2006

An Empirical Study into User Problems with Thesaurus and Commercial Search Systems

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19th Bled eConference

eValues

Bled, Slovenia, June 5 - 7, 2006

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Abstract

Over the last decade Internet Service Providers (ISPs) have supplied affordable residential access to the internet. Traditionally searching techniques have mainly been self taught for the early twenty's to thirty's age group who had access to the internet but did not have the appropriate education. Now this group have careers or have gone into higher education and may be in the position where they need to search electronic systems or are teaching their searching skills to others.

This paper establishes what problems this age group encountered when searching with little or no formal training of searching techniques. Volunteers were given search tasks on two search systems, the commercial search engine Google and the technical database thesaurus search system, INSPEC. It was found that many of the users performed efficiently when using Google but were uncomfortable with INSPEC and were quick to stop using the thesaurus feature when unsuccessful with initial queries. These results helped identify the need for formal training at both an early educational level and at a work level especially in today's modern environment where a large proportion of research is conducted via the internet and the validity of data is paramount.

Keywords*: Search Engine, Search System, Thesaurus, eEducation, eLearning, eSociety and Societal Impact*

1. Introduction

With the widespread use of the internet, the role of search systems has become increasingly important. As the internet has a mass of unregulated information, search systems are required to refine information down to the necessary websites. Despite the high usage of search systems, there are many problems found when analysing different techniques utilised by users when searching for information.

Hard copy resources such as libraries and encyclopedias were considered the main information resources for the general population in the past however, electronic search

systems have impacted greatly on these methods. The change from hard copy resources to electronic systems have changed the way information is written, stored and retrieved.

These changes have been identified as an increased amount of information, a reduction in the amount of time and effort required, an increase in formats for information resources, an increase in techniques used to organise and represent information, an increase in information processing software and a change information searching techniques (Marchionini, 1999).

Many businesses expect employees to be computer literate as electronic systems are standard in a multitude of work places. A variety of business services are becoming available online including suppliers and government services. It is also important for companies to maintain and improve competitive advantage by keeping up to date with the knowledge economy. The ability to find and access these services is of importance and therefore an efficient searching technique can save companies time and money.

More people are using search engines when looking for information than any other resource. A study of American internet users showed that searching takes place on average every other day, with 1.5 hours spent searching every week (Sullivan, 2001). Despite the regular use, many users are becoming frustrated when their searches take too long or yield unsuccessful results. Sullivan also identified search rage (also known as web rage) as the frustration associated with unsuccessful searches (Sullivan, 2001). Twenty-nine percent of users were described as very frustrated when finding irrelevant information. Forty-nine percent of users would become frustrated if a search took longer than fifteen minutes. Ineffective and time laden searches can mainly be identified as users not knowing how to efficiently use search engines.

Several barriers have been identified that prevent the access to information (Marchionini, 1999). These include: access to education, information overload, access to computing facilities, disorientation, distraction and disinformation. The education of effective searching can limit or prevent these barriers.

Teaching of effective use of search systems is limited and only in the last three years have search engines been included in the British school curriculum (Framework for Teaching ICT Capability, 2002). The early twenty's to early thirty's age group were amongst the first to have affordable internet access from their private residence while still attending school. Unfortunately the school system had not caught up with their learning needs and for this age group, the use of the internet and search techniques has mainly been self taught. This demographic now find themselves in careers where they need to use electronic search systems or they may even be teaching search skills to others.

This study concerns a pilot investigation into user attitudes and techniques of the twenty's to thirty's age group when searching for information on the internet. The investigation identifies and explores user searching problems employing the use of a thesaurus search system and a commercial search engine. In order to achieve this, an experiment was designed to test volunteers and observe their search skills when using both search systems. The research set out to identify user problems, the accuracy of information, user techniques, search system reliability and user attitudes.

2. Methodology

2.1 Background Research

A methodology was developed which initially involved a literature review. The review was conducted to find relevant work and research on similar projects undertaken in the

past. This highlighted any success and failure encountered by previous researchers and also gave a more in depth understanding of the project.

Fidel et al (1999) conducted a search test with high school students. The results of the study showed that students had a low tolerance for large amounts of text with no images. Additionally it showed that students tend to create a 'landmark' page which they were reluctant to explore away from. A landmark page provides links to other pages and becomes the basis for a user to navigate from. Once the user believes they navigated too far away they will return to the landmark page. Fidel et al (1999) also found that students had difficulties narrowing down the information they were given to create search terms.

