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44P. Search Engines and Academic Research Process

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Abstract

Information Technologies shape the way users retrieve information. The Internet has become one of the most important information resources where people look for various kind of information. Search engines are seen as a gateway to the online information. This paper describes a survey carried out on graduate students pursuing Master or PhD to investigate the impact of search engines on their research process. Information quality, cost and copyright issue were examined to give an insight on how Internet was used as an information source. Overall, quality of information and time spent were the main influences when using search engines. Students are generally aware of copyright issues. However, most of them do not check copyright issue when downloading online materials. Nearly half of the participants also agree that search engines are biased towards English.

Keywords

Search Engine, Database, Academic Research, Academic Resource, Search Engine Impact, Copyright.

1. Introduction

Search engines allow a user to search the Web using words and phrases, essentially text query. There are a number of search engines available on the web; some are more heavily used than others (such as Google, Yahoo search, MSN Live). The variety of available search engines provides searchers with a variety of interfaces, advanced features, accessibility and output modalities. They also may offer different results and various types of information. In order to have more comprehensive search on the web, more than one search engine should be used (Spink et al., 2006).

According to studies done by Deborah (2005), it was reported that 84% of polled internet users in the United States utilized search engines and almost all of them (92%) were confident in searching information. 68% of the respondents were found to trust that search engines are an objective information resource, with 19% disputing that idea. It is ironic that while 38% of the respondents reported that they knew the difference between sponsored and non- sponsored results, 45% of the respondents expressed their wishes to halt the use of search engines if paid searched results were not indicated clearly.

Scholars conduct research within certain theoretical frameworks and through their own predispositions of how they view the world. Researchers collect data and analyze the data as objectively as possible but also through some particular lens. The lens may be supplied by their disciplinary or by a specific ideology to which the researcher subscribes. Then, researchers make judgments about their findings (Bowman and Fennick, 2007). However, all academic research, whether qualitative or quantitative, engages specific steps of inquiry to answer a specific research question. It is a cyclical process of steps that typically begins with identifying research problem or issue of study. It then involves reviewing the literature, specifying a purpose for the study, collecting and analyzing data, and forming an interpretation of the information. This process culminates in report, disseminated to audiences, and that is evaluated and used in educational community (Strunk and White, 1979; Fielding et al., 2008).

In the last decade, a growing trend of a diverse group of users has been evident. Users depend on the Internet to satisfy their information needs. The majority of them begin their information quest with a web search tool, particularly an Internet search engine. As a result, search engines are perceived as the new type of information gateway. What information one can retrieve online depends on the search engine used. In recent years extensive studies have been conducted on the use of Internet by academics (Bates, 1989; Silverstein et al., 1999; Jansen and Pooch, 2000; Spink et al., 2002).

Some information literacy studies have reported that students tend to use online resource without much thought (Webber and Johnston, 2000; Grafstein, 2002; Johnston and Webber, 2007). However, the consequence of that behavior has not been studied systematically. The objective of this research was to investigate the impacts the search engines have on the scholar's academic research. We studied the extent of using the Internet as a source for academic research, as well as the effects of factors like information quality, costs and legal issues on the graduate student research process when using search engines. The scope of this research is confined to the followings:

1. The research only considers students pursuing graduate studies, masters and doctoral students, as end-users.
2. The main impacts considered are only quality of information, costs, legal issues and time.

This paper reports on the impact of search engines in research process in terms of cost, time, and content, by understanding the role of search engines in academic research, the extent to which search engines assist research students, and the usage of search engines in contrast to online databases. The findings show the changing landscape of scholar's search resources and shed some light on the human side of IT. The results can aid policy makers confronting issues like availability or affordability of information sources.

2. Literature review

Impact is defined as the means of bringing about a result in indirect or intangible ways. We looked at how search engines affect the various steps in a typical academic research process. In this paper, we report on several aspects: quality, cost, time, and legal issues. Search engines may have impact on scholars' research processes suggested previously (Goddard, 2001; O'Leary, 2004; Bourner, 2002; and Blaxter et al. 2006).

