PSOAR and PGIAR Customized Search Engines For Open Access Scholarly Literature Retrieval Relevant To Pharmaceutical Education And Research

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Research Article

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Abstract

Background: The advancement of internet and information technology has improved enormously the ways of information retrieval. However, the enormous data in the form of scholarly articles, online thesis or other forms is available on internet which is difficult to search for full text contents.

Aim: To create and maintain custom search engines (CSEs) for Open Access (OA) scholarly literature retrieval and to host them on a single blogsite which will serve as a platform for all the scholarly information requirements.

Methods: We, authors, have compiled Open Access (OA) resources for pharmaceutical sciences. Two custom built search engines PSOAR (Pharmaceutical Sciences Open Access Resources) and PGIAR (Pharmaceutical Guidelines for Industry, Academia & Research) were created and hosted on blogsite http://vikaspsoar.blogspot.com.

Results: Currently PSOAR and PGIAR searches more than 500 and 50 selected resources respectively for open access scholarly literature. Updates for new website additions to these CSEs and other new identified resources are provided as blog updates.

Conclusions: These custom built search engines are helpful to reduce the burden as well as time for scholarly literature retrieval on internet.

Introduction

Scientific content available via Internet is rapidly growing both in terms of quality and quantity. Print only journals have adopted the change and started publishing articles online. Online journals and open access to peer-reviewed articles in repositories have significantly altered the readers' dependency on fixed hour libraries in academic and research institutions. *Vis a vis* the changes of scholarly information on Internet, general shift of internet browsing have been observed. Readers have started using general purpose search engines, like Google, Yahoo, Altavista, Live Search etc., and sophisticated search engines available on publishers' websites for scholarly information retrieval[1].

Web search engines have been developed as powerful tools to alleviate the problem of finding useful and relevant information. Today, search engines are numbered in the hundreds, possibly thousands including metasearch engines and specialized search engines. However, their effectiveness and usefulness have been debatable due to differences in their search precision, presentation and relevance[2]. Studies have indicated that no single search engine is likely to return more than 45 % of the relevant results[3]. Search engines do not index sites equally and no engine indexes more than 16% web[4]. Working efficiently with the entire collection of search engines may be a challenge to even the most experienced users[5].

General purpose search engines often retrieve a large number of documents, many of them not relevant to user queries. Users themselves must manually explore suggested links and judge their relevance. Complications arise when users find that most of the quality information (peer reviewed) is available in restricted or closed access. From the user's perspective, dealing with closed or restricted access adds much confusion and presents an additional barrier. Not every user is willing to pay to access the closed or restricted access information. In such cases, users try to locate same or similar information from other resources which are available freely.

Since 2000, several new journals, magazines, websites, repositories have been started with an aim to provide peer-reviewed articles in Open Access (OA) on Internet. OA is generally defined as the availability of a published item without charge to the user for the right to read, download, copy, print, or distribute the item[6]. With the advancement of Open Access Initiatives, the World Wide Web has been divided into two parts Open Access Resources and Closed or Restricted Access Resources. However, an interface in between these two parts also exists. Strong evidence suggests that open access increases the readership of articles[7]. A recent study suggested that 8 out of 17 OA journals in library information system have significant research impact in the scholarly communication process[8]. No evidence was found to support the OA postulate *per se; i.e.* article OA status alone has little or no effect on citations[9]. Furthermore no evidence of open access advantage on working papers in economics was observed[10].

Table 1: Comparison of various custom search engine services available on internet[14].

CSE Service	Database	Website	Keywords	Need Site to Publish	Sub-directories	Limit	Stats
Gigablast Custom Topic Search	Gigablast	http://www.gigablast.com	No	Yes	Yes	500 sites	No
Google Custom Search Engine	Google	http://google.com/coop/cse/	Yes	No	Yes	?	Yes
Live Search Macros	Live Search	http://search.live.com/macros	Yes	No	No (until inurl: functions again)	30 basic; more in advanced	No
Swicki	Yahoo!	http://swicki.eurekster.com/	Yes	No	Yes	4000 characters	Yes
Rollyo	Yahoo!	http://rollyo.com/	No	No	No	25 sites	No

Scientific information retrieval with the help of general purpose search engines requires careful use of keywords and ends up in huge amount of irrelevant information.