Hockley & Pollock (1997) carried out two search studies, one involving individuals with little computer experience and another involving regular computer users. Both groups had similar results showing computer literacy was not a factor. The report also identified that users ignored the advanced search and help options. Hockley & Pollock (1997) identified hierarchical categories to be favoured over keywords but this would appear to no longer be the case as more recent studies show that users appear to prefer keywords (Sullivan, 2000).

Yahoo! have developed a web-portal for American children aged seven to twelve entitled Yahooligans! (2006).This portal includes teachers' resources for search tutorials which address the importance of accessibility, accuracy, appropriateness and appealing websites. It also has a section on the importance of citing sources, correct spelling, keyword searches and their relational terms. As useful as Yahooligans! appears, it is aimed as an introduction to searching for children and not serious research.

The review led to the design of a pilot experiment which was tested with a volunteer and redesigned addressing any problems identified. This led to the final test which consisted of a pre-test questionnaire, two twenty minute tests using Google and INSPEC and was followed by a post-test questionnaire. The tasks chosen for both the Google section and the INSPEC section were carefully considered and researched as they were needed to highlight different types of capabilities and searches.

A search engine is a software program that allows a user to find specific information which reside on servers on the internet. They do not search the web directly, but search a database that contains full text web pages taken from websites. When a user searches the internet for information via a search engine, they search an older copy of a web page and not the current up to date version. When a site is selected from search results, an up to date copy of the page is displayed. The Google search engine was chosen for section one as it was considered to be one of the most used search engines and users would be familiar and comfortable with it (Sullivan, 2002).

A thesaurus search system attempts to match the search terms entered by a user to those words used by the indexer, who is responsible for categorising a database. As users may enter different search terms when looking for the same query, a thesaurus will search for the user's entered terms, synonyms and associated terms to help find relational records.

INSPEC is an academic journal database which employs a thesaurus search system and is available to UK universities. The database holds specific records to articles with the assumption that the user knows about the subject they are looking for. Therefore searches have to be more specific. INSPEC was chosen due to its widespread access across UK universities and may have been used by those who have attended further education.

The extent of the internet can lead to a search query bringing up several thousand results and in theory a volunteer could look through them all. So it was decided that limits were needed. Gornoll & Nicol, (1990) recommend a time limit of no more than an hour should be used as volunteers seem to lose concentration and interest.

Even though an observation without a time limit would yield more results, a time limit of five minutes per task was implemented. This would allow forty minutes for the observation study and a further ten minutes for the questionnaires. The time limit was necessary to keep the volunteers interest and to manage the test.

The questionnaire was deemed important, as it would give some background information about the volunteers as well as their opinions on the study. This would give some insight into any training and experience the volunteer had with the internet and search systems.

It was decided that volunteers within the twenty's to thirty's age group should be chosen from an educational background. The reason for this is that volunteers who have spent time in higher education were likely to have used the internet regularly and may have come across some form of search engine training.

2.2 Search Tasks

Table 1 shows the tasks chosen for the Google search section of the test. The tasks chosen were carefully considered and researched. A search theme was introduced as the topic for the test.

Table 1: Google Search Tasks

Number	Search tasks
1	Find out how a search engine thesaurus works; list 2 URL's and authors.
2	Find out what a Meta Tag is and list 2 URL's and authors.
3	Find a guide for searching on the internet and list the URL and author.
4	Find a guide that compares different search engines, list the URL and author.

Task one asks the volunteer to find how a thesaurus search system works. This task was designed so when entering the most obvious search terms, no one site appeared giving a direct explanation. Instead volunteers had to search through results and for a definition. Prior to this task, volunteers were given a brief explanation of how a thesaurus search system works. This task is difficult and has been placed early on in the test to see if the volunteers became frustrated

Task two involved searching for information on meta tags and was designed to be easier than task one, however volunteers were not told what a meta tag is. Most of the sites that appeared with the obvious search terms produced several articles that give brief explanations of a meta tag and it uses. This task was designed to be easy with more emphasis placed on whether a volunteer would accept the first explanation they found or confirm the information with several other sites.

Task three involves finding a guide for searching on the internet. This was designed to be a relatively simple task when compared to the first two. There are many guides, tips and tutorials to searching on the internet and this allows the volunteers to know that they can improve on their current skills if they so wish. This task allows the volunteer a bit more freedom to surf the internet.

