND CITATIONS

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Introduction

To succeed as a researcher and a scholar, it is vital for a scientist to be updated on the new breakthroughs in the field of his research. Having access to the best information sources is not adequate, but developing key skills on using search tools effectively to filter the high quality and most relevant information from the vast range of resources is of utmost importance. Skills also need to be developed on critical evaluation of the information retrieved before using for research and educational purposes. Publishing the research findings is the climax in the research process. Publishing is the channel for communicating the research results to the scholarly community. Therefore the researcher as an author should be well aware of his rights to share his work with peers in his field to the highest extent. New trends such as '*Open Access publishing*' and maintenance of '*Institutional Repositories*' (IR) are becoming popular to give authors their due rights. However, the researcher also has an ethical obligation to abide by the terms of copyright laws and other ethics associated in research publishing. This chapter describes how to develop an effective search strategy, evaluating the sources of information for their quality, publishing, and issues related to correct citation of literature sources.

Developing and Conducting a Search

Many subject specific databases are complicated to use and most of the features are hardly applied by users due to lack of skills and awareness of their benefits. Therefore it is essential that researchers develop sophisticated search techniques in order to reap the best results from their searches. Searching is a process. Commands will vary and change in different databases and search engines, but search principles remain the same. It is the capability of the searcher to evaluate and modify the results as suitable that will result in a more effective and precise search. All databases do not offer the same type of search mechanisms and facilities. Working through a few of these would develop sufficient information literacy skills to use any database successfully. There are online tutorials to learn common search mechanisms. A few are Penn State's University[1], University of South California[2] and Stanford's key to Information literacy[3] web sites. Many database vendors such as Elsevier[4] and EBSCO[5] also offer online help and tutorials.

Some common database and internet search techniques are: use of controlled vocabularies, Boolean searching, phrase searching, truncation of terms and wild card searching, limiting the search to one field, URL search etc.

Use of Controlled Vocabularies

Searches can be improved with the use of controlled vocabularies. Systematically organized controlled lists of vocabularies known as 'thesauri' are available in specific subject fields to support effective searching. AGROVOC[6] and MeSH[7] are two thesauri available online for searching Agriculture and Medical Sciences databases, respectively. Most of the subject databases developed by Sri Lankan libraries and networks use thesauri to index research papers. Many local databases, especially those developed on WINISIS software offer an online dictionary from which users could select search terms during a search. This improves the precision of the search and at the same time avoids any spelling mistakes that could occur while keying in search terms. Thesauri allow broadening or narrowing the search as suitable with appropriate terms for better results. Large international subject databases usually use thesauri to index literature. Pubmed[8] uses MeSH[7] and AGRIS[9] (a database on agriculture) uses Agrovoc[6] while Mathematical databases use MSC[10] (Mathematics Subject Classification) scheme.

Boolean Searching

Boolean searching offers a combination of search terms with 'AND' , 'OR', 'AND NOT'. Some databases allow the use of plus (+) and minus (-) symbols in place of 'AND' and 'OR', Boolean searching allow combination of terms or phrases within a single search field as well as between two or more fields. Boolean searching does not always result in the best results and therefore certain databases and many search engines use sophisticated techniques to rank the search results. However, Google ranking is more precise than many others. 'Phrase searching' is powerful and often brings out good results. For better results, phrase searching could be combined with Boolean searching. There are online tutorials on the internet for researchers to learn these techniques. The University at Albany web site[11], *'Online tutorials on search strategies'* offer detailed information on Boolean searching techniques.

Truncation

Truncation or wild card features allow variations in spellings or word forms. There are basically two types of truncation; *root truncation* and *internal truncation*. Truncation symbols will vary depending on what tool is used for searching. Some common symbols are *, !, ? and $. The symbol tells the search engine to return alternate spellings for a word at the point that the symbol appears. *Root truncation* (or root expander) is generally used more frequently because it will return plural and other forms of the search term. For example, 'farmer*' would return records or

web pages with farmer, farmers, farming, farmhouse etc. An example for internal truncation is 'wom*n' which retrieves both 'women' and 'woman'.