2.1 Research Process

The basic ingredient to any research is information. Information can be interpreted in many ways. Madden's (2000) understanding of scholarly information includes expertise, data in surroundings, and means to exchange ideas. Doldi and Brarengvor (2005) found that scholars use the Internet mainly for searching for references, full text papers, grey literature, and patents.

Bourner (2002) had broadly classified the typical research process into four stages: reviewing the field, theory building, theory testing, and reflecting and integrating. In the reviewing the field phase, Goddard (2001) had suggested the necessity of extensive reading from various sources. This phase is critical to identifying any potential alternative to define and to study research problem(s). O'Leary (2004) underlines the important role of reviewing the literature at every stage of the research process for guidance. Bourner (op. cit.) suggested that both induction and deduction can be inferred from previously known literature. Primarily, previous knowledge would be the basis for the creation of theories. A theory can be tested by utilizing a variety of qualitative or quantitative approaches whose research is based on previous literature. Usually, the research findings are fitted into a theoretical framework in the domain of the research topic. Blaxter et al. (2006) visualizes a research process as a circular or even continual spiral process with information and data playing fundamental roles.

2.2 Quality of information

The quality of information is characterized using a modified adaptation of Robinson's (2000) framework. The quality issues studied are relevance, authority, currency, and accuracy. However, there are several limitations to these characteristics in relation to the search engines as discussed in the following paragraphs.

2.2.1 Relevance

Relevance of retrieved information can be measured using the recall and precision methods. There is no clear evidence that suggest one single search engine can consistently deliver more relevant information than the rest (Gordon et al., 1999; Vaughan, 2004; Jansen and Spink, 2006). This puts into the doubt the value of the information provided by the respective search engines. Miller (2005) has reinforced this observation by emphasizing the exclusive niches of search engines in handling different types of searches.

2.2.2 Authority

With the vast amount of information in the web, it is impossible to determine the credibility of the information retrieved. Search engines such as Google Scholar allows searches to focus on exclusively scholarly articles. The top few placements in the list returned by search engines have a higher probability to be visited. Thomas (2001) found that such highly ranked placements can be artificially generated by paying the search engines or by defining good keywords. This gives rises to the question of credibility of the returned result from these retrieval tools.

2.2.3 Currency

Gray (1996) indicated that distributed, dynamic, and rapidly growing nature of the web complicates the indexing of information by traditional methods. Typical search engines do not index documents that are hidden, require authentication, or ask the crawler to exclude them. The fractional coverage of any one search engine is only 3 to 34% of the indexable web. This clearly illustrates the confined scope of the combed Internet domain (Lawrence et

al., 1998). This evidently creates the doubt of the currency of documents returned by the search engine.

2.2.4 Accuracy

Users must be able to distinguish accurate information from the rest. However, proper cross-checking of information with any known form of validation procedure such as the triangulation is rarely performed. Surveys indicated that students took more time to find rather than to verify the accuracy of retrieved information from the web (Graham & Metaxas, 2003; Liu and Huang, 2005). It is something that questions the accuracy of the retrieved information. However, the web has attained a certain level maturity with regards to scientific and qualitative content. Some content can be considered a worthwhile source of scientific information (Doldi and Brarengvor, 2005).

2.3 Other issues

Millions of research articles are freely available on the web (Lawrence, 2001). However, access and usage of commercial databases is expensive. The number of subscriptions to scientific journals and database licenses that libraries can offer depends on the available financial resources (Anderson, 2004). Escalating cost of academic research documents forces us to find out alternative way.

There are other legal aspects in terms of using the internet resources. The Digital Millennium Copyright Act (DMCA) has ruled that internet service providers (ISP) are not liable for copyright infringement in transmitting information over the internet. In response, publishers are preparing to take search engine, particularly Google, to task over content ownership and copyright issues. The European Publishers Council (EPC) has announced plans to give publishers greater control over their content and prevent search engines earning revenue off the back of publishers' content. The software Automated Content Access Protocol (ACAP) was to outline the conditions for how the content can be used. However, the search companies may not be interested in being a publishers or content owner.