Task four involves searching for a search engine comparison and is also similar to task three in the sense that it allowed the volunteer to surf more than tasks one and two. This task involved searching for a guide, site or article that compares commercial search engines.

Table 2 shows the tasks chosen for the INSPEC section of the test. The tasks chosen were carefully considered and researched. As INSPEC contains less records compared to Google, the searches could be more specific.

Table 2: INSPEC Search Tasks

Number	Search Tasks
5	Find 3 articles about search system thesaurus and their development. Make a note of the article names and authors.
6	Find 2 articles about problems with Meta Tags. Make a note of the article names and authors.
7	Find which article has this line and complete it: "Meta-tags are used in particular by certain search engines to…". Make a note of the article name and author.
8	Find 2 articles by RH Stern concerning web copyright. Make a note of the titles of the articles.

The fifth task required the volunteer to search for records concerning thesaurus search systems and their development. The best records are obtained via typing the single keyword 'thesaurus'. For this task it was expected that most volunteers would type a query similar to 'search systems thesaurus development', which yielded zero results. The volunteer must then refine their search and once they have found an article, the thesaurus feature can be used to find similar articles.

The sixth task required the volunteers to search for records concerning 'problems with meta tags'. If volunteers entered a query similar to 'problems with meta tags', they will receive zero records. The keyword 'meta tags' yielded twenty records. One of the records which appears on the first page of the search was titled 'a dangerous game of tag Web site meta-tags' by P. Sanderson. This article is also relevant for task seven.

Task seven is a text search and required the volunteer to find the only article containing the lines "Meta-tags are used in particular by certain search engines to…". This task demonstrated if a volunteer was aware how searching can be achieved with tools other than keywords as the volunteer had to find the sentence and complete it. This task can be completed in two ways. The first time consuming way consisted of looking through the text of possible articles until the volunteer finds the correct one. The second was to type in the sentence including quote marks, which will instantly lead to the correct record. The correct record 'a dangerous game of tag Web site meta-tags' by P. Sanderson may have been listed in task two. This task was selected to observe how many volunteers will start a new search and how many will go back to their search results from task six. Search speed can be increased by selecting search the abstract only.

Task eight required the volunteers to find two articles from the author R.H. Stern concerning web copyright. This task could be completed in several different ways. The volunteer can enter the authors name in the text box but will only get the correct results if they change the text box selection from keyword to author. This option will return all authors with the name Stern, which leads to the sixty five articles currently residing on INSPEC by R.H. Stern. Another way to find Stern articles would require the volunteer to search for web copyright which would return three articles, none of them are written by Stern. The volunteer could then select a record and scroll down to the subject heading selection and click on the word copyright which produced over one thousand five hundred articles, which is half as much as just entering the keyword 'copyright'. Then the

volunteer would have to work through the information until they found the correct records. This task was used to demonstrate if users could easily search different types of queries in unfamiliar systems.

2.3 Recordings

As the project required observation in order to ensure that all search information was accurately captured, two electronic methods were incorporated. These methods were screen capture software and a voice recording device. Both methods would record any information in case anything was missed during the study by the observer. The recordings were then replayed after the study to help identify keywords, websites and authors.

In order to accurately analyse each volunteer's navigation, screen capture software was used to record every action taken as it appeared on screen. This allowed all keywords entered and searches conducted to be examined in more detail in case any information was missed during the initial observation.

For the voice recordings, volunteers were required to talk through their actions in order to understand why they are navigating to a particular website. For example a volunteer would state what they are typing into the search engine, why they thought a page was suitable or unsuitable and so on. This process is referred to as 'thinking out loud', and when combined with the screen capture software proved invaluable for post study analysis as well as giving user insight.

As a thorough analysis of the results from both recordings were needed, a manageable sample of volunteers was required. Eleven volunteers were chosen with one of the volunteers a prerequisite for a pilot study which would be used to identify any problems that needed to be addressed. The other ten volunteers would take the final test from which the results of the study would be derived.

3. Results and Discussion

3.1 Group Demographics

The group was made up of seventy percent males and thirty percent females aged between twenty-one and twenty-seven, with a mean age of twenty-three. All volunteers had qualifications beyond GCSE's (compulsory UK education) which they had completed or were in the process of completing. These qualifications varied from an Ordinary National Certificate (ONC), to master's degrees and Post Graduate Certificate of Education (PGCE, Teaching).