Other Search Techniques

Limiting the search to a single field such as 'title', 'year of publication' or 'keywords' is also a good technique to obtain more precise results. '*Phrase searching*' is also very effective. '*Proximity searching*' allows searching for terms within a specific number of words of each other. This technique could be applied for searching terms within the same sentence, or within the same paragraph. Often they also allow to specify the order in which the search terms appear. e.g. the two terms 'soil' and 'moisture' appearing with one word apart from each other in the same sentence or in the same paragraph could be searched using this technique. Nested searching allows very specific searches, although it is a little complicated to learn.

In addition, other helpful field searching strategies include the *domain search*, the *host search*, the *link search*, and the *URL search*. *URL search* limits search results to web pages where the keyword appears in the URL or website address. A URL search can narrow very broad results to web pages devoted to the keyword topic. The *LINK search* is helpful to find what websites are linked to a particular site of interest. *Link searches* are useful for conducting backward citations.

Search Engines

Search engines are very effective to search for specific information on the web and are different from subject directories. Computer programs, called spiders or robots, crawl through the web and return's a file with links to websites containing the word or words specified. General search engines such as *Yahoo* and *Google* are not helpful in retrieving the best scientific literature. There are specific search engines to search scientific literature. It is estimated that 20% of peer-reviewed research papers across all disciplines are now freely available. These valuable collections are difficult to consult from a single platform but searching through several search engines will help retrieving good results. '*Free Full PDF search engine*'[12], *Open Access Journals Search Engine*[13] (OAJSE) and *Google Scholar*[14] are the most effective. *Free Full PDF search engine*[12] searches through more than 80 million free full text scientific articles in PDF Format on the internet while *Open OAJSE*[13] searches through several millions of peer-reviewed and free articles across all disciplines. *Google Scholar*[14] retrieves both free and non free items. A search could result in thousands of web pages and therefore it is essential to use a suitable search strategy or technique to get the precise results.

Older Resources

In most cases, the web-based indexes do not cover literature as far back as their print counterparts. Therefore scientists should be prepared to include print indexes as part of their search strategy. Many of today's popular databases do not cover literature before the 1970s. The Science Citation Index, print version would be very useful in such cases. The *'International catalogue of scientific literature'* maintained by the Smithsonian Institution Archives' in USA is a printed catalogue and covers information during the period 1893 - 1945. The '*Catalogue of Scientific papers 1800-1900'*[15], compiled by the Royal Society of London is another important source for older information. It is available online for free access.

Evaluating Information Sources

Critical evaluation of the information retrieved by the scholar is of utmost importance. Although the publishers maintain different levels of quality control over the information they publish, it is up to the scholar to evaluate the information before using for research and educational purposes.

Resources found within the library are reliable since books initially undergo a review process by publishers or editors for quality of content and writing style. Library professionals review the material in their subject specialties and carefully select the sources. Scholarly journals generally publish articles that have undergone a more rigorous peer review process: experts in the subject field review the article manuscript before publication. Articles in journals with a high impact factor are an indication of the high quality and reliability of the contents.

Material found on the web, however, should be carefully evaluated before use. Free web sources should be reviewed more cautiously although they are not necessarily invalid. Some criteria useful to assess the information are authority; accuracy; objectivity and content; intended audience; level of information; how current the work is and the frequency of updating; scope, depth, breadth; design organization and ease of use. All books, journal articles, research/technical reports, conference papers, web sites, and other electronic material could be adequately evaluated using checklists. A number of check lists for evaluating web sites are available on the internet. Few such sites are *Critical Evaluation of Resources*, University of California, Berkeley Library[16], *Comprehensive Online Research Education*, Purdue University, and the University of Maryland web site[17].

Citation Indexes

A bibliographic citation is a reference to a book, article, web page, or other published item giving information on its authors, title, abstract and source etc. A citation

index is a bibliographic database, and an index of citations between publications, allowing the researcher to easily trace which later documents cite which earlier documents. They track references in journal articles and allow users to identify other relevant articles through shared references. Therefore, citation indexes are useful tools for researchers to trace how many people have cited their work. Journal impact factor, the measure for journal ranking, is based on citation data. Citation indexes were originally designed for information retrieval purposes, but are now being increasingly used for *bibliometrics* and other studies involving research. *Bibliometrics* is the use of statistical methods in the analysis of a body of literature to reveal the historical development of subject fields and patterns of authorship, publication, and their use etc.