3. Methodology

Due of the space limitations, we do not include the survey questionnaire in this paper. The survey questions were developed addressing the following issues: document cost, searching time, relevance, accuracy, currency, copyright, search engine selection, content quality, availability, and accessibility, type of documents and preference of sources. The questionnaire contained 48 closed ended questions into three sections: Demographic Profiles, Information sources for academic research, and Search Engine's impact on research process. The questionnaire was tested with five people to ensure the questions were understandable before it was widely distributed. The questionnaire was distributed in two formats-- Printed and E-mails.

The questions were distributed to convenient samples. The survey was conducted directly with graduate students in classes during the interval and practical session, other participants were invited at work place, and some personally known scholars were invited via e-mail. The participants were from Nanyang Technological University (NTU), Singapore, and research institute students from India. A total of 100 people participated in the survey.

This survey was conducted during first three weeks of October 2008. The response rate in Singapore was 100%, since all students answered the survey were invited in the classroom. 5 participants from India were contacted through email. The participants were primarily

consists of Master Degree students and Ph.D Students. 49% of the participants were holding bachelor degree, 48% master degree, and 3% Ph.D. The collected data were processed by using univariate data analysis method to explore individual variable separately.

4. Results

4.1 Information sources

From the response we received, we find that 45% of the respondents used the printed documents only occasionally. As for the full text electronic database, 46% of them used it frequently for their research. And the majority of them (65%) used the Internet very frequently for their research work. This figure clearly indicates the Internet as the most popular among the 3 sources evaluated.

4.2 Internet versus full-text databases

96% of the respondents used the Internet for their academic work. And 45% mentioned that they would use 2 or 3 search engines to find the required material. 58% also confirmed that they would not be able to do their academic research without the assistance of search engine. These figures clearly indicate the importance of Internet in the academic work. But there are still a very small percentage of people who don't depend on Internet for their research work.

Our study shows that 53% of the participants voted for online databases to be the main source for academic research, with 37% stated they would start their research with information from online databases, and 35% start with information from the Internet. Although the Internet is widely used in research work, the main source for research work is still online database. We also found that 88% of the participants look for full-text journal paper when they go online. This may be the reason why online database is their main source of information as it is easier to get full-text journal in online databases than from web sites.

4.3 Search engine as an alternative

As expected 75% of the respondents confirmed that they would use search engine if online databases were not available. We found out that 61% of the participants would not pay for downloading materials. This could be the reason why they had no hesitation in using search engines as an alternative as it is possible to get free material from the Internet. On the other hand, the participants were asked about what their alternatives would result if search engine were not available to assist them in their research. 92% of respondents stated that they would spend more effort in looking for more materials from other relevant sources such as printed and online databases. 64% of them mentioned they would not settle for less information, which suggested that students would still try to get enough information from other sources to satisfy their information needs. But only 10% would pay for more information. Table 1 list the findings.

Action	(%)
Spend more effort in looking for information	92
Find less information	36
pay more for subscribing to online databases for more information	10

Table 1: If search engines are not available

4.4 Use of search engines for the tasks

Table 2 shows the detailed breakdown of the top two-frequency usage of search engine to accomplish certain tasks.

Tasks	Always	Most of the time
to look for sources of funding such as research grants and scholarships	34%	14%
to source for potential research collaborations such as research groups, institutes and universities	27%	25%
to locate other research staff worldwide for online discussions, conference calls or otherwise	30%	13%
To locate other/suitable research staff worldwide for discussion	28	19%
to locate any gateways of academic value (i.e. journal submission guidelines)	12%	14%
to access websites whose URLs are too long or complicated to remember	11%	15%
to source for tools that are used for your research data collection such as survey donkey	13%	12%
to source for tools that are used for data analysis	8%	13%

Table 2: Tasks that search Engine involved

4.5 Use of search engines at different stages of research process

The scholars use search engines at different stages of research process. The table 3 gives a summarized statistics of the percentage of participants using of search engine at each respective stage of research process. The result shows Search engines are used most of the time for background information, next for literature review and methodology. The scholars use search engine less for data analysis and write up stage.