Ninety percent of the volunteers stated that they would use the internet as their first resource when looking for general information. Only ten percent would use a library as their main resource as they had daily access. None of the volunteers were interested in the more traditional hard copy dictionary or encyclopedia.

During their education and working life, only twenty percent of the volunteers had received any form of internet training. Ten percent have received brief training during their degrees, but was discouraged by tutors as the internet was claimed to be an unreliable source. This ten percent were amongst the least successful in the searching tasks. The other ten percent had received training as part of their PGCE and currently receives regular tutoring on teacher training days. This ten percent performed favourably in the test but claimed the training received is below current knowledge as searching

skills have been developed through interaction with the internet prior to PGCE. It was also stated that the current training is useful to other teachers but could be more in depth.

Seventy percent of the volunteers used the internet on a daily basis with the other thirty percent of volunteers using the internet once a week if they had time and access. This thirty percent performed less favourably in the test compared to the daily users. The daily users were also more likely to use the internet for both work and leisure.

It is also worth noting that the eighty percent of volunteers who used the internet regularly for both work and leisure performed to a better standard then the twenty percent who used the internet solely for leisure.

This implied that volunteers who used the internet as a serious business/education and leisure tool could utilise it more fully.

The males generally performed better than the females, however is should be noted that 85% of the males were studying or had qualifications in technical subjects compared to just 33% of females. The only volunteer who did not have a degree was from a technical background and performed averagely with both search systems when compared to the other volunteers. It appeared that those who possessed a technical job and/or education performed more favourably than those who didn't.

3.2 Google and INSPEC Comparison

Multiple keywords refer to using the most important words within a task, for example from task one "Find out how a search system thesaurus works" the keywords are "search system thesaurus". As Figure 1 shows this was the most popular method of search terms used by volunteers and was the first type of search entered in the majority of the tasks. This would indicate that volunteers understood the importance of finding keywords within a sentence and using them to search. When searches resulted in irrelevant results, most of the volunteers used synonyms. For example, changing the keywords 'search system thesaurus' to 'search engine thesaurus'. However, when these search terms were unsuccessful, the volunteers attempted to use questions and statements.

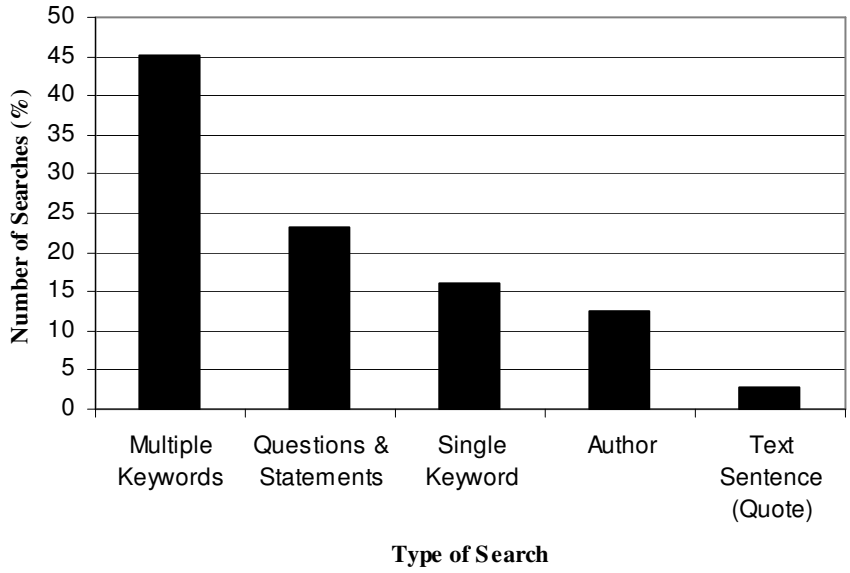

Figure 1: Search Terms for all Volunteers

The second most popular method of searching used questions and statements search terms. This refers to formulating the known search terms into a question or statement. For example, "how should I search on the internet" or a statement such as "guide to searching on the internet". The main reason for this form of search terms is it allows the volunteer to think about what they are looking for. For example, the keywords "search system thesaurus" only conveys that the user is looking for information on this subject.

However, the question "how does a thesaurus search system work" helps the user identify that they are looking for information on a thesaurus systems workings. The results of these terms vary as some were successful and some were of course unsuccessful. Some of the volunteers didn't appear to understand how common words or stop words are excluded from their search. For example the word "the" would not be used as it slows down the search and is to a large extent irrelevant.