Furthermore, the specialized search engines like Google Scholar, Scirus, Chemref etc results are mixture of open and closed access scholarly articles. The free full text access through OA journals, magazines, regulatory guidelines and other literature sources is extremely useful to pharmacy students, teachers, pharmacists, research scholars, and scientists to update their knowledge with recent changes. There was a surging need for such search engine which could provide results in the form of open access scholarly articles. Such a search engine was conceptualized and hypothesized that it would reduce the time required for literature retrieval for various academic and other purposes of students, research scholars and others. Furthermore, the use of such custom built search engine may require minimum information technology and training skills.

To address these problems with existing Web search approaches, we developed PSOAR & PGIAR, two custom search engines that performs content searching from hand picked websites, an information retrieval technique that has been shown to produce superior results. PSOAR & PGIAR are web utilities for persons who are novice or inexperienced in information retrieval. Further, PSOAR & PGIAR retrieve useful OA information quickly sifting through closed access literature.

Recently, interest has increased in developing vertical search engines that provide access to targeted content to better meet the needs of particular communities or subject domains[11]. These collaborative custom search engines are valuable Web 2.0 application for educators in their subject domains [12]. Google Custom Search Engine (CSE) is one of the most popular and easiest applications

to built CSE in a special field[13]. However, some other applications for building custom search engines are also available (Table 1) and reviewed[14, 15].

OA movement has also initiated the need to built search engines for well-defined collections of special relevance to OA[16]. CSE based on Google platform have been provided in Table 2. Table 3 provides summary of various OA search engines based on OAI harvester.

Methodology

We explored websites providing open access literature in various disciplines of pharmaceutical sciences by making use of Goggle, an internet search engine. Relevant keywords were used in different permutations and combinations in searches and reviewed the webpage results from time to time. We also performed searches on

Table 2: Google Custom Search Engines (CSE) for OA scholarly literature searching

Name of CSE	Website/Blogsite	Code CSE	Institution/Company/ Creator	Features
OpenDOAR	http://www.opendoar.org/search.php	http://www.google.com/cse/home?cx=005943177783402775348%3A0jxffbisbzk	Bill Hubbard at SHERPA	The OpenDOAR service provides a quality-assured listing of open access repositories (800+ OA repositories) around the world.
UK Repositories	http://www.sherpa.ac.uk/repositories/sherpasearchalluk.html		Bill Hubbard at SHERPA	Searches UK open access repositories, as listed in *Open*DOAR.
SHERPA Partner Repositories	http://www.sherpa.ac.uk/repositories/sherpasearch.html	http://google.com/coop/cse?cx=009118135948994945300%3Agvogitng0da	Bill Hubbard at SHERPA	Searches SHERPA Partner Repositories
AuseSearch	http://leven.comp.utas.edu.au/AuseAccess/uploads/Main/AuseSearch.html	http://www.google.com/cse/home?cx=012189697858739272261:yyyqychcumo	Arthur Sale, University of Tasmania	Searches all open access research repositories in Australia listed in Kennan & Kingsley (First Monday Feb 2009).
Economics Search Engine	http://cook.rfe.org/ESE_Google.html; http://ese.rfe.org		Bill Goffe at State University of New York, Oswego	Searches the contents of some 11,000 economics web sites selected from RFE (Resources for Economists on the Internet) and EDIRC (Economics Departments, Institutes and Research Centers in the World)
PSOAR	http://vikaspsoar.blogspot.com	http://www.google.com/coop/cse?cx=004661586693649773900%3A_2x3q90pcba.	Vikas Anand Saharan at Seth GL Bihani SD College of Technical Education, Sri Ganganagar, India	PSOAR searches more than 480 selected websites of magazines, journals, online thesis, regulatory agencies and drug information websites
PGIAR	http://vikaspsoar.blogspot.com	http://www.google.com/coop/cse?cx=004661586693649773900%3A4n0tm5iih-8&hl=en	Vikas Anand Saharan at Seth GL Bihani SD College of Technical Education, Sri Ganganagar, India	PGIAR searches more than 50 selected websites of drug regulatory agencies, associations, or other websites for guidance documents and other regulatory information
Consumer Health and Patient Education Information	http://davidrothman.net/consumer-health-and-patient-education-information-search-engine/	http://www.google.com/cse/home?cx=013802770067061674484%3A69nuz7drcvm		This CSE searches authoritative and trusted consumer health information and patient education resources recommended by the U.S. National Library of Medicine, by CAPHIS (the Consumer and Patient Health Information Section of the Medical Library Association), or by the British Medical Association