The first *Science Citation Index* was developed in 1960, by the Institute for Scientific Information (ISI) in print form for papers published in academic journals. Today, it has developed into the *Web of Science*[18] the most reputed citation index. Unfortunately no library in the country can afford to subscribe to the web of science due to the very high subscription price. The National Library and Documentation Services Board of Sri Lanka subscribed to the CD version of the Science Citation Index (SCI) until 2009. *SCOPUS*[19] offers a substitute to *Web of Science* at a more affordable price. The National Science Foundation currently subscribes to *SCOPUS* and offers searching facilities for scientists at its premises. *Google Scholar*[14], *CiteSeerX*[20] and *Citebase*[21] are free citation indexes offered on the web and they provide a simple way to broadly search for scholarly literature. These are briefly described below.

Google Scholar[14] is the largest and most popular and is able to search across many disciplines and sources: articles, theses, books, abstracts and court opinions, from academic publishers, professional societies, online repositories, universities and other web sites. *Google Scholar* ranks the documents retrieved in a search weighing the full text of each document, based on a number of factors such as, where it was published, who wrote it, how often and how recently it was cited in other scholarly literature etc. The precision of the search and the recall to a search is also very high. A number of advanced search techniques are also offered to further improve the precision.

CiteSeerX[20] is a public search engine and also a digital library and a repository for scientific and academic papers with a focus on computer and information sciences. *CiteSeer* was the first automated citation index and was developed in 1997. Search results are ranked based on the impact of citations. It does not index commercial publishers sites but is based on the public web. *CiteSeerX* continues to be rated as one of the world's top repositories and it currently has over 1.5 million documents with nearly 1.5 million unique authors and 30 million citations.

Citebase Search[21] is a semi-autonomous citation index created in 2005 by the University of Southampton, UK for free, online research literature. It is still at the experimental stage. It harvests open access e-prints from OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting) compliant archives in the fields of physics, maths, information science, and biomedical sciences.

Web Citation Index[22] is a very comprehensive citation index which covers the free peer reviewed authenticated literature on the internet including journal articles. Access is not free since it is a part of the *Web of Science.*

SciFinder[23] is the Citation index of Chemical Abstracts which covers important scientific discoveries from the present to the mid-1800s across many scientific disciplines including biomedical sciences, chemistry, engineering, materials science, agricultural science, and more. This however is not a free tool.

Database Selection Tools

A thorough and comprehensive literature search across all relevant databases can save valuable time for the scholar. For best results, searching multiple databases can be recommended. In this context, it is essential that the best databases are selected to find the exact information required. The National Science Library of the National Science Foundation web site[24] offers a comprehensive list of local and international databases accessible by local scholars. It can be used as a guide for the selection of the best databases within the scope of the respective research fields. The library web sites of research and academic libraries in the country, serve as guides for scientists to select appropriate databases and journal collections. Scientists searching the web are encouraged to use multiple search engines because different search engines show little overlap in their results.

Tools for keeping up to date

A popular means of keeping up-to-date on one's research area is through the personalized information services offered through e-mail by journal publishers. Registration is free with the publishers who would regularly deliver the 'Table of Contents' of the selected journals to the desktop via email. They also provide subject and author update services across all journals. Database vendors such as EBSCO[5], Oxford press[25], Wiley Inter Science[26] and citation databases such as Google scholar[14] and SCOPUS[19] too offer similar alert services upon registration.

PubCrawler[27] is a free 'alerting service' for medical professionals that scans daily updates to the Medline (PubMed[8]) and *GenBank*[28] databases and informs the scientists of the current contents. Some other alert services are *Biomail*[29] and *EurekAlert*[30]. *BioMail* is a small web-based application for medical researchers, biologists, and

those who are interested in the latest information on a disease or a biological phenomenon. It is written to automate searching for recent scientific papers in the PubMed Medline[8] database. *EurekAlert* is an online global news service operated by American Association for the Advancement of Science[31], *EurekAlert* provides a central place through which universities, medical centers, journals, government agencies, corporations and other organizations engaged in research can bring their news to the media.