Most search engines such as Google would not contain this word in a search as the return in results would be too large. If questions were unsuccessful, then volunteers reformulated their searches to a single keyword. This was the third most popular choice when searching the internet. This search term requires the volunteer to pick what they consider to be the most important single word and then use it to search. Most volunteers used this option to search when multiple keywords and questions have been unsuccessful in searches. When using INSPEC, these terms were the most useful.

Searches for text sentences and authors were mostly successful with only twenty percent not understanding how to use quotes. Another twenty percent used quotes but received incorrect answers as they had misspelt a word and ten percent had observed the INSPEC environment and limited their search to the abstract which provided the correct result without the use of quotation marks.

Through most of the searches, volunteers were unwilling to look much further than the first page of search results. As Figure 2 shows, eighty percent of the volunteers were willing to look on a second page of results, but this happened rarely. Only forty percent of volunteers were willing to search the third page of results. The ten percent who searched page four and beyond, only did so through desperation as their other search attempts failed. Later search pages did contain relevant records. This lack of searching beyond the first page shows why it is important to optimise a website to appear as highly ranked as possible and also builds a good case for using paid placement adverts as the higher ranked the site the more likely it will be viewed.

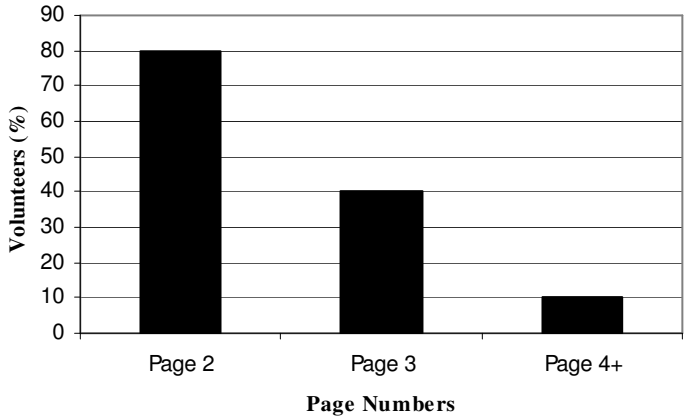

Figure 2: Beyond First Page Searching

Many volunteers did not understand the importance of website authors or copyright. To help sort legitimate websites and articles, establishing who wrote and who owns the article is significant.

On two searches conducted by the same volunteer, the volunteer incorrectly lists the website as the author of an article even though the authors name was listed by the title of each article.

The main problem identified was that of spelling and typographical errors. Ninety percent of the volunteers conducted searches which contained spelling mistakes.

Most volunteers made spelling mistakes but quickly reread and corrected them before performing the search. Many utilised the search engines suggested spelling feature to correct their search terms. However some spelling mistakes went unnoticed leaving the volunteer to believe the search terms were in error. During task seven a volunteer noticed a spelling mistake and incorrectly stated that it would make little difference to the search. As this search was looking for a specific text sentence, the correct spelling would have returned the relevant record.

Ninety percent of the volunteers attempted to use capitalisation within a minority of their searches. Both INSPEC and Google do not support capitalisation. Only 10% of the volunteers attempted Boolean searches which consist of 'and', 'or' and 'not' statements. Phrase searching was used by 60% of the volunteers mainly for the task involving a quote. Alternative search methods such as truncation and proximity searching were not attempted by any of the volunteers.

INSPEC was seen as less favourable compared to Google. Only twenty percent of the volunteers favoured INSPEC as they preferred INSPEC's accuracy and options over Google. It is of note that INSPEC has far less records than Google which are all in the same format and therefore searches can be more specific and accurate. Many of the volunteers who disliked INSPEC stated it was unfamiliar and appeared to have fewer options than Google. This can be attributed to the design layout of INSPEC not being as user friendly as Google.

Volunteers cited problems with INSPEC including the lack of ability to search for authors or text sentences. Both of these options are available, but were overlooked or misused. As the volunteer is required to search for the author, the author button must be selected at the top of the screen. However, if several searches have been conducted, then the specific help buttons (including the author button) are out of sight, as the volunteers tend to go straight for the text input box. Many volunteers did state that they could improve their searching with INSPEC if given a tutorial.

User problems with the design layout of INSPEC can also be attributed to all the volunteers limiting their searching outside of the test to one search engine. Users have been taken out of their established search environment and have been introduced to a search system which in some respects operates in a similar manner but appears different on the surface. Despite the INSPEC demonstration, the majority of the users ignored the thesaurus search facility and used the trial and error searching they were familiar with when using normal search engines.