ROAR Search Engine	http://roar.eprints.org/	http://www.google.com/cse/home?cx=009118135948994945300%3Agvogitng0da		Open Access Content from ROAR OAI Sources
JURN	http://jurn.org/	http://www.google.com/cse/home?cx=017986067167581999535:rnewgrysmpe&hl=en	Lecturer, School of Theoretical and Historical Studies in Art and Design, Birmingham City University, UK	A curated academic search-engine, indexing 3,598 free ejournals in the arts & humanities.
Edublogs		http://www.google.com/cse/home?cx=008973165841904615521:bqay7pgn8dg		Education weblogs and related sites
Theological Journals Search		http://www.google.com/cse/home?cx=018443097211386924752:luwi5uy2qbe		Search over 340 religion journals related to scripture studies, systematic theology, practical ministries, and cognate disciplines for which full text is freely available on the Internet.

PubMed, DOAJ, OpenJGate, Google Scholar, PubMed Central, IndMed and MedInd, publisher websites and databases and other current contents databases to find relevant electronic resources for OA contents. Furthermore, university websites, repositories, industry magazines, online thesis repositories were also investigated for available OA content.

Our primary target was to limit indexing to English language internet resources. However, the resources which publish their content in addition to English language were also included. Criterion for inclusion of a potential relevant internet website was compliance with the free full-text availability of the content. To increase the accessibility of this work, we published the resources information on our blogsite and submitted and published

Table 3: Search engines based on OAI harvester

Name	Website/Blogsite	Institution/Company/Creator	Features
OAIster	http://www.oclc.org/oaister/	From the beginning of 2002 to the end of October 2009 it was the benchmark OAI search engine project of the University of Michigan. In October 2009 OAIster's records transitioned to the WorldCat database, which is operated by the semi-commercial library service OCLC.	OOAIster is a comprehensive metadata catalogue of the documents in OAI-compatible repositories. In January 2010, OCLC plans to release a freely-accessible discrete view of the OAIster records through a URL specific to OAIster
Socolar	http://www.socolar.com/	China Educational Publications Import and Export Corporation(CEPIEC)	Collection and aggregation of OA journals and repositories across the globe into one website in a searchable format for the convenience of end users.
BASE	http://www.base-search.net/index.php?l=en	Operated by Bielefeld University Library,	BASE is a multi-disciplinary academic search engine for freely-accessible documents. BASE focuses mainly on document servers.
oan-Suche	http://oansuche.open-access.net/findnbrowse/pages/start.faces	It is being developed within the framework of Open-Access-Network (Open Access Network), a project funded by the German Research Foundation (DFG).	OAN-Suche (Open Access Network Search) is a search interface for documents in DINI-certified repositories.
Open J-Gate	http://www.openj-gate.com/Search/QuickSearch.aspx	It is sponsored by Informatics India Ltd..	Open J-Gate is a search engine which indexes articles in OA journals. Both full texts and metadata are indexed.

the results in a pharmaceutical sciences journal[17].