Building up networks with peers, both locally and globally, is an easy channel towards keeping up to date. Latest web technologies such as *Blogs, Wikis, RSS Feeds, Listservs and Social book marking* offer a good opportunity to form and maintain such social networking to communicate, discuss and debate ideas and they form an integral part in the body of knowledge. These are briefly explained below.

Blogs: Blogs are small personal news services usually run by an individual or a small group covering current events in a specialist area. Today there is a wide range of academic blogs. They often encourage response from readers. Although not a must, most good quality blogs are interactive, allowing visitors to leave comments and even messages and therefore offer good opportunity for scholars for networking with their peers for resource sharing. *Science blogs*[32] is a gateway or a directory leading to many science blogs categorized under different subjects such as Life Sciences, Environmental Sciences, Physical Sciences etc. Two more examples for 'blogs' are *Social Science Statistical blog*[33] which is a Social science related Mathematical blog and the *Ars Mathematica*[34], which is a blog dedicated to Mathematical arts.

Wikis: The *wiki* technology creates a webpage that anyone with access to it can modify quickly and easily. A *wiki* is essentially a webpage with open web-pages, where anyone registered with the wiki can publish to it, amend it, and change it. Therefore all wiki pages will have an edit button. Scholars can use wikis to work with peers to create resources such as websites, fact sheets, and policy papers on a subject of their choice, to maintain up-to-date resource lists, create calendars on related events, to manage projects among individuals in different geographic locations etc. A few examples of Science Wikis are *Biomol wiki*[35] with information on the latest product developments in molecular biology such as antibodies, enzymes and reagents etc., *MicrobeWiki*[36] and *EcoliWiki*[37], which aims at generating community pages on nonpathogenic *E-coli*.

RSS feeds : *RSS newsfeeds* is another form of keeping up to date on a subject. When selected websites and blogs add new information, users are kept updated. Scholars could make use of this service to be updated in their subjects. An account

is required for a newsfeed service, which is free. Instructions are given on the site on how to open an account. A few top Science RSS feeds are *Scientific American*[38], *New Scientist – Environment*[39] and *Biology and Biochemistry news*[40].

Listservs: *Listservs* are group email lists dedicated to a specific topic and offers a convenient mechanism to be in touch with others around the world who have similar interests. Anyone interested could join the list by signing on to receive everyone's posts. Instructions are provided on the site on how to join the group. There are *listservs* on many topics covering all aspects of knowledge. *Biology Listserv*[41] is a popular one for biologists. *American Association for Clinical Chemists*[42] provides a gateway to several *listservs* within its scope.

Social bookmarking: *Social bookmarking* is a relatively new and informal way of discovering internet resources. *Social bookmarking* sites allow people to save, share and "tag" their lists of favourite or bookmarked web sites. These sites are free to use, but require registration. While many people use the sites as a way of storing their own lists of useful web resources, an additional benefit is that everyone else can then view and search the collections of others. Two popular sites are *Compredia*[43] by Bio-science Consulting group and *Connotea*[44] a free online reference management service for all researchers, clinicians and scientists.

Publishing Research

To achieve professional recognition as a successful researcher, communicating the research results to the scholarly community is vital. The aim of the author is recognition and not remuneration from the publisher. The author of a journal article should be therefore free to share his/her own work with peers as much as possible. However, the publishers due to their editorial and peer review services, either demand exclusive rights for the articles or allow authors to disseminate their work, after an embargo period. The level of an author's right to disseminate their articles differs from publisher to publisher. The result is that the rights of the scholars to read the scholarly works of their counterparts are severely limited.

Copyright and Publishing

Institutions are now both demanding and claiming on the position of copyright ownership[45]. The publishing contract is slowly changing from a transfer of rights to license. Several movements have been successful in strengthening the author's rights to disseminate their work to a wider audience free of charge. When publishing under the *Creative CommonsLicense*[46] in subscription based journals, authors do not transfer the copyright to the publisher but retain it for themselves. Depositing the work in an institutional repository is permitted, as this offers unlimited free access

to the work. Underlying the *Creative Commons License* are several principles that express the balance between author and publisher in the copyright arrangement. It is not practical to describe each license here but the authors can get the necessary information from the respective websites. The author could choose the preferred license variety at the relevant web site and confirm the choice. The web site will then provide a HTML code for including the license statement on the web of the respective Institutional Repository.