Despite the majority favouring Google, most did state that INSPEC would be useful for credible research and that they would be willing to use it again. However only forty percent of the volunteers attempted to use INSPEC's thesaurus tool despite being taken through a brief demonstration.

As Figure 3 illustrates, out of all the searches conducted using INSPEC, fewer than seven percent were thesaurus searches and only one quarter of these thesaurus searches were successful.

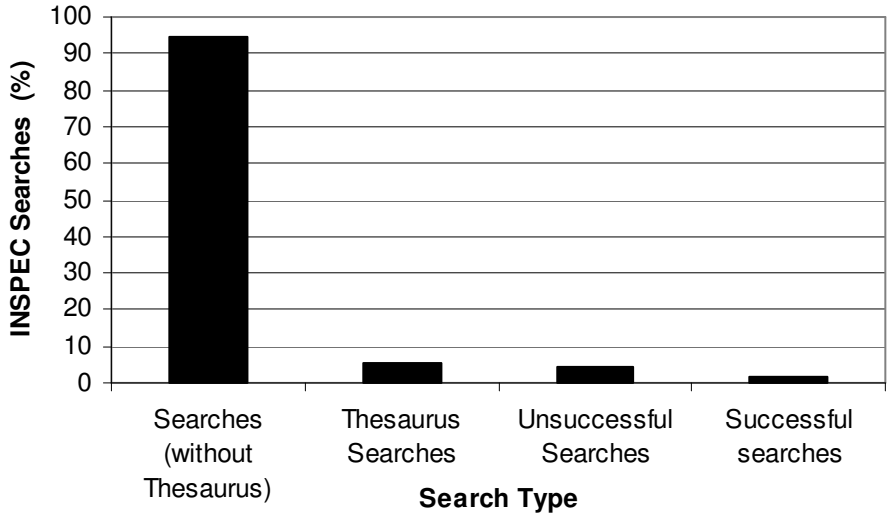

Figure 3: INSPEC Searches

4. Conclusion and Recommendations

The main focus of this study was to highlight problems with search techniques amongst the self taught generation who may now be in a position to teach skills to others. Most of this group can navigate the internet efficiently and find required information. However their searching technique could be improved and the volunteers appeared inattentive to the importance of author, copyright issues and credibility. The overall study was successful, however there are several points to be considered if the study or one similar were to be repeated.

The majority of the volunteers were quick to identify both the most important single keyword or keywords. Many used question type search terms, however few of them understood that common or stop words such as 'the' were not included in the search. Some of the volunteers did not understand how to search for a text sentence with few willing to use the more in depth options of either search system including the help pages. Search results could be greatly improved if volunteers learned how to use these features. The help pages on search systems explain how the system works which could have saved time as opposed to the trial and error technique employed by most volunteers.

Nearly all of the volunteers made spelling mistakes when performing searches. Some volunteers failed to identify some of these mistakes leading to ineffective searches. Volunteers should be encouraged to read their entered search terms before performing the search. Another problem identified concerned the lack of beyond first page searching. Many of the volunteers ventured onto the second page of search results only after several failed search attempts. The general opinion amongst volunteers is that any search results not displayed on the first page were irrelevant.

If this test were to be further developed, a larger pool of volunteers would be required. There were ten volunteers who took part in the test and one volunteer who took part in the pilot test. These sessions are time consuming and could be better controlled if there were two or more conductors. It is also recommended that the volunteers should be picked from more varied backgrounds as the majority of volunteers in this study were educated at university.

Many search engines already have built in tutorials, however a general searching tutorial should be developed which does not focus on confining all searches to one search engine

but using different engines for different needs. The use of one system for all searching appears to make users less adventurous when put into new search environments. Other engines have different features such as Exalead which supports letter replacement searching as well as phonetic spelling. The tutorial should also consider the use of keywords, text sentences, help options, and address the issues of beyond first page searching and the importance of author and copyright issues.

The pilot test only focused on a journal database and standard website HTML documents. Newer forms of media should be considered such as audio, video, pictures, blogs, wikis and RSS feeds. The tutorial does not necessarily have to be taught and could be delivered through eLearning means such as the internet.

What appeared evident is that regular informal searching for personal interests such as hobbies can help develop a user's searching skill as well as make them comfortable within the environment of the internet.

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