Research Process	% of participants who answered always
1) Choosing the Research Topic	34
2) Background Information	51
3) Literature Review	40
4) Methodology	40
5) Data Collection	39
6) Data Analysis	35
7) Writing Up	36

Table 3: Frequency of Usage in Research Process

4.6 Search engine impact

4.6.1 Quality and time

The respondents' two main concerns in using search engines in research process are quality and time. Table 5 list the percentage of participants who rank either quality or time as their top one concern in each stage.

Research Process	Quality	Time
1) Choosing the Research Topic	33	35
2) Background Information	33	32
3) Literature Review	34	30
4) Methodology	31	31
5) Data Collection	33	26
6) Data Analysis	36	28
7) Writing Up	29	35

Table 4: Main concerns of respondents using search engines in research process

43% of our respondents remained neutral to the fact that using search engines would lead to an increase in the number of internet citations in their references, with 32% do agree that it will lead to more web citations. The respondents (32%) agree that Internet search engines may locate links to articles belonging to electronic databases or websites of authoritative nature. It is interesting to note that up to 53% of respondents agree that search engines are biased in retrieving articles written in English Language. 40% of respondents indicated that they do examine English translated articles from other languages.

It was found that 36% of respondents agree that the utilization of search engines saves time compared to using proprietary commercial electronic databases, with 37% are neutral to this statement. 42% of respondents agree that time is saved by using Internet search engines in comparison the traditional library resources.

It can be summarized that a substantial proportion of respondents find that using Internet search engines increases their efficiency in searching for articles. The time spent is found to be reduced compared to them using more traditional resources such as the library services and electronic databases.

4.6.2 Cost

Relevance, credibility, currency of the articles are the top 3 purchase criteria considered in order of preference. 20% indicated their willingness to pay for online scholarly articles due to time constraints, 43% for their currency, while 60% for the credible content. A majority (66%) indicated their preference to pay for relevance information.

Majority of respondents (86%) do not pay for their research articles. 32% believe in paying for premium articles which can value-add their research output, which may give them the competitive advantage in their ongoing research work. However 40% of respondents register a neutral stance. There are a number of already-paid-for services such as the Internet, electronic databases and other library services available to our respondents. It is not surprising that the majority (60%) will choose to utilize these services first. This underlines a latent demand that respondents are willing to remunerate financially third parties for their searching and filtering expertise to unearth articles of a better quality for their academic research needs.

4.6.3 Copyright

Generally students can avoid copyright infringement by making a copy under the fair use clause exception for the purpose of criticism, comment, news reporting, scholarly or instructional purposes. Usually downloading journal articles demonstrates the purpose more clearly than downloading films, music, or movies. It is less likely that downloading the latter type of materials in their entirety will convincingly meet the "fair use" criteria. We can assume our participants mainly used scholarly materials such as journal articles for their academic work. In this study, 59% of the respondents have indicated their awareness of copyright issues when utilizing the search engines in their search for their academic output. In addition, another 40% indicate their neutral belief that copyrighted materials are of a higher value than non-copyrighted ones.

The majority of respondents did not frequently check any articles found for copyright issues. In fact, 33% seldom check articles for their copyright before using them for their research

work. 28% and 33% of respondents indicate that they do download copyrighted materials without permission sometimes and seldom respectively. This reflects their disregard for copyrights in their searching process.

The majority indicated that they will not use such articles without the due consent of the author. In addition, slightly less than half will obtain the required permission before using those articles. The same proportion of users will continue to use the articles but give due credit to the owners of the articles with proper citation. The remaining quarter will choose to give up the use of the articles rather than to infringe any copyright law. It was found that the majority of the respondents are very much aware of issue of copyrights. This is especially so for using articles in their research work. Credit is often given to the relevant authors in one way or another. Table 5 lists the percentage of response in each item.