Open Access Publishing

Open Access movement has opened up new dimensions to copy right issues. The purpose is to make published material freely available to anybody, whereas under the existing system of publishing, libraries have to obtain subscription or the reader should pay for articles to download. There are two ways to provide Open Access to peer-reviewed research journal articles. One way is to publish them in an OA journal (Open Access). This is also called the golden road to OA or '*Gold OA*'. Under Gold OA, the cost of publishing is borne by the author. The author has to pay a certain fee to the publisher to cover the cost of certification and dissemination of the content. The journal is made available, on the internet, for free access [47,48]. Since authors in developing countries do not find it affordable to pay the fee to publisher, certain funding organizations offer to pay on their behalf [49,50]. The National Science Foundation in Sri Lanka is able to help Sri Lankan authors to pay the fee.

Some organizations promote and help free on-line publishing. The INASP/PERI (International Availability of Scientific Periodicals/Programme for the Enhancement of Research Information) offers free online journal publishing. Many African and Asian Journals including 42 Sri Lankan Journals are published online offering free access to the full text[51]. Public Library of Science[52], Hindawi[53], and Academic Journals[54] are a few open access publishers. Scientific Research Publishing (SCIRP)[55] is another Open Access academic publisher. It also publishes academic books and conference proceedings. SCIRP currently has more than 150 open access journals in the areas of science, technology, and medicine. Many commercial publishers such as Springer[56], EBSCO[57], Wiley[57] and Elsevier[59] have started open access publishing.

The second way to provide '*Open Access*' is the Green Road to Open Access or 'Green OA'. The Green Road is meant for continuing publishing in subscription based journals but the author of each article makes it *Open Access* by self-archiving a copy of the author's peer reviewed final draft (the post print) in the author's Open Access Institutional Repository (IR) [60]. An institutional repository is a digital collection of institution's intellectual output. Many commercial publishers now allow the authors to archive a copy of the final draft in the IR.

Copyright and Information Ethics

Scholars should have a sound knowledge on the copyright issues both as a user and an author/creator. Copyright is the legal concept enacted by most governments giving the creator of an original document, exclusive rights to it, usually for a limited time[61]. The majority of resources (eg. books, journal articles, web sites, images etc.) is the intellectual work of someone and is copyrighted. Copyright offers a balance of rights between the creator, publisher and the user. It offers a channel for the creator and the rights holder of the work to get the due reward for their intellectual property while at the same time it secures the right of the user community to access the information for beneficial use. Copyright is protected by federal law of governments including Sri Lanka[62]. If the intended use can be considered *'fair use'* under the copyright law, then the materials may be used without obtaining permission or paying royalties to the copyright holder. *Fair use* is a special set of circumstances that permits someone to use portions of a resource without permission[63]. If the use of materials falls outside the acceptable limits, permission should be sought from the copyright owner to use the work. Educational uses that are generally acceptable under *fair use* are (a) quoting a small amount from a creative work (b) incorporating portions of a video into a presentation as long as it is directly related to the curriculum. Uses that are generally not acceptable include (a) using or copying entire works (b) posting copyrighted material to web sites that do not have restricted access.

Researchers also have an ethical obligation to abide by the terms of subscription agreements and database licenses. They are not permitted to share the passwords to electronic journal subscriptions with colleagues outside their university or research institute. Many scholars after returning to the island on completion of their research or other tasks abroad continue to use the passwords which were permitted to be used only at the relevant institution abroad. Such violations are easy to detect in the electronic environment because the publisher's web logs records on every transaction that occurs on the server. Scientists also should avoid downloading of complete journals using their passwords, which is a violation of copy rights. If researchers do not abide by the terms of subscription agreements and database licenses, they risk being sued and losing the privilege to use those resources.

Conclusion

To succeed and gain recognition as a researcher and a scholar, scientists have to face many challenges. Harnessing the best information from the wide range of available resources and keeping up to date, ethical use of resources for research and educational purposes and successful publishing of research results to reach a

wider set of audience are a few to quote. However, with the use of the right tools and strategies, scientists could successfully overcome such challenges and succeed in their career.

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