Google CSE beta service provides facilities to search selected websites and/or blogsites[13]. Two CSEs, PSOAR and PGIAR, were created using the CSE facilities of Google. This set is defined by PSAOR and PGIAR group whose members are qualified postgraduates and/or doctorates in pharmaceutical sciences. PSOAR and PGIAR group also prioritizes and ranks sites according to user-defined criteria and designs the visual appearance of the results page.

The aim was to combine the functionality of a general algorithmic search engine with the editorial assistance of experts, for selection of web resources, in the fields of pharmaceutical sciences.

PSOAR (Pharmaceutical Sciences Open Access Resources Custom Search Engine) is a custom built search engine tailored to explore the internet for scholarly literature (articles, books, thesis, databases, repository contents and drug information) in the fields of pharmaceutics, pharmacognosy, analysis, chemistry, biotechnology, microbiology, bioinformatics, pharmacology, toxicology, pathology, physiology, and multidisciplinary pharmaceutical sciences. It utilizes Google custom search engine services while crawling through selected websites for providing OA articles relevant to pharmaceutical education and research.

A custom-built guideline search engine PGIAR (Pharmaceutical Guidelines for Industry, Academia and Research Custom Search Engine) was also created for searching pharmaceutical guidelines relevant to industry, academia and research. This search engine is helpful in retrieving latest guidelines, notifications and other regulatory information from the selected drug regulatory agencies' websites.

A blogsite was developed with an aim to promote the use and OA literature retrieval in pharmaceutical education and research. PSOAR and PGIAR were hosted on this blogsite. Subscription service for the blog was started using Feedburner so that the new updated information on CSEs and blog shall be made available by e-mail to the subscribers of the blog. Performance poll options have been provided for both of these search engines. Health on Net (HON) foundation was approached for granting the blog an authentic information resource in the medical and allied healthcare fields. The blog was made compliant to the norms of HON principles. Blogsite further provides discipline-wise list of OA journals and magazines. The information of search services and blog was spread via e-mail and by publishing on internet, conference and print media[18-20]. To increase the accessibility and acceptability of the CSEs and blogsite, a community profile was also stated on 'www.orkut.com' under name PSOAR group. The blogsite as well as CSEs are regularly updated to

include latest OA information resources in the field of pharmaceutical sciences. A schematic of the development of PSOAR, PGIAR and the blog is shown in Figure 1.

Figure 1: Schematic development and integration of various freely available internet tools for PSOAR and PGIAR custom search engines and promotion of OA in pharmaceutical education and research.

E-mail requests for journal editors were received from various journal editors and/or publishers for indexing of their journals on PSOAR. In response to it, the indexing of journals at PSOAR was started in 2010. E-mail notifications to OA journals were sent regarding their indexing at PSOAR. They were also requested to include the name of PSOAR in their list of indexing agencies/databases/search engines.

Results & Discussion:

The blogsite is available online (Figure 2). The blogsite hosts the custom search engines PSOAR & PGIAR. The vertical navigation menu includes subscription of blog via Feedburner, PSOAR and PGIAR Performance Polls, blogsite policy, blog archieve and compiled indexes of OA pharmaceutical resources. OA resources have been categorized into journals and magazines for various disciplines in pharmacy viz. pharmaceutics, pharmaceutical chemisty, pharmacognosy, pharmacology, pharmaceutical analysis, pharmaceutical biotechnology and multidisciplinary pharmaceutical sciences. The web links are provided for all of them. Below this menu, registration via Feedurner. Registered users receive blog updates and may contribute by adding links to the compiled resources directory.

Currently, PSOAR searches more than 500 selected websites of magazines, journals, online thesis, regulatory agencies and drug information websites which disseminate their scholarly articles or other contents freely available on internet. PGIAR searches more than 50 selected websites of drug regulatory agencies,

associations, or other websites which provide regulatory guidance documents for manufacturing, quality control and distribution of drug products.
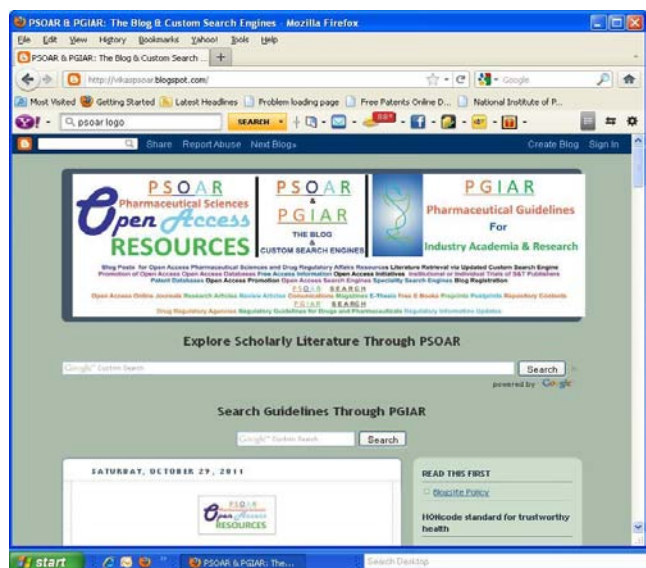

Figure 2: PSOAR and PGIAR as embedded and hosted on blogsite http://vikaspsoar.blogspot.com

These custom built search engines are supposed to reduce the burden as well as time required for literature retrieval. Pharmacy students, research scholars, scientists and pharmacist may take the help from these CSEs for their information requirements while working on seminars, library assignments, laboratory assignments, research and other projects.

HONcode is the oldest and most used ethical and trustworthy code for medical and health related information available on Internet. The blogsite was accredited by Health On Net (HON; http://www.hon.ch/) Foundation and HON Code was provided by the foundation for the first time on 18th Feb. 2008 after inspection of the blogsite. Thereafter, the accreditation was reviewed and a certificate of accreditation was granted each year in the month of February. Till date more than 95 members have joined the PSOAR and PGIAR community on Orkut. More than 60 readers have joined the initiative via Feedurner.

PSOAR and PGIAR group have been granted associate membership of Open Access Scholarly Publishers Association (OASPA: http://www.oaspa.org/). More than 15 online journals in pharmaceutical sciences have started mentioning the name of PSOAR or its logo(s) on journal website as an indexing search engine.

Pros and Cons

Google has grown to be one of the most popular search engines available on the Internet due to its proprietary algorithms, which work based on the assumption that if a page is useful, other pages covering the similar topic are likely to provide a link to it[21]. Therefore, it can be said that Google CSE also focuses on a page's relevance and not on the number of responses.

Larger web search engines attempt to index the total web which results in false positives. While smaller web search engines search considerable more focused group of websites or databases. Thus, Google custom search is better than straight Google, by eliminating false positives. Furthermore, CSE search is also better than OAIster and other OAI based search engines as CSE search the contents full text manner which is beyond metadata. Straight Google is better if one wish to find OA content at publisher or personal websites.

Google Custom search crawl selected sites and borrows results from the master Google index. Therefore, CSE search results are inadequate for sites which are inadequately crawled by Google. Google has started crawling OA repositories but for several reasons inhibit to crawl them comprehensively. Google and Peter Suber have put together a set of tips to help configure open-access scholarly repositories for full-text Google crawling[22]. Being Google CSE, PSOAR and PGIAR, suffers the limitations of the Google CSE[23].

Hand On Experience

Faculty members, graduates and postgraduate students find the initiative quite helpful in retrieving the OA scholarly literature. Keyword searching directly at PSOAR or PGIAR gave them full text results which could be downloaded without spending time on resource selection. Furthermore, it was also easier for the faculty members to guide the students who are novice to information retrieval on Internet. General purpose search engines provide results which are a mix of open and closed access. Users waste their appreciable time in selecting open access scholarly literature among the results of general purpose search engines.

A study was planned to verify the above fact. Google, Google Scholar, Scirus Pubmed and PSOAR were given search queries viz. "nifedipine dissolution", "itraconazole dissolution", "platycladus orientalis", "spectrohotometric ondansetron", "synthesis prodrug", "microbial testing drug". The obtained results (citations) of open access scholarly articles appeared on

first page (10 or 20 results) were counted after confirming the availability of full text pdf or html. The duplicate citations which appeared from more than one source and citations or which did not provide full text pdf or html were not counted. The results are presented in Table 4.

For each search query, PSOAR gave maximum number of citations linked to full text html or pdf contents which was

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followed by Google and Google Scholar. For naive users of the Internet, literature retrieval means simply following links. The results of this study additionally support that PSOAR save time and efforts to find scholarly OA literature by surfacing the paper on web[16].

exhaustive and the methodology used permitted us to retrieve only a sub-population of the relevant resources. However, the continuous interaction of scholar community may enrich the compiled directories. The dynamic form of content available on internet makes it challengeable for continuous monitoring resource links for their integrity. The quality of the available information through these resources also varies considerably.

Table 4: Number of full text articles (pdf or html) from journals and/or full text thesis on first page of search results. (Search Conducted on 7 to 8:30 pm on Sunday, 9th May 2010)

Keywords	Google	Google Scholar	Scirus	Pubmed	PSOAR
Nifedipine dissolution	2 Articles	1 Article	0 Articles	0 Articles in first 10 results; 2 Articles in first 20 results	6 Articles
Itraconazole Dissolution	3 Articles	I Article	1 Thesis	None in first 10 and 20 results	7 Articles
Platycladus orientalis	0 Article	0 Articles	1 Article	3 in first 20 results	7 Articles
Spectrophotometric ondansetron	3 Articles	4 Articles	3 Articles	0 in first 20 results	6 Articles
Syntheis prodrug	7 Articles	0 Article	1 Article	0 in first 20 results	8 Full Text Articles; 2 Thesis
Microbial testing drug	2 Articles	4 Articles	2 Articles	1 in first 10 results, 4 in first 20 results	7 Articles

Conclusion

Searching scholarly literature on Internet is a personal activity which is affected by differing interests, expectations, and styles. An appreciable time is required to check thoroughness, accuracy and resource selection. The resources available on the Internet are vast and limitless. In, PSOAR and PGIAR search, we have tried to explore how the users' need to find information can be most effectively satisfied without wasting their precious time.

PSOAR, PGIAR and blog is an integrated effort to promote Open Access (OA) in the field of pharmaceutical sciences. The effort utilized technical supports from Google like creation of custom search engine, blogsite development, Feedburner and social networking website Orkut. The effort is not yet complete and will never complete as the new information resources will increase with time. The resources provided on the blogsite are far from

Despite the limitations, challenges and present shortcomings, the blog and CSEs may contribute to the OA movement in the field of pharmaceutical sciences. This effort may especially be beneficial for information retrieval to persons who are novice and inexperienced. A simple query on the developed CSEs will give numerous free full text scholarly articles as results.

The approach is also beneficial to the users for retrieving OA content for their project works, assignments, research works in academics and industry as well. The effort, therefore, is able to provide a prototype platform of OA resources for pharmaceutical sciences contents. The motto is to provide "Free Information from Free Tools". Based on the considerable positive attention and steadily increasing usage, we conclude that CSE searching adds value to web searching.

Conflict of Interests

The custom search engines (PSOAR & PGIAR) and the blog http://vikaspsoar.blogspot.com have been developed for educational and research purposes by PSOAR & PGIAR group which is actively involved in pharmaceutical education and research.

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AUTHORS' CONTRIBUTIONS

Authors contributed equally to all aspects of the study.

PEER REVIEW

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