	Respondents (%)
Obtain permission before using the article	41
Use it without permission, but with proper citation	41
Use article without author's consent or acknowledge	13
Give up the article, without using it	25

Table 5: Influence of copyright on using articles

5. Summary of Findings and Conclusions

Based on our study conducted, we have divided the findings into two critical parts. The findings highlights on these two aspects: Internet as an Information source, and Impact of search engines in academic research

The findings show that Internet is the most popular source for online materials compared to printed sources and electronic online databases. Getting this crucial information opened a new dimension, as now we recognize the importance of Internet in an academic research. Therefore we can justify search engine has an impact on academic research as it's the most convenient gateway for information in the Internet. However there were still a very small percentage of participants who don't use Internet at all for their research.

Before we started our study, we assumed there would be a close contest between electronic online databases and Internet; the results came as we had expected. However there was a controversy in the results generated. Even though Internet was extensively used in academic research, the participants voted online databases as their main source of information. We find that the participants are mostly looking for full-text journal online. Therefore we can co-relate the possibility this may be the reason they chose online databases as their main source for online materials. The participants also clearly acknowledged that they would preferably use free sources instead of paying for the materials.

A study was also conducted to know the when the search engine was used extensively. We found that in the research process stage of background information, literature review and methodology search engine was used extensively. As the participants have already mentioned that they use search engine mainly as gateways of academic value and they believe that generally literatures retrieved from search engines are from authoritative sources. From this data we can understand the reason why search engines are used extensively in the preliminary stages of research process.

In the second section we wanted to find out how search engine caused an impact to academic research. We used factors such as quality, cost and copyright issues to evaluate the impacts. And we derived the following conclusion based on the results received:

The respondents were asked about the quality of information retrieved by search engine and cross-referencing. Based on the feedback we received from the respondents, we could tell that the majority of them were unsure of authoritative aspect of literature retrieved by the search engines. However, only minorities of them cross-reference with other search engine to validate the information. More than half of the respondents also indicated currency is important to their research. And nearly half of them agree that search engines are biased towards English.

Cost and copyright issues were other factors taken into consideration when evaluating the impacts. Most of the respondents mentioned that they would only go for free resources. As most of the respondents are students they may not have the financial support to pay for premium services, or they might already have free access to premium articles. This could be the reason why majority of them opted for free articles. As for copyright issues, the respondents take it quite seriously in their academic field only. An astonishing figure shows that they will not use articles without the due consent from the author. And most of them mentioned that they give due credit to the author if they have used the articles in their research work. Strict academic regulation has caused the respondents to focus more attention when using articles in their research work. However the irony is that when they download the articles, most of them do not check for copyright issues. Only when they use these articles for their academic work, they check for copyright infringement. Therefore, based on these results we can see that cost plays a more important role than copyright issues when it comes to impacts.

Another impact, which is time, was evaluated. The result was not what we had expected. There was no clear distinction to indicate that by using search engines; a lot of time can be saved. Even when comparing with traditional libraries, not even half of the respondents could agree that researching with search engine was faster. However accessibility and availability were also taken into consideration when choosing the search engine for research.

6. Recommendation for future research

The result shows the Search Engines are highly popular among scholars in academic research. During the data analysis and the research processes, a few other ideas and questions turned up that could be of interest and useful to investigate more thoroughly.

In this research we did not investigate how search engines and online databases are intertwined. Users may start with a search engine, but eventually are led to an online database where the articles can be downloaded or purchased. It blurs the distinction of the two activities. Although databases are seen as more useful in getting scholarly papers; other the other hand, search engines provide better search mechanisms in locating what databases contain. Further research can be done by conducting close observation of researcher's activities to get a better picture of the roles of search engines playing in research process